Design for All

UNIVERSAL DESIGN AT SF STATE

SAN FRANCISCO
STATE UNIVERSITY

Editorial Forward:

Universal Design @ SFSU, Ricardo Gomes, Director, Design Center for Global Needs, Professor, Design and Industry Department, SFSU

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Editorial Forward

Universal Design @ San Francisco State University:

Ricardo Gomes

Universal design is the design of all products and environments to be usable by people of all ages and abilities, to the greatest extent possible. (Mace, 1991)

Significance

In June 2001, San Francisco State University settled a class-action lawsuit by disabled students and faculty, agreeing to make the campus more accessible. SFSU has stated that the settlement reaffirmed the university's long-standing commitment to serving the needs of students and faculty members with disabilities and a long-term program of improving accessibility.

> *The wide range of people coming to San Francisco State University in differing capacities necessitates a strong commitment to improved access and flexibility. This commitment will shape the way the University serves its students and delivers its academic programs; the access to resources it provides its employees; and the efforts it makes to meet the needs of the community by providing educational and other services to a wide audience.*
> (SFSU Strategic Plan)

Overview

The history, development and evolution of Universal Design at San Francisco State University (SFSU) and within the Design and Industry (DAI) department has demonstrated the cross-disciplinary applications, and exchanges of the various services and resources at SFSU. This cooperative "universal" exchange has complimented the consonant academic and applied community outreach and service learning goals by such university sources as: the Accessible Landscapes: Designing for Inclusion Project; the Institute On Disabilities; The Disability Program and Resource Center; the Center for Teaching and Faculty Development: Universal Design for Learning Program; the Academic Technology: Accessible Technology Program; the Gerontology Program; The Rehabilitation Engineering Program; the Whirlwind Wheelchair International; and the Design Center for Global Needs.

The principles, policies, influences and applications of Universal Design have spanned the physical, cognitive, social, and economic realms within the universities from the built environment to academic policies and practice relevant to accessible technology, curriculum development, , policies from the built-environment to the pedagogical learning experiences. An integrated approach to universal design, - a.k.a."Good Design," in our department, has promoted an integrated academic environment. An interdisciplinary environment that has combined the expertise and methodology of disability advocates, and design professionals in the San Francisco Bay Area, along with educators, and students at the university. These mutual interests have promoted advancing the holistic principles and applications of universal design in the built and cognitive learning environments at SF State.

> *"…Essentially, Universal Design in architecture is about incorporating accessibility into the initial blueprint, thus eliminating the need for costly retrofits and ungainly, inefficient add-ons. Universal Design for Learning applies these same concepts to the field of education, asking faculty to rethink how they deliver their courses, engage students, and assess student performance in order to make learning accessible to all."*

> *"[Here at SF State] UDL is built on solid foundations: brain research on how we learn, a commitment to social justice, and time-proven, best pedagogical practices."*

> - **Dr. Pamela Vaughn** is Associate Dean for Faculty Development and Director of the Center for Teaching and Faculty Development at San Francisco State University

Universal Design in the Design and Industry (DAI) department at SFSU:

The integrated approach of universal design principles into the curriculum development in DAI has been consistent with the mission of the department. This mission has been to promote an interdisciplinary educational program. An inclusive program that provides, to an ethnically diverse and multicultural student population, an opportunity to develop an individualized course of study in the areas of product design, graphic design /visual communications, manufacturing, and technology education. The department advocates a design program that is both inclusive and responsive in its representation of community-based needs, and services, as well as, the mainstream professional business and manufacturing sector needs.

The integrated approach to universal design in the DAI department is very holistic. It addresses the physical, as well as the social parameters of universal design. Its approach is both quantitative and qualitative. It is as interdisciplinary as it is inclusive. It is an approach that is socially and ethnically diverse, in its attempt addresses barriers of economic disparity, gender bias, or racial and cultural difference in mainstream society.

Since 1991, in conjunction with the Design Center for Global Needs, universal design has steadily become an integral and pervasive element within the undergraduate and graduate degree programs in the Department of Design and Industry. Professors teaching in the area of product design and development received a seed grant from the Universal Design Education Project to develop strategies for teaching lifespan issues to future designers - the students in DAI department and the university community at large.

The ACCESIBLE LANDSCAPES Project:

The ACCESIBLE LANDSCAPES Project was conceived in 1990 by Phil Evans, Director of the SFSU Campus, Buildings, Grounds and Facilities, as a logical extension of the excellent work in park and playground access by the firm of Moore Iacofano Goltsman, Inc. Their program was published in 1987 under the title "Play For All."
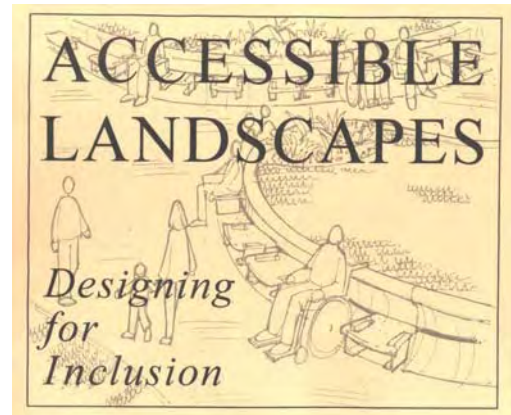
Seed money was provided by the National Endowment for the Arts, under the Design Arts Program. Throughout the project we have had the expert assistance of Moore Iacofano Goltsman, Inc., Berkeley, California. Administrative and design costs were borne by San Francisco State University, primarily through the Department of Design and Industry, led by former Associate Professor, Brian Donnelly. The Departments of Disabled Student Services and the Campus Disability Coordinator provided guidance.

The objectives and principles of this inclusive design project was to design a more accessible landscape on campus that would facilitate accessible improvements to the built environment in meeting the diverse needs of a wide range of people.

The Process
The interdisciplinary and collaborative ACCESIBLE LANDSCAPES Project involved a series of participatory design focus group sessions, as well as scheduled design development sessions, with people who have experience with disability and accessibility issues. This collaborative experiential design process consisted of continual engagement with the same, as well as, different groups with evolving concepts for new furniture and other features which address the need to make the urban landscaped environment more user-friendly for all of us.

The results of the Accessible Landscapes Project have produced a booklet and several environmental design installations which have exemplified inclusive and accessible design solutions which will be featured in the proceeding chapters of this special newsletter. These preliminary solutions and prototypes have stimulated discussion and further innovation throughout the professional community. The Project has helped

create a new vocabulary of inclusion and a new standard for design of accessible, inclusive landscapes, to promote the development of user-friendly public landscapes throughout the world.

The Design Center for Global Needs and Universal Design

The Design Center for Global Needs, was established in 1992 and co-founded by the DAI faculty members Brian Donnelly, James Bebee and Ricardo Gomes. Since its inception, the Design Center for Global Needs has been dedicated to the research and development of design solutions around such issues as accessibility, the elderly, healthcare, community development and disaster relief.

The Design Center for Global Needs in the Department of Design & Industry at SFSU sees a tremendous opportunity to make a profound impact on the issues of diversity in design education and its relative environment. An environment that constitutes, and needs to be more responsive, to the social, cultural and physical needs of the underrepresented, the disabled, and the disenfranchised. There is a need to expand and enhance the representation, awareness and the traditional focus of design education. A responsive awareness that goes beyond the esoteric values of the conventional marketplace to engage the needs of the expanding non-traditional markets of emerging economies. Economies that must exist and evolve, on the local, or international level, within the context of sustainable development.

Co-founder Donnelly had initiated several design projects on the SFSU campus, including a recycling container system with the Plant Operations; a fiber optic light guide for the visually impaired; a residential and a public seating system for the elderly.

Universal Design Symposium and Workshop

In an effort to promote design practices that recognize the capacities and needs of diverse individuals, the Department of Design and Industry (DAI), in conjunction with the Design Center for Global Needs (DCGN), conducted a special Universal Design Symposium in October of 1996. Promoting an interdisciplinary approach to design issues, the symposium featured seminars, and presentations by advocates from diverse user populations and design professionals, highlighted by an intensive 3-day student design workshop and final presentation.

This event featured some of the leading universal designers, disability-user advocates and policy makers such as: John Saleman, Universal Designers & Consultants; Molly Story, from the Center for Universal Design at North Carolina State University; Abir Mullick from the IDEA at State University of New York (SUNY), Buffalo; Susan Goltsman, principle, Moore, Iacafano & Goltsman; Barry Atwood, president of Accessible

Environments; Ralf Hotchkiss, Director of the Whirlwind Wheelchair International (WWI); Dr. Paul Longmore, SFSU, Disability Rights Historian and Policy Maker; and Dr. Mario Marino from the Center for Industrial Design Research at the University of Buenos Aires, Argentina

The symposium also featured the debut of a presentation, by John Saleman, of selected works from the Images of Excellence in Universal Design Project, a juried competition sponsored by the National Endowment for the Arts and the National Building Museum. The symposium was made possible in part by a grant from the Adaptive Environments Center (now the Institute for Human-Centered Design) in Boston as part of the Center's Universal Design Education Project.

The Symposium also gave us the opportunity to have the University President Robert Corrigan, give the opening address in recognition of significance and support of Universal Design at SF State. The symposium was highlighted by awarding Ralf Hotchkiss with a "UD" Award in recognition of all the beneficial contribution and work he has done in promoting social equity and well being through universal design, accessibility and independent living through the Whirlwind Wheelchair International projects and community service learning experiences.

The Workshop participants greatly benefited from the international leadership and user-centered research expertise of Dr. Mario Marino, from the Center of Industrial Design Research (CIDI) at the University of Buenos Aires in Argentina, who facilitated the workshop sessions.

What was one of the most significant aspect of the universal design conference at SFSU was that it was the first universal design symposium and conference on the west coast of the United States. Up to this time most of the universal design initiatives were being conducted either at the Center for Universal Design at North Carolina State University at Adaptive Environments in Boston, at the IDEA Center at SUNY, Buffalo New York or at the Trace Center in Wisconsin. Consequently, we were very pleased to be able establish such a presence by hosting such a pivotal event for the UD community in the San Francisco Bay Area.

Today, Universal Design at SF State is represented in many diverse and interdisciplinary areas throughout the university faculty, curriculum, administration, facilities and grounds. The university has made and delivered on its commitment to sustaining accessible, flexible and diverse Universal Design learning and built environment.
To this affect, the university has embarked upon and implemented programs in facilitating free, open and equitable access to the physical, technological and learning environment.

The special "Universal Design @ SFSU" issue highlights the longstanding, as well as most recent interdisciplinary efforts and accomplishments at SFSU, such as:

- "Landscapes For All," Designing for Inclusion (Phil Evans)
- The Design Center for Global Needs (DCGN) Universal Design Education Initiatives
- Universal Design (UD) Curriculum Initiatives in the Design and Industry (DAI) department
- Coordination and Participation in the Designing for the 21st Century International Student Design Competition, Rio de Janiero, Brazil, Dec. 2004
- Hosting of the "Universal Design Symposium & Workshop" at San Francisco State University (SFSU), October 1996
- SFSU Institute on Disability (Prof. Paul Longmore)
- Rehabilitation Engineering Program (Prof. Ray Grott)
- Special Education Program, Prof. Sandi Rosen and Dr. Alise Palliard
- Universal Design and Aging in Place, Gerontology Program, (Prof. Darlene Yee and Dr. Anabel Pelham) *Exploration of Concepts of building and retrofitting facilities for aging in place, as will the use of design elements to create healing environments to improve the quality of life for residents..*
- Disability Program and Resource Center, Web Accessibility Standards and ACCESS Website initiatives (Gene Chelberg, Geoff Brown, Nicole Bohn)
- Academic Technology, On-Line Learning and Accessible Technology Initiatives (Dr. Maggie Beers and Kevin Kelly)
- Center for Teaching and Faculty Development (CTFD), Universal Design for Learning Initiatives and Faculty Associates Program

This long-awaited special issue on "Universal Design @ SFSU" at the gracious bequest of the Dr. Sunil Bhatia of the "Design for All Institute of India" features a historical retrospect, state and vision of Universal Design at San Francisco State University dating from 1991 to today. It is a great honor and privilege to coordinate and edit the vast range of accomplishments and contributions that are reflected in the selected writings, articles and projects that are enclosed in the proceeding chapters in this special "monument" of Newsletter dedicated to "Universal Design @ SF State!"

Chapter 1.1

Accessible Landscapes: Designing for Inclusion

Phil Evans

America's public landscapes have traditionally been designed based on criteria appropriate to only the non-disabled population. As regulations have begun to dictate the need for access, we have seen a proliferation of ramps, railings, and other improvements. Unfortunately, some of these new features in access have been obtrusive or otherwise dysfunctional in terms of the overall use and enjoyment of the site. Despite federal and state legislation, most persons with disabilities still have limited access to the pleasures of public landscapes.

