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JUST Design

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AHEAD Association on Higher Education And Disability®
107 Commerce Center Drive, Suite 204
Huntersville, NC 28078 USA
www.ahead.org

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Table of Contents

Journal of Postsecondary Education and Disability

Volume *25*(3)

FROM THE GUEST EDITORS

Elizabeth G. Harrison
University of Dayton

Christopher S. Lanterman
Northern Arizona University

In their 2010 JPED article "The Social Justice Perspective," Gladys Loewen and Bill Pollard point to respect, dignity, economic and social equality, inclusive environments, and equitable opportunity for full participation as hallmarks of social justice for disabled persons. Their perspective describes the foundations of JUST (Just, Usable, Sustainable, and Transformational) Design that foreground this special issue.

Design is a far-reaching construct that touches every aspect of a postsecondary institution--and of life. It is a series of intentional choices that brings function together with aesthetics and usability together with effectiveness. In this sense design has the power to enable or constrain equitable participation in our institutions for students, staff, and faculty with diverse experiences, backgrounds, and abilities. And it has the power to transform people's thinking, to help them see and experience their world in new and more just ways.

But design is commonly seen as the province of professionally trained "designers" who create marketable goods such as handbags and dresses, computer games, posters, and cars. Similarly, in our postsecondary institutions course design is seen as the prerogative of faculty, the experts in their academic fields, and facilities design is under the purview of professional facilities management staff including architects and planners. Disability service (DS) providers have been left to react to the often uninformed (in terms of disability) design choices made by these designers, to find or create accommodations so that all members of the institution's community can participate equitably.

Our aim in this special issue of JPED is to demonstrate that DS providers can enter into institutional design processes as partners whose expertise in disability-related thinking can help ensure that the results are not simply functional and pleasing but JUST—just, usable, sustainable, and transformational. From issues in engineering design curriculum and foreign language teaching pedagogy to the design of assessments and a campus recreation center, the articles, practice briefs, and book reviews collected here describe a variety of ways that DS providers are moving out of the DS office and into active, collaborative relationships with faculty and staff across campus. We hope that this special issue will encourage readers to reexamine what they have to offer their campus community as experts in disability and accessibility and to look for opportunities to collaborate in design processes. By helping to make institutional design decisions more human-centered and inclusive, DS providers can lead their institutions toward the kind of transformational and systemic change that will ensure a just college experience for everyone.

This issue begins with Kim Bigelow's study on infusing universal design into the design process in an introductory engineering design course. "Designing for Success: Developing Engineers Who Consider Universal Design Principles" highlights the importance of developing engineers and designers who consider and apply principles of universal and inclusive design in design decisions and demonstrates how a disability resource center can partner in the process of developing and implementing this kind of course.

Heather Shinn and Nicole Ofiesh explore JUST Design in assessment practices in "Cognitive Diversity and the Design of Classroom Tests for All Learners." This article explores the research base for understanding differences in the ways students with and without disabilities approach classroom tests. Their literature review is followed by suggestions for transforming assessment practices to create JUST assessments that more effectively measure student learning.

Three practice briefs follow these two articles. "Infusing JUST Design in Campus Recreation" by Katheryne Staeger Wilson and Doug Sampson outlines the collaborative process used by Missouri State University in the design of its new Campus Recreation Center. The collaboration emphasized user participation in design decisions and a partnering with the university architect to apply elements of universal design in the design of the facility.

Our second practice brief suggests a JUST alternative to traditional accommodations, modified instruction, and waivers offered to students with various disabilities as part of foreign language instruction. Sally Scott and Wade Edwards ("Project LINC: Supporting Lecturers and Adjunct Instructors in Foreign Language Classrooms") describe an innovative faculty development program for temporary and adjunct faculty that embeds awareness of diverse learners and principles of inclusive pedagogy. Project results reflected an increase in the average grades of students with disabilities across all sections, a reduction in the number of students with disabilities who withdrew during the semester, and a dramatic decrease in the number of foreign language waivers requested.

Rachel Smith and Tara Buchannan authored the third practice brief in this issue, "Community Collaboration: Use of Universal Design in the Classroom." This brief documents a partnership between faculty and disability resource center professionals in developing sustainable, equitable, and just course designs. The authors found that flexibility and usability within the course design garnered positive student outcomes, including better grades on assignments in which choice was offered.

For the book reviews we have chosen two books that explore the convergence of disability and design. Graham Pullin's 2009 award-winning *Design Meets Disability* is reviewed in a conversation between Teresa Haven, an "old hand" in the DS field, and Suki Kwon, a faculty designer and artist. Haven and Kwon reflect on the book's theme of bringing assistive technologies into mainstream design to create usable, aesthetic, and functional products that meet the needs of a diversity of users. Both the book and the conversation-review present more examples of how this can be accomplished.

To complete our special issue, Graham Pullin reviews the 2011 second edition of the *Universal Design Handbook*, edited by Wolfgang Preiser and Korydon Smith. This handbook is a resource that might be used across an institution, from the disability resources office to design programs, campus planning, and e-learning units. Pullin's frank review of the *Universal Design Handbook* gives valuable context to this sweeping collection of contributions that discuss universal design in the built environment as well as policy, information, media, and instructional environments.

This special issue has been a collaboration between the editors and the Access to Design Professions (ADP) program of the Institute for Human Centered Design (IHCD), with support from the National Endowment for the Arts. The ADP program seeks to inform and transform practice toward the goal of facilitating more human-centered practices and design strategies in higher education in order (1) to expose the importance of inclusive design in all facets of postsecondary institutions, and (2) to encourage disabled persons to consider careers in design professions from which they can promote practices that create equitable opportunities for disabled persons at postsecondary institutions, within design programs, and in society at large. We thank IHCD and ADP for their support in this project.

We would also like to express our appreciation to the authors who submitted manuscripts to be considered for this issue. Their submissions demonstrated to us that there are many people in the postsecondary DS world who are already engaging in collaborative design processes with other professionals at their institutions. By sharing their work in this special issue of JPED, we hope to provide examples, models, and resources that will help others take on the role of "designer" and bring meaningful, JUST change to their institutions.

Designing for Success: Developing Engineers Who Consider Universal Design Principles

Kimberly Edginton Bigelow
University of Dayton

Abstract

Engineers must design for a diverse group of potential users of their products; however, engineering curricula rarely include an emphasis on universal design principles. This research article details the effectiveness of a design project implemented in a first-year engineering course in an effort to raise awareness of the need for engineers to be more inclusive when designing. Students were asked to apply universal design principles to redesign an engineering laboratory to make it more usable to all, including individuals with disabilities who use the room. A representative from the university's disability services staff, as well as individuals with first-hand experience of disability, provided guidance to the class by serving as project mentors.

Design decision analyses were reviewed to determine the specific criteria student teams believed were most important in identifying specific design ideas to pursue. These analyses were used to evaluate the success of this project in helping students be more cognizant of the need for designs to be flexible, versatile, and universally designed. These criteria were compared to projects from previous classes in which universal design had not been explicitly addressed. Results indicated that students who participated in the universal design project were much more likely to consider criteria related to universal design principles, though they identified accessibility as more important than the more overarching goals of achieving a universally usable design. Results suggest that such a universal design project is one possible model to better prepare engineering students and that the model can be strengthened through involvement of disability services professionals.

Keywords: Universal design, engineering education, project-based learning, design decision analysis

From tennis shoes to automobiles, engineering design is an integral part of everyday life. Even products as simplistic as paperclips and drinking cups have been highlighted as examples of products with a deep and rich history of engineering design and product evolution (Petroski, 1994, 2004). More sophisticated designs such as medical devices, wind turbines, and robots impact the global community in even more significant ways – improving quality of life, preserving natural resources, and enabling safer ways of doing dangerous tasks. A common thread of all types of engineered products, whether a kitchen can opener or a motorized wheelchair, is that each is used and maintained by a diverse group of individuals. As such, universal design considerations have an important place in engineering design.

Engineering Design Process

To fully understand the role these considerations can play, it is important to first understand the engineering design process and how it is taught in the engineering curriculum. Knowing this allows a better understanding of the challenges and opportunities for making engineering design – and designed products – more inclusive to all.

The term *engineering design* refers to the end product that is created and produced, but even more so to the systematic, and iterative, process that engineers go through to reach the end deliverable (Dym & Little, 2009). In the engineering curriculum, this process is often taught through a senior capstone design course, in which students form design teams to work on real-world industry-sponsored projects (Dutson, Todd, Magelby, & Sorenson, 1997). More recently, programs have initiated first-year “cornerstone” classes that mimic this experience but introduce students to the process during their freshman year (Dym, Agogino, Eris, Frey, & Leifer, 2005).

The engineering process is very much driven by people – from the client who has a problem that needs to be solved, to the design team that works to solve it, to the potential users who will interface with the solution. Throughout the engineering design process the interactions between these three entities are integral to the process’s success.

This becomes most clear during the Problem Definition phase of the process, in which the design team must question the client and potential users to better understand the problem they have just been presented (Dym & Little, 2009; Pahl & Beitz, 1996). During this time the design team also often gains insight into the problem through additional research, field observation, review of known standards, interviews, and other means. Once the design team feels that they understand what the client and users need and want, as well as what limitations and restrictions exist in how they go about achieving this, they then move on to generating design possibilities.

In the Generation of Design Alternatives stage of the design process, various brainstorming and other idea generation methods are used to generate innovative and creative solution possibilities (Daly, Christian, Yilmaz, Seifert, & Gonzalez, 2011; Dym & Little, 2009). The success of this step of the design process is strongly correlated with the diversity of thought represented by the brainstorming team, making it advantageous to have teams composed of individuals of various backgrounds and experiences (Post, De Lia, DiTomaso, Tirpak, & Borwankar, 2009). Often to achieve this diversity it is necessary to supplement the design team by adding non-engineers to the mix, including individuals with expertise and experience in the problem at hand.

Once designs are generated, the team moves in to the Design Selection phase of the process. During this phase the design team refines, narrows down, and selects the best idea(s) from the design alternatives (Dym & Little, 2009). To ensure that the design picked is the best to meet the wants and needs of all involved, a design decision analysis is normally performed (Dym et al., 2005). One common way to do this is to use a chart to objectively compare multiple design possibilities based on a set of criteria related to the objectives and requirements of the project (Pugh, 1991). The criteria are generally weighted to indicate relative importance, and each design is then scored on how well it meets each criterion, multiplied by the criteria weight. The weighted criteria scores are then summed for each design, with the highest score being the one most promising to pursue, assuming it meets all the project constraints.

After Design Selection, the design team more fully develops their concept (Dym & Little, 2009). Prior to moving too far forward with it, they will often present the idea to the client, potential users, key stakeholders, and experts in the field to receive feedback, in a process known as a conceptual design review. Based on constructive feedback received, the design team must then determine how to proceed, often returning to earlier stages in the design process.

Once a conceptual design is reviewed favorably, it advances to a more detailed design and a prototype or model is built; then, it is tested in some way to prove feasibility (Dym & Little, 2009). The types of tests that are performed range from computerized models and simulations to focus group and surveys to elicit potential user opinions. Depending on which route of testing the design team chooses, outside individuals and experts in the field may be critically involved to provide quantitative and qualitative feedback about how well the device functions, what problems it has, and what its overall potential is. Following testing, the results and feedback must be critically analyzed by the team to determine the design’s current success.

With sufficient time, design teams then take what they have learned from the testing and revisit earlier stages in the design sequence to revise before proceeding through the process again, iteratively getting closer and closer to a quality end product. In many semester-long classes, however, the process must stop here due to time. Students instead move into the Documentation stage, during which they prepare oral presentations and written reports to convey the entire process they followed in reaching their end conclusion. This stage also includes recommendations for future research.

Gaps in Practice

Though the engineering cornerstone and capstone courses are generally recognized as successful in teaching students the engineering design process (Dym et al., 2005), there are several gaps in practice when it comes to issues related to usability, inclusivity, and accessibility. Three main areas of concern, which serve as the focus of the current research, are:

- The majority of engineering curricula do not well prepare engineering students with the skills to recognize the need for and ability to implement universal design principles into their products.
- Despite a push for diversity in the field of engineering, there remains a need to be more inclusive and make the engineering curriculum more accessible for all students, particularly individuals with disabilities, so that they might fully participate and pursue careers in the field.
- Though the engineering design curriculum has room for, and would benefit from, interactions with a variety of external individuals, these opportunities are not always transparent; qualified and interested individuals may never know about their ability to be involved

These three areas are discussed briefly below.

State of the current engineering curriculum. In the United States, the engineering curriculum is mainly driven by the requirements of the *Accreditation Board for Engineering and Technology* ([ABET]; Felder & Brent, 2003). ABET outlines specific outcome criteria for graduates of accredited programs. Therefore, most institutions structure their engineering curricula, particularly their senior capstone courses, to demonstrate that all criteria have been met prior to graduation (Tooley & Hall, 1999). These criteria, according to the 2010-2011 ABET review process (ABET, 2011), include:

A. an ability to apply knowledge of mathematics, science, and engineering;
B. an ability to design and conduct experiments, as well as to analyze and interpret data;
C. an ability to design a system, component, or process to meet desired needs within realistic constrains such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
D. an ability to function on multidisciplinary teams;
E. an ability to identify, formulate, and solve engineering problems;
F. an understanding of professional and ethical responsibility;
G. an ability to communicate effectively;
H. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
I. a recognition of the need for, and an ability to engage in life-long learning;
J. a knowledge of contemporary issues; and
K. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Throughout the years, refinements have been made in the language of the criteria to arrive at their current wording. For example, authors have adapted the more generic criteria *(C) An ability to design a system, component, or process to meet desired needs* (Shuman, Besterfield-Sacre, & McGourty, 2005) to its current form, which elaborates the specific types of constraints that engineering students must consider. This has helped guide engineering curriculum to ensure that topics such as economics, environment, ethics, and sustainability are highlighted in the design process (Dahm & Newell, 2001; Shuman et al., 2005).

The ethics requirement of ABET has helped highlight the role engineers must take to ensure their designs "hold paramount the safety, health, and welfare of the public" (National Society of Professional Engineers [NSPE], 2007). This helps to raise awareness of an engineer's long-term personal responsibility to the end user, but with a focus almost entirely on safety and disaster avoidance. Though the groundwork is partially in place, there are limited efforts to translate this sense of responsibility to ensuring that the designs created are inclusive and ensure equitable use by all.

Though some engineering students, particularly those who will be designing public buildings and structures, are versed in the legal requirements for ensuring accessibility (e.g., Americans with Disability Act [ADA]), the broader topic of universal design receives very little attention in the undergraduate engineering curriculum (Erlandson, Enderle, & Winters, 2006).

Universal design is the act of making spaces, processes–and products–flexible enough to be easily used by the entire spectrum of possible users, without the need for adaptation or specialized design (Zeff, 2007). Though universal design certainly assists individuals with disabilities, it differs from accessibility, as well as assistive and orphan technology, in that the main goal is to make designs more useful *for all* (Welch, 1995). Universal design may not be appropriate for all applications, such as designs that specifically address the proprietary needs of an individual. However, universal design is far more sustainable for most design situations, as it benefits more potential users than other approaches. The guiding principles of universal design are: Equitable Use, Flexibility in Use, Simple and Intuitive, Perceptible Information, Tolerance for Error, Low Physical Effort, and Size and Space for Approach and Use (Story, Mueller, & Mace, 1998; Zeff, 2007). The fundamental principle behind universal design is to design products and environments to respond to the unique nature of all potential users. Since engineering designers create with potential users in mind, there is both opportunity and need for the specific principles and concepts of universal design to be heavily integrated into the design curriculum.

Barriers to increasing diversity in the engineering field. In recent years, there has been a national push to increase diversity in the engineering workforce by increasing the opportunities for females, underrepresented minorities, and individuals with disabilities to pursue engineering as a career (National Science Board, 2004). It is believed that greater diversity will help to sustain and promote innovation (National Science Board, 2004). Current estimates indicate that individuals with disabilities remain poorly represented in engineering fields, with only 1.3% of all individuals with disabilities, and only 0.4% of females with disabilities, working in engineering and architectural professions (Bureau of Labor Statistics [BLS], 2009).

Research has highlighted numerous reasons for the poor representation of individuals with disabilities in engineering careers. Burgstahler (1994) grouped the barriers of individuals with disabilities to pursue careers in science, engineering, and technology in to three categories: Preparation, Access, and Acceptance. The engineering design process is one such example where these issues can play out. For example, the requirement that students work together in a team may heighten issues related to acceptance, while the expectation that students have the prior knowledge and ability to use power tools can limit participation by some individuals with physical or cognitive disabilities (access). Because engineering design is so fundamental to the engineering curriculum, there is a need to ensure that the design curriculum, and especially the design classroom or lab, tries to address these issues to be more inclusive to all.

Involvement of disability services professionals in the design curriculum. As outlined above, the engineering design process includes multiple opportunities to involve individuals from outside the field of engineering, including during the stages of Problem Definition, Generation of Design Alternatives, Conceptual Design Review, and Testing. Engineering programs have begun to build in these opportunities to various degrees. At the University of Dayton, for example, brainstorming sessions in the senior capstone design classes include the design team, project sponsors (clients), any users they would like represented, faculty mentor(s) with expertise in the field, and sometimes other individuals identified by the design team who have prior experience relating to the problem.

In recent years, projects focused on designing for individuals with a disability have emerged (Enderle, 1999). The success of these types of projects requires a strong interface between the engineering design team, professionals in the disability field, and often the specific individual with disability being designed for. Though not necessarily imperative for the project's success, it can also be envisioned that professionals from disability services could provide important insight to *all* engineering teams, in an effort to make any product design more usable for potential users with disabilities. However, many professionals in disability services, especially those working outside of academia, may not be aware of their potential contributions to the engineering design curriculum. These professionals might suggest a project, volunteer to serve as a project mentor, or share resources about disability and universal design. These individuals could serve an important role in educating and raising awareness among engineering students about disability. It is imperative that this occurs on a more widespread scale.