The Accessible Landscapes Project was conceived in 1990 as a logical extension of the excellent work in park and playground access by the firm of Moore, Iacofano & Goltsman, Inc. Their program was published in 1987 under the title "Play for All."

The Accessible Landscapes Project is San Francisco State University's award winning program committed to bringing inclusiveness to the campus landscape. Through efforts by students, faculty, facilities, and administration, inclusiveness and accessibility standards have been raised throughout the campus. Without the help of the Engineering Design Center (EDC), Design and Industry department (DAI), Grounds Department and the Disability Programs and Resource Center (DPRC) this project would not be possible.

We believe it is possible and practical to design more accessible landscapes, and that access improvements can meet the needs of a wide range of people. The Accessible Landscapes Project is dedicated to these principles.

The Goals of the Accessible Landscapes Project and this book are to stimulate discussion and further innovation throughout the professional community, to help create a new vocabulary of inclusion and a new standard for design of accessible, inclusive landscapes, to promote the development of user-friendly public landscapes throughout the world.
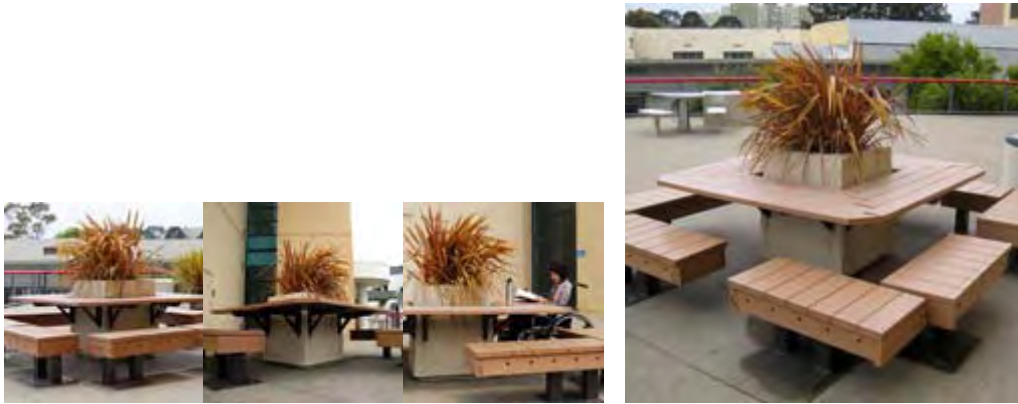
Click photos to enlarge

The Universal Seating Design Studio is part of San Francisco State University's ongoing process to maintain a sustainable and accessible campus. Located on the Fine Arts Patio are the 'Open Bench' and 'My Table 2'projects that recognize the need to create outdoor furniture that is accessible and usable for all users. The seating studio is accessible via ramp, stairs, and elevator and each seating space features adjustable benches and tables to maximize utility and comfort.

The Open Bench is an answer to the constraints of traditional fixed benches. This bench is user-friendly and accessible for all. The bench is safe, practical, combines design and comfort in a truly versatile, inclusive, and accessible outdoor bench.

Features:

- Elevated floral landscape for a communal centerpiece.

- Fully integrated accessibility

- Dynamic and versatile for comfortable seating

- Bench seats slide horizontally in either direction

- Bench seats become stationary while seating

- Friction brake controls the slide

- Vandal resistant surface, virtually no maintenance

- Table and bench material is 100% recycled plastic lumber
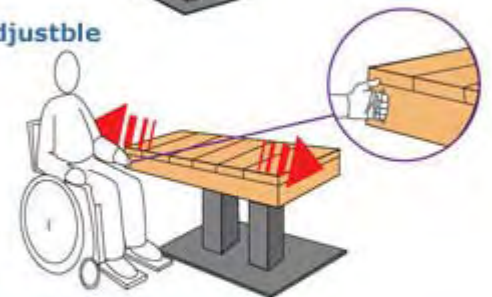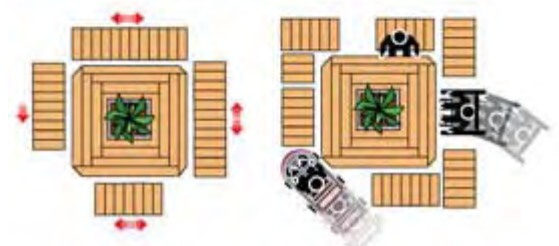
My Table 2 is designed to be easily adjustable using an electrical motor powered by solar energy. By allowing users to adjust the height of the table the designers have made it possible for wheelchair access from all sides. Features:

- Fully integrated accessibility

- Solar powered electric motor

- Dynamic and versatile for comfortable seating

- Capable of lifting up to 500 lbs.

- Safety switches prevent the table from moving downward when pressed

- 100% Recycled plastic table top

- Vandal resistant surface, with little to no maintenance

Universal Design Seating Studio

The Universal Design Seating Studio is a collaboration between the departments of Design And Industry (DAI), Engineering, Facilities, and the Disability Programs and Resource Center (DPRC), to sponsor and showcase student design innovation in seating for public spaces. The MyTable Project provides user-adjustable table height. Please visit us on the web: http://plopws.sfsu.edu/alp/

MyTable 1
MyTable 1 features a manual lift.

MyTable 2
MyTable 2 features a solar powered electric lift.

Solar Power
Uses renewable and sustainable energy.

Turntable
Users rotate the wheel to manually adjust the table height.

Buttons
Pairs of up/down buttons are located on each side of the tabletop to adjust the height.

Lower   Lift

Sound Web

The SFSU 'Sound-Web' is a pioneering universal design based audible wayfinding project, currently being spun throughout the San Francisco State University campus. The Sound-Web utilizes a series of solar-powered electronic playback devices to steadily emit a pulse of uniquely discernable sounds. These pleasing tones are sensitively projected from sculptural enclosures strategically placed throughout the campus landscape, acting as both a pleasing environmental entity and as an informative fixed audible point of reference.

To facilitate improved wayfinding, the Sound-Web distinguishes between four fundamental types of campus landmark. These local geographic components are the schools major pathway intersections, the access to student support facilities such as the library and health services, as well as the campuses main entrance points and arterial public transportation stops.

A Sound-Web audible landmark unit catches morning sunlight while marking the entrance to the campus from 19th Ave.

Audible Landmark

Careful attention was given to the selection of sound for each style of campus landmark. As in the original pilot program, the sound of wind-chimes are used to mark major pathway intersections; their 'ding' and 'dong' tones may help provide a mental association to the walkways random interweaving pattern of travel. Likewise, the structured and rhythmic beat of a percussion section fittingly marks the access to selected student support facilities. At the entrances to the campus, visitors are welcomed with the friendly call of a non-native bird, and while awaiting public transportation, the chirp of a country cricket may now keep you company.

The Sound-Web project currently consists of seven audible features, and continues to grow with a number of additional installations in progress.

A map showing current Sound-Web installations on the SFSU campus.

Aluminum Enclosure

To make each installation a simple one, a team of SFSU students designed and fabricated a sculptural enclosure to house each landmarks electronic components in one easy-to-install unit.

Each enclosure is made from a frame of aluminum angle stock surrounded by a tight skin of bent aluminum sheet, and capped at 45 degrees with a solar-panel. A cement base is then poured, providing the unit with a secure weighted foundation for easy installation in planted areas.
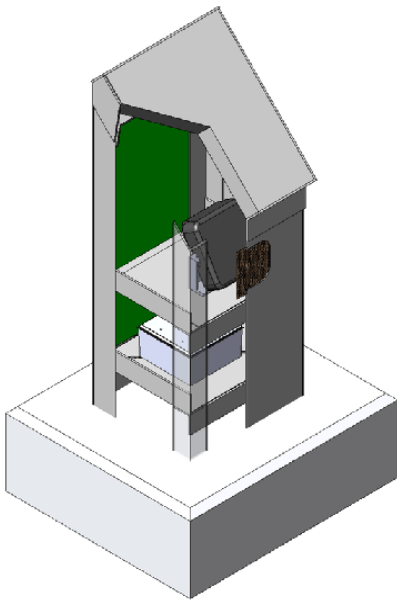
A cut-away view of the sculptural aluminum enclosure.

Take a 360 degree tour of a Sound-Web feature
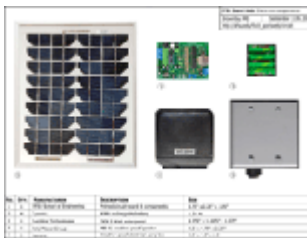
Electronics

When it came to designing and producing the heartbeat of the Sound-Web, students and staff from the San Francisco State University school of Engineering successfully developed a low-maintenance, solar-powered electronic playback device.

The teams current design consists of a chain of five core components: A 5-watt solar-panel, an all-weather speaker, a printed circuit-board with a connected rechargeable battery pack, and a watertight electrical gang-box. This series is capable of emitting a pulse of recorded sound in all types of weather; it is easy to produce and requires little to no on-site maintenance.

A layout of the five main electrical components which combined creates the heartbeat of the Sound-Web.
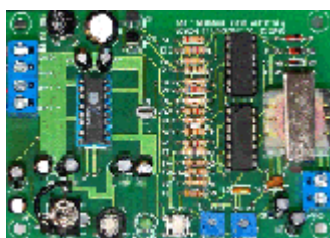
The circuit board and controls.

Campus Pathway Access Program

SF State's Campus Pathway Access Program is an ongoing project to render all campus pathways fully accessible and graciously inclusive. We have succeeded in virtually eliminating staircases as an element of outdoor public circulation. The campus maintains an up to date map that provides detailed information on accessible routes, restrooms, and parking throughout the campus. The campus also maintains an online construction access alert program which advises on any disruptions or detours necessary during campus improvement work.

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Chapter 1.2

Campus Winds of Change Chime to Inclusive Design

Excerpted Articles from Contributing Writers, D. Springer (SF State News, January 23, 2006); Laura LoForti (Golden Gate X-Press, SFSU, February 13, 2006); Lisa Rau with Nan Broadbent, Staff Writers (SF State News, May 28, 2008), Editor, Ricardo Gomes

In 2004, a partially blind San Francisco State University (SFSU) student, Toshiro Yamamoto, found the answer to facilitating his problem of navigating the campus pathways and building locations through the use of conventional wind chimes.   The initial implementation of wind chimes placed strategically through the campus pathway intersections, became a 'guiding light' to Yamamoto

Yamamoto was walking with his white cane from 19th Avenue to his house on 31st Avenue. As he was counting each crossing he got distracted, lost his count and ended up lost. The sound of familiar wind chimes in the neighborhood helped him find his way home.

Chronicle / Paul Chinn

Yamamoto related this home experience to similar situations when he was on the university campus. He stated that if a visually-impaired person gets lost they can ask people (where they are), but sometimes nobody is around, especially at nighttime, or weekends. In this situation, if there were wind chimes placed strategically on campus, these audio cues could be very helpful, as well as a comforting ambient sound.

This motivational experience prompted Yamamoto to contact sources in the Disability Programs and Resource Center (DPRC), which led to the collaborative creative and resourceful exploration with Phil Evans, manager of campus grounds; Geoff Brown, a coordinator of the DPRC; and Ricardo Gomes, Chair and professor of the Design and Industry department.

This is not the first time SFSU has explored offering audible clues to visually impaired persons. In 1990, Evans collaborated with design and industry faculty members Brian Donnelly and Robert Natata on a study funded by the National Endowment for the Arts. The project, entitled "Accessible Landscapes, Designing for Inclusion," explored such multipurpose campus enhancements as talking maps and furniture that would accommodate wheelchair users. Not long after, design and industry students constructed two examples of accessible outdoor study tables on the Fine Arts building patio. The project also spawned a book and an accessible landscapes Web site, which are routinely consulted by designers worldwide.

The initial Wind Chime pilot program consisted of wind chimes hung from a light pole near the library and other strategic resource and service centers on campus, where students who are blind, have other disabling impairments, or any other campus pedestrian may find it beneficial and/or resourceful to have these wayfinding audio cues. Wind chimes were strategically placed near entrances and pathway intersections adjacent to the Student Center as a reminder of an approaching steep, wide staircase leading down into a building is nearby. More sets were hung near other buildings on campus such as the Humanities and Student Services buildings.

The wind chimes near the J. Paul Leonard Library

Geoff Brown, stated that our legislation requires to make things accessible, for example with the room number in braille, or the yellow tape on steps for low vision students, but it doesn't say anything on auditory inputs. Phil Evans believed from the outset that the wind chimes would, "… provide a multi-dimensional experience for everyone."

While the chimes were an easy and logical innovation to implement, the pilot program had revealed a few environmental problems of its own. The problem with efficiency and reliability of wind chimes is often the wind, either too much, or not enough. It is an element that is only as predictable, as Mother nature wants to be. Sometimes the wind chimes are easily damaged and their strings get tangled into silencing knots, requiring a frustrating and constant need for maintenance.