Objective of the Current Research

In an effort to address the need for engineers to be more prepared to design for all, this research study evaluated the implementation and effect of a first-year engineering design course project explicitly focused on universal design. It was hypothesized that students who participated in this project would exhibit clear indications of having considered universal design principles during design selection, as compared to previous projects focused on designing for individuals with disabilities and well-defined "intro to engineering" projects.

The chosen universal design project challenged students to redesign elements in their engineering classroom to ensure a more inclusive environment for all who use, and interact in, the room. This project, therefore, had not only the goal of building awareness and skills related to universal design, but also improving inclusiveness and accessibility of the engineering design curriculum through the ideas and products that were developed. Professionals in disability services, and other individuals with personal experiences relating to diverse needs and abilities, served as class mentors in an effort to establish a possible model for other such partnerships.

Methods

This mixed-methods research was based in the University of Dayton's first-year engineering design course entitled EGR 103 Engineering Innovation, which is described in detail below. A total of 48 first-year engineering students, 24 students per course section, were involved. Students completed either a design project explicitly focused on universal design (as presented to one course section) or a design project focused on designing for individuals with disabilities (as presented to the other section). To compare the effectiveness of each project on increasing student awareness and consideration of usability, inclusiveness, accessibility, and flexibility of design, the decision analysis matrices produced during the Design Selection stage of the engineering design process were quantitatively and qualitatively compared. As a secondary comparison, a similar analysis was performed on a small-scale, well-defined, "intro to engineering" design project that lacked a human-centered focus. Details on all course projects, as well as more information about the data analysis, are presented below. Per the focus of this particular paper, the Universal Design Project is presented in elaborate detail so that it would be possible to be reproduced by others.

Course Structure

EGR 103 Engineering Innovation is a "cornerstone" course to teach the fundamentals of the engineering design and product realization process through project-based learning. It is a two-credit, one semester course required of all first-year engineering students. Multiple course sections, each of approximately 24 multidisciplinary engineering students, are taught each semester, with each section taught by a different instructor. The instructors follow a common course structure, but are given freedom to choose a course project that aligns with their own area of expertise or interest. Projects are intended to address real-world issues, and instructors are encouraged to consider service-learning type projects focused on humanitarian need, sustainability, or assistive devices. For the majority of projects, it is expected that the project be driven by an external partner, such as a local non-profit organization or a local company. This partner, and any other mentors identified by the instructor, serve to help the class throughout the various stages of the design process.

Students are given over 2 months for the project, and work in design teams of approximately four. The class follows the engineering design process outlined at the start of this paper, with a conceptual design review occurring approximately halfway through the project, with time for the design team to receive feedback from class mentors who can attend. Each design team then builds a prototype or model, and concludes the semester by giving a presentation and writing a design report. Though ideas are generally very innovative, because of the underdeveloped engineering skills of first-year students, the built product is not typically developed enough or safe enough to provide an end-product to the client. There is, however, the opportunity for especially promising devices to be pursued in future semesters by upperclassmen or senior design classes.

Project Descriptions

The Universal Design Project. The Universal Design Project was implemented for the first time in one section of Engineering Innovation during Spring 2011. For this project, the instructor approached the University's Director for Student Learning Services, who oversees accommodation for students with disabilities, to serve as the project client.

The Universal Design Project was introduced to the class by first posing a fairly open-ended, ill-defined problem statement about the classroom that the students had been using for the first six weeks of the semester:

> Kettering Labs room 353 (KL353) is a laboratory-based classroom used by many, but certain aspects of it make it difficult to use and maintain efficiently and effectively. We desire to make it more accessible

to all by applying Universal Design principles to solving some of the underlying problems in the room.

Students were then presented a very short description summarizing universal design:

> Universal Design is about improving accessibility and usability of a product, building, or service for all people. Though novice universal designers often start thinking about the design's accessibility with regard to certain populations, such as those with physical disabilities or older users, universal design is best achieved when it is applied by considering the entire spectrum of users when conceiving possible solutions. A driving factor behind Universal Design is that changes that are made to make the product, building, or service better accommodate a certain type of user will often have benefits that carry over into improving usability for all users. For example, a common illustration of Universal Design is the curb cutaways that were originally intended for wheelchair users. Who else benefits from this design feature, however?

To help guide students through preliminary problem definition, a class discussion was held to discuss the classroom space through guiding questions such as (a) Who uses KL353? (b) What do we know about these users? (c) What do we assume about the abilities required for an effective user-environment interaction? and (d) What about the room does not work for you?

At the conclusion of this discussion, which lasted for approximately one hour, a refined problem statement was presented to help those students who were lost at the open-endedness of the project. This included suggesting that students concentrate on one of the following room requirements:

- Ability to meet all users' needs in entering, exiting, and moving about the classroom space
- Ability for all users to sit and work comfortably and efficiently in the classroom space
- Ability to locate, identify, reach, and use equipment, tools, and building supplies
- Ability to read, see, follow, and actively participate in lectures, presentations, demonstrations, experiments, or design building
- Ability to adhere to and ensure safety of all users of the classroom space
- Ability to safely and effectively store supplies and clean the classroom space

During the following class period, a panel of four guest speakers provided additional insight into the problem. All panelists first discussed some of the key points they felt were important and then allowed for question and answer time with the class. The client for the project, the Director of Student Learning Services, spoke about universal design, as well as the needs of some of the students she assists, including students who have used or may use the particular classroom in question. Another guest speaker for the class was a teacher who had been temporarily disabled, and who had taught in the particular classroom while using a wheelchair, then later using crutches. The third guest speaker was a student with an injury requiring the use of crutches, and later a cane, who had used the classroom for the Engineering Innovation course. He shared obstacles he had experienced when working with his team while having limited mobility. A final guest speaker was an engineering student designing an assistive custodial device. This last speaker provided the class insight about considerations that should be taken into account regarding the care and maintenance of the room. This speaker also spoke of personal insights into the psychological effects and frustrations that barriers caused for individuals with disability.

To supplement their learning, all students in the class were also required to find three resources that helped them better understand the problem. These included web-based resources, news articles, academic journals, personal interviews, field observations, etc. Table 1 includes a sample of suggested resources.

The Design for Individuals with Disabilities Project. This project, carried out in a semester previous to The Universal Design Project, asked design teams to develop playground equipment appropriate for installation at baseball parks designed for leagues catering to children with disabilities. Students were challenged to make sure that their designs promote positive interactions between children with disabilities and their peers without disabilities. In this sense, the project had elements of designing for inclusiveness, but focused mainly on designing for persons with disabilities. This focus on individuals with disability was also fostered in the nature of class conversations and research conducted by students.

The Introduction to Engineering Design Project.

Table 1

Sample Web-based References and Resources for Students Learning about Universal Design

Web Resource	Website URL	Summary
Center for Excellence in Universal Design – National Disability Authority, Ireland	http://www.universaldesign.ie	Comprehensive informational site focused on what universal design is, how it is taught, and related standards and guidelines
Center for Universal Design – North Carolina State University	http://www.ncsu.edu/projects/design-projects/udi	Features overview of universal design, relevant publications, examples of past projects, and research
Institute for Human Centered Design	http://www.humancentereddesign.org/index.php	Focus on making all designs more human centered, with a particular emphasis on universal design
Universal Design Education – North Carolina State, University at Buffalo, & Global Universal Design Educator's Network	http://www.udeducation.org	Website to support the teaching and study of universal design through the compilation of numerous resources
Universal Design: Housing Solutions for All Ages and Abilities – The Ohio State University	http://ehe.osu.edu/cs/ud	Site focuses on universal design associated with housing with many examples and videos, as well as educational resources

The smaller-scale Introduction to Engineering Design Project has been used for multiple semesters as a lead-in to the engineering design process. Compared to the large-scale projects detailed above, this project was much more contrived, and well-defined, asking students to design a cardboard table of certain dimensions, using limited materials and time, and being strong enough to support a given weight. No client or potential users were mentioned in the problem definition, though students were given freedom to come up with their own "back-story" and any other additional objectives important to the design team. Students spent approximately three weeks completing the entire design project.

Data Analysis

The instructor used the design decision analysis criteria presented in each team's final project report to quantitatively and qualitatively compare results. In Engineering Innovation, design decision analysis criteria are developed by the students based on the knowledge they gain from the original problem statement and information presented by the instructor, from discussions with the client, mentor, and stakeholders, and through research and any additional resources used. As such, the criteria used in decision analysis indicate what the design team feels is important in identifying "the best" design. The weight given to each criterion conveys the relative importance.

The design decision analysis criteria and their relative weights were first compiled for all six teams for each project separately. These criteria were then reviewed and categorized based on common themes that emerged. These themes, chosen by the instructor to emphasize consideration of universal design principles, included: (a) Criteria that clearly conveyed a correct understanding and recognition of importance of universal design principles, (b) Criteria that conveyed universal design by focusing on accessibility, (c) Criteria that indirectly conveyed universal design knowledge through consideration of functions and requirements, and (d) Criteria related to project feasibility. The average weight of the criteria within each grouping was calculated so that thematic groupings could be compared. Most engineering design groups weighted criteria on a scale of 1 – 10, with 10 being most important, though some teams used a maximum score of 9. However, for the particular semester of the Design for Individuals with Disabilities project, students had not weighted their criteria based on importance, limiting the direct comparisons that could be made.

Results

Analysis of Universal Design Project

For The Universal Design Project, the six design teams used a total of 51 criteria in their decision analyses. Five of the six teams included at least one criterion that clearly conveyed a correct understanding of universal design principles. These criteria are shown in Table 2 and include six directly related principles, and an additional three criteria dealing with functions or features that related to improved usability. The team number is noted in the results table, to demonstrate the fairly even distribution amongst teams. The average weight of importance of these variables was 7.7 ± 1.1 (s.d.), with some students using a maximum importance score of 9, and others 10.

An additional seven criteria were related to universal design, but focused specifically on accessibility. Table 3 shows these measures. The average weight of importance of these criteria was 8.3 ± 1.4 (s.d.), again with some students using a maximum importance score of 9, and others 10.

Though not directly conveying universal design principles, a third category of criteria emerged that demonstrated the students' efforts to apply features, functions, and elements of universal design. These criteria are shown in Table 4. The average weight of importance of these criteria was 6.0 ± 1.8 (s.d.), out of either 9 or 10 (depending on the group).

The last category of criteria that tangentially touched on universal design principles was safety. All six teams included the criteria "Safety" for an average criteria importance weight of 9.29 ± 0.45 (s.d.). An additional team [1] also included the safety-related criteria "Will Not Tip Over" assigning a weight of 5.

The remaining 18 criteria were related to cost, aesthetics, durability, and other less person-centered design criteria. Team 3 was the only team that had all of its eight objectives reflect universal design or human-centered design in some way.

Analysis of Playground for Children with Disabilities Project

A review of the design decision analyses for the project, which asked students to design a playground to be inclusive for children with disabilities, without an explicit focus on universal design, showed differences. Notably, none of the six teams' decision analyses included any criteria that directly reflected principles of universal design, such as flexibility and versatility of use. Similar to the universal design project, however, students did demonstrate a clear focus on accessibility. Five of the six teams included either Accessibility (3 teams), Accessible (1 team), or Wheelchair/Walker Accessible (1 team) as criteria. Additional criteria describing accessibility (Rubber Surface and Avoids Many Levels) were also included.

Additional criteria focusing on the human-centered nature of design, with a particular emphasis on disability, were also evident. For example, after learning that children with autism often benefit from tactile feedback, several design teams chose to include "Texture" as a criterion in their design decision analysis. Table 5 shows those criteria that fit this theme. As with the Universal Design Project, safety was a criterion for all teams.

Analysis of Cardboard Chair Project

In contrast to either of the other two projects, the criteria used for the decision analysis of the cardboard chair concentrated almost entirely on functions and features, without any emphasis on users. Of 35 criteria used by the six teams, the only criteria that conveyed consideration of people, in some way, were: (1) Safety (2 teams), (2) Prior Experience, (3) Build Difficulty, and (4) Meets Clients Demands. In these rare cases, the emphasis was placed on the design team, or the design request. Only safety, noted by two of the six teams, referred back to the users.

Analysis Summary and Comparison

Comparison of the three projects showed that

Table 2

Summary of Design Decision Analysis Criteria that Clearly Conveyed a Correct Understanding and Recognition of Importance of Universal Design Principles

Student Defined Criteria	Weighted Criteria	[Team]
Universal Design	10	[5]
Avoids Setting People Up for Failure	8	[1]
Easy for All to Use	8	[3]
Feeling of Equality	7	[6]
Versatility	7	[5]
Obvious Use	6	[2]
Versatile Height	8	[3]
Easy to Move by All	8	[3]
Doesn't Inhibit Ability to Reach Storage	7	[3]

Table 3

Summary of Design Decision Analysis Criteria that Conveyed Universal Design by Focusing on Accessibility

Student Defined Criteria	Weighted Criteria	[Team]
Accessible	10	[6]
Universally Accessible to Handicap	9	[2]
Accessibility	9	[4]
Accessible to Many People	9	[1]
Group Accessible	8	[6]
Wheelchair Accessible	7	[3]
Value for Non-Handicapped too	6	[2]

Table 4

Summary of Design Decision Analysis Criteria that Indirectly Conveyed Universal Design Knowledge through Consideration of Functions and Requirements

Student Defined Criteria	Weighted Criteria	[Team]
Better Workspace for Individual Work	9	[3]
Moves Up and Down	7	[1]
Movable	7	[6]
Opens Up Floor Space	6	[3]
Maximize Space	6	[4]
Easy to Clean	6	[4]
Maneuverability	6	[4]
Comfort	6	[5]
Weight	5	[6]
Easy to Use	2	[1]

safety was consistently viewed as one of the most important considerations for engineering design, being the only criteria category to be represented in all three projects. For the larger projects, safety was the only criteria that every team included in their decision analysis, and when weighted received the highest average importance, 9.29 ± 0.45.

Accessibility criteria were next most commonly represented. They were incorporated into the decision analyses of 5 of 6 teams for each of the large projects, and had an average score of weighted importance of 8.3 ± 1.4.

Criteria relating to the application of universal design principles to the design were only present in the decision analyses of the Universal Design Project. These criteria were present for 5 of the 6 teams and accounted for almost 18% of the total number of criteria. These criteria received an average weighted importance of 6.0 ± 1.8. Additionally, there were another 10 criteria (about 20% of total responses) that indirectly conveyed universal design knowledge through consideration of functions and requirements.

Though no criteria directly or indirectly related to universal design were included in the decision analyses for the playground project, a new set of criteria related to consideration for the needs of individuals with specific disabilities was included.

Discussion

Raising Awareness of Universal Design

Results suggest that the Universal Design Project was successful in helping engineering students consider the importance of designing for inclusivity in their projects, supporting the study hypothesis. The majority of criteria used in the design teams' decision analyses reflected consideration of the end user, with many criteria directly reflecting universal design principles. This was especially notable, as there was very limited formal education about universal design, leaving students to draw only from their own research and the guest panel presentation. Though it is clear students were able to draw many parallels, a more

Table 5

Summary of Design Decision Analysis Criteria for Playground Project Indicating a Focus on the Disability

Student Defined Criteria	[Team]
Texture	[1]
Shade Provided	[1]
Building Skills	[1]
Encourages Survival Skills	[2]
Variety of Textures	[2]
Contains Sensory Stimulus	[4]
Avoid Crazy Patterns	[4]
Encourages Social Interaction / Teamwork	[2]
Physically Interactive	[6]
Educationally Interactive	[6]
Socially Interactive	[6]
Educational	[2, 4, 5]

structured lesson on the topic may have led to more refined design decision criteria. For example, the inclusion of the seven guiding principles of universal design (Story et al., 1998) in a targeted lecture may have contributed to identifying design criteria that were more clearly related to universal design principles. Similarly, revisiting the project description to better emphasize certain aspects of design (e.g. flexibility of use) and de-emphasizing others (e.g. accessibility and disability) may have helped better guide students.

Results are especially promising in comparison to the two other types of projects considered. The project posing the challenge of designing a playground where children with disabilities can interact with their peers without disabilities had the potential to include a very strong emphasis on universal design. Even without the explicit focus on universal design principles, there was still opportunity for students to include criteria that would have reflected the inclusive nature that their playgrounds were aiming for. Had they done so, students would have unknowingly incorporated elements of universal design. This, however, was not the case. These findings suggest that universal design knowledge does not happen naturally, and that students do not inherently think in these ways. As such, this further promotes the need to find ways to explicitly emphasize universal design in the engineering curriculum.

Results of both the Universal Design Project and the Playground for Children with Disabilities Project did support, as suggested in the introduction of this paper, that students do seem to have heightened awareness of issues related to accessibility. In fact, in the Universal Design Project, students rated accessibility-related criteria as more important, on average, than the criteria related to universal design principles. Though the recognition of accessibility is clearly important, it may hinder students from looking at the broader scope of the importance of designing for all. As such, there may be a need to begin to better delineate universal design from accessibility, as proposed by Welch (1995).

Similarly, it is clear that students have some ability to cater their designs to ensure they meet the specific needs of individuals with disabilities. Though this is a good start, products developed according to the seven guiding principles of universal design would not only encompass these needs, but have additional favorable outcomes. It appears that, to develop engineers who have a universal design mindset, it is important that design instructors de-emphasize the need to design specifically for individuals with disabilities. In fact, designing for an individual with a disability in mind, which is growing in popularity in the engineering curriculum, often leads to designing specialized assistive devices, which contradicts the driving forces of universal design.

In contrast to the other two projects, the Cardboard Chair Project used to introduce students to the engineering design process, not surprisingly, did very little to get students to consider the human-centered nature of design. This is likely due to the fact that the project was not "real-world" in nature, and was not presented in the scope of a specific client or group of users. This is somewhat of a concern, as these types of contrived problems are often used to introduce young engineers to engineering design. Though they may achieve this goal, results suggest that they do little to promote the important skill of considering the end user. In fact, only two of six teams even considered safety in their design.

These results have implications for teaching engineering students to be more inclusive in their design thinking. It appears that projects with an explicit universal design focus do raise student awareness on these topics. In the course where the project was framed around universal design, it was promoted to students as a type of skill set that they could take on to future design projects. It is unclear, though, how well this knowledge will translate to future projects where the focus is not specifically universal design in nature. Future work should seek to evaluate the effect of this type of project on future design decision analyses. It may also be beneficial to determine whether a full project, such as described in this paper, is necessary to raise student awareness on the issues, or whether lectures on universal design to all students is sufficient. Regardless, it was observed that even when the project lends itself to universal design considerations, such as the Playground for Children with Disabilities Project, students do not think in this mindset without universal design having been promoted. This suggests that universal design knowledge is not inherent in engineering students and does need to be taught in some way. The Universal Design Project is one model to achieve this.

Student reactions to the Universal Design Project were mixed. Two teams did a very good job of demonstrating a much higher level thinking of universal design principles than the rest of the class. For example, one team designed a table that was accessible for a range of people, including individuals who were pregnant or obese, but also showed how the tables could be arranged in different ways to emphasize either group work or small group teacher-led instruction. This demonstrated that they had clearly understood the idea of accommodating for all, as well as designing products that could be flexible and used in multiple ways and situations. Another group designed modular tables, each fully adjustable, arguing that this approach circumvented the assumption that everyone is the same. Instead, the tables were specifically designed to show that each individual was unique and had different preferences.

Some of the students in the class seemed to enjoy the project. Further, they recognized that, by carrying it out, they had developed a new skill set that could help them be more successful designers in the future. Other students, however, did not especially like the scope of the project. This may have been related to the fact that most of the students chose to focus on building tables and workspaces for the Universal Design Project, even after having built the cardboard tables for the previous project. This choice was despite the latitude students were given to design anything, from more adaptable tools to more user-friendly storage systems. Students claimed that listening to the guest panel led them in the direction of tables and workspaces. This was disappointing to them, because they had already done a table for the first project, and it meant everyone was doing something fairly similar.

Aim for Increased Usability and Inclusiveness of Classroom Lab Space

The majority of the design prototypes were not fully functional because of the less sophisticated technical background of the first-year students. As such, the project did not result in any readily implementable means of improving the classroom space to be more inclusive of all of the potential students who might use the space. However, some of the design ideas that were presented by the design teams were appropriate and achievable solutions for increasing the usability of the classroom, if further refined or more professionally built. Interestingly, five of the six teams designed tables and workspaces. It had been hoped that a broader range of designs would be developed, but these common designs did meet the important need to ensure equality of all team members in design classes, where meeting and work is generally done around a central workspace.

Involvement of Professionals in Disability Services

This project demonstrates the role that professionals in disability services fields, individuals with disabilities, and other key stakeholders can play in the engineering design process. In the case of the Universal Design Project, as is often the case, the information conveyed by the guest panel was invaluable. Additionally, feedback received during the conceptual design phase of the project was also beneficial, though the majority of class mentors could not attend due to scheduling conflicts. Professionals interested in participating in such a project should be aware that many engineering programs have an office dedicated to engineering design curriculum, staffed by an individual in charge of directing senior capstone design courses. First-year engineering design classes are often run through this office. As a first step to becoming involved, interested individuals can contact the engineering design office at their institution, and express their interest, background and expertise, any project ideas, and ways they envision helping. Even if an immediate need does not exist, because of the variety of projects that come up, there may likely be an opportunity in the near future. Individuals knowledgeable in universal design might also be in a position to offer a guest lecture for all engineering classes.

For those individuals who do wish to get involved in engineering design projects, it is important to remember that a key to the success of the project is to systematically narrow down the originally posed open-ended problem. As such, it is not as beneficial to those involved if course mentors propose well thought-through, narrowly defined problem or problem solutions. Rather, keeping answers and information open-ended can help lead students into design generation that is not limited or confined, and that promotes innovation. This type of guidance is, therefore, ultimately mutually beneficial.

Opportunities for involvement will likely increase as more formalized human-centered design efforts grow. Lande and Leifer (2009) have shown how design clinic projects have begun to shift focus from manufacturing, tools, and products, to projects that emphasize the person who will use the product (i.e., human-centered design). With this shift has come increased efforts to better interact with potential users who have insight into design needs, as well as ways to document this new knowledge (Roschuni & Agogino, 2011). As such, there will be increased need for diverse users, including individuals with disabilities, and individuals in the disability services profession to participate in interviews, ethnographic studies, and other means of sharing experiences. This will enable better designs and richer student experiences.

Conclusion

In conclusion, this research project shows that students do not implicitly consider universal design principles in designing products, even when these products are to be used by a diverse user group. The use of a specific universal design project did demonstrate that students were largely able to understand, and correctly apply, the principles of universal design to maximize the inclusivity of their designs. Though it is currently unclear how this knowledge translates to projects that are not specially focused on universal design, it is clear that there is a need to introduce and promote universal design in the curriculum in some way, with the project described as one possible model. Involvement of disability professionals, individuals with disabilities, and other key stakeholders is invaluable to enhancing the engineering design process and preparing engineers who are more cognizant of the needs to design for inclusivity.

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About the Author

Kimberly Bigelow received her BS degree in engineering mechanics from Michigan State University and MS and Ph.D. in mechanical engineering with a focus in biomechanics from Ohio State University. She is currently an assistant professor in the Department of Mechanical and Aerospace Engineering and directs the Engineering Wellness and Safety Lab. Her research interests include engineering design education and clinical biomechanics. She can be reached by email at: Kimberly.Bigelow@udayton.edu

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Cognitive Diversity and the Design of Classroom Tests for All Learners

Erin Shinn
Morrissey-Compton Educational Center

Nicole S. Ofiesh
Stanford University

Abstract

It is well documented that many successful individuals are challenged by cognitive-based disabilities that impact their performance in school and on tests. While commonly believed to be related mostly to the constructs of processing speed or reading fluency, there are other aspects of cognition that affect how an individual interacts with the demands of a test. Moreover, it is not only students with disabilities who bring a range of cognitive considerations to the postsecondary environment. As the diversity rises in postsecondary settings in terms of older students, veterans, non-native speakers of English, and students who lack exposure to academic vocabulary, faculty members will experience greater differences in the cognitive diversity of their students with increased frequency. In order for faculty members to develop assessments that genuinely measure the knowledge and skills that are intended to be measured, an understanding of cognition as it relates to test taking is needed. Therefore the purpose of this article is to integrate research on cognition and test taking by providing disability service providers and faculty with an understanding of how cognitive traits impact test taking. This article begins with a discussion on the main aspects of cognition that influence test taking. We then provide an overview of those student populations that are on the rise, and the areas of cognition that these individuals most often struggle with in postsecondary classrooms. Next, this article outlines basic guidelines for transforming tests so that their design is just for all learners. We end with a proposed training series that disability service providers can offer faculty.

Keywords: Classroom assessment, cognition, disability, diversity, tests

The term “cognitive diversity” can be used to conceptualize the different cognitive traits each student brings to the learning environment. This diversity includes, but is not limited to, individuals with disabilities. While every individual has unique cognitive traits, research indicates commonalities amongst specific populations. For example, individuals with attention-deficit hyperactivity disorder (ADHD) have greater challenges with attention span, and individuals with dyslexia are usually stymied in the domain of reading. While adult students with learning disabilities, ADHD, psychological disorders such as depression, anxiety, and Post Traumatic Stress Disorder (PTSD) can exhibit differences in their ability to perform academic tasks, the same is true of other segments of the postsecondary population. Individuals without disabilities such as older students, culturally and linguistically diverse students, returning war veterans exposed to trauma or violence, as well as students from varying socio-economic backgrounds also bring a level of cognitive diversity to postsecondary institutions.

Current data surrounding postsecondary enrollment trends suggests that greater awareness, understanding, and responsiveness to cognitive diversity within post-secondary institutions is needed. The need to obtain postsecondary education for career opportunities in America is more critical now than ever (Carnevale & Desrochers, 2003), shedding light upon the high stakes associated with achievement at the postsecondary level. Not surprisingly, national data indicate that adults are heeding the need for further education and that their enrollment at postsecondary institutions is on the rise (Institute of Education Sciences [IES], 2010). The increase in general student enrollment is leading to greater cognitive diversity within classrooms and lecture halls. Specifically, survey data indicate a rise in the number of culturally diverse students and students with disabilities attending postsecondary institutions (IES, 2010; Newman, Wagner, Cameto, Knokey, & Shaver, 2010). During the 2003-2004 school year, 12.9% of the postsecondary student population self-reported being Hispanic; three years later (2007 – 2008) the percentage of Hispanic students rose to 14.1 (IES, 2010; Newman, Wagner, Cameto, & Knokey, 2009; Newman et al., Shaver, 2010). A similar trend was observed for those who self-reported as Asian/ Pacific Islander, 5.9% to 6.6%, respectively. According to the IES 2010 report, which contains the most recently collected postsecondary enrollment figures by group affiliation, there were 2,154,000 students with disabilities enrolled in undergraduate studies during the 2003 – 2004 academic year. This number rose to 2,226,000 for the 2007 – 2008 academic year. While the overall percentage of students with disabilities compared to students without disabilities dropped by half of one-percent (.5), the total number of students with disabilities still increased.

If we assume that not all adult students with disabilities report having a disability or that others have undiagnosed disabilities, then these statistics may be underestimations of the diversity in our classrooms. Indeed, "fifty-five percent of postsecondary students who were identified by their secondary schools as having a disability did not consider themselves to have a disability by the time they transitioned to postsecondary school" (Newman et al., 2010, p. 12). While students may not report having a disability, research tells us that symptoms associated with disabilities, such as ADHD, language disorders, and learning disabilities remain over time and into adulthood (Mugnaini, Lassi, Giampeolo, Albertini, 2009; Norvilitis, Sun, & Zhang, 2010). In addition to adult students with diagnosed or undiagnosed disabilities, it is important to think about the cognitive diversity within a variety of populations including older students, those going back to school for a career change, adult students exposed to violence, such as military service men and women, and adult students from varying socioeconomic backgrounds. Clearly the face of the "typical" college student has become "not so typical."

Tests are inescapable for all students, particularly postsecondary students. In fact, tests are a substantial contributor to an adult student's letter grade and/or allocation of course credit. Additionally, test performance can either promote or inhibit access to other resources such as financial assistance and career enhancement (Goonan, 2003). Given that test performance makes a critical difference during and beyond postsecondary education, college and university faculty members must think carefully about how tests are designed. Disability service providers can be instrumental in fostering this awareness. Care must be given to ensure that tests not only measure the intended content area, but are also accessible to the wide variety of postsecondary students.

Considering the ever-growing body of diverse learners in postsecondary academic settings today (Ewell & Wellman, 2007), it is critical that we understand and integrate the research findings in regard to cognition and test taking. That is the purpose of this paper. In addition, the authors hope that the extensive bibliography at the end of the paper will provide disability services providers with access to a wide range of research findings, both for their own interest and learning and to help them satisfy faculty questions.

Test-Related Cognitive Demands

Some common types of postsecondary test formats include, but are not limited to, multiple-choice, true/ false, fill-in-the-blank, short-answer written responses, diagram and/or label, and question and answer (Brookhart, 1999). While students and faculty alike are often familiar with these common test formats, the cognitive demands required to access, attempt, and complete these common tests are less widely understood (Rutkowski, Vasterling, Proctor, & Anderson, 2010). Recent research from the fields of neuropsychology and neuroscience has helped us to understand what is going on in the brain when it comes to learning and test taking (Gregg, 2010; Korbin and Young, 2003; Rose & Meyer, 2002; Sireci & Pitoniak, 2007; Thompson, Johnstone, & Thurlow, 2002). Moreover, there has been an increase in the amount of research on how learning disabilities and emotions, such as PTSD (Rutkowski, et al., 2010), influence test taking.

To help with conceptualization within the scope of this article, select test-related cognitive demands are presented in three categories. First, there are those cognitive demands that primarily influence *access* to the test: language comprehension, visual spatial skills, and academic fluency. Second, long-term retrieval and visual motor integration primarily influence the student's ability to respond to the test or demonstrate knowledge. We refer to this as *output*. Third, working memory, attention, and processing speed influence *both test access and test output*. We caution that there is a great deal of overlap and "back and forth" when it comes to cognitive demands, and that this framework is best applied when addressing test design (see Figure 1).

Cognitive Demands Associated with Test Access

Language comprehension. Language comprehension, or the ability to understand spoken and/or written language, is fundamental to accessing test content (Treiman, Clifton, Meyer, & Wurm, 2003). Within the context of test taking, language comprehension is different from the ability to accurately hear sounds in spoken words or the ability to decode or read text. Rather, language comprehension refers to the student's ability to understand what a professor is saying or asking for, be it in spoken or written form. Often difficulties can arise as the student may misunderstand directions or directional words. The ability to comprehend language in this vein may or may not be related to whether the language spoken in a class is native or non-native to the speaker; language comprehension differences can be found in both non-native speakers of English, as well as those with language disorders (explained later in this article). It is critical for faculty and other test authors alike to appreciate the importance of language comprehension because most, if not all, postsecondary tests require some level of language comprehension. That is, across all subject areas, including Chemistry, Biology, World Religion, and so forth, tests include written directions and specific problems posed through language, which are separate from technical and academic vocabulary.

Visual-spatial thinking. While language comprehension encompasses the verbal demands of tests, visual-spatial thinking is also needed to access tests. Visual-spatial thinking refers to the ability to perceive, analyze, synthesize, and think with visual patterns, including the ability to store and recall visual representations (Mather & Jaffe, 2002). In other words, visual-spatial thinking allows the student to make sense of and work with visual input. Visual-spatial thinking is separate from visual acuity (Fletcher & Currie, 2011). Some examples of visual-spatial demands required for test taking include filling in bubbles on Scantron® test forms, labeling parts of an image, graphing an equation, and recognizing patterns.

Academic fluency. Most tests require some combination of reading, writing, and/or math skills; therefore, a certain level of academic fluency is required to access tests. Academic fluency is the "ease and speed by which an individual performs simple to more complex academic tasks" (Mather & Jaffe, 2002). A common

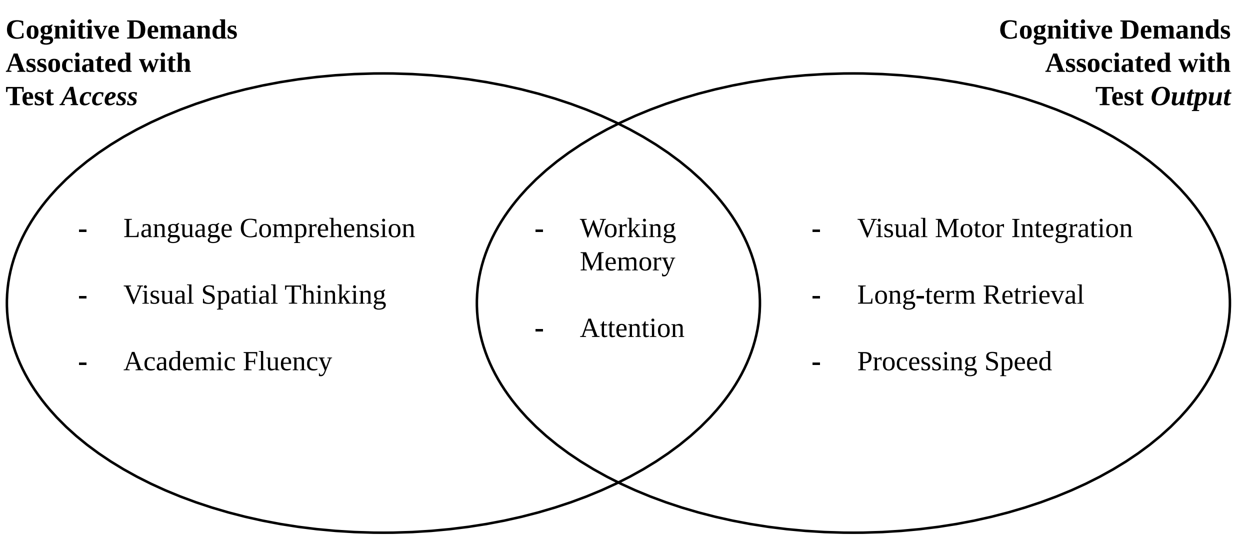

Figure 1. Cognitive demands associated with test taking.

mantra in education is, "First you learn to read, then you read to learn," the premise being that once a student masters foundational academic skills, then those basic skills serve as the foundation for deeper, richer learning. In the realm of a test, a student must be able to quickly read a test question, solve a simple equation, or spell words in order to have enough mental energy to think critically about the test content.

Cognitive Demands Associated with Test Output

Visual-motor integration. All tests require some form of output, be that giving a speech, writing an essay, executing pencil-to-paper calculations, or even running a mile. Assuming every postsecondary student takes tests that require written output, the cognitive demand of visual motor integration holds great weight. Specifically, visual motor integration is the ability to coordinate information from the eyes with body movements; "[it] is the degree to which visual perception and finger-hand movements are well coordinated" (Beery, Buktenica, & Beery, 2010). In turn, the cognitive demand of visual motor integration encompasses copying text, writing spontaneously, drawing a diagram, aligning numbers for a math calculation, filling in a bubble, circling an answer, and so forth. Christopher serves as an example. Christopher is a college-senior with dysgraphia, a learning disability which impacts handwriting legibility (Feifer & De Fina, 2002). For his sociology test, Christopher has to copy a demographics chart from the white board and then write an essay explaining the significance behind the chart. Christopher has to exert more mental energy than his classmates to visually comprehend the chart and then process this information through his fingers and onto the page (Beery, et al., 2010). Complicating matters, he also has to exert more mental energy or cognitive resources to form each and every letter (Feifer & De Fina, 2002).