The weight and design of the test chimes did not guarantee regular ringing in campus winds, and the sounds of each set were too similar for users to make a distinction about which location they represented. Consequently, Phil Evans approached the engineering and product design students at SF State and asked them to develop a more controlled, reliable and efficient concept of a wind chime. This interdisciplinary design collaborative venture between students and professors in the Engineering and Design and Industry departments, emulated the applied hands-on learning experiences that are executed in the real world research development environment.

Design and Industry students together with students from the Engineering department collaborated to develop a more effective solar-powered, audible device with variable audio cues. The "Sound Web" is a series of wind chimes that provide visually impaired people with audible cues, helping them navigate the campus. This successful collaborative problem-solving venture launched the development of the "Sound Web Audio Wayfinding System at San Francisco State University."

Former Design and Industry department Product Design major, Mike Day, who was one of the principle design coordinators for the project, in conjunction with other Phil Evans, Director of Campus Buildings, Grounds and Facilities Services, utilized the "Sound Web" project as his senior degree thesis project. "Inclusiveness is a hallmark of a mature and forward-looking institution and certainly of the pre-eminent urban university," said Phil Evans, director of campus grounds. "It takes effort, creativity and determination to develop a new idea well, and we have succeeded thanks to the many individuals who have contributed energy and thought to this goal."

A Sound Web audible landmark unit marks the entrance to campus from 19th Avenue.
Photo credit: Mike Day

The "Sound Web" project draws on student contributions in all aspects, including initial brainstorming, conceptual design, construction modeling, project management, publications, outreach and focus groups. Senior DAI Product Design major, Josh Williams, who has worked with many of his classmates on the Accessible Landscapes Project, takes pride in his work maintaining the Sound Web on campus. "People enjoy them as cultural objects," said Williams, who has worked with the project since 2006. "The intention was to have them also be enjoyable to see. It's for way-finding, but this brings it to a whole other level. I find that rewarding."

The collaboration between staff, faculty and students includes the Department of Special Education, the Disability Programs and Resource Center, the Department of Design & Industry, the School of Engineering and the Universal Seating Design Studio, a program which formulates new ideas each year. The various ongoing projects also employ new sustainable technologies: solar power, recycled plastic lumber and other special means of enhancing environmental stewardship.

The University's Accessible Landscapes Project has received a national award from the American Physical Plant Administrator's Association (APPA) for its multifaceted commitment to the accessibility of SF State's campus. The APPA's Effective and Innovative Practices Award recognized the project for enhancing the inclusive campus. The award includes a $4,000 grant and special recognition in APPA's Facilities Manager magazine, and is part of the organization's mission to elevate the value and recognition of facilities in education.

References:

D. Springer, (2006) **Campus wind chimes guide visually impaired,** Staff Writers, SF State News, January 23, 2006

Laura LoForti, (2006), **Wind Chimes to Help the Blind SF State Student Discovers Idea to Help the Visually Impaired,** Staff Writer, Golden Gate X-Press, SFSU, February 13, 2006

Lisa Rau with Nan Broadbent, (2008) **Campus Commitment to Inclusive Landscape Garners National Award,** Staff Writers, SF State News, May 28, 2008

Chapter 1.3

The Sound-Web
Audible Wayfinding at San Francisco State University

M. Day, P. Evans, S. Rosen and H.Y. Chu

Introduction

Learning to navigate a large public space such as a college campus can be a difficult task for anyone. Common wayfinding tools found in these types of civic environments, such as signs and maps, are highly practical and can be very beneficial in helping to orient and guide a majority of site users. These tools however are almost always the only indicator as to the location of the facilities main features, and often fall short of meeting the navigational need of the entire user group.

In addition to signs and maps, sound has great potential to be used as a wayfinding tool in many situations, and in applications for people with vision impairments. Audible signals used at traffic crossings for example, help blind and low-vision pedestrians with timing and orienting their crossing. However, audible signals need not always come in the form of a warning tone, but can also be used as a pleasant cue from within an environment, indicating a local point of navigational reference in a given area.

At San Francisco State University, a pilot project has successfully been implemented using pleasing sounds as navigational landmarks. The Sound-Web is demonstrating that audible wayfinding can be achieved in a meaningful and unobtrusive way, and can enhance the overall experience of users to the environment.

Project Overview

The Sound-Web is an audible wayfinding program, consisting of a series of solar-powered audio playback devices, strategically placed within the San Francisco State University landscape. Each sculptural device indicates the type and location of an important campus feature by continuously emitting a localized pulse of pleasingly discernable sounds, acting as an *audible landmark* within the campus geography. These installations provide users to the campus with an additional element of enjoyable environmental stimulation, as well as a location specific, informative network of *fixed audible points of reference*.

These campus-wide audible features keep with the principles of universal design in that they are equally applicable to all users of the facility, and additionally highlight and enhance the sensory characteristics of the landscape by complementing its visual diversity with a variety of audible experiences.

Careful attention was given to the selection of sounds used to indicate each different style of audible landmark. A variety of sound clips from nature, music, and industry were tested in focus groups and in the field, for elements of clarity, likability, obtrusiveness, and resonance. The results of the tests indicated a strong user preference for audio samples taken from animals such as frogs, birds and crickets, and for the simple tones of basic musical instruments such as the drum and the chime.

Figure 1. – An *audible landmark* on the university campus provides an additional source of wayfinding cues

A selected group of these samples were then paired to corresponding campus components through an inferred association of the sound clip, to the type of campus feature in which the installation is to indicate. An example of this type of intended correlation can be illustrated in the use of wind chime samples in all features marking the campuses major pathway intersections. The juxtaposing 'ding' and 'dong' tones of the chimes can be related to the walkways dichotomous and continually variable patterns of travel.

Student support facilities such as the library, student center, and health services building are likewise indicated by the controlled and rhythmic beat of a percussion section; with drums emphasizing the stability and organization of the operations within. The primary entrance points to the campus are designated by the welcoming and friendly call of a non-native bird, and public transportation terminals are accompanied by the chirp of a country cricket.

Each sound installation is relatively easy and inexpensive to manufacture using off the shelf components, requires little to no maintenance, is reliable, and weatherproof, and can be customized with any variety of electronic sounds for use in different environments.

Project Partnership

The pilot program has brought together students, faculty and staff at San Francisco State University from a variety of departments and programs including the Design and Industry, Engineering, Special Education, and Broadcast and Communication Arts departments; and the Campus Grounds, Disability Programs Resource Center, and Whirlwind Wheelchair International programs. Together, they conceptualized, tested, built, and installed seven audible landmarks to date around the 104-acre San Francisco State University campus, with three landmarks currently being constructed, and a number of additional installations in planning.

Conclusions

The pilot program has brought together students, faculty and staff at San Francisco State University from a variety of departments and programs including the Design and Industry, Engineering, Special Education, and Broadcast and Communication Arts departments; and the Campus Grounds, Disability Programs Resource Center, and Whirlwind Wheelchair International programs. Together, they conceptualized, tested, built, and installed seven audible landmarks to date around the 104-acre San Francisco State University campus, with three landmarks currently being constructed, and a number of additional installations in planning.

Chapter 2.1

Creating a Sustainable Universal Design Curriculum Methodology

Ricardo Gomes

Since 1990, Universal Design (UD) has steadily become an increasingly integral and pervasive element within the mainstream built environment, consumer products industry, and overall marketplace. Concurrently, further design research, education, and dissemination of these wide-ranging principles have emerged to become synonymous with good design ethics, social responsibility, and design methodology in the undergraduate and graduate degree programs in the DAI department. These ethics and values have continued to expand, as well as evolve, with the diverse infusion and directives of disability advocates, educators, design professionals and students interested in advancing the principles of universal design principles in the built environment.

Since the seven principals of UD was introduced in 1991, there has been little evolution of these foundation principles beyond its homogenous and "clinical" approach to facilitating a wider range of users physical needs and abilities. There is a need to enhance these principles to address the significance of aesthetic appeal, emotional impact, as well as social and cultural relevance of design to the end user and overall environment. A successful and well-designed universal product, or environment should accommodate the multiple senses of touch, smell, taste, visual emotion, as well as enhancing ones user/environmental experience. In addition, the fundamental principles of universal design are still very much limited to a conventional Western concept of usability, which largely represents a contemporary, urban and industrialized perspective to the pragmatic world of accessible/barrier-free design.

The investigation and preliminary presentation presented at the Universal Design 2002 Conference in Yokohama, Japan, looked at expanding the focus of Universal Design to be more "inclusive" and holistic in respect to issues of developing products and environments that better appeal, as well as facilitate users of various ages, abilities, cultures, and economies of scale.

Universal Design Assessment Paradigm

In the Fall of 1995, through the Design Center for Global Needs at SFSU, Dr. James Bebee developed an assessment instrument for Universal Design concepts.[1] This evaluation instrument looked at expanding and enhancing the core principles of universal design to address concerns of socioeconomic, cultural aspects, along with considerations for aesthetic, function, production, and market factors.

In the utilization of the revised universal design assessment paradigm, a number of factors, or filters were applied to the core seven principles of universal design. An equity filter expanded the equitable-use principle of universal design to take into account specific concerns and considerations relative to culture, race, gender, age, and physical status. The use of such social factors acknowledges that the foundation and traditional criteria for the creation of universal design principles stems from the values of a largely industrialized-Western society, economy, and infrastructure. Consideration and utilization of such equity filters, within the core context of universal design principles, will facilitate bridging the global path of dissemination and implementation of universal design principles in a holistic, comprehensive, and inclusive manner between diverse cultures and societies.

In addition to aesthetic and functional, the universal design assessment instrument has included, production and market filters to add the pragmatic component necessary for a realistic and feasible chance of product realization and success. There are those well meaning universal design fundamentalists who may perceive the inclusion of these additional factors may complicate, and possible intimidate, or alienate potential conformers. However, without the practical consideration for the flexibility and enhancement of the core universal design principles in respect to socioeconomic, cultural factors, along with the concerns for aesthetic, function, production, and market factors, there is a limited hope of designing sustainable and responsible products for a diverse global society.

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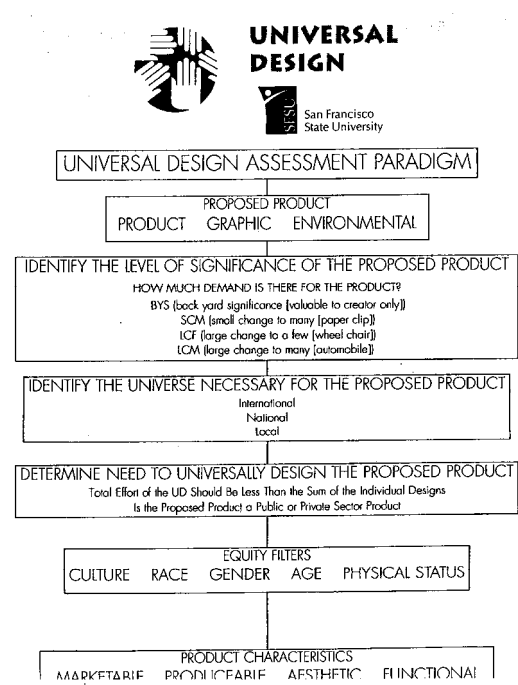
[1] 1 Bebee, James. 1995. *Universal Design Assessment Paradigm*. San Francisco, CA: Design and Industry Department, San Francisco State University

Universal Design Research & Development Curriculum Methodology

One of the key success in universal design was to also develop a clear instructor curriculum methodology in this respect we look at a number of concepts for universal design a number of curricula structures both nationally and internationally thru looking at design professional organizations or design firms such as IDEO, as well as studios in Argentina and Brazil. The universal design that we outline looks at areas of the basis of interest in projects in which we are concerned not only with the design issues , but also issues of health, legal policies, economic standing and social values. In this regards we have developed a universal design curricula for a fifteen weeks semester that constituted,