Long-term retrieval. Ideally, tests assess mastery of course content by asking students to think back and demonstrate what they have learned. The cognitive demand of long-term retrieval refers to the ability to recall what was previously learned (Carroll, 1997). Long-term retrieval is two-pronged. One, the student must be able to accurately learn course material and store that information in memory, and, two, the student must be able to retrieve or "find" that information during the test (Mather & Jaffe 2002). Thinking of Christopher, he may have studied for several hours for his sociology test, but if he has long-term retrieval weaknesses, he may have to work harder to retrieve that information while writing his essay. The tip-of-the-tongue phenomenon is another good example. This phenomenon was first defined as an inability to retrieve a word even though there is a feeling of knowing the intended word (Brown & McNeill, 1966). Students with retrieval weaknesses often know course material, but cannot demonstrate that knowledge without prompting or cueing (e.g., multiple-choice tests).

Processing speed. Assuming that most postsecondary tests must be completed within a set time frame, processing speed is another core test taking demand. Indeed, many higher education tests are timed according the length of a class versus the purpose or function of the test (Ofiesh, Mather & Russell, 2005). While different researchers refer to the cognitive construct of speed in different ways (Ofiesh, 2000), processing speed, in a broad sense, refers to the ability to process or make sense of incoming information and to then produce a response (Carroll, 1997). Students with slower processing speed, whether due to a learning disability, depression, or other contributing factor, oftentimes do not finish tests within standard administration time, and use the most time on tests that involve math reasoning or math calculations (Ofiesh & Hughes, 2002). When students are unable to access an entire test due to limited time, then their test performance may be reflective of slower processing speed, among other constructs, and not an accurate measure of their understanding of the test content.

Cognitive Demands Associated with Test Access and Test Output

Working memory. Working memory is fundamental to test taking. Working memory refers to the ability to hold information in awareness while performing a mental operation or manipulation on the information (Levine & Reed, 1999; Mather & Jaffe, 2002). Moreover, working memory is "highly related" or central to all types of academic learning including reading, mathematics, written language, and reading comprehension (Dehn, 2008; Evans, Floyd, Mcgrew, & Leforgee, 2001). Unlike long-term retrieval, working memory focuses on recall while work is being done. To provide more clarity, examples are provided. Rebecca, a 24-year-old graduate student, reads the essay prompt for her course final. She must hold onto the content of the prompt while simultaneously reflecting upon information obtained during the course. To complicate matters and place heavier demands on working memory, she must then hold that information while thinking about the best way to convey her knowledge in written form. Another example of working memory demands during a test is offered. Miles is a 19-year-old college freshman taking his Calculus midterm. Miles reviews the first problem then begins to execute his calculations. Miles must perform each calculation step while simultaneously thinking about the next move, thus placing demands on his working memory (Feifer & DeFina, 2005). Of all the cognitive demands associated with test taking, working memory may be the most fundamental and multi-faceted (Swanson, 1994).

Indeed, Baddeley (2000) breaks working memory into a three-component system. The first component is the "phonological loop," which refers to holding and manipulating sounds or speech-based information while performing a mental operation. In Miles' case, he must use a verbal retrieval system for recalling basic math facts (e.g., 5 + 5 = 10) as he solves more complex calculations. The second component is the "visual-spatial sketch pad," which refers to holding and manipulating visual, spatial, and kinesthetic information in awareness in the form of visual imagery. Thinking about Miles again, if he needs to graph an equation for his midterm, then he will need to use his visual-spatial sketchpad as he works. The third component of Baddeley's working memory systems is the "central executive system," which controls the functions of phonological loop and visual-spatial sketchpad. This complex component system brings into focus the complexity and far-reaching aspects of working memory. That is, students with fewer working memory capabilities are likely to be challenged and taxed on a variety of tests, regardless of content area.

Attention. Similar to working memory, attention is critical to test taking. While attention is a seemingly simple concept, the neurological underpinnings required for us to pay attention are complex. In reality, attention requires selecting and focusing on what is important, maintaining that focus over a period of time, and filtering out or ignoring what is not necessary (McCabe, Roediger, McDaniel, Balota, & Hambrick 2010). Examples of attention demands for common postsecondary tests are provided.

One student, Anna, has significant depression, which impacts her concentration and attention. During her Anatomy course final, which includes several multiple-choice questions, Anna must pay careful attention to the questions; for example, multiple-choice questions with words or phrases such as *all, including, excluding,* and *best matches*. These require Anna's close attention not only to the content or purpose of the question, but also to discrete words. If Anna misses the word "except" due to inattention, then her answer may be wrong not due to a poor understanding of the material (e.g., anatomy of the lungs), but rather due to inattention. Jose is in Anna's course, and he too is taking the Anatomy final. Unlike Anna, Jose is an adult student with ADHD and has consequent difficulty filtering out extraneous visual input. Unfortunately for Jose, the lecture hall where the test is being proctored has several windows looking out onto a busy street. Jose must exert more mental energy than his peers to filter out or ignore the view of bustling cars and pedestrians, leaving less mental energy to demonstrate his knowledge of the human lung.

Exploration of Cognitive Diversity in Postsecondary Settings

It can be helpful for disability services providers and professors alike to better understand the cognitive diversity or specific cognitive traits students can bring to the learning environment. The following categories are discussed, with an understanding that there is great deal of overlap and comorbidity among them: learning disabilities, ADHD, language disorders, anxiety, depression, Post Traumatic Stress Disorder PTSD, Linguistic Diversity, Poverty, and Age.

Learning Disabilities. More and more students with learning disabilities are attending colleges and universities (Henderson, 2001). "Learning disabilities cross-culturally describe significant and impairing difficulties in reading, writing, and math domains" (Mugnaini et al., 2009, p. 255). Within the scope of this article, students with learning disabilities exhibit functional limitations in their ability to access and complete tests. "Deficits in speeded performance are one of the most common ways in which learning disabilities can impact an individual" (Ofiesh, Hughes, & Scott, 2004, p. 60). This is why extended time is often requested by individuals with learning disabilities in postsecondary settings. Indeed both processing speed and working memory impact test taking among students with learning disabilities (Gregg, 2010). Students with learning disabilities often need extended time on a variety of academic tasks such as organizing ideas when writing (Gregg, 2010; Ofiesh, et al., 2004), reading text (Jenkins, Fuchs, Van Den Broek, Espin, & Deno, 2003; Ofiesh, et al., 2004), and performing math calculations (Swanson, 1994).

Students with learning disabilities are also at a disadvantage when it comes to allocation of cognitive resources. Adult students with learning disabilities allocate their mental energy or cognitive resources differently than their same age, non-learning disabled peers when it comes to reading, writing, and math (Carroll, 1997; Feifer & DeFina, 2000; Meyer et al., 2001; Mugnaini et al., 2009). For example, students with reading disabilities, such as dyslexia, or poor readers in-general, must place heavier cognitive demands on word identification, thereby draining other cognitive resources needed to comprehend or construct meaning from text (Jenkins, et al, 2003; Ofiesh, et al., 2004; Torgesen, Wagner, & Rashotte (1997). Similarly, students with writing disabilities, such as dysgraphia, have to work harder and longer when it comes to handwriting (spontaneous writing and copying), spelling, and integrating capitals and punctuation (Berninger, 2008; Feifer & De Fina, 2002; Gregg, 2010). In turn, when tests require written output, students with writing disabilities have fewer cognitive resources available for demonstrating their concept mastery or knowledge (Gregg, et al., 2005). The same pattern is true for math. When students such as Miles have to exert extra energy to recall basic math facts, fewer cognitive resources are available for the intended test content (Feifer & DeFina, 2005; Swanson, 2004). Simply put, adult students with learning disabilities exhibit impairment in the test-related cognitive demand of academic fluency.

Attention Deficit Hyperactivity Disorder (ADHD). Research suggests a comorbidity or concurrence of learning disabilities and ADHD (Mugnaini et al., 2009). It is estimated that 2% to 8% of college students within the United States have ADHD (Weyandt & DePaul, 2006). This statistic does not reflect students with undiagnosed ADHD. This is noteworthy since Biederman and Faraone (2005) studied a group of 19-year-olds formerly diagnosed with ADHD and found that while 60% of the group no longer met full criteria for ADHD, 90% still presented with ADHD symptoms. Indeed, individuals with ADHD have life-long difficulties (Barkley, 1998; Barkley, Fischer, Smallish, & Fletcher, 2002), which underscores the need for support even at the postsecondary level. Adult students with ADHD exhibit impairment in the following test-related cognitive demands: attention, working memory, long-term retrieval, and processing speed (Barkley, 1997). As in Jose's case, he must exert more mental energy to filter out the comings and goings outside the window of his lecture hall. Moreover, Jose must work harder to sustain attention to the test over time, meaning that his cognitive resources are drained or taken away from the actual purpose of the test. For longer, more complex problems, fewer working memory resources can lead to small errors or mistakes, not reflective of poor course mastery, but rather of functional limitations associated with ADHD. Similarly, many students with ADHD exhibit weaknesses in the cognitive demand of long-term retrieval (Pollak, Kahana-Vax, & Hoofie, 2008).

Language Disorders. It is important to note that language disorders are different in nature and manifestation than academic difficulties sometimes associated with being an English language learner. However, for some individuals who struggle with language comprehension, English can function as if it were a foreign language, even if it is their native language. Individuals with language disorders exhibit impairment in comprehending and/or using spoken, written, or other symbolic language systems (American Speech-Language-Hearing Association, 1993, 2008). While about one million people in the United States have aphasia (partial or complete impairment of language comprehension caused by stroke or brain damage), many individuals attend school from early on with mild to moderate language comprehension difficulties and are considered to have language disorders (American Speech-Language Association, 2008). Fahey (2000) in a chapter on Oral Language Problems, states that "children do not outgrow language and learning problems. Rather, the problems change and manifest differently over time as demands increases in complexity" (p. 138).

Anxiety. Survey data indicates that approximately 18% of American adults have an anxiety disorder (Kessler, Chiu, Demler, & Walters, 2005). Students with ADHD and/or learning disabilities can experience anxiety (Mugnaini, et al., 2009). While many students with learning disabilities and/or ADHD may not meet criteria for clinically significant levels of anxiety, they do report increased scores on measures of anxiety (Maag & Reid, 2006; Nelson & Harwood, 2011a, 2011b). There is a wealth of research on the interplay between anxiety, clinical or not, and academic performance (Eysenck, Derakshan, Santos, & Calvo, 2007; Nelson & Harwood, 2011a, 2011b). Specifically, individuals with anxiety exhibit particular difficulty with the cognitive demand of long-term retrieval, working memory, and processing speed. As mentioned earlier, these are all critical components to test taking.

Depression. According to the World Health Organization (2004), depression is the leading cause of disability in the world. This is particularly noteworthy within academic settings because depression detrimentally influences cognitive functioning, academic achievement, (Mugnaini et al., 2009; Nelson & Harwood, 2011b), memory recall (e.g., long-term retrieval) and recognition (Burt, Zembar, & Niederehe, 1995; Maag & Reid, 2006; Mugnaini et al., 2009). Moreover, because depression impedes learning and achievement beyond LD itself, depressive symptomology among students with LD has implications for educational programming and assessment (Mugnaini et al., 2009). Specifically, because depression can influence alertness a depressed student may show impairment in the test-related cognitive demand of attention (Eysenck et al., 2007). There is also an interplay between depression and memory (Burt et al., 1995; Mugnaini et al., 2009), such that students with depression show impairment in the test-related cognitive demand of long-term retrieval.

Post Traumatic Stress Disorder (PTSD). Rutkowski et al. (2010) studied military personnel before and after war-zone exposure to ascertain the impacts of PTSD symptoms (e.g., intrusive thoughts, poor concentration, and hypervigilance) on test-taking. Indeed, these researchers found that posttraumatic stress symptoms have potential detrimental effects on standardized test performance. This is significant because over 1.5 million service members have been deployed to war zones (Rutkowski et al., 2010). A substantial number who return not only present with PTSD, but also with impaired cognitive abilities in processing speed, short-term memory and long term retrieval, as well as other areas of cognition (Tanielian & Jaycox, 2008). Moreover, many veterans return and pursue postsecondary education funded by GI bills (Rutkowski et al, 2002; Tanielian & Jaycox, 2008). If we assume that Rutkowski's findings map onto a percentage of the civilian population exposed to trauma or violence, then the need for tests that are designed for a broad array of cognitive diversity is all the more critical.

Linguistic Diversity

Within the United States alone, there are growing numbers of culturally diverse students, including English language learners (ELL) (Cartledge & Kourea, 2008). Also of importance, national data indicates that culturally and linguistically diverse students, including ELL students, have higher rates of school drop out, disproportionate representation in special education, and the lowest outcomes of all students (National Research Council, 2002). This unfortunate statistic calls even greater attention to the need for postsecondary educators to be aware of and sensitive to the cognitive diversity and consequent needs of this already underserved population of students. Much like students with language disorders, students new to the English language carry associated challenges into postsecondary education settings, specifically in regards to the test-related cognitive demand of language comprehension (Rasmussen, 2010).

Poverty

There is an expanding corpus of research discussing the relationship between poverty and education (Hernandez, 2011; Parish, Roderick, Grinstein-Weiss, Richman, & Andrews, 2008; Pfeffer & Glodrick-Rab, 2011). Sadly, educational outcomes for students with some family poverty experience are far from ideal. For example, "22 percent of children with some family poverty experience do not graduate from high school, a figure about three times greater than the 6 percent rate for children with no family poverty experience" (Hernandez, 2011, p. 7). Students who have experienced what some may consider impoverished or simply a background that is financially disparate from the majority of their postsecondary peers often have weaker academic skills (Hernandez, 2011). Specifically, they exhibit less developed literacy skills due, in part, to living in communities with less access to print, such as the lack of bookstores and libraries funded by local tax dollars (Neuman & Celano, 2001). In turn, this can impact the cognitive demand of language comprehension and academic fluency.

Age

According to the Center for Education Statistics (NCES), during the 2007-2008 academic year, 23% of the total postsecondary student population was age 30 or older (IES, 2010). Of note, older students are and have been returning to postsecondary schools in substantial numbers. In 2002 they were subsumed under the data category of "nontraditional" students, which includes students who delay enrollment, attend school part time, work full time, have dependents, are single parents, and so forth (IES, 2002). Research tells us that students who start postsecondary education not in the same calendar year as high school completion (IES, 2002) are going back to school in record numbers for additional education and training (Creighton & Hudson, 2002; Kim, Collins-Hagedorn, Williamson, & Chapman, 2004). With aging come changes in cognition, most notably short-term memory, and another type of memory known as episodic memory. These changes begin to appear in midlife, and are exacerbated with anxiety and depression (Craik & Salthouse, 2000).

In summary, given the intersection between cognitive diversity and test demands in higher education, there is an apparent need for creating and using tests that address the needs of all learners while staying true to what faculty members want to measure (Ofiesh, Rojas, & Ward, 2006). Further, when tests are designed in a manner that removes barriers to access and barriers to output, then tests can be considered more true measures of a student's concept mastery, knowledge, and skill set.

Putting Research to Practice: Service Providers and Faculty Have the Power to Change Test Design

Creating tests that are just, useable, and sustainable can be challenging given the rigorous teaching and research demands placed on faculty members. In hopes of helping and encouraging faculty members and service providers alike to embrace the creating of accessible tests, we pull from and add to recent research related to universal design and offer a three-pronged framework that focuses on (a) test presentation, (b) test output, and (c) test content. Specifically, we offer disability service providers recommendations to ensure that test presentation and test output are designed in a manner that maximizes accessibility and that tests are designed so as to allow for more valid assessment of a student's mastery and knowledge. Next, we offer recommendations that can be shared with faculty for their designing of tests. We conclude with a proposed Faculty Training Series that disability service providers can offer faculty as a means of encouraging and fostering test design that is useable for our increasingly diverse postsecondary student populations.

Recommendations for Service Providers

Many times the onus for ensuring that students with learning differences maintain equal access to curriculum and equal opportunity to demonstrate concept mastery on tests falls on the shoulders of disability service providers at university disability resource centers (Block, 2006; Cryer & Home, 2008; Embry, Parker, McGuire, & Scott, 2009). A common responsibility of disability service providers is to level the playing field for students with disabilities by re-formatting test material (e.g., changing a printed text into Braille). We refer to this process as designing test presentation. Simply put, test presentation is how tests appear or, better said, how students can take in test information. Rose and Meyer (2002) suggest "flexibility in presentation." Because most test material is absorbed and processed through visual and/or auditory channels, suggestions are provided to help service providers maximize test accessibility through effective visual and auditory design.

Test Presentation and Visual Design. In this era of ever-evolving technology that is empowering between individuals with and without disabilities, service providers can offer students computer-based tests designed to accommodate multiple representations of test content (Thurlow, Lazarus, Albus, & Hodgson, 2010). Visual design suggestions are provided (see Figure 2):

- Service providers need the ability to create digital text, which allows for the altering of font type and font size; the same is true for digital images (Rose & Meyer, 2002). In fact, larger font size (size 14 versus size 12) benefits students with and without disabilities (Fuchs, et al., 2000).
- Particularly for students with low-incidence visual impairments such as blindness, service providers need the technology and equipment to turn text into Braille (Laitusis & Attali, 2011).
- Visual content should be designed so that it is simple and not cluttered. Examples include avoiding using Roman numerals, which can be difficult to visually discriminate, allowing appropriate spacing between questions, and placing keys and legends directly under the text where they are to be applied (Anderson-Inman & Horney, 2007; Gaster & Clark 1995; Ofiesh, et al., 2006;).