1. EIGHT (8) modules of DESIGN emphasis for eight weeks of design emphasis;
2. TWO (2) modules of two weeks of HEALTH areas;
3. ONE (1)module or one week of LEGAL issues and policies;
4. ONE (1) module or one week that goes with ECONOMIC concerns in terms of affordability of design;
5. THREE (3) modules that also looks at the SOCIAL areas of design in terms of aging transitions, independent living lifestyles and the social environment.
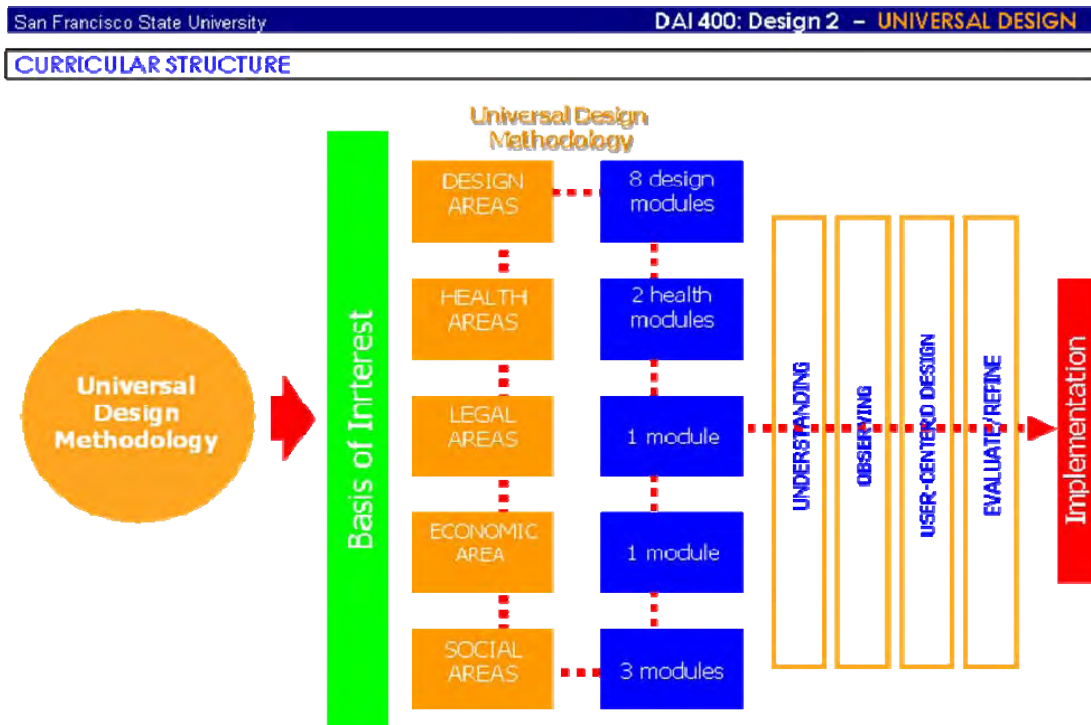
Chart Concept: Centro de Estudios de Diseno Universal, Estudio S+F, Buenos Aires, Argentina

In all these modular areas we conducted a lot of community and professional outreach which were executed thru the principle design research methodologies of understanding, observation, user center design, evaluation refinement, finally implementation.

- In regards to the **DESIGN** areas we were looking at domestic and personal environments, looking at existing product profile. We conducted consultation with Ralph Hotchkiss in the world one wheelchair, so he could better give us understanding about handle utensils and appliances, as well as analyzing and conducting other comparative research.

- In regards to the **HEALTH** area we were looking at issues of gerontology,

mature market places, dependence and self-efficiency, stereotypes and assumptions, and other parameter and criteria that help to frame an inclusive environment. We would conduct workshops with various retirement communities in the San Francisco Bay Area, and we would consult with these users and the environmental spaces at the outset of the design stage, so we can establish a clear understanding of what the problems may be.

- In regards to the **SOCIAL** areas we are looking at optimizing independent living and life style, grow and flexibility in the domestic environment, universal design as a social phenomena, as well as linking into generational benefits. In our efforts to gain a better understanding of independent life style and flexible environments, we would consult with Gene Chelberg, Director of the SFSU Disability Program and Resource Center Director in regards to some of the concerns, services, and resources that they provide to their constituency. We were very interested in knowing how design can be more cognizant of those resources and services.

- In regards to the **LEGAL** areas we are looking at dismantling discrimination by design, social policies, and the quality of life, the overall benefits of the disability rights regulation and policies for all. In this respect we consulted with Dr. Paul Longmore, the Director of the Institute on Disability at SFSU, who has written a book call "Why I Burn My Book" and other essays on disability. I believe it is very important that students have a sense of the legal nature of design, and the environment, and how they can be more responsive in having design meet those needs.
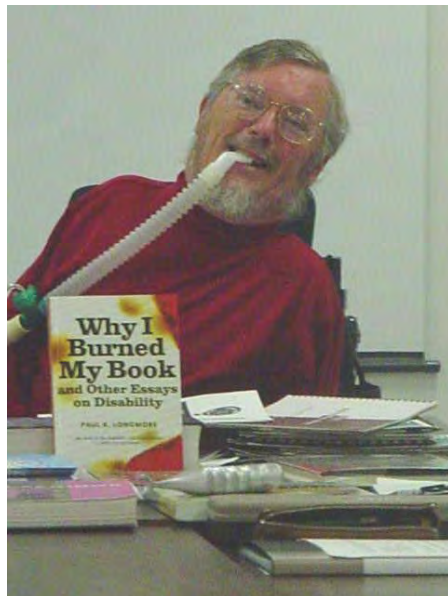
- In regards to the **ECONOMIC** area, we are looking at the benefits of an inclusive approach to identifying target markets. In this respect we seek to emphasize that marketing be affordable and feasible benefit of the universal design. We also seek to quantify the value-added appeal, desire and usability of universal design. In this respect we trying to optimize product development and management, particularly in regards to concern of lifecycle design factors and assessment. So, in this regard, economics addresses not only affordability; not only appeal and desire; but also addresses the feasibility of the sustainable nature of a product.

Another curricular model that we utilize at SFSU illustrates how students address design methodology and processes in the implementation of universal design curricula development, is having to have a clear understanding of the environment, in this case,

(1) **UNDERSTANDING** is the first and primary stage that we look at to finding the problem, understanding the problem thru discovery. We want to compel students to be removed out of their comfort zone. We want them to go there, to go beyond their studio, their work place, their home, their computer … where design is applied and where it can be most beneficial. In this regard we look at trying to orientate the students to universal design principles and methodology. We have them look at existing products and environments to profile them and

analyze them. We have them conduct literature reviews, compare market research. We look at content analysis as well as assimilation analysis, we also have them begin to conduct interviews in focus groups.

(2) **OBSERVATION** is the second stage that we have them look up after they established their clear understanding of the problem. Observation can be done in a variety of manners and approaches such as:

- interview focus
- artifacts reviews
- looking at the existing market
- looking at the user profile
- site observation
- user observation
- media documentation
- interview
- shadowing

There are number of different ways and methods that we can engage our students in prompting them to explore problems and research that is outside of their comfort zone and sphere of influence. The areas that we really like to touch on, which address again universal design learning principles are representation, engagement and expression done thru participation and documentation. Once the students have been able to collect and gather all this information thru the compilation of developing a clear understanding and observation of the subject matter, they them need to analyze and interpret that data.

(3) **INTERPRETING** is the third stage which will be translating the research data, realizing they are not the experts and they need to be very narrative and interpretative and in their own words understand the situation. So developing their basis of interest for the project, their project proposal, comparative design researching examples, inspiration, branding strategy, how again they are going to frame or package this concept in terms of the interpretation, the validation of the problem. This can be done also in developing character profiles, user

profiles, and also to establish what would be the key features or specifications or selling points of their design.

(4) **VISUALIZING/REALIZING** Once they have established all of these areas, then at that time can they begin to start to visualize, to realize their design idea, their design approach through conceptualization and solution development. This is where the exploration begins from the visual idealization in modeling. Visual brainstorming, initial design sketches, establishing a design guide and frame work for their design, looking at potential life cycle assessments in regards to material considerations, further development of their concepts in establishing a clear design direction but at the same time always addressing user participation and this regard this is what we've also have students reach out to design professionals. In this case we've worked with Susan Goltsman, and who has been very kind over the years to assist the DAI department and being very cognizant of where the design profession is going with these areas.

(5) **EVALUATING & REFINING** is that testing and refining process of design that is paramount. The whole design problem solving process must engage in the testing and refinement of design solutions. So this can be done through simulations, role playing, testing with various groups so they can try to discover problems that they could not forsee. So this process involves engaging potential

users or placing the project in the particular environment which could be developed.

(6) IMPLEMENTATION is the final stage in area number six would be the implementation stage: the tangible solution.

In regards to the projects that students have developed as result of these universal design curriculum and methodology, its allowed us to produce some very comprehensive, responsible, and inclusive projects. This again is highly due to the collaborative participatory outreach that is an integral component of all design processes. We have had our students not only work with various elderly communities but also dealing with persons with different abilities and disabilities to gain a higher sensitivity and awareness of the diverse needs of a wide range of users.

In summarizing the benefits of universal designs and sustainable design, one looks at principles of how you can establish the inclusive premise for a good design. Over 30 years ago, the artist Richard Hamilton wrote a book entitled "Popular Culture and Personal Responsibility", in which he defines ideal culture as one in which awareness of its condition is universal. Good design can be achieved by focusing the efforts of the designers to develop products in environments that will be more inclusive as oppose to preferential and enhancing and facilitating the areas of urban community development.

Three Levels of Sustainable Universal Design Curriculum Development

General Education/Introductory-Level Design Course

DAI 300: Design Process is an introduction to creativity and the design process. The course follows progressive steps to develop and enhance the student's knowledge and ability in executing the design skills necessary to analyze, visualize, and conceptualize the design development process. In this course, the students engaged in a "user-environmentally friendly packaging design seminar/workshop." The Packaging Design Seminar/Workshops exemplify how we have been able to promote a cooperative and integrated approach to curriculum development.

User-Environmentally Friendly Packaging Design Seminar/Workshop

The DCGN, in conjunction with the Institute on Disabilities at San Francisco State University, conducted a special program for design and packaging professionals that was structured to heighten the general awareness of many of the problems associated with opening today's packaged consumer products. Whether able-handed or not, everyone can relate at least one "trying experience" he, or she has had while attempting to open a particular package.

Ellen Leiber, president of Access Abilities, facilitated the focus of the seminar and workshop with a critical look at the user-friendliness of present day consumer packaging. The seminar focus was structured to address the concepts of Universal Design, as well as the rapidly growing size of the "not-so-able-handed" market within the American consumer base.

The seminar consisted of a diverse and interdisciplinary panel of design and packaging
professionals and student participants. Each panelist represented one of the major areas of concern in developing creative and appealing packaging concepts that safely and securely protected the packaged contents in an environmentally and user-friendly context. Representing the graphic, commercial, and marketing criteria was Fabienne David, senior designer from Primo Angeli Design. Representing the preservation, structural, as well as

shipping and handling criteria, was Dr. Jorge Marcondes, coordinator of the Packaging Engineering Program at San Jose State University, and, finally, representing the consumers' concerns for the ease of access to adequately opening and closing packaged products and containers was Ellen Leiber.

The workshop provided students with a more "experiential experience." To personalize the difficulties in question, Ms. Lieber led the students in a variety of simulation experiential exercises in which they attempted to open an array of consumer packaging items, while wearing devices that limit their hand motor skills and upper-extremity motion.

Package Design Focus
The focus of the packaging design project was to alleviate and facilitate the sometimes difficult task of opening consumer packages, while consequently addressing the environmental concerns for developing more ecologically responsive packaging. The objectives of this assignment were to heighten the awareness of many of the problems associated with opening today's consumer packaging. Students were also were asked to address in their solutions, the problems associated with the disposal of excessive packaging.

Intermediate/Upper-Level Course
In the intermediate/upper-level course, **DAI 400: Product Design 2**, taught out of the Design and Industry (DAI) department at San Francisco State University (SFSU), students have focused on the applications of products and environments that address the principles of universal design. These inclusive design considerations look at issues of accessibility, diversity, and sustainability in product design, development and implementation.

The course objective is to develop a comprehensive understanding of the principles of universal and inclusive design within the context, guidelines, and objectives of responsible design. Students are required to develop two projects over the course of the semester that vary from houseware utensils and appliances; kitchen and bathroom faucet fixtures; and universal wireless communication devices.

Before developing their projects, students are required to conduct an evaluation of a selected existing product utilizing the universal design assessment paradigm form. Following this analytical assessment, students must conduct an existing product profile documentation in order to establish the merits and potential for improvement of the product in respect universal design principles, target market, product material and production sustainability; and product-development management.

The course format places greater emphasis on user-based design instead of object based design methodologies. The coursework is divided into three equal and parallel layers which concentrate on the three basic aspects of product design[2]:

Process: The knowledge, techniques, and skills designers employ in the product development process. (product line management system)

People: The development of knowledge, insights, and sensitivity, about the users of our products, our final clients. (universal design)

Product Feasibility of product concept in respect to its manufacturing design efficacy in ease-of-assembly, as well as, overall assessment of the product life cycle's environmental impact.

Students also participated in collaborative focus groups, such as with the Center for Elders and Youth in the Arts (CEYA) in conjunction with the BridgePoint Retirement Community and the Goldman Institute on Aging/On-Lok Senior Health Center. These sessions have greatly facilitated the universal design handheld kitchen housewares/utensils product research and development for the students. The seniors, the CEYA, BridgePoint and On-Lok staff evaluated and suggested how the students could better develop and market their product design houseware utensils. The senior's feedback and comments were critical to enhancing the student's understanding of the needs of elderly users with limited hand dexterity. This community-service learning experience greatly enhanced the student's ability to develop a responsible awareness to the value and significance of end-user research and interaction in the product development process.

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[2] Anders, Robert, IDSA, and Fechtner, Daniel, MD. 1992. Design for Physical Independence Program, Industrial Design Curriculum Development: "Universal Design." Brooklyn, NY: Pratt Institute, Department of Industrial Design, School of Art and Design.

The course has included consultation, visiting lectures and critiques by internationally recognized designers in the field of design for the aging and disabled, such as Patricia Moore, president of Guynes Design; and Ralf Hotchkiss, Whirlwind Wheelchair International. The resultant projects in this course have received outstanding praise and recognition from national and international experts in the field of design for persons with disabilities.

Student projects generated in this course, have been submitted to national and international design competitions, such as: The Industrial Designers Society of America (IDSA)/Motorola Universal Access Wireless Communication Device Student Design Competition; the National Houseware Manufacturers Association Student Design

Competition; the Handitec International Design Competition for Persons with Disabilities in Paris, France.

In 1997, the NHMA awarded another student for his patented universal design "Scnife" kitchen utensil concept. The IDSA/Motorola Universal Access Wireless Communication Device jury awarded two of our students, Ming-Wei Cheung and Joanna Lee, for their Universal Solar Cellular Phone concept. This resourceful and responsible product was featured in the Motorola Booth at the 2001 Consumer Electronic Show in Las Vegas, Nevada. In 2004, Mortar & Pistle; In 2002, universal designed, one-handed vegetable/fruit peeler. In January 2009, the National Housewares Manufacturers Association (NHMA) Student Design Competition awarded one of our students, Tom Ethridge, an Honorable Mention Award for his "H2 AID," Water Temperature Indicator for Stroke Patients.

Student UD Product Concepts

Vegetable Peeler, 2002 IHMA Award (Adolph "Johnny" Venida)

Stationary vegetable peeler, designed for a manual, one-handed use. One may say, well why may one want to have a one-handed peeler? How many one-handed users are out there? Well the situation that we look at in addressing such a need is that when one looks carefully at one-handed use, there are many situations when we have only one use of one hand. For example, a mother that may be holding an infant while on the phone and having to reach for something, people are constantly multi-tasking and being able to do something with one hand, or with a limited range of movement or grips, facilitates a wide range of users. Someone who has small hands, large hands, maybe arthritic hands, or low strength hands, these are all considerations that span age,

generation, user ability, gender, race, and culture. So in this study, we had our student developing this one-handed user by going to a retirement community.

In this case it was the OnLok retirement community, in which we engaged a number of users, and he gained a great understanding of the function and use of the project, and was able to make significant improvements on the product as a result of his interface in outreach and feedback from the older users. We went through a series of workshops where he would come back for constant improvement and refinement and also not only from the functional sense but also in what may be appealing in terms of shape and form for the users.
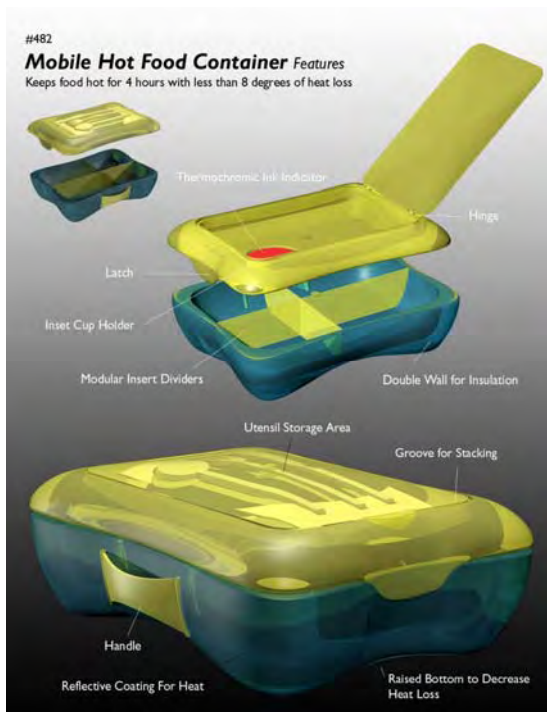
Hot Food Containers, 2002 (Arvind Gupta) Facilitating food delivery services for or elderly, disabled, low income users, similar to a "Meals On Wheels" service

"Faucet Friend", 2002 IDEA/BusinessWeek Award (Charles Floyd)
 "Faucet Friend," developed by Charles Floyd. A simple, adaptable water temperature indicator device for kitchen and bath faucets. It has a chromatic coating device, which changes color with temperature, to indicate whether the water temperature is hot, or cold which can be beneficial to all users, particularly children, or elderly users.

THE FAUCET FRIEND

WATER TEMPERATURE INDICATOR
FOR KITCHEN AND BATH FAUCETS

The thermo-chromic
coating changes color
with temperature to
indicate hot or cold
water at the spout.

cold

hot
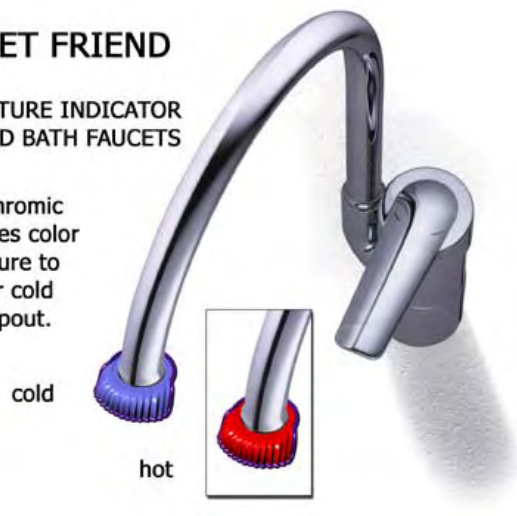
Lotus Laundry Sorter, 2002 (Tuyet Tran)
Stationary and transporting laundry bag that can be used by all users, but particularly for wheelchair users.

"El Kettle," 2003 (Dan Xiong)
Another project was called El Kettle which was essentially a design of a kettle, a tea kettle, water kettle, and one took into account many concerns for safety and terms of in the stove having hot water, being able to transfer that from the water faucet to the container to the stove to the glass or cup in which you may be pouring. So there were a lot of dynamics that one thinks about in using a tea kettle not just about heating the element but also about pouring it and being concerned about safety and efficiency and ease of use.

Mortar and Pistil, 2004, IHMA Award
(Aya Osada-Rosada and Laura Urquiaga)
Another product was a design award for a
Mortar and Pistil for cooking preparation that
couldn't facilitate a number of different types
of grips and hand sizes as well as the quantity
and amount one may want to work with. This
is a project that was done by two students
Aya Osada-Rosada and Laura Urquiaga and
they produced a fantastic project that won an
International Houseware Manufacturer's
Design Award, so we are very happy with that
project.

Graduate-Level Course and Creative Work/Thesis Projects

In the graduate-level course, **DAI 800: Graduate Design Seminar in Industrial Design
Practices**, as well as in the graduate students' Creative Work/Thesis Projects, students
have focused on advancing inclusive approaches to universal design principles and
applications.

The objective of the graduate seminar is to familiarize the student with the influence
and impact of design in our global marketplace and social community. The seminar's
focus is to establish a "global design consciousness" that is environmentally responsive
and user-friendly in its attempt to improve our general livelihood. The seminar examines
the question of how cultural identity and influences can, or should, contribute to
product form, function and social development in the product marketplace and built
environment.

The seminar also reviews the concerns for the appropriate development, use and fusion
of advanced technology that could assist lesser economically developed countries in
establishing their own identity in the both in a domestic (local) and international (global)
marketplace. The seminar evaluates the ideology of what constitutes socially
responsible design.

Students are required to develop case study topic of their choice that identifies and develops design applications that address inclusive design goals, in respect to universal design, sustainable growth, and development in all societies.

The seminar seeks to nurture a cross-cultural and diverse interdisciplinary environment that will promote a responsive exchange amongst not only design scholars, students and professionals, but also manufacturers, consumers and the socially alienated. Such dialogues have been realized and disseminated through the designated lectures, research, and development activities.

The participation of visiting lectures from the local and international arenas facilitates the varied seminar topics. The diverse weekly seminar topics and backgrounds of the speakers include: architecture, universal design, sustainable design, community development, urban design, small-scale enterprises, gender-issues, product, visual communication and information technology.

Our location in the San Francisco Bay Area has exposed our program to a tremendous wealth of design researchers, professionals and firms that have built their reputation and expertise in the successful commercial marketing, consumer interest and institutional/public appeal of universal design principles and applications in our built-environment. Individuals and groups like Molly Story, former Director of the Center for Universal Design, Professor/Author, Paul Longmore, Disability Rights Historian/Advocate, Ralf Hotchkiss, Whirlwind Wheelchair International, Susan Goltsman, MIG and Smart Design have participated in exposing and sharing with our students the broad-based and inclusive everyday approaches to universal design as an inherent and indistinguishable criteria of "Good Design."

In the Creative Work Projects that graduate students develop, it is quite often that their projects will also incorporate social, cultural and low-income economic conditions both locally and internationally. Recent projects have addressed, Public Wayfinding Systems in San Francisco, Public Toilets for Women, Applying Universal Design to Package Design, and Universal Manual Carpentry Tools in Brazil.

Lessons Learned for Expanding the Scope of Universal Design

In the past eighteen years, the integrated approach to universal design education has been a "seamless" infusion of into the integral design ethics, values, and principles of the product design curriculum in the design and industry department. This inclusive design approach has heightened the awareness of the functional requirements and opportunities for students, faculty, and the extended community to the value of interdisciplinary educational development at San Francisco State University.

The Department of Design and Industry at SFSU sees a tremendous opportunity to make a profound impact on the issues of diversity in design education and its relative environment. An environment that constitutes, and needs to be more responsive to, the social, cultural, and physical needs of the underrepresented, the disabled, and the disenfranchised.

There is a need to expand and enhance the representation, awareness, and the traditional focus of design education. A responsive awareness needs to be established, that goes beyond the esoteric values of the conventional marketplace to engage the needs of the expanding nontraditional markets of emerging economies. These economies must flourish and evolve, on the local or international level, within the context of sustainable development.

References

1. Al-Tal, Samil. 2002."Integrated Universal Design: A Solution for Everyone."
    Pgs.32–35. *The Union Institute Dissertation*.
2. Balaram, Singanapalli. 2001. "Universal Design in a Majority World." *Universal
    Design Handbook* 5.1. McGraw-Hill.
3. Bebee, James. 1995. *Universal Design Assessment Paradigm*. San Francisco, CA:
    Design and Industry Department, San Francisco State University.
4. Corrigan, Robert A. *1994-1996 Bulletin, San Francisco State University*,
    San Francisco, CA: California State University.
5. "Developing Economies and Universal Design." Providence, RI: Designing for
    the 21st Century II, An International Conference on Universal Design.
    June 16, 2001
6. Donnelly, Brian, and Phil Evans. 1993. "Accessible Landscapes." Designing for
7. Inclusion, Accessible Landscapes Project. San Francisco, CA: Department of
    Plant Operations, San Francisco State University.
8. Harrison, James D. 2001. "Housing for Older Persons in Southeast Asia:
    Evolving Policy and Design." *Universal Design Handbook* 40.1*.* McGraw-Hill.
9. Mathiason, John, Sara-Serran, and Maria Cristina. 2001. "United Nations
    Standards and Rules." *Universal Design Handbook* 11.1. McGraw-Hill.
10. *MIG Communications*, Berkeley, CA, 1987
11. Mueller, James L., and Story, Molly Follette. 2001. "Universal Design of
    Products." *Universal Design Handbook* 49.1. McGraw-Hill.
12. Ostroff, Elaine. 2002. *Universal Design Education Online*
13. Parker, Kenneth J. 2001. "Developing Economies: A Reality Check." *Universal
    Design Handbook* 32.1. McGraw-Hill.
14. Sandu, Jim. 2001. "An Integrated Approach to Universal Design: Toward the
    Inclusion of all Ages, Cultures, and Diversity." *Universal Design Handbook* 3.3.
    McGraw-Hill.
15. Walsh, C. J. 2001. "Sustainable Human and Social Development: An
    Examination of Contextual Factors." *Universal Design Handbook* 33.1. McGraw-
    Hill.
16. Weisman, Leslie Kanes. 2001*.* "Creating the Universally Designed City:
    Prospects for the New Century." *Universal Design Handbook* 69.3. McGraw-Hill.
17. Weisman, Leslie Kanes. 1992*.* "Discrimination by Design: A Feminist Critique of
    a Man-Made Environment." Urbana, IL: University of Illinois Press.
18. Whirlwind Wheelchair International. San Francisco, CA: School of Engineering,
    San Francisco State University.

Chapter 2.2

Course Module:
Universal Product Design-Breaking the Stereotypes

Brian Donnelly

Brian Donnelly received a MFA degree in Industrial Design from the Rhode Island School of Design in 1980 and is currently completing his doctorate in Educational Leadership at the University of California. Davis.