Test Presentation and Visual Design	
Font Size	cat, cat, cat
Spacing	cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat cat
Organization	Chart with key underneath
Braille	⠉⠁⠞
Highlighting	cat cat **cat**

Figure 2. Test presentation and visual design.

- The National Center for Supported Electronic Text (NCSeT) has a list of "Typology Resources" (Anderson-Inman & Horney, 2007). Amongst others, they suggest "notational" resources. In other words, if a computer-based test is being offered, then the student should be able to make notations such as underlining, highlighting, or writing notes.

As a cautionary note, we cannot assume that all computer-based assessments are universally designed. For example, older students may be less familiar with computers, therefore taking computer-based tests potentially leads to more rather than fewer barriers for this group of students (Thompson, Johnson et al., 2002). To this end, there can be limitations in the accessibility of certain software and hardware. The above further underscores the need for "flexibility in presentation," such that computer-based tests should also be able to be presented in paper form. Moreover, older students may benefit from workshops or training in computer usage.

Test Presentation and Auditory Design. Similar to visual design, new technologies are improving the auditory design of tests. Several examples are provided:

- An accommodation for some students, such as students with learning disabilities in reading or visual impairments, is access to a reader (Sireci & Pitoniak, 2007). It can be costly and time consuming to have a human reader. Recent advances in text-to-speech software can be more cost-effective and support student independence. Also, there are software programs that read text aloud and simultaneously highlight the image of the text as it is being read; changes in speed, voice, and volume can also be made (Higgins & Raskind, 1997; See Table 1).
- Access to text-to-speech software can also be helpful with editing writing samples. For example, poor readers may have difficulty reviewing what they have written in order to make corrections. Similarly, students with limited attention may benefit from hearing and seeing their writing as a tool for editing. An empirical analysis by Garrison (2009) indicates that despite some other limitations, text-to-speech software can facilitate proofreading.

Table 1

Test presentation and auditory design

Test Presentation and Auditory Design	
Speed	The pace at which auditory information is presented to the student
Voice	Male or female, dialect, accent
Volume	Level of sound

Table 2

Gaster and Clark Eight Readability Guidelines

Gaster and Clark Eight Readability Guidelines (1995)

1. Use simple, clear, commonly used words, eliminating unnecessary words
2. When technical terms must be used, they should be clearly defined.
3. Compound, complex sentences should be broken down into several short sentences, stating the most important ideas first.
4. Introduce one idea, facts or process at a time; then develop the ideas logically.
5. All noun-pronoun relationships should be made clear.
6. When time and setting are important to the sentences, place them at the beginning of the sentence.
7. When presenting instructions, sequences steps in the exact order of occurrence.
8. If processes are being described, they should be simply illustrated, labeled, and placed close to the text they support.

Since most technology uses speech synthesis for either text-to-speech or speech-to-text, it is helpful to be cognizant of how to best use synthesized speech when transforming tests. In the postsecondary setting, this would most often occur when a faculty member decides to allow students to take a test via a computer with speech output. Cryer and Home (2008) found that the subjective acceptance of synthetic speech may depend on the users' experience, as people were found to "get used to" synthetic voices. The Centre's research also found that synthetic speech may be less intelligible than natural speech, particularly with background noise, and may need to be presented more slowly to be fully understood. However, measures of reading performance with synthetic speech improve with experience. Finally, some users of synthetic speech prefer less expressive synthetic voices as they felt it helped them to focus on the content of the text. This is important as it tells us a test may not be the best situation to try synthetic speech for the first time. Furthermore, headsets are warranted when tests are used with speech synthesis to eliminate background noise.

Test Output. Test output refers to how students demonstrate their knowledge on a test (e.g., handwriting, typing, drawing, or speaking). Test output is particularly critical because it is what faculty members use to grade and evaluate students. Disability services providers can supply students with alternate means for demonstrating concept mastery on tests. Examples and considerations are offered:

- Access to a computer for writing limits visual motor integration or graphomotor barriers. Moreover, when working on a computer students can more easily edit (e.g., cut, copy, and paste) their work versus having to erase and re-write.
- Speech-to-text (dictation) software allows students to dictate responses, limiting graphomotor and visual barriers. Dictation software should be implemented with care. Dictation software includes a learning curve. Advanced planning and practice is needed to ensure that the student has access to a dictation program that has been trained to process his or her voice.
- Allow students to document answers directly on the test booklet. Many times tests have separate components: a test booklet and a response sheet such as a Scantron. Separate components are inherently biased for students with poor visual motor integration (Thompson, Johnson et al., 2002). Moreover, students with attention weaknesses may lose their attention set while transferring answers from the test booklet to the Scantron or other response form.

Recommendations for Faculty Members

One role of faculty is to facilitate the acquisition of knowledge and skills within a given discipline. The reciprocal role of students is to prove mastery of that knowledge, typically by taking a test. As the creators and authors of tests, faculty have the power to design tests that accurately measure student knowledge without bias. Several suggestions are provided to facilitate faculty in designing test content that is sensitive to cognitive diversity within student populations.

Test Content. Test content refers to the meat or heart of the assessment; it consists of the course concepts that faculty want their students to master. According to Thompson et al. (2002, p. 8), "An important function of well-designed assessments is that they measure what they actually intend to measure." Accordingly, faculty should create tests that accurately assess course goals and objectives (Ofiesh, et al., 2006). The following factors should be taken into consideration to ensure that test content is accessible to as many adult students as possible:

- Avoid using irrelevant graphs or pictures (Ofiesh, et al. 2006),
- Verbal content should be clear, concise, and specific. Questions should be easy to understand regardless of the student's experience, knowledge or language skills, or current concentration levels (Thompson, Johnstone, et al., 2002).
- Advanced and technical vocabulary should be used only when it is part of the content to be measured, not as an exercise in verbosity (Ofiesh, et al., 2006).
- Directions and questions need to be in simple, clear, and understandable language. "Compound, complex sentences should be broken down into several short sentences, stating the most important ideas first… All noun-pronoun relationships should be made clear… When presenting instructions, sequence steps in the exact order of occurrence." (Thompson, Johnstone, et al., 2002, p. 14; Gaster and Clark, 1995).

- Test content should not be biased based on a student's socioeconomic status or experience outside of school (Thompson, Blount et al., 2002; See Table 2).

Faculty Training Series: A Tool for Disability Services Providers and Faculty

Faculty and disability service providers have a common goal: educating students. However, each brings different and equally valuable expertise and knowledge to a university. On one hand, a postsecondary faculty member is a master of his or her subject and has thorough training in the content area, and, in some cases, less direct training in pedagogy and teaching. On the other hand, a disability service provider has a background in disabilities, including how disabilities can impact learning. Both faculty and disability service providers are charged with the responsibility of not only designing accessible tests for all students, but also ensuring that test design is an accurate and valid estimate of a student's true mastery. Furthermore, valid test results from student exams can better inform a professor's potential need to modify/improve subsequent instruction.

Disability service providers have a wealth of information in terms of disabilities, functional limitations associated with disabilities, and necessary academic accommodations or supports. Dispersing or sharing this information during a phone conversation or over a chain of emails can be challenging. Disability service providers must then decide how best to share their knowledge with faculty members. Murray, Lombardi, and Wren (2011) conducted a survey on the effect of disability-focused training on university staff members, and their findings are encouraging. Their study included two key findings: (1) University staff who have received "disability-focused" training experiences in the past report more positive attitudes towards students with learning disabilities, and (2) 112 survey participants who had not received prior learning disability training expressed interest in receiving learning disability training and felt that they needed more knowledge in regard to how to support students with learning disabilities (Murray, Lombardi, & Wren, 2011). Given the inherent interest and need, we offer a model training series (see Tables 3 and 4).

There are always cases which engender more questions than answers. In these cases, ongoing collaboration between faculty and disability service providers is needed to ensure that individual needs are met.

Ofiesh et al. (2006) use the term "thoughtful assessment" to refer to assessments that serve both faculty and students in postsecondary settings. Specifically, thoughtfully designed tests measure intended content, allow faculty to evaluate their teaching, and are accessible to a variety of learners.

A thoughtful, universally designed assessment consists of a multitude of considerations, including, but not limited to, subject content, electronic flexibility, English language usage, format options (e.g., essay, short-answer), time limits, text characteristics, a direct link form the goals and objectives of the course, instruction, and informational delivery system, and more (Ofiesh et al., 2006).

Researchers at the National Center for Education Outcomes created a list of key elements of assessments that maximize access to a wide range of learners with varying cognitive characteristics (Thompson, Johnstone, & Thurlow, 2002). These elements are (a) inclusive assessment population (e.g., test design takes into account all types of learners: those who need large font due to aging, users of Braille, individuals with migraines who may want to adjust font and background colors on computer screens, etc.); (b) precisely defined constructs (e.g., what the test is designed to measure in terms of content, skills, knowledge base, and what one is required to be able to do to take the test are clearly laid out); (c) accessible, non-biased items amenable to accommodations (e.g., words with double meanings or that are more readily understood by males or females are eliminated); (d) simple, clear, and intuitive instructions and procedures (e.g., understanding how to take the test should not be part of what is being measured); (e) maximum readability (e.g., large font, adjustable foreground and background colors, speech output options, etc.); and (f) maximum legibility (e.g., options for use of speech recognition systems, scribe, adjustable font size, different paper options when needed).

What The Future Holds

Fortunately, research regarding how the brain works, learns, and responds and innovations in the field of computer technology are growing in parallel. Future studies are likely to inform and improve the creation and application of accessible tests, also allowing for greater test validity. Research tells us that the act of taking a test or, more specifically, the act of retrieving previously learned information, promotes

Table 3

Faculty Training Series: Designing Accessible Tests Parts 1 – 3

Part 1 Introduction to Disability Resource Center	**Part 2 Accommodations**	**Part 3 Accessible Test Design versus Accommodations**
Introduction: Universities can be worlds unto themselves with a breadth of programs and services. Introduce faculty and other staff to the disability resource center, including its staff, supports, and services. Additionally, many faculty and staff would benefit from a basic overview of the variations in learning processes among different types of learners.	Accommodations: Briefly review federal regulations that mandate that academic accommodations are offered to students who have a disability that obfuscates learning. Reinforce how accommodations, such as extended time or access to a computer, serve to level the playing field and provide equal access; they do not offer an advantage or leg-up. Documentation and Allocation of Accommodations: Given a lack of training, some may question the process behind determining who receives what accommodations and how much. Review documentation procedures and standardized testing standards. Time for a review in statistics; bring out the bell curve!	Accessible Test Design: Accessible test design can remove the need for many accommodations. Combat misperceptions. Example: Research tells us that extended time does not benefit individuals who do not need the time (Ofiesh & Hughes, 2002)

learning (Pastötter, Schicker, Niedernhuber, Bauml, 2011). Laitusis & Attali (2011) are studying computer-based tests that can eliminate a distracter and provide immediate feedback to the test taker. Moreover, Mills, Hansen, Laitusis, Slater (2011) are researching usability of reading items on various equipment such as the iPad and Netbook. While the continued development and implementation of accessible tests rests on faculty members and disability service providers, it is equally important that administration provide financial and systemic support (Rose and Meyer, 2002).

Table 4

Faculty Training Series: Designing Accessible Tests Parts 4 – 6

Part 4 **Promote "Thoughtful Assessment." Help faculty to understand the relationship between the goals and objectives of the course and how that translates into exam content.**	**Part 5** **Application- Review, revise, and redesign test content with a hypothetical example.**	**Part 6** **Application- Review, revise, and redesign test content with a personally created test.**
Inquire: Given a hypothetical science-based syllabus, ask participants what they think students should be able to do by the end of the course? *Nurture Insight:* What would a student need to show you in order to be able to demonstrate this competence to you? What are the goals and objectives in YOUR class? What would a student need to do to demonstrate competence in those areas? *Application:* Given a hypothetical test from the science course noted above, ask yourself if the test is a good measure in terms of content? Do YOUR tests match YOUR goals and objectives?	*Review:* Samples of non-accessible test content. *Revise:* Non-accessible test content. Provide a simple, uncluttered, and organized handout with examples and solutions for support. Use these ideas to foster redesign. *Redesign:* Tests to include accessible content. The challenge is to put research to practice and design tests that are accessible to the diverse population of postsecondary students. *Divide participants into small groups.	*Review*: Compare samples of non-accessible test content to a real test. *Revise:* Non-accessible test content. Share examples with others in a similar academic domain for input and more ideas. *Redesign:* Tests to include accessible content. Put research to practice and consider what else can be done to redesign your own tests that are accessible to the diverse population of postsecondary students. *Divide participants into small groups for feedback and sharing.

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About the Authors

Erin Shinn received her M.Ed. in Mind, Brain, and Education at the Harvard Graduate School of Education. Her experience includes working as an educational specialist and serving children and adults with learning disabilities. She also does educational advocacy work on behalf of children in the juvenile justice system. She is currently a Senior Educational Specialist at Morrissey-Compton Educational Center, Palo Alto, CA where she oversees the education department, conducts psychoeducational evaluations, and provides educational therapy. Erin can be reached by email at: erin.shinn@morrissey-compton.org.

Nicole Ofiesh received her Ph.D. in Special Education: Learning Disabilities from The Pennsylvania State University. Her experience includes working as an educational therapist, learning disabilities specialist, teacher and researcher. She is currently Associate Director of the Schwab Learning Center at Stanford University, Stanford, CA where she conducts research pertaining to students with LD and ADHD. Her research interests include test accommodations, assessment, resilience, and universal design. She can be reached by email at: nofiesh@stanford.edu.

PRACTICE BRIEF
Infusing JUST Design in Campus Recreation

Katheryne Staeger-Wilson
Douglas H. Sampson
Missouri State University

Abstract

This practice brief highlights the collaborative work among a disability resource professional, a university architect, and students with disabilities to create a campus recreation center with universal design features. This partnership serves to illustrate that building to minimum compliance standards does not necessarily remove barriers to equitable participation for persons with disabilities. It became evident that valuing the disability experience led to high quality design for all. From this project, best practices in inclusive, usable, and equitable design can be observed and applied to future projects.

Keywords: Universal design, inclusion, collaboration, recreation

Universal design (UD) has been an approach that is receiving greater attention as institutions seek to achieve inclusive excellence in built, learning, policy, and informational environments. The Institute for Human-Centered Design (2010, as cited by Lanterman, 2010) notes that in its broadest context, UD is "an orientation to any design process that starts with a responsibility to the experience of the user." The Center for Universal Design (2011) defines UD as:

> The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design… The intent of universal design is to simplify life for everyone by making products, communications, and the built environment more usable by as many people as possible at little or no cost.

Longmore (1995) argues that the social construction of disability and poor design creates barriers and hinders participation of those with disabilities. From this perspective, the design of environments, along with society's perception of disability as a deficit, serve to exclude disabled individuals. Guzman and Balcazar (2010) explored the historical developments and principles that guide the disability resource profession. They noted that, while most disability resource professionals support the social model of disability and the principles of UD, the policies and practices of the majority of these professionals do not reflect this philosophy. Typically, practices and policies lead to a delayed, segregated, and individualized service, requiring a great deal of time, effort, and patience on the part of the disabled student. Non-disabled peers can use campus facilities and programs without undertaking these additional steps (Smith, Sartin-Kirby, & O'Connor, 2004).

An increasing number of professionals believe that designing policies, learning environments, and buildings with inclusion and diversity in mind would ultimately be more efficient, less costly, and more inclusive for all users and learners (Smith, et al., 2004).

Problem

Postsecondary education institutions provide many programs and services, all of which must be accessible and usable to everyone, including those with disabilities. Recreational buildings may meet accessible standards, according to building codes, but programs and services must also be designed to meet the needs of a diverse group in order to be usable by all. Considerations must be made for the usability of programs, policies, and equipment, as well as the building's design. Good inclusive design considers differences in potential users and is essential in providing a successful recreational experience (North Carolina Office on Disability and Health, 2008).

Approximately 19% of the population has a disability (U.S. Census Bureau, 2010) and, as our population continues to age, the likelihood of disability will also continue to increase sharply (Administration on Aging, 2003). "Disability is not an indicator of poor health, requiring specialized programs for physical activity. Instead, people with disabilities look toward community facilities to meet their health and exercise needs" (North Carolina Office on Disability and Health, 2008, p. 4). Consequently, there needs to be more emphasis on good, inclusive design that honors the disability experience.

Student and Location Information

Missouri State University (MSU) is the second largest 4-year, public university in the state of Missouri, with a total student enrollment of nearly 20,000. There are a variety of different recreation options for students across the campus, and students at MSU pay $80.00 per semester to use these facilities. However, it is difficult for disabled students to fully participate in activities, because these facilities are distributed widely across a large campus, and often consist of outdated and unusable or inaccessible equipment. When the student body voted to add an additional student fee to cover the costs of building a new recreation center, disabled students raised concerns about being assessed a fee for recreation services that might not be usable. The goal was to fund a new student recreation center and develop programming that all students could equitably use.

Strategy

The Campus Recreation Office and the Office of the University Architect informed the campus community of the student-led initiative and encouraged student involvement throughout the design process. The role students played was a significant one: university administration requested that a diverse group of students serve on all of the design committees. Students served on all committees from conceptualization of the project through the design of the building, including programming and policy development. Throughout this process, disabled students were valued participants as was the director of the DRC. Within the design process, priority was placed on the usability of building features and programs that disabled users valued. Compliance played a secondary role, although it was certainly considered.