Brian has worked full time for two major Silicon Valley firms as an industrial designer and project manager.   Brian was president of a design and manufacturing corporation, LifeSpan Furnishings, which developed universal designed furniture and environments that supported independent living for a wide range of users. As an educator, Brian worked for seventeen years at the university level as an Associate Professor in Product Design, Development and Manufacturing in the Design and Industry Department at San Francisco State University; Assistant Professor at Southern Illinois University; and adjunct Professor at the University of California, Los Angeles. While in the Design and Industry department at San Francisco State University, Brian Donnelly co-founded and was Director of the Design Center for Global Needs.

In recent years, Brian has been working at the K-12 level in Career Technical Education in the area of Industrial Technology and Engineering. Brian has been a Design Education Consultant for the Autodesk Education Program since 2003, where, as one of the lead authors, one can find evidence of Brian's work in the 2008 and 2009 editions of Autodesk DesignKids.

Course Module

Universal Product Design- *Breaking the Stereotypes*

Brian Donnelly
Design Consultant
Former Associate Professor,
Department of Design and Industry
San Francisco State University

Intro
The following module serves as the initial phase of a one semester (15 wk. x 6 hrs/wk.) Intermediate level product development course taught at San Francisco State University. The course, which is described on this site in a separate outline, directs students through a development process that begins with acquiring a deeper understanding of market opportunities and the potential of using Universal Design as one of a series of guidelines to maximize chances for successful commercial product development. The process continues with a series of activity modules that include in-depth user centered research, concept ideation, prototyping/ user testing and concept finalization. Historically, several students in the class have carried their project through to the completion of a provisional patent application. Two examples of the diverse array of student projects are depicted below.

Fig.1 Laundry Carrier **Student:** Tuyet Tran
See attached Caption, alt Tag and descriptive text

Fig.2 Information Kiosk
Students: Troy Stevens and Len Gonzales
See attached Caption, alt Tag and descriptive text

Course Module Goals:
 As a Design educator with nineteen years of studio experience, I have made several important observations: **1.** In many cases, a student will often come to class with a very limited vision regarding the broad scope of opportunities for product innovation. **2.** This limited vision is particularly acute when asked to consider how they could develop a product in a way that would make it useable to a diverse population of users in terms of gender, age and ability. A widely

1

held view considers products that facilitate greater inclusion as generally falling into the realm of assistive devices and health care products. **3**. Students generally will be more motivated, energized and challenged if the course framework for intermediate and senior level studios allows them to pursue a project that is aligned with their own area of interest and (in many cases) has strong commercial viability.

Subsequently, there are two key goals for this and the preceding course module, (both included in this site):

1. Help students expand their vision of the world of product design that includes an appreciation of how Universal Design principles can enhance a competitive product development methodology.
2. Establish a foundation from which a student can identify a market need or desire that can be satisfied through the pursuit of a product development project that offers the student inspiration and motivation.

A Few Notes:

1. I have included a series of activities that are designed for group (large and small) and individual work. Organizing these into neat, computer generated tables gives them a sterile feel. In class I work with large sheets of paper and employ a number of animated techniques to engage students and especially draw in those students who seem to be reserved. To get the most out of the exercises, I encourage instructors to bring in lots of props and avoid being neat…Use markers and large sheets attached to the walls- provide ample opportunities for students to have fun - challenge them to think outside the box with no idea considered as too crazy! This is where innovation begins…

2. The term product as used in this course includes both **Physica**l products- (–*the keyboard, the hammer, the bike, the cell phone body)* and **Virtual** products- *the Web site interface, the screen menu for a DV camera, the information architecture for an internet appliance….*

Fig. 3 *See attached descriptions*
This internet appliance incorporates a physical produt (the, components, enclosure controls etc.) and a Virtual product- the software interface

3. The activities described in the preceding pages are designed with a great deal of flexibility in mind. Although written for product development, categories can be renamed for use by instructors in related fields of design such as Architecture, Graphics and Environmental Design.

Activity # 1 "*How did we get so much stuff?"*

Duration (Approximately 1 hour)   **Format:** large group activity

Goals: The following activity is designed to:

1. "Break the Ice" and establish a positive, energetic tone for the course.
2. Help students develop a more focused awareness regarding the extensive cycle of actions related to the development of a product.
3. Initiate thought regarding the value of considering the needs of a diverse user population.

1-A. *(3-5 minutes)* Randomly divide the class into groups of two. Have student pairs introduce themselves to each other (very briefly)Give each group an 8.5 x 11 in. sheet of paper with all of the letters of the alphabet listed in a vertical column with a 2-3 in. horizontal blank line next to each letter. Each group should fill in the name of at least one "thing" that starts with each of the letters in the list. *They are limited to using things that they either have on them or brought with them to class. (Exclude parts of their anatomy)* They can add additional names for any of the letters. Encourage "creative" thinking…

A. <u>Apple, Altoids…._____</u>
B. <u>Book, ball point pen, bungee cord</u>
C. <u>Clip, coin, crash helmet,…._____</u>   *Etc. You get the idea*

1-B. Stop after 5 minutes**.** Play it up as a "friendly competition
" What group filled in a name for all the letters of the alphabet?
 Let them announce their (personal) names to the class and then read off some of the "things" they listed. Rapidly continue the competition –"Who got 20 letters or more completed and so on. Try and give every student in class a chance to share something about their list.
You can write some of these on large sheets of paper or on a whiteboard.

1-C. Ask the students to count up how many things they had on their list and to divide them between **"products of nature"** (apple, banana, lint, dust…) and **man-made products** (dollar, camera, Frisbee, nose ring….) Quickly go around and ask groups to verbally present their totals…"7 natural   and 29 man made-etc. You could write these out on the large paper or whiteboard.

1-D. Ask students to identify some the things they listed that would be difficult for some people to use due to a limited ability such as hearing, vision, mobility. Ask them to give a few examples and explain why they might be problematic for some users.

What can be learned?

1. Insight regarding the impact of product design and manufacturing on the environment.
Select a few of the things they listed (hold them up as props and initiate a discussion about the resources (human and natural)that were used in designing, producing and distributing these things:

- How much energy is used to make and transport the product?
- What type and amount of material is used for production and packaging.
- What is the impact on air, water, soil quality from the various stages of production and distribution?
- What are the labor requirements and how do they impact the quality of life for people?

2 Insight regarding the extensive cycle of actions related to the development of a product
Ask students to consider how much "stuff" we have in our culture that is man-made (for the most part the result of some level of design and manufacturing. Take a few of the man-made things they listed and using them as props talk about the process used to move them from the point of identifying a market need or desire to distribution and use. (I like to choose something simple *(pencil)* and something a bit more complex. (E.g. what was the impetus for a company to decide that it will commit lots of money to the design, manufacture and distribution of this *bike helmet?*) Encourage students to share their own ideas regarding the development of the products.

3. Insight regarding opportunities to improve the quality of a product (and the potential for increase marketability) by considering the needs of a broad range of users when either developing new or improving upon old products. Use the activity **D** (above) to imitate a short discussion about the value of considering a diverse user population in the Research and development of products.

Summary- I conclude this discussion by stressing the fact that it is obvious (from this simple exercise) that in our culture we already have "lots of things". As we move ahead with this class on product Development we need to be aware that the introduction of any new product has multiple consequences. With this understanding perhaps we can generate some desings that really have value.

Activity # 2 "*Universal Design- isn't it about designing Things like ramps and grab bars…*"

Goals: The following activity is designed to:

1. Help students recognize the importance of understanding the user (their needs, desires, and the use context as a foundation for discovering a market opportunity as the basis for innovative product development.

2. Help students discover that the application of Universal design principles can benefit the development process for a wide range of products extending beyond the stereotypical categories of health care and assistive devices.

3. Help students begin the process of identifying a market need and desire as a foundation for their course project.

Some Notes: Prior to this activity it would be useful to make a brief presentation on the principles of Universal Design. You could use the materials found at the Center for Universal Design web site or as I do, create your own presentation (with images and props) to give the students a basic idea about the concept. In my examples I make it clear that all types of products, including those that are "mainstream" can incorporate some aspects of Universal Design. I like to note that in most cases, companies generate profits when they can sell product or services to a large market (I'll talk a little about market share) In this regard, universal design as a methodology directed towards including a diverse range of users, can be viewed as part of a good business strategy.

It should be explained that student responses to the various questions posed in this activity are based upon "best guess" and assumptions. It is helpful to spend a few minutes and explain how more scientific market research methods would be conducted to obtain more reliable data: e.g. Focus groups, polls, interviews, contextual/ observational research, Interviews, usability testing, literature and human factors data reviews etc. Explain that several of these methodologies will be employed as they progress on their project.

2A *the User, Use Context and Universal Design*
Duration (1.5 hrs.)   **Format-** Large Group

Fig 4. *(see attached descriptions)*   **Fig 5.** *(see attached descriptions)*
Understanding the User, where and how a product is used is critical for the development of innovation solutions.

Instructor Preparation:
In order to make this an engaging and fun activity, it is important that the instructor bring in props or images of a diverse array of products. These will be used to conduct a reverse analysis regarding some fundamental characteristics of the product user populations and the

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use context(s). The type of product and the means of presentation are contingent on the type of classroom and presentation technologies available. Some examples to bring in: Children's playground structure (image) toilet, cell phone, CD, Playschool-trike, set of utensils, computer, a web site (e.g. applemusic.com) , Yellow pages, PDA, Scissors, tooth brush, soap dispenser….

The tables that are presented on the following pages were divided up into smaller segments to comply with the constraints of web page layout. In order to conduct this activity you should merge and replicate the charts onto large sheets of paper to facilitate large group interaction. List the products that you selected down the far left vertical column. (An alternative is to use if a computer and projection system)

You can click this link to obtain a PDF file with the tables merged. This can be printed out and distributed to students for their reference. (Insert link to PDF file)

Encourage wild thinking and work towards involving all the students in class.

2-A.1: Use Environments.
When the class meets break them into small groups of approximately four. Briefly Show the class each of the products that you selected (the real object or image). You will then explain that this first step is intended to analyze the frequency of use in three broad categories of environments. Start by defining the three categories**:**

Public: Use is conducted in an environment where a person or group is exposed for observation by the general public. *(Example- drinking at a public fountain in a park)*

Semi-Public- use is restricted to an environment where there is a limited exposure to the general public. *(Example-drinking water from a fountain inside a gym locker room.)*

Private a large degree of control is maintained who uses the product and when use is observed. *(Example drinking water from a faucet in your home.)*

For each product in succession ask the small groups to arrive at a consensus on the numbers to use for their groups' frequency rating. Quickly record each groups ratings (I'll use different colored markers and arrive at an aggregate rating for the class. Use a number scale to indicate the frequency rate for use of the product in each of the broad environment categories:
0= Never   5 = Very high frequency of use.

Example

	PUBLIC	SEMI-PRIVATE	PRIVATE
Toto Toilet	1	2	5
Nokia Cell Phone	5	5	5
applemusic.com	2	3	5

2-A.2: Patterns of Use. Explain that for the same series of products we will analyze the general patterns by which a product is used. Repeat the process of developing small group consensus and arriving at an aggregate number for the class.
Use a number scale to indicate the frequency rate for use of the product in each of the broad scenarios: 0= Never   5 = Very high frequency rate.

Example

	One product used by many (10+ people) simultan-eously	One product used by many (10+ people) at separate times	One product used by a few (3-9 people) simultan-eously	One product used by a few (3-9 people) at separate times	One product used by 1-2 people exclusively
Toto Toilet	0	5	0	5	5
Nokia Phone	1	4	3	4	5
apple music.com	1	5	2	5	5

2-A.3: Basic User Profiles- *Gender*

In each box indicate the rate of frequency by which members of each gender use the product:
Repeat the process of developing small group consensus and arriving at an aggregate number for the class.   0= Never   5 = Very high frequency rate.
Example

	M	F
Toto Toilet	5	5
Nokia Cell Phone	5	5
Applemusic.com	5	4

2-A.4: Basic User Profiles- *Age*

In order to complete this task it is important that students acquire a basic understanding of the following age categories.

Infant	1 month to 1 year
Toddler	1 year to 2 years
Preschooler	2 years to 6 years
School age	6 years to 12 years
Adolescent	12 years to 20 years
Young adult	20 years to 40 years
Middle aged adult	40 years to 60 years
Young-old adult	60 years to 80 years
Old-old adult	80 years and beyond

In each box indicate the rate of frequency by which members of each age group might use the product: *0= Never   5 = Very high frequency rate.*
Example

	Infant:	Toddler	Preschooler	School age	Adolescent	Young adult	Middle aged adult	Young-old adult	Old-old adult
Toto Toilet	0	1	4	5	5	5	5	5	3
Nokia Phone	0	1	1	2	5	5	4	2	1
Applemusic.com	0	0	1	2	5	5	3	2	0

2-A.5: Basic User Profiles- *Basic Ability Levels*

Explain that this task is intended to examine the extent to which the listed products **currently** accommodate use by people of diverse abilities. This chart is purposely positioned before the final chart (2-A.5) pertaining to the integration of UD principles. Note that this chart does not cover every ability but as meant as an overview. Remind students that their responses are based on best guess and assumptions. This provides a good opportunity to emphasize the importance of user centered research involving diverse populations to avoid erroneous assumptions and stereotyping.