The Director of the Disability Resource Center (DRC) specifically identified and recommended two disabled students to serve on the overall, primary design committee. Their selection was based upon their academic interests and disability experiences. These students played a key role in the conceptualization of the project. One student was interested in a career in Student Affairs, the other in architecture and/or engineering. Both students had the opportunity to work collaboratively with the architects, project managers, and campus administrators, which included two Vice-Presidents. These two students shared their expertise during meetings and attended a field trip with the design team to a newly designed recreational facility at another university. During the field trip with the design team, the students demonstrated and discussed their expertise. They also discussed which design features were valuable and usable for those with similar disabilities.

The disabled students on this design committee were perceived by others as the experts on the disability experience. They educated the committee on what features should be included in the design of the building, programs, and equipment procurement, not the DRC Director (though the Director did review with the administration the inaccessibility of the current recreation facilities and programs). The students spent time with the Director, discussing what they wanted to see in the building, programs, and equipment selection, but while the Director became the resource or consultant for the students, they took the lead. The Director educated the students on the roles each administrator played, discussed strategy, and provided educational materials regarding UD. Following some of the design committee meetings, the Director met with the students to recap what had occurred and considered what steps might be taken to strategize for the next meeting.

In addition, the campus President's Council on Disability, which is comprised of faculty, staff, and students with disabilities, provided suggestions throughout the project. Open forums were also held for the entire campus community to provide feedback. The National Center for Physical Activity and Disability ([NCPAD], 2004) web resources were helpful in identifying building design features, equipment procurement, and programming ideas. The Campus Recreation Office also developed an advisory council to drive best practices in programming for all student desires regarding campus recreation. Disabled students also served on this council, and the DRC Director provided resources when requested.

The design team established six objectives that would serve as the University's scorecard to gauge the level of success in designing, constructing, and operating a new recreation center. It was clear that the disabled student experience had been validated when the design team included UD as one of the six objectives. The third objective read as follows: "Be designed, using universal design concepts, to be accessible to all individuals of the University community" (Hastings & Chivetta Architects, 2006, Goals and Objectives, p. 2).

One factor the students stressed for the project from the beginning was sustainability. Developing a sustainable building was important enough to the students that the Student Government Association voted to share the cost of registering the project with the United States Green Building Council with the University. With the support of the students, the University is pursuing a LEED certification at the Silver level for this project. The desire for sustainability, which can also be understood as inclusiveness in UD terms, did not end with the construction of the building, however. The design and selection of equipment for the facility, as well as of the programming, were understood to lead to an inclusive environment. Because of this focus, there are no segregated areas or equipment, nor is there a segregated entrance.

Observed Outcomes

Many observed outcomes have surfaced from this proactive, collaborative project. Students with disabilities perceive that the University values them and their experiences through the opportunity to work with designers and administrators. Disabled students have verbalized to University staff how they felt their input was valued and included in the design of the building and programs (personal communication, August 14 & 17, 2012), and have reflected on the importance of being represented as an independent stakeholder group. They noted that having disabled students physically present at every meeting made it impossible for others to unintentionally exclude and overlook design features that were important to them. They reported their favorite part of participating in the project was touring the other campus recreation centers with designers and campus administrators. There, students enjoyed sharing their own experiences, considering what design worked best for them, and learning new ways they could be further included in recreation. The DRC staff was perceived as instrumental in giving students the opportunity to participate in the process and effectively share their stories. More specific outcome data will be collected following the full completion of the project and will be reported using the six points identified on the scorecard developed by Hastings & Chivetta (2006, Goals and Objectives, p. 2).

Through their work on this project, MSU disabled students have been part of the paradigm shift on their campus that has put the focus on inclusion and equity rather than minimum compliance. It was recognized that student voices were powerful and were valued even more than that of the DRC Director. The most powerful messages were those observed on the field trip to another campus recreation center when the design committee was able to see firsthand what equipment, building, and program design features worked for those with disabilities. The design committee members developed a relationship with the disabled students and witnessed the barriers they experienced, and only then did they appear to fully value inclusive design elements in their work. After this, it seemed that design committee members grasped the importance of usability and inclusion, and they seemed to become motivated to incorporate suggested design features rather than to simply meet minimal compliance requirements. Value was then placed on good design, not meeting code requirements.

The disabled students who served on the design committee identified that being part of the committee enhanced their personal and professional development. The two students had the opportunity to network and collaborate on a venture with professionals related to their future careers, as well as to gain exposure to the design and student affairs professions. One student reported:

> I recognize I am up to the task of being the voice for those with disabilities, which I believe is a fundamental responsibility as someone with a

> disability…I know I have the power to make things better for others…The experience helped me to find my voice in other environments. It gave me the confidence to know that I have a right to advocate for myself in many different situations. As a student it is hard to take on that advocacy role (personal communication, August 17, 2012).

Non-disabled students on the committees learned about the disability experience from the disabled students and embraced the need for UD features after recognizing the positive impact of UD. These students became allies and advocated for inclusive design alongside their disabled peers. It is hoped they will continue to be advocates for inclusion and equity in their future careers.

This project has also helped increase recognition in the design world that sustainable, equitable, usable design equates to good design. The project has already earned the respect of architects across the Midwest as evidenced by two awards for design excellence. The American Institute of Architects, Central States Region, awarded this project a Merit Award for design in the Unbuilt category as the project construction was beginning. In addition, the St. Louis Chapter of the American Institute of Architects awarded it an Honor Award in the Unbuilt category. This recognition by fellow architects validates the idea that good design does not come at the expense of UD. In addition, we believe that the success of this project means that future building projects and programs will be more likely to consider and value the disability experience. This will happen through the utilization of disabled students and DRC staff in creating the design of buildings, programs, and services.

Throughout this project, the DRC was viewed as a campus consultant and was sought out for other resources and ideas related to disability as well. One example was a collaboration that came about with the campus Faculty Center for Teaching and Learning (FCTL). The DRC Director worked with the Director of the FCTL to host a faculty book club in which faculty were provided a book regarding disability history and culture to read and discuss throughout one semester. This was a faculty driven program with select faculty members assigned to lead discussions on each chapter, and rather than the DRC Director educating faculty regarding these topics, the DRC took on a consultant role, merely providing resources and guidance for the book club. In a survey administered at the end of the semester, book club faculty expressed a better understanding of disability issues. They also reported greater comfort with teaching disability as a part of their diversity curricula and better understanding of how disability intersects with their field of study. This outcome holds the promise of developing future leaders in differing fields of study.

Another example was a collaboration between the DRC and the Division of Student Affairs. The DRC was sought out by Student Affairs to provide a division-wide professional development program on the value of the disability experience and how this intersects with student development theory and work. The DRC Director worked with a Student Affairs professional to provide this session. Here, the collaborative work that went into the recreation center was highlighted and discussed with regard to how the project enhanced development for all students at the same time that it enhanced a student service. It is hoped that this collaborative process in which DRC staff acted as consultants will become a pattern in the Division of Student Affairs.

Implications

In all of these examples, valuing the disability experience and full inclusion are the focus, not minimal compliance with the law. The disability community is seen as a valued, integral part of the University experience, and good, inclusive, usable design of our buildings, programs, and services is recognized as key. People with disability experience are perceived as a valued identity group, and full inclusion is achieved through partnerships and collaborations in which they are actively included. Inclusion is not the sole responsibility of the DRC, but the desire of everyone.

As the disability resource profession transitions through a paradigm shift, embracing a social justice approach and reframing disability as a social construct, we need to further assess and examine how this new way of thinking can be applied to our work. In this project, the DRC staff did not dictate how things should be done by quoting law and regulations and leaving out the student voice. Rather, the DRC staff worked collaboratively to be a resource to disabled students, staff, and administrators. The process allowed all participants to contemplate barriers to full participation in a meaningful way. The agent of change was not the DRC staff but the entire campus design committee, which enabled understanding of what is necessary for real inclusion to occur. This led to work that will reduce the need for disabled students to go through a burdensome process to obtain what is typically a delayed, segregated service, or accommodation. This kind of work should be explored further as it can be applied to many other areas of campus.

While postsecondary educational institutions must provide equal access to their programs and services, the manner and processes through which an institution provides equal access are not necessarily defined. When achieved through collaboration, UD offers a seamless, transformative approach to providing access which allows the University to be in compliance while implementing approaches to design that are more usable by everyone (Thornton & Downs, 2006).

Loewen and Pollard (2010) reinforce this reflective, social justice approach to inclusion by noting:

> Service professionals must explore a more enlightened view of disability and social justice in their work. If the movement towards social justice and the strengthening of community and culture are still for the most part elusive to the disabled students they serve, it is incumbent on service professionals to develop strategies which will educate and inform the campus community, including students, that full participation is a right, not a privilege (p. 13).

Loewen and Pollard (2010) also identify the need for disability resource providers to create a paradigm shift in their work to include collaboration:

> Disability Service professionals must increase individual and collective efforts to educate students, the campus community, and other disenfranchised groups that disability is not an isolated issue of social welfare, but must be acknowledged as a struggle for human dignity, non-discrimination, equal opportunity, and personal empowerment through independence (p. 14).

Collaborative consultation efforts continue at MSU regarding building projects and programming ideas. As a result of this particular project, relationships have been established that will hopefully lead to further collaborative work, and more students and administrators better understand the importance of universal, inclusive design and full, equitable participation. Through these collaborations, our campus community is increasing our cultural competence regarding disability and diversity. By changing the way the campus perceives disability and the impact of design on disabled people, the University has created a recreation center that is usable, inclusive, sustainable, and equitable. Further collaborations based in this social justice approach should lead to more inclusive, equitable environments and programming on our campus.

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About the Authors

Katheryne Staeger-Wilson received her BA degrees in psychology and criminology from Drury University and a Master of Social Work from the University of Missouri -Columbia. She is the Director of the Disability Resource Center at Missouri State University. She is currently serving on the Board of Directors of AHEAD and is the 2010 recipient of AHEAD's Professional Recognition Award. Staeger-Wilson was one of twenty-five selected to participate in a U.S. Department of Education grant, Project ShIFT (shaping inclusion through foundational transformation) which focuses on the application of the social model of disability and universal design in higher education. Staeger-Wilson has also chaired a Missouri statewide committee to draft proposed legislation, requiring universal design features in affordable housing. She can be reached by email at: KatheryneStaeger-Wilson@MissouriState.edu.

Douglas H. Sampson, AIA, LEED AP, received his BA degree in Architectural Studies from the University of Nebraska, Lincoln and received his architectural registration from the State of Missouri in 1982. He is currently the director of the planning, design & construction department at Missouri State University. He can be reached by email at: DougSampson@MissouriState.edu.

PRACTICE BRIEF
Project LINC: Supporting Lecturers and Adjunct Instructors in Foreign Language Classrooms

Sally S. Scott
University of Mary Washington

Wade Edwards
Longwood University

Abstract

Foreign language learning can pose a barrier to some students with disabilities. This practice brief describes a collaborative process used on one campus to provide professional development for foreign language instructors. Training opportunities were intentionally focused on the needs of adjunct and temporary lecturers in providing inclusive beginning and intermediate language courses. Trends in student final grades and foreign language requirement waivers are discussed.

Keywords: Faculty development, inclusive instruction, foreign language

A recent survey by the Modern Language Association found that approximately 50% of U.S. colleges require the study of foreign language for graduation (Lewin, 2010). A long history of research has shown that students with learning disabilities (LD) may experience difficulty in foreign language classrooms in such key areas as phonological/orthographic processing, syntactic and semantic knowledge, and expressive or receptive oral and written language (Sparks, 2008). Empirical findings of potential difficulty have been extended to students with attention deficit/hyperactivity disorders (ADHD) as well (Sparks, Philips, & Javorsky, 2003). Published case studies (e.g., Abrams, 2008) provide insight into other potentially challenging interactions of disability and foreign language learning across the broad pedagogical areas of reading, writing, speaking, and listening as well as cultural awareness.

Colleges and universities have responded to the needs of students with disabilities in foreign language learning through a combination of classroom accommodation, instructional modification, and policy considerations. In a review of the literature on evidence-based practices, Ofiesh (2007) reported that extended time on tests and the provision of a note taker were two primary accommodations in foreign language classrooms. Instructional approaches to access have consisted of extended accommodations designed specifically for the discipline of foreign language learning (Scott & Manglitz, 2000) and the development of modified instruction provided in separate classrooms focused on the specific needs of students with learning disabilities (e.g., Downey & Snyder, 2001). A final approach to access has been to permit waivers or course substitutions for the foreign language requirement on a selective case-by-case basis (Shaw, 1999). While institutional policies and practices vary, a majority of college campuses include this administrative option for individual students with disabilities (Driscoll, 2003).

Problem

A foreign language requirement for all students was implemented at Longwood University in 2002. In order to assure access, students with disabilities were offered traditional classroom accommodations and, on a case-by-case basis, the administrative option to petition for a waiver of the foreign language requirement. Over a four-year period the number of student petitions increased annually. The Modern Languages program and the Disability Resources Office began a collaboration to examine the accommodation process, clarify advising for students provided by both departments, consider policy revisions, and examine instructional options. An outcome of that collaboration was the hypothesis that providing more inclusive instruction would result in the need for fewer waivers of the requirement—a desirable goal for both departments. After a review of the professional literature, it was found that models for specially designed sections of foreign language classes for students with LD were available (e.g., Leons & Hebert, 2002), but little information could be located on making the learning experience more inclusive for students with a variety of disabilities within the regular foreign language curriculum. Another challenge was that most beginning and intermediate foreign language courses on campus were taught by adjunct instructors and temporary lecturers, a widespread staffing practice in higher education (Modern Language Association [MLA], 2007).

Students and Location

Longwood University is a residential, state-supported, four-year institution in rural central Virginia, enrolling 4000 undergraduates in three colleges: Arts and Sciences, Education and Human Services, and Business and Economics. Five percent of the student body is registered with the Office of Disability Resources. With the exception of students granted a foreign language waiver, all students earning a degree pass a foreign language course at the intermediate level (the third semester of the standard sequence) or higher. Most students who complete a placement test during freshmen orientation enter the sequence through one of the beginning level courses. Seventy percent of students place in a level below the required course, and thus spend at least two semesters in the foreign language sequence. In any given semester, approximately 750 students (19% of the undergraduate student body) are enrolled in general education classes in French, German, or Spanish. Seventy-nine percent of those courses are taught by part time, temporary, or untenured faculty.

Strategy

An approach to support students with disabilities and instructors in the foreign language classroom was developed, and Project LINC (Learning in Inclusive Classrooms) was successfully funded through the U.S. Department of Education. The purpose of LINC was to create a faculty development curriculum that increases instructors' awareness both of diverse learners and of design strategies for inclusive pedagogy. The co-directors of the project—one, the director of Disability Resources; the other, a French professor and program coordinator—met monthly over the course of a year with a small group of senior language faculty (a Leadership and Development Team, [LDT]) to isolate key topics and research best practices. Then, in two subsequent years, a two-pronged approach was used to train adjunct and contingent instructors in the department. In a series of workshops, traditional approaches to disability access were addressed: clarifying university requirements, increasing awareness of non-visible disabilities, and specifying procedures for student accommodation. Second, after an introduction to the principles of Universal Design for Instruction (Scott, McGuire, & Shaw, 2003), monthly meetings were held to examine barriers to learning experienced by students with disabilities and to reevaluate the design of classroom instruction.

The curriculum's bifurcated structure allowed participants to maintain a heightened awareness of inclusive design over the course of the academic year. A first meeting was held one week before the semester started. This 3-hour foundation workshop introduced participants to the value of inclusive design, stressed the importance of considering the background, anxieties, and motivations of all students in the classroom, and suggested some simple start-up activities (see Table 1). The foundation workshop was followed by monthly 90-minute topical workshops addressing key areas identified by the LDT including target language use, error correction, inclusive group work, foreign language instruction anxiety, and assessment strategies. To help animate and inform the conversation throughout the year, participants prepared for each workshop by reviewing a set of brief reflection questions and a recent article from a peer reviewed journal. During these topical workshops, a variety of inclusive strategies were introduced, such as providing a list of useful classroom expressions to scaffold support in target language use, designing group activities that consider mobility needs of students in wheelchairs, and providing assignments and assessments in multiple formats.

Although members of the cohort were able to tailor individual design elements to their specific classrooms, styles, and needs, most LINC participants implemented

Table 1

Foundation Workshop Overview and Resources

Foundation Workshop Overview
The need for Project LINC

Who are our students?
- Longwood student demographic information
- Students with disabilities: Numbers and diagnoses

Working with the Disability Resources Office
Inclusive teaching
- The power of design: How design influences performance
- Principles of Universal Design for Instruction

Getting started: Early steps toward a more inclusive instruction
- High school and college for students with disabilities: Key differences
- Case study: Foreign language autobiography as a tool for understanding individual learning needs

Schedule for the year ahead: Topical workshops in the fall and spring

Foreign Language Teaching Resources (Handouts)
The Effective Foreign Language Teacher Checklist
Important Activities for the Beginning of the Semester
Getting to Know your Students: Foreign Language Autobiography Activity
Advising Tips for the Foreign Language Goal
Foreign Language Placement Guidelines
American Council on the Teaching of Foreign Languages: Standards for Foreign Language Learning

Disability Resources (Handouts)
Disability Services FAQ
Early Warning Feedback Form: A Communication Tool for Monitoring Student Performance
Options for Accommodation & Supports in Foreign Language Learning

Related Reading
Gregory, M. (2008). Do we teach disciplines or do we teach students? *Profession*, 117-129.
Kinzie, S. (2008, October 25). Bumps abound when students become their own advocates; Special needs can make transition to college tricky. *The Washington Post*, p. A1.

several basic techniques. First, a disability statement alerting students to the resources available on campus was added to course syllabi. This simple statement signaled the instructor's awareness of learning diversity and helped to create a welcoming environment for all students. Second, during the first week of classes, instructors asked students to complete a short "foreign language autobiography" that encouraged them to reflect on their specific experiences and learning needs. The information gleaned from this autobiography allowed instructors to discuss with all students common course concerns and barriers, just as the semester was starting. Finally, through internal communication avenues, LINC participants were encouraged to provide early feedback to the Office of Disability Resources about the performance of registered students who self-identified to the instructor. If needed, the facilitation of an early three-way conversation involving the student, the instructor, and the Office of Disability Resources ensured prompt support for identified students.