Rate the degree of ability that can be accommodated by the product.
0= Full Ability/No disability   5= Severe Impairment

Example

	Hearing	Vision	Mobility	Balance	Grasp	Strength	memory	Attention
Toto toilet	5	4	3	4	4	3	3	4
Nokia phone	4	1	3	2	1	4	1	1
Applemusic.com	5	5	5	4	n/a	n/a	3	3

2-A.6:   Integration of Universal Design Principles

This activity provides an opportunity to expand upon the original presentation on UD. In the previous chart students offered their best guess regarding the extent to which a product supports various types of abilities. In this activity the UD principles serve as tools to analyze the product with respect to the features or lack of features (form, size, colors, mechanics, controls, interface, information architecture etc.) that impact the extent to which the product supports use by individuals with diverse abilities. In addition to looking at the product in terms of how it currently integrates UD principles, a second column is included for each principle that asks students to consider areas where there is potential for improving the product. This aspect of the activity offers an opportunity for students to identify a possible opportunity for innovation that they could pursue in the course as their project.

The following summary of the 7 UD principles are included as a reference for students. Use this opportunity to remind them of the presentation you made previously and encourage them to use on-line sources such as the Center for UD web site.9 put in URL)
1. **Equitable Use:** The design is useful and marketable to people with diverse abilities.
2. **Flexibility in Use:** The design accommodates a wide range of individual preferences and abilities.
3. **Simple and Intuitive:** Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. **Perceptible Information:** The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. **Tolerance for Error:** The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. **Low Physical Effort:** The design can be used efficiently and comfortably and with a minimum of fatigue**.**
7. **Size and Space for Approach and Use:** Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Repeat the process of developing small group consensus and arriving at an aggregate number for the class. *Under the column labeled **Current**, rate the degree to which the product currently integrates each of the seven principles of Universal Design: 0= No integration 5= Very high level of integration. Under the column labeled **Potential**, rate the degree to which you think each of the seven principles of Universal Design could be integrated into a next generation product: 0= No integration 5= Very high level of integration. .*

	Equitable Use		Flexibility in Use		Simple & Intuitive		Perceptible Information		Tolerance for Error		Low Physical Effort		Size and Space	
	Current	Potential	Current	Potential	Current	Potential	Current	Potential	Current	Potential	Current	Potential	Current	Potential
Toilet														
Cell Phone														
Web Site														

2B   *The Student's Turn*
Format- Small group and individual work outside class

In Activity 2A, the instructor introduced the products for the exercise. In this activity students, working in small groups, will develop their own list of products to examine. This accomplishes two goals: It provides students with more practice in developing their product analysis skills relative to User profiles, Use context and Universal Design. Secondly it presents another deeper opportunity for students to explore possible semester projects that they will be motivated to pursue.

2-B. 1 Instructor Preparation:
You can click this link to obtain a PDF file with the tables merged. Print out and distribute to students for their reference. (Insert link to PDF file). Instruct students on how to find the PDF file that they can print out inn multiple copies for their homework assignment (to be explained later)

Divide class into new combinations of four. Provide each group with large sheets of paper and markers. Explain that during this first activity they are going to brainstorm a long list of products. For each of the 18 categories listed below that have one minute to come up with as many as possible. No discussion is necessary just write down anything a person says. Encourage

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craziness. I'll use a watch and tell them when to move to the next category. In 18 minutes the class will come up with an amazing list of products. It can be helpful to quickly review the categories as a large group and then tell them to dive in.

Note *the term* **product** *could be interchanged with words such as* **environemtal** *so that the activity could be incorporated into course form other design areas*

1. A product that will help someone **relax**: *chair, massager, hammock, CD player…*
2. A product that will help improve a person's **health**: *scale, exercise bike, treadmill…*
3. A product that will help a person **create**: *potters wheel, sketch pad, 3d software…*
4. A product that will provide **safety**: *car seat, table saw guard, batting helmet…*
5. A product that will make **work easier:** *shovel, cordless drill, a work light…*
6. A product that will provide **entertainment**: *MP3 player, Karaoke machine, book…*
7. A product that will provide **comfort**: *pillow, heated car sear, Jacuzzi,….*
8. A product that will help a person **play:** *Monopoly,* **golf** *clubs, boogie board…*
9. A product that will help a person **learn:** *Leap frog, flash card, Internet encyclopedia*
10. A product that will provide **transportation:** *bike, scooter, Mini-Cooper, train, Segway…*
11. A product that will keep track of and manage **time** *Swatch, Alarm clock, sundial*
12. A product that will support **wayfinding**: Map, Trimble GPS, road signs,
13. A product that will help **conserve energy;** *Compact Fluorescent, Electric car…*
14. A product that will **organize information;** *Rolodex, Palm Pilot, Filemaker Pro, recipe…*
15. A product that will help **conserve resources** *Recycle bin, composter, Port-a-potty*
16. A product that will **save time:** *Microwave, Tivo, credit card, catalogs, eBay, Amazon…*
17. A product to create, capture manipulate **images**: *DV cam, Scanner, Photoshop*
18. A product that will help a person **eat***: steamer, camping stove, Cuisinart…*

2-B.2 Homework Assignment

Have each group divide up the Categories so each student has at least four. Each student is to then select at least three products from the list generated by the group for that category. As an outside assignment they are to complete the charts located on the handout you provided. (2A 1-6). For the next class they are to bring in the completed charts (approximately 12) accompanied by their own props which can either be a real product or an image of each of the products they have listed. If a computer and projector is available students could place digital images on a CD or send them to the instructor via e-mail.

2-B.3 Class Presentation

When students return to class they are instructed to reconvene into their last groups.
Allow each student 10 minutes to present the results of their homework assignment to the members of their group. Encourage dialogue between group members. I use this opportunity to move around and "eavesdrop" on groups-offering some input and especially encouragement.

After each group member has had a chance to speak take a break. Upon returning ask each group to make a short (five minute presentation on a few of the more interesting products that their group had just reviewed. Encourage them to pick some examples where there appears to be strong potential for improving the product. This creates an opportunity for students to really start to zero in on some potential product. Encourage dialogue within the entire large group. Offer students guidance in terms of presentation skills (oral and visual)

Chapter 2.3

Course Module 2: Universal Product Design – Discovery the Market Need

Brian Donnelly

Brian Donnelly received a MFA degree in Industrial Design from the Rhode Island School of Design in 1980 and is currently completing his doctorate in Educational Leadership at the University of California. Davis.

Brian was president of a design and manufacturing corporation, LifeSpan Furnishings, which developed universal designed furniture and environments that supported independent living for a wide range of users. As an educator, Brian worked for seventeen years at the university level as an Associate Professor in Product Design, Development and Manufacturing in the Design and Industry Department at San Francisco State University. Brian Donnelly co-founded and was Director of the Design Center for Global Needs at SFSU.

Brian has been a Design Education Consultant for the Autodesk Education Program since 2003, where, as one of the lead authors, one can find evidence of Brian's work in the 2008 and 2009 editions of Autodesk DesignKids.

Course Module 2
Universal Product Design- Discovery the Market Need

Brian Donnelly
Design Consultant
Former Associate Professor,
Department of Design and Industry
San Francisco State University

Intro
The following module serves as the second phase of a one semester (15 wk. x 6 hrs/wk.) Intermediate level product development course taught at San Francisco State University. The course, which is described on this site in a separate outline, directs students through a development process that begins with acquiring a deeper understanding of market opportunities and the potential of using Universal Design as one of a series of guidelines to maximize chances for successful commercial product development. The process continues with a series of activity modules that include in-depth user centered research, concept ideation, prototyping/ user testing and concept finalization. Historically, several students in the class have carried their project through to the completion of a provisional patent application. Two examples of the diverse array of student projects are depicted below.

Insert Mod 2 Figure 1   **Insert Mod 2 fig 2.**

Note Work on this module should be initiated after completion of Module one

Course Module 2 Goals:

1. Provide students with skills in the area of observational research and competitive product analysis.

2. Further establish a foundation from which a student can identify a market need or desire that can be satisfied through the pursuit of a product development project that offers the student inspiration and motivation.

Reminder:
The term product as used in this course includes both **Physica**l products- (–*the keyboard, the hammer, the bike, the cell phone body)* and **Virtual** products- *the Web site interface, the screen menu for a DV camera, the information architecture for an internet appliance….*

The activities described in the preceding pages are designed with a great deal of flexibility in mind. Although written for product development, categories can be renamed for use by instructors in related fields of design such as Architecture, Graphics and Environmental Design.

Module 2- Activity # 1

In this activity, students are going to be organized into groups hat form a variety of "family groupings with a diversity of ages, genders and abilities. (While there are many more variables that distinguish people these three seem to be enough to contend with. You will set up some basic organizational structure but you want to leave room for students to come up with imaginative profiles for the characters that will become part of this activity. Once the "families are organized they will be assigned different group experiences. *(For example one family will be going on a camping trip, another trip to the shopping mall).* The objective for this activity is to inspire each group to generate an exhaustive list of all the activities that each family member will engage in as they embark on their respective outings
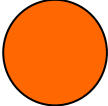
Instructor Preparation: Before class, organize a series of cards equal to the number

of students in class. (3X5 index cards work well). In the top left corner place a colored sticker or a colored mark that corresponds with the age groupings below. Come up with a mix of cards so that there are a reasonable number of adults and a good combination of other ages.

Infant	1 month to 1 year	Yellow
Toddler	1 year to 2 years	Dark Blue
Preschooler	2 years to 6 years	Dark Green
School age	6 years to 12 years	Orange
Adolescent	12years to 20 years	Purple
Young adult	20 years to 40 years	Red
Middle aged adult	40 years to 60 years	Light Blue
Young-old adult	60 years to 80 years	Lime
Old-old adult	80 years and beyond	Magenta

Mod 2 Figure 3

Divide the cards into diverse groups *(minimum 3 people per family with the largest group at 5 max.)* Place a number in the upper right hand corner to identify the group. *(See illustration for card sample.)* Place the cards in a box and have students randomly select and get together with the students with the same group number. In the lower right you should have included a table (you can print this out) with a list of abilities. Students should rate their level of ability with *0= Full Ability/No disability   5= Severe Impairment.* In the upper section they should record a name for their character (real or fictitious). In the center area they should write a few sentences to describe the person- what sorts of things they like, favorite foods, activities etc.

It is often fun to have each student very quickly introduce "themselves" to the entire class- it can result in some funny moments….

	Name of your character (real or fictitious)	Group #

Brief Description of the character

Vision	
Hearing	
Mobility	
Grasp	
Balance	
Strength	
Memory	
Attention	

Mod 2 figure 4

After the groups are formed you assign each one to a group experience. Some examples include:
- A trip to a shopping mall
- A Camping trip
- Trip to a museum
- Trip to a Baseball game
- A day at home
- A vacation flight to Hawaii

Provide each group with some large sheets of paper. They have 40 minutes to come up with a detailed list of all the activities each family member would engage in as they move through a 12 hour period from 7 a.m. till 7.p.m. Suggest that they write the names of each person along the top horizontal edge. Along the left vertical edge place the time in one hour increments. Now as a group, encourage them to get crazy and as detailed as possible with as many activities they can think of that the various characters would engage in for each of the different 12 hour slots. At the end of 40 minutes have the groups stop. It can be fun to take a few moments and have each group read out some of the more interesting or amusing activities.

Take a break…

Reconvene groups and distribute a large sheet of paper to each of the group members. Each group member should write down the name of their character at the top of their sheet. Ask them to divide the paper into four vertical columns. In the first left hand column write down the 10 most intriguing or challenging activities that their character engaged in during the 12 hour period. Leave enough horizontal space between each of the ten so the list extends from bottom to top of the page. Label the second column **Degree of Difficulty**. Label the third column: **Current Product Solutions** and label the fourth column **Product Rating**.

At this point you want the students to work as groups. Each member will get a turn to have the group discus their 10 activities. Under degree of difficulty get each "family member' to indicate the rate of difficulty for them relative to their age and ability level. **0=impossible to accomplish task 5 = easy to accomplish the task** *(I've placed space for five respondents that can be modified to suit the group size- each group member is identified by a number- you could also use initials.). It is interesting for students to realize how the ratings will vary depending on variables such as age and ability level of the respondent.*

In the third column let the group brainstorms any **products or combination of products** that they think could help a person successfully complete the task.