Observations and Outcomes

Feedback from faculty after each workshop and at the end of the academic year indicated that participants had greater awareness of the diversity of students in their classrooms and more confidence in their ability to accommodate and teach these students. Scheduling the monthly workshops was a challenge with varied adjunct instructors' schedules and availability, as was providing sufficient incentives for these busy professionals. Using grant funds of Project LINC, participants were paid a small honorarium for their participation in the training. This was minimal, however, and other no-cost incentives were also used by the project to address this challenge. The rare opportunity to meet regularly and talk about teaching with other faculty members (adjuncts as well as senior faculty) was reported as motivating and germane. Also, faculty who participated in five or more of the monthly workshops were awarded a Certificate of Inclusive Teaching signed by the Dean of the College of Arts and Sciences and intended for inclusion in their professional portfolios.

Two broad measures of student outcomes were examined. Final grades in all beginning and intermediate foreign language classes were compiled for five semesters of baseline data before Project LINC and throughout the project. Performance of students with disclosed disabilities (defined as students registered with the campus Disability Resources Office) was compared with students without disclosed disabilities (see Table 2). The average performance of students with disabilities in foreign language classrooms across instructors and across languages showed an increase in the number of students achieving a final grade of A, B, or C and a decrease in the number of students withdrawing at some point during the semester. Student final grades across groups are now similar.

Foreign language waiver requests submitted to the campus Petitions Committee (the university structure charged with reviewing this accommodation) were also reviewed over a nine year period (see Table 3). During the six years prior to Project LINC, eight waivers on average were approved annually. Since the onset of Project LINC the annual average has dropped to four foreign language waivers.

Table 2

Associated Impact of Project Linc: Student Final Grades in Beginning and Intermediate Language Courses (Spanish, French, German)

Fall 2006 - Fall 2008 (Before Project LINC)

	Final Grade A - C	Final Grade D	Final Grade F	Final Grade W
Disability N=213	63%	12%	7%	18%
No Disability N=3942	76%	12%	7%	5%

Fall 2009 - Fall 2010

	Final Grade A - C	Final Grade D	Final Grade F	Final Grade W
Disability N=213	74%	14%	5%	7%
No Disability N=2817	76%	12%	7%	5%

Implications

Adjunct instructors, knowledgeable in foreign language but working outside the mainstream of the university, are in need of support and resources to teach the many diverse learners in their classrooms. Professional development designed to enhance connections with campus disability offices and senior faculty contributed to a viable and sustainable approach to supporting these instructors. Additionally, creating formal opportunities for instructors to talk about the challenges of teaching lead to a greater understanding of inclusive foreign language learning experiences.

Change has occurred within the foreign language program at Longwood University. While no single causative factor can be identified, student outcomes on the measures of final grades and foreign language waivers are compelling. Performance patterns of students without disabilities have remained consistent, while students with disabilities—reflecting a broad cross-section of cognitive and physical diversity—have demonstrated a shift toward greater academic success. In the context of greater student success in passing foreign language coursework, waivers of the foreign language requirement have decreased 50%. These changes may perhaps be attributed to greater awareness of student diversity, enhanced communication across departments, and encouragement of faculty to focus on their ability to modify instructional features to be more inclusive. The design of professional development catered to the needs of adjuncts and temporary instructors has increased communication and collaboration between the foreign language program and the Disability Resources Office, resulting in a more positive and equitable experience for students with disabilities.

Table 3

Associated Impact of Project Linc: Number of Foreign Language Waivers Approved

Academic Year	Number of FL Waivers Approved
2002-2003	4
2003-2004	5
2004-2005	9
2005-2006	15
2006-2007	9
2007-2008	9
2008-2009	2
2009-2010	8
2010-2011	2

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About the Authors

Sally S. Scott, Ph.D. is the Director of Disability Resources and Associate Professor of Education at the University of Mary Washington. She is the co-director of Project LINC.

Wade Edwards, Ph.D. is Associate Professor of French and Program Coordinator of Modern Languages at Longwood University. He is the co-director of Project LINC.

PRACTICE BRIEF
Community Collaboration, Use of Universal Design in the Classroom

Rachel E. Smith
Tara Buchannan
Western Illinois University

Abstract

Barriers to classroom participation for postsecondary students with disabilities are often addressed through accommodations via disability resource offices. However, the use of individualized accommodations as the sole method for resolving access barriers in the classroom is neither sustainable nor equitable. Furthermore, this somewhat flawed methodology creates systemic barriers, places the locus of control in the disability resource office, and reinforces stereotypical thinking about disability. An evaluation and redesign of course material by faculty may decrease the need for retrofit accommodations, create a community environment of empowerment, and change the nature of the relationship between faculty, students with disabilities, and disability resource center professionals. This practice brief details the results of a collaboration between a faculty member and a disability resource professional on course design to create sustainable, equitable, and just learning environments at Western Illinois University, a Midwestern comprehensive university.

Keywords: Disability, universal design, higher education, collaboration, accommodation

Problem

The postsecondary accommodation process for students with disabilities typically follows a medical model (Guzman, 2009) through which the student becomes the focus of interventions that are determined by a disability resource professional. This model requires constant administrative oversight on the part of the disability resource staff, places additional responsibilities on students with disabilities beyond what their non-disabled classmates experience, and often puts disability service providers at odds with faculty. In addition, the process itself creates a systemic barrier and serves to perpetuate the myth that persons with disabilities require assistance. The locus of control is placed within the disability resource department rather than with the primary constituents in a classroom setting, the students and faculty. Furthermore, accessibility modifications made through this approach tend to be retroactive and consumable in that each semester they must be reapplied. Although we cannot expect to completely eliminate the need for individual classroom accommodations at our institutions, we can and should explore avenues to create more equitable and sustainable access in the classroom.

Proposed Resolution

Universal design (UD) refers to a design approach that strives to ensure that environments are useable by the broadest possible spectrum of people rather than being designed to accommodate the needs of either disabled or non-disabled people alone (Lusher & Mace, 1989). While UD has its roots in the field of architecture, its application to education is readily apparent in the variety of ways the concept has been reinterpreted recently: Human Centered Design, Universal Design for Learning (UDL), Universal Design for Instruction (UDI), and the broader approach of Universal Design for Education (UDE).

When used in the process of course design, a UD approach can minimize the need for separateness and accommodations for students with disabilities. Additionally, "Universal Design (UD) shifts our focus from the person with a disability, the focus of the medical model, to the environment within which she or he lives"

(Harrison, 2006, p. 152). It can also lessen administrative demands because usability is considered during the design phase of course production rather than only later, when the course is being offered.

In a UD approach to course design, faculty proactively create a usable and accessible course product, ideally in consultation with the institution's disability resource department. The basic access that this creates places the locus of control with the student; the more immediate, independent navigation of college classroom requirements that is promoted through this method promotes self-efficacy and advocacy, and if specific individual accommodation remains necessary, students can choose when and if they collaborate with faculty and disability resources.

If this design technique offers so many benefits, why aren't more people using it? Simply put, they don't know how. While several sets of guiding principles for UD have been developed to assist in implementation, UD is a dynamic process and a theoretical framework. Each class and classroom environment is unique and must be designed according to the needs of the course content. This practice brief illustrates an attempt by a faculty member and a disability resource professional to work collaboratively to customize UD techniques to course content and individual classroom environments at the university level.

Faculty/Disability Resource Collaboration

A Western Illinois University (WIU) faculty member and the WIU Disability Resource Center director participated in a 3-year program called Project ShIFT (Shaping Inclusion Through Foundational Transformation) designed to transform disability resource department practices and the instructional environment utilizing UD principles. On the last day of training, the faculty member and the director developed a course re-design action plan that focused on a review of course elements by the instructor and the collaborative development of design ideas to reduce the need for separate accommodation requests. Once the action plan was developed, the instructor took the responsibility for redesigning courses while the disability service professional was available as a consultant. The faculty member and the disability service professional communicated several times throughout the semester to discuss course design and the outcomes of the initiative.

Strategy

Five courses in the WIU Department of Recreation, Park, and Tourism Administration were modified utilizing UD techniques in preparation for the 2010-2011 academic year. These courses were selected due to the instructor's willingness to collaborate with the Disability Resource Center. The courses demonstrated a variant sample in student population as well as course material, length, and teaching delivery methods (See Table 1).

The implementation of course changes began with a theoretical application in which each course was evaluated in terms of delivery method, assessment of learning outcomes, and communication methods with an eye to maintaining the academic integrity of the course. Questions asked included: What is the point of the course? How is the point conveyed? What is critical to assessment? What can't be changed? What won't be changed? How will changes impact all students? What assumptions are being made about students? Changes applied to the design of individual courses depended on the nature of the course and the resources available. All changes made to course design were available to all students enrolled in the courses, regardless of disability status. The following sections describe the changes made to the delivery, communication, and assessment methods used in these courses in general terms. See Table 2 for a list of all techniques applied to project courses.

Delivery Methods

PowerPoint. PowerPoint slides used to compliment lectures were evaluated to ensure that they were accessible with screen reader software, and all presentations were placed on the electronic course management system (CMS) to be accessed by students at any time during the semester. Students were helped to understand how they could most effectively use the slides to assist their learning.

Lectures. Lectures were recorded and made into podcasts that were placed on the server in multiple formats. Videos were evaluated for captions.

Course Management System. An online CMS was used to ensure student access to information. During the 2010-2011 academic year, WIU used a Blackboard CMS product. Because the product had limited accessibility features for students who access the Web with adaptive technology, accommodations were used for those students. All resources on the CMS site were provided to students by way of direct email from the instructor if requested.

Table 1

Test Presentation and Auditory Design

Course	Enrollment	Level	Description
Concepts of Leisure	Maximum 22	Freshman, general education, First Year Experience	Traditional lecture with off-site group exposure to a variety of recreation environments
Introduction to Therapeutic Recreation	20 to 60, depending on the semester	Predominantly juniors	Traditional lecture and extensive hands-on, outside-the-classroom learning experiences
Programming Principles and Applications	20 to 60, depending on the semester	Predominantly juniors	Traditional lecture and extensive hands-on, outside-the-classroom learning experiences
Internship Seminar		Senior seminar	Eight week intensive course designed to prepare students for internship and career placement
Issues in Leisure Services		Senior seminar	Eight week intensive course designed to expose students to ethical issues.

Table 2

UD Techniques Applied to Project Courses

	UD Techniques
Delivery of Content	• PPT slides constructed using Outline function • PPT slides posted to CMS • Students advised to print slides, bring to class for notes • Slides give outline of what to expect in lecture, don't repeat it • Lectures recorded using Mac OS X Podcast Producer and mic, PPT slides synched with audio • Lecture podcasts posted to CMS and available through RSS feed • Lectures available in multiple formats: audio, video + audio, plain text transcription (used Dragon Naturally Speaking) • YouTube videos captioned using a captioning service • Ensured access anytime through materials on CMS: lecture notes, handouts, web links, videos shown in class, podcasts of lectures, transcriptions of podcasts, discussion and announcement boards, gradebook • Resources on the CMS provided by email upon request • Selected textbooks that were available to all students in both print and electronic formats
Communication	• Course expectations communicated in multiple ways: in course syllabus (print and electronic), explained verbally in class and with PPT • University accommodation statement in syllabus • Usability statement highlighted in class • Introduction to the environment (building layout, restrooms, emergency procedures) • Collaborative notetaking process • Notes posted to CMS • Students comment on notes as part of class participation • Class announcements and changes verbalized in class, posted to CMS as part of podcasts • Announcements typed, posted to CMS • Group email and text lists used for immediate changes • Text-only phone number created for class use
Assessment	• Assignments designed to allow choice of modes/medium (e.g. project, paper, or service activity) • All students given as much time as needed to complete exams • Instructor remained flexible in receiving accommodation requests

Textbooks. When possible, textbooks available to all students in a choice of print or electronic format were chosen. This is because electronic texts can be read by screen readers and enlarged using screen magnification software, require low physical effort, and are often more economical for the student. Multiple textbooks can be transported easily using a reader device, and tablet devices offer in-text highlighting, note-taking, and group work options.

Communication

Course expectations. Course expectations were communicated to students in a variety of ways. The University's accommodation statement was included in all syllabi, and the instructor highlighted a usability statement that emphasized the desire for usable learning environments and encouraged all students to be advocates:

> It is the policy and practice of this instructor to create inclusive learning environments. If there are aspects of the instruction or design of this course that result in barriers to your participation or accurate assessment of achievement, please notify the instructor as soon as possible.

Furthermore, the first day of each course also included an introduction to the environment, including building layout, restroom locations, and emergency procedures.

Notes. Note-taking accommodations were completely eliminated by use of a collaborative note-taking process in which students were assigned to note-taking groups at random intervals. Students in each group decided who would be the primary note-taker(s), and after class, group members collaborated to create a final draft of the notes and post it on the CMS discussion board. In addition all students were encouraged to comment on the notes as one form of class participation.

Changes and announcements. When announcements and changes to due dates and/or schedules were verbalized during class, these items became part of the podcast and thus recorded and transcribed. The announcement was then typed and placed on the CMS announcement board. Group email and text lists were used to convey immediate changes. A text message application generated a text-only phone number that allowed students to have text access to their instructor without disclosure of the instructor's personal cell phone number.

Assessments

Choice of assessment method. Where possible, assignments were designed to allow student choice. For example, a student could choose to complete a project, write a paper, or participate in a service activity. This allowed the student to decide which method would best demonstrate their learning in the course.

It has been observed that extended testing time is one of the most requested accommodations (Lindstrom, 2007). Because length of exam time was not a crucial element for the courses in this project, all students were given as much time as they needed to complete exams. When the classroom was used immediately following the exam period, students were given the option to complete the exam outside the instructor's office in an outer office area secluded from the main hallway. Similarly, students were able to use this space to start an exam early.

Accommodations.

In all courses in this project, the use of UD techniques minimized but did not entirely eliminate the need for accommodations. For example, one student chose to take exams in the Disability Resource Center for its reduced distraction and private testing environment. This was not viewed as a flaw in the project, but rather as an example of student advocacy and choice. The same student chose not to request a copy of class notes as the collaborative note-taking process eliminated the need. The student voiced her appreciation for the techniques used in class as a way of making her feel that she belonged and was part of the group. This example demonstrates the multifaceted collaboration between the instructor, Disability Resource Center, and student and illustrates one of the many positive outcomes from using UD in the classroom.

Outcomes

Using UD to redesign the project courses changed content delivery to meet student needs proactively rather than reactively, and as a result, in most of the project courses retrofit accommodations were no longer necessary. Prior to changes in course design, 100% of eligible students in the courses used testing accommodations. This changed dramatically when UD techniques were utilized: only one eligible student used testing accommodations in the altered courses.

At WIU the most commonly requested accommodations are extended test time and a copy of class notes.

While 13 students with disabilities in the project courses had approved note-taking accommodations, none of them used that accommodation in these courses--in comparison, note-taking accommodations were used by this same sample of students in other courses where UD techniques had not been applied. Techniques such as collaborative note-taking also produced an increase in student involvement as a community, and students with disabilities expressed a feeling of equality because provision of notes was no longer seen as something different or negative when it was done for the entire class. Class discussion regarding the effectiveness of note-taking resulted in one student disclosing her learning disability to her peers and voicing relief that her notes were of the same caliber as theirs. Having been told by past teachers that she was not capable of taking collegiate level notes, it was liberating for her to view how other students take notes and to contribute to the success of a group in note taking.

Furthermore, we know that students used the notes (both PowerPoint and text) that were posted in the CMS. Of the total time spent viewing materials from one of the project courses, freshman students accessed the PowerPoint slides 36.2% of the time and the notes section 17.53%. To put this in perspective, the students in this course spent only 14.95% of their time accessing their grades. The notes were being used!

Having lectures available via podcast allowed students to replay lectures to reinforce their learning. Since the students could access the podcasts either through a link on the course website or through a direct RSS feed emailed to them, data was not available on usage. This presentation method benefitted students who learn from repeat information and was also helpful when a student missed a class meeting due to illness, death in the family, or other unforeseen circumstance. According to anecdotal student feedback, both students with and without disabilities benefited from the flexibility of presentation for missed classes.

It was initially thought that community note-taking and podcasting of all class sessions would negatively impact student attendance. Attendance levels remained normal, however, possibly due to the fact that students were randomly assigned note-taking duties on the day of class and were assessed on the quality of their note-taking. These results are similar to those presented by Rose (2006), which noted that students continued to attend class despite lectures being available in video format via the internet. Students said they used the recorded lectures for study sessions before exams or to catch up on days missed, not as alternatives to class attendance. One student who disclosed a hearing impairment to the instructor stated that she did not use Disability Resource Center services for that class because the combination of community note-taking and podcasting allowed her to thoroughly review daily lectures to ensure that she did not miss key points when looking down to take notes.

Video captioning provided another mode through which information was delivered to students. While no students requested a video captioning accommodation, this modification may have assisted some students in attending to the videos being shown. Transcriptions and e-text were also offered for all students, although there was no way to collect data on the usage or results or impact of these modalities. Allowing unlimited time to complete exams eliminated the need for the Disability Resource Center to administer exams, although exams were still administered when a quiet room or a scribe was requested by the student.

Students consistently performed better when choice was offered on assignments as compared to assignments with no choice. One possible explanation is that students chose assignments that more accurately reflected their learning preferences and that provided a more accurate reflection of their learning. Having the opportunity to choose may also have impacted their motivation in a positive manner. Overall, students reported feeling more comfortable and safe in the learning environment. This was achieved in part by meeting their basic needs for information regarding bathroom location and emergency procedures on the first day of class.

Implications

The goal of this pilot project was to investigate the practical application of UD principles, and we have seen that faculty collaboration with the Disability Resources Office on course design provided sustainable, usable courses for students with varying learning needs and preferences. Despite diverse course formats and student populations, practical application of UD proved to be flexible and usable beyond the theoretical framework. And while the changes discussed in this practice brief were limited to one faculty member in one department, the results appear to be applicable across disciplines. We therefore believe that collaboration between faculty and disability resource professionals can assist in propelling the UD movement from theory into practice.

Training faculty on the use of UD ensures that real change will occur at the course level, resulting in fewer requests for accommodations. Less need for accommodations will, in turn, free up the resources of disability resource offices to focus on training and consulting and will encourage both faculty and students to become vested in the UD process. This shift in the locus of control away from the disability resources office does not diminish their role in supporting students with disabilities, however. In fact, it allows each party to serve as the experts in their appropriate areas: disability resources in the area of accessibility, faculty in their academic disciplines, and students in their learning. Disability resource staff can then be viewed as consultants to both faculty and students when they need additional support.

As a follow up to this pilot project, a faculty partners program is being developed in which faculty will be trained on UD principles and their individual courses evaluated and redesigned with UD techniques, all using a collaborative approach. The goal of the program is for faculty members who have received formal training on UD to take on the role of design experts and share their best practices with colleagues.

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About the Authors

Rachel E. Smith received her BS degree in psychology and MS in recreation, park and tourism administration both from from Western Illinois University. She is a certified therapeutic recreation specialist. Her experience includes 17 years as an advocate and educator in the many facets of disability. She is currently associate faculty and Internship Coordinator in the Department of Recreation, Park and Tourism Administration at Western Illinois University. She can be reached by email at: Re-Smith@wiu.edu

Tara Buchannan received her BS degree in physical education and her MS degree in rehabilitation administration and services from Southern Illinois University at Carbondale. She has 12 years of experience in disability resources in higher education. She is currently the Director of the Disability Resource Center at Western Illinois University. She can be reached by email at: T-Buchannan@wiu.edu.

BOOK REVIEW

Teresa L. W. Haven
Arizona State University

Suki Kwon
University of Dayton

Graham Pullin. (2009). *Design meets disability*. Cambridge: The MIT Press, 341 pp., $29.95.

Pullin's text is, as he opens the volume, "a book about how the worlds of design and disability could inspire each other" (p. 1). As a professional who has worked in both the fields of assistive technology and commercial design, the author starts in the first section by demonstrating how "distant those two worlds still are," and the tensions, both positive and negative, that can inform the two fields if they choose to work together. The second half of the volume focuses on individual case studies that exemplify the concepts under discussion. The book as a whole involves conversations across disciplines, including engineers, designers, artists, and people with disabilities, so in keeping with that model we have structured our review as a conversation between two professionals from very different backgrounds that inform our practice and influence our voices, including the ways in which we speak, hear, and write English.

<Teresa> I'm Teresa Haven, and I'm an "old hand" in the Disability Services profession, starting in my youth when I learned Signed English and Braille to communicate with a new friend who was Deaf-Blind. My areas of expertise are mostly technical: access technology, web and course accessibility, and alternative media production. I'm also a Ph.D. in an academic field that most people wouldn't typically connect with disability – linguistics – so my perspective is often different from many of my colleagues who trained in social work or rehabilitation. Whether I'm in a traditional classroom or working in DS, I've always enjoyed searching for better learning and teaching techniques as I work with students with a wide range of skills and abilities, and encouraging others to be more broad-minded in their own endeavors.

<Suki> I am Suki Kwon. I was born in Korea, studied psychology in college, but a yearlong stay in London, and a life-changing backpacking travel through Europe in 1995 convinced me to change my path and pursue a career as an artist. I came to the United States in 1997 as a part of an exchange program at the University of Iowa where I earned M.A. and M.F.A in design. I currently serve as an associate professor of design in the Visual Arts department at the University of Dayton. I teach graphic design, electronic design through the World Wide Web, and other design fundamental courses. I have had a particular interest in web usability and it led me to an issue of web accessibility.

Some books change one's perspective. This book, *Design Meets Disability,* written by Graham Pullin, has brought my thinking on accessibility and design to another level. The term "design for disability" in this book is used in rather broader meaning which encompasses design for special needs, inclusive design, and designs for people with or without disabilities. The purpose of this book is to promote people's notion about disability and the meaning of design.

The author starts the book with a story about the Charles and Ray Eames sculpture design and their inspiration of a leg splint. He points out that there's a healthy tension between two cultures, i.e. mainstream furniture design and design for disability. It is a great way to introduce how the design for disability heavily came from clinical and engineering backgrounds, how not much playful exploration has been done, and how valuable it could be to approach it that way.

<Teresa> Exactly. We've also witnessed, but probably not consciously paid attention to, the shift from "eyeglasses" as prosthetic devices to "eyewear"

as fashion objects. This is a great example, but a very rare one, of design and need meeting to create something new, better, larger than either field alone. Most people working towards producing items for people with disabilities think about what they are doing in very medical terms, while “mainstream” designers often tend to focus on a very narrow concept of the “ideal person” who isn’t really representative of the majority of human beings.

<Suki> Yes, when people think about design for disability they think of special needs for a certain group of people “with disability.” However, the World Health Organization (WHO) acknowledges that every human being can experience some degree of disability. It was an important notion the author brought up that I have never thought about.

As a foreign born adult living in the United States, I occasionally experience some types of disability. In fact, a common mistake made by persons speaking English as a second language is to say that they have a “hearing” problem instead of saying “listening” when they have hard time of understanding. When one is in a foreign environment, his or her cognitive, auditory, visual ability drastically drops. It feels similar to the way a visual-, hearing-, and cognitively-impaired person experiences in his or her surroundings. I came to a realization that everybody can be situated in a foreign country, needs to operate machines in darkness, arms occupied with stuff trying to open a door, situated in an environment that their height is smaller than the average height around them and in numerous situations alike. Therefore, designing for disability would benefit not only people with disability but also so-called able-bodied people in many ways as well.

<Teresa> However, the author also points out that this doesn’t mean that we need to make all products so that they work for all people in all situations. Too often people misunderstand universal design in this way, and end up creating products with so many features or controls that they ultimately don’t work well for anyone. His analogy is of a flying submarine – rather than creating such a complex feat of engineering, people have stayed with the more practical approach of using discrete methods of travel (airplanes, submarines, ships, trains, etc.) for crossing different types of spaces, and changing modes when they need to. Following this idea, the author highlights some very “limited” products which are nevertheless very good examples of design that serve large populations: the Apple iPod Shuffle, which deliberately dispensed with some features in the original iPod (most notably the display screen) in favor of other features which were considered more valuable (most notably the smaller size).

<Suki> Another interesting thought introduced by the author is that there are many instances of accessibility applications (e.g., ramps, braille) which have been made after the building or the product has been made. In order to make it a true inclusive design, those applications have to be considered at the beginning of designing stage not as afterthought. The ramp has to be integrated into a part of the structure, braille signage has to have co-relation with the typed signage. Even the braille could be taken as a motif of graphic arts or sculptural objects as designers explore typography purely for aesthetic purpose.

<Teresa> And a related concept was the idea of taking something that may have been originally designed with disability in mind, and expanding it to a wider audience. TableTalk was a great concept to illustrate this: induction loop and earbud receiver technology made available in noisy environments like coffee shops and bars, so that everyone at the table could “screen out” ambient noise and focus more clearly on their tablemates. There are lots of examples of this kind of adaptation in history, but most folks nowadays don’t realize that many “everyday” items or practices were once disability adaptations, like typewriters, hand signals in baseball, or the football huddle.

<Suki> I especially appreciate the latter part of this book on meetings with designers. A series of discussions with the leading designers in various mediums and areas engaging with the issues of accessibility is inspiring and thought provoking. As the author mentioned, not one designer works the same way. Witnessing how the fellow designers approach, solve diversity of problems in accessibility and how they integrate them into their usual problem solving processes and their design aesthetics are invaluable lessons. I found this to be the great value of this book because it is not only bringing up an issue around design for disability, provoking thoughts and ideas about it, but also suggesting an example of how it has been practiced by other designers so that designers could take a step forward to act on creating inclusive design in their own ways.

<Teresa> I agree completely. In Disability Services I would recommend this work as a way to break out of old patterns of thought and become open to acceptance of difference and change, something that many of us

in the field forget that we need to do ourselves as well as teaching others to do. I think it's safe to say this is a book that we will recommend strongly to colleagues across disciplines, within Disability Services, Design, and all other areas, as an informative and valuable resource for re-thinking many of our past and present assumptions and practices.

About the Authors

Teresa L. W. Haven received her Ph.D. degree in linguistics from Arizona State University. Her experience includes working as a university instructor, disability services professional and access technology professional for multiple institutions. She is currently head of Alternative Format Services for Arizona State University. Her research interests include universal design and usability in educational and technological environments. She can be reached by email at: Teresa.Haven@asu.edu.

Suki Kwon received her BA degree in psychology from Daegu University, Korea and M.A. and M.F.A. in Design from the University of Iowa. She is currently an Associate professor of Design in the Department of Visual Arts. Her research interest includes universal design, web design, web usability in particular. She can be reached by email at: suki.kwon@udayton.edu

BOOK REVIEW

Graham Pullin
University of Dundee

Preiser, W., & Smith, K. H. (Eds.) (2009). *Universal design handbook* (2nd ed.). New York: McGraw-Hill.

There is no universal definition of universal design (UD), as revealed elsewhere in this issue of JPED. The back cover of the *Universal Design Handbook* promises that "Students, advocates, policy makers, and design practitioners will get a theoretical grounding in and practical reference on the physical and social roles of design from this definitive volume." This is an audacious book then, in its breadth of audience, role, and scope. This must have made it a challenging undertaking—and also makes it a daunting book to review.

The book is in seven parts, organised from the most comprehensive to more specific topics. Part 1 is "Premises and Perspectives," a historical and theoretical context for UD. Part 2 is "Principles, Standards & Guidelines." Part 3 is "International Perspectives." Part 4 is "Public Spaces, Private Spaces, Products and Technologies." Part 5 is "Education and Research." Part 6 is entitled "The Past and Future of Universal Design." Part 7 is described as an "Epilogue." There are over 60 contributing authors, including many internationally-recognised pioneers and opinion-formers in this field.

For disability service providers and other readers of JPED, Part 5 is directly relevant. "Universal Design for Learning in the College Classroom" (pp. 39.1–39.6) gives an overview of UD within general educational settings whilst other chapters concern UD within design education. "Camp Aldersgate: A New Model for Architectural Education" (pp. 40.1–40.10) offers an inspiring instance as an illustration of how Disability Services and design education can come together, for once.

This second edition of UDH begins by stating that "in less than a decade" since the first edition in 2001, "the world has experienced a century's worth of change" (p. xxiii). Mention is made of nearly 200 million iPods having been sold in that time—although, given a widening perspective highlighted in the chapter "Universal Design and the Majority World" (pp. 3.1–3.6), an estimated 5 billion mobile phones worldwide might have been a more significant observation. Either way, the increasing role of the digital in our everyday lives doesn't yet feel reflected even in this 2011 edition, which still seems more concerned with the built environment than with digital inclusion, curb-cuts for sidewalks rather than whatever the equivalent might be for social networks.

There is a brief encounter between the two perspectives in the case of "Rear Window" (p. 34.6), which is an inspiring blend of architectural and interaction design, of the physical and the digital. Transparent panels fitting into the cup-holder of cinema seats allow hard of hearing people to watch captions (a reflection of reversed captions displayed on the rear wall behind them) whilst sitting wherever they want, with whomever.

One chapter's authors lament that "UD is burdened by perceptions that it is only concerned with functionalism" (p. 9.1). Unfortunately there is a risk in that this book tacitly reinforces these perceptions. From its 500 pages of dense text and centered photographs to the decimal point section numbers, the book feels as though it is aimed at UD academics and policy makers. The design of this book on design could have done more to engage the rest of us.

At the scale of its 45 chapters, however, it is much more engaging. Each is typically 8-10 pages long, comfortably read at a sitting, and the chapter breaks afford reflection. But for its size (it is not at all clear why the book is termed a "handbook," being neither very portable nor a handbook in the sense of a concise manual or reference), one could imagine reading these whilst commuting or travelling. This is where a Kindle edition might be appealing (and more affordable at less than $150 for the hardcover book).

Chapter by chapter the tone of the writing changes and the reader gets a sense of different voices in the field. From industrial designer James Mueller's snappy "Zip up your jacket–with one hand. Carry on a conversation–while a train goes by next to you" (p. 32.1) to the more obscure "Unobservable logic mathematical models that establish wholeness and transformation through self-regulatory processes provide the framework to test reciprocal relationships of variables in a database system of observable, successful results" (p. 14.4). Overall the writing is academic in style, its editors Wolfgang Preiser, a Professor of Architecture and Korydon Smith, also an architectural academic.

And so to the penultimate section, "The Past and Future of Universal Design"—a title that might suggest a comfortable narrative to round off the Second Edition and anticipate a third in 2021. But here something remarkable happens, because Jim Sandhu, a pioneer of inclusive design (ID, a European term related to UD, which is largely an American term), has written "A Contrarian View of Universal Design" (p.44.3–44.12). He criticises what he sees as the "recent practice of labelling conventional use of good human-centred design as UD" (p. 44.3), but also points out that elsewhere UD has "moved away from the activity of designing, i.e., producing objects and environments for users, to mere abstractions such as codes and standards authoring" (p. 44.3). Referring to the "Seven Principles of Universal Design," which have been introduced by Molly Follette Story early in the book (pp. 4.3–4.12), Sandhu suggests that "this broadening is of serious concern in the light of the seven principles as these only apply to design and designing" (p. 44.3). Such distinctions should be relevant and thought-provoking to JPED readers. Is UD confined to teaching environments and teaching materials? Or can it also—and how does it—relate to curricula and modes of delivery?

Sandhu nonetheless endorses this book as an exemplary "base for discussion, communication, exchange, and development of ideas centered on UD/ID" (p. 44.8). This might be a more realistic and at the same time more inspiring description (i.e., publisher's blurb). Coming to these thoughts at the end of the book throws a different light on the contradictions illuminated by—or sometimes lurking between—the previous chapters.

One such contradiction is highlighted in a chapter on "U.S. Accessibility Codes and Standards," which warns of how well-meaning regulations that establish minimum criteria can inadvertently inhibit improvements in best practice. The bare minimum acceptable standard becomes perceived as being an absolute, and designers design to achieve compliance and no further, "resulting in the minimums becoming maximums" (p. 6.4).

For this reviewer at least, the richness of the book comes from these tensions as much as from any universals. If Sandhu's chapter had been a provocative foreword, rather than a postscript, it might have set very different expectations for the book. Reading each chapter in the light of this perspective, the whole can exceed the sum of its considerable parts.

I would recommend this book to anyone wishing to be exposed to the breadth and many of the depths of UD. But readers should be prepared to wrestle with some of its contradictions—even to arrive at their own conception of what UD is and could be.

About the Author

Graham Pullin is a Senior Lecturer and Course Director of Digital Interaction Design at DJCAD at the University of Dundee, Scotland, where his research is exploring and designing more expressive communication for people without speech. He is the author of Design Meets Disability (The MIT Press, 2009) and co-chaired the Include 2011 conference on inclusive design at the Royal College of Art, London. Previously he was a designer and studio head at the design consultancy IDEO.

Journal of Postsecondary Education and Disability

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The *Journal of Postsecondary Education and Disability* welcomes submissions of innovative and scholarly manuscripts relevant to the issues and practices of educating students with disabilities in postsecondary educational programs. Manuscripts must be submitted electronically via email to jped@ahead.org

Guidelines for authors:

Content
Manuscripts should demonstrate scholarly excellence in at least one of the following categories:

- Research: Reports original quantitative, qualitative, or mixed-method research
- Integration: Integrates research of others in a meaningful way; compares or contrasts theories; critiques results; and/or provides context for future exploration.
- Innovation: Proposes innovation of theory, approach, or process of service delivery based on reviews of the literature and research
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Format
All manuscripts must be prepared according to APA format as described in The Publication Manual (6th ed.), American Psychological Association, 2010. For responses to frequently asked questions about APA style, consult the APA web site at http://www.apastyle.org/faqs.html

- Manuscript length typically ranges between 25 and 35 pages including figures, tables, and references. Exceptions may be made depending upon topic and content.
- Include 3-5 keywords.
- Write sentences using active voice.
- Authors should use terminology that emphasizes the individual first and the disability second (see pages 71-76 of the APA Manual). Authors should also avoid the use of sexist language and the generic masculine pronoun.
- Manuscripts should have a title page that provides the names and affiliations of all authors and the address of the principal author.
- Include an abstract that does not exceed 250 words. Abstracts must be double spaced on a separate page of the manuscript, between the cover page and the first page of the body of the manuscript. List 3-5 key terms immediately beneath the text of the abstract.
- Provide a cover letter asking that the manuscript be reviewed for publication consideration and that it has not been published or is being reviewed for publication elsewhere.
- Tables and figures must conform to APA standards, and must be in black and white only. All tables and figures should be vertical and fit on the page, no landscape format.

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- Title Page
- Abstract
- Summary of Relevant Literature
- Depiction of the Problem
- Participant Demographics and Institutional Partners/Resources
- Description of Practice
- Evaluation of observed outcomes
- Implications and Portability
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