In the fourth have the group reach consensus on a rating number indicating the degree to which each product or combination of products would accomplish the task.
 O= the product is a total failure 5= the product looks and works great

Activity	Degree of Difficulty					Current Product Solutions	Product rating				
	1	2	3	4	5		1	2	3	4	5
Cooking eggs	5	5	4	2	0	Egg-buddy Frying pan microwave mixing bowl Spatula Wooden - spoon chicken	4 4	4 4	3 4	2 3	2 1
Packing Suitcase						Crowbar Straps Soft luggage Trunk Garment bag Duffle bag					

Mod 2 Figure 5

After groups have had enough time to work on their grids take a break. When the groups reconvene take a few minutes to have each group present a few of their more interesting and challenging listings.

What was Learned:

Students gained more experience in group work and thinking outside the box. The importance of considering the diversity of user needs, backgrounds and abilities is reinforced

As a result of this activity students have started to recognize some patterns that reveal activities that are problematic for a number of people and a lack of good product solutions for those activities. Consequently, many students will be getting close to identifying a project that they are both interested in and that has market potential.

Module 2- Activity # 2 "Observing Others-
The key to User centered research"

For home work each student is to select their most intriguing activity. (It can come from the previous exercise or one that was identified elsewhere. Using a camera, Video recorder or drawing they are to observe and document a minimum of five people engaged in the activity. The group of 5 subjects should incorporate some level of appropriate diversity.

 Mod 2 Figure 6
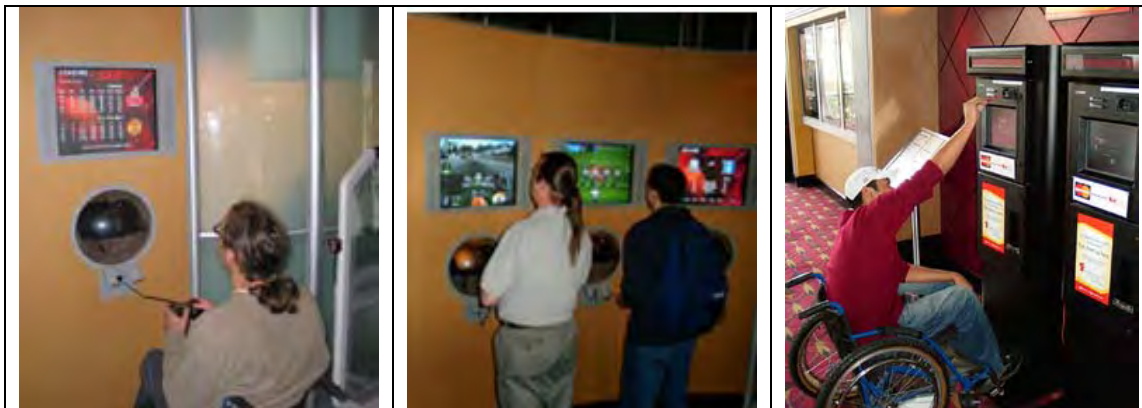
Mod 2 Fig 7   Examples of student initiated Observational research

Students are to prepare a 10 minute in-class oral/ visual presentation where they provide a detailed explanation for each of the following questions: *Students should use images to the greatest degree possible with their responses*

- What were the specific goals of the activity?
- How long did it take for each of the users to complete the activity?
- What product or combination of products were employed by each user to accomplish the activity
- What was the degree of difficulty for each of the users? **0=impossible 5 = easy**
- What specific aspects of the activity presented challenges or created frustration for the users?
- What product features enhanced the activity?
- What product features presented challenges?
- Hoe important was the style/appearance of the product (s) to the users? (subjective)
- What new product features might enhance the user's ability for completing the activity?
- What ideas might you have for a totally new innovative solution for this activity?

If possible the student can also try and interview the users to gain feedback to these questions.

What was Learned
The in-class presentations offer students an opportunity to understand the importance of observational research and develop the skills to use this process as an effecting product development tool.

As a consequence of the research presentation and class feedback, the vast majority of students will have finally discovered a project that they are interested in. they also tend to have a sense of what projects may have some commercial potential. For those students who are still "searching" for the best project, they have (as a result of module 1 and 2 activities) a mechanism for discovering a project that will work for them.

What is Next: Following the completion of module 2, each student is required to submit a detailed Design proposal for their project. This document includes items such as: Concise description of the needs and or problems that the proposed project will satisfy. A detailed explanation of all design criteria including a detailed profile of the proposed market... A number of the activity charts used in module 1 and 2 along with observational research documentation are incorporated into their proposal.

Chapter 2.4

H2 AID

Tom Etheridge

H₂ **AID**

Tom Etheridge
San Francisco State University
Entry 510

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CONTENTS

H₂**AID**

Entry 510

01

PROBLEM

Bathing is an essential part of personal hygiene. However, bathing carries the risk of being burned or scalded by hot water. This risk is especially high for infants; for disabled persons; and for stroke victims, who have difficulties gauging temperature as a result of their stroke. I aim to design a device that uses visual feedback to indicate relative water temperature, so that people of all abilities can bathe safely and independently without the risk of scalding. My design process is informed by research and interviews with occupational therapists concerning stroke patients and their specific needs.

SCENARIO

To set the scene for the problem i have devised a scenario indicating all the problems that are currently facing a stroke patient.

SHOWER TEMPERATURE

Showers have just as much danger as a bath when it comes to the risk of burning, users may enter the shower with out knowing the temperature of the shower water.

BATH TEMPERATURE

Hard to detect the change in temperature when running a bath. This puts the user at risk of involuntary burning themselves.
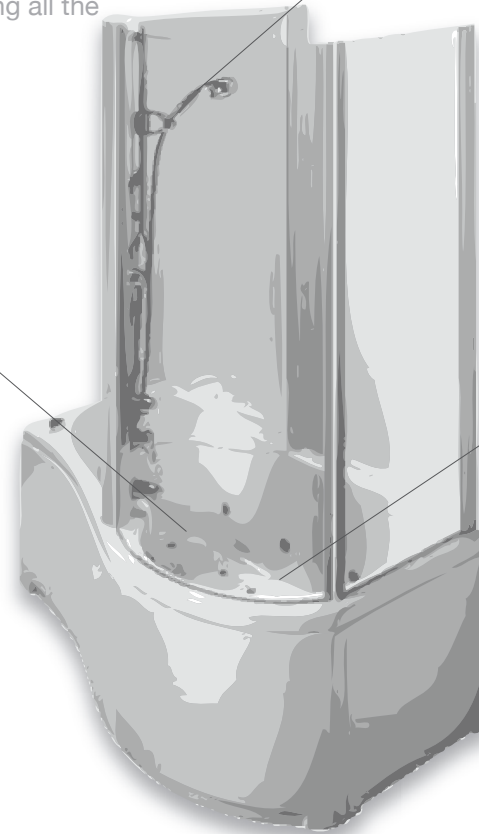
The depth of the bath water can often be a problem not only with people who suffer stroke , There is the risk of flooding the bathroom if the bath water taps aren't turned off at the correct time.

H₂ **AID**

02

INTERVIEW WITH A OCCUPATIONAL THERAPIST

In order to design for an inclusive market, I first needed to understand the types of impairments that stroke victims can suffer. I worked closely with an occupational therapist to understand how strokes could affect daily activities such as self care and bathing, and have summarized the information below. A stroke victim can suffer a variety of long-term effects from neurological to physical disorders. In particular, the stroke can damage the neural pathways so that the patient **cannot differentiate between temperatures** and tends to recognize all **stimuli as pain**. Some treatments are available to compensate for these deficits using visual feedback and transcutaneous nerve stimulation. However, through patent research and interviews I found that there is no aid currently available on the market that uses visual feedback to relay information about changes in water temperature. Since bathing has both **hygienic and therapeutic value for stroke victims**, this indicated a particularly meaningful design opportunity.

H₂ **AID**

Entry 510

03

PERSONA

It may be hard to appreciate how difficult it is for a person suffering from the effects of a stroke to undergo the simple task of running a bath. In order to develop empathy and understanding, I constructed a persona based on the interviews with the occupational therapist. Although this persona is fictional, the character exhibits some of the characteristics that a stroke victim might have and was thus an essential aid in the design process.

AGE 53

STATUS married

STROKE IMPAIRMENT desensitization to painful stimuli, recovery of sensory function is needed

REHABILITATION sensory functions will increase from 50% - 67% over 1-2 months period prior to the stroke.

NOTES difficulty in sensory feedback, hard to sense change in object temperatures, suffers from myopia therefore has trouble in determining depth
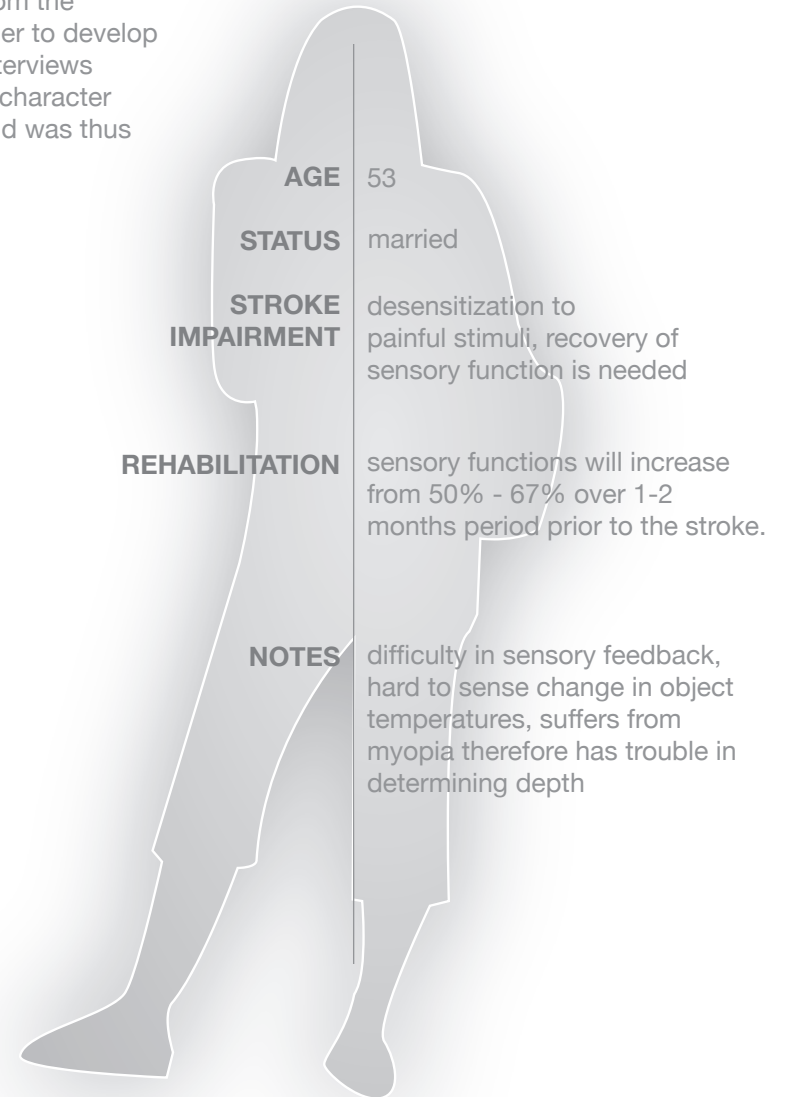
H₂**AID**

04

EXISTING PRODUCTS

To research what is on the market I want to see what is available for regular bath time users and what is currently available for stroke patients. I based the research on the current market niches and the existing bath temperature thermometers.

ANALOG THERMOMETER

PROS: Colorful, Child Friendly, Easy to manufacture

CONS: Hard to view the thermometer from a distance. Hard to know when the bath temperature is at the right to enter. Looks cheap.
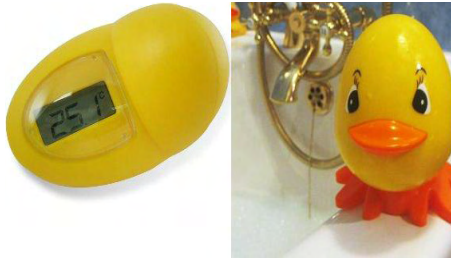
LCD RUBBER DUCK

PROS: Quirky design, Floats, Bright colors

CONS: Childish, can only be aimed at a chidrens market. Very small LED screen

COLOR CHANGING DISC

PROS: Colorful floating device Changes color when the temperature of the water increase

CONS: The scale is complicated it needs to be simplified if to be used in the inclusive market.

FLOATING LCD

PROS: Large visible screen and can stick on the side of the bath tub

CONS: You will need to be close to the bath to be able to see the temperature.

H₂**AID**

05

PRODUCT DESIGN SPECIFICATION

From the research gathered from the Interview and looking at existing products on the market I have been able to construct a Product design specification highlighting all the important points I need to cover when designing the water device.

Performance
• Visual indication of temperature using LEDs
• Sleek appearance
• Floats in water
• Displays temperature clearly
• Incremental temperature scale
• Watertight
• Can be connected to bath plug
• Won't corrode in water
• Temperature resistant to 212F
• Uses ultra-bright LED's
• Emits beeping warning when temperature changes
• Clear visible display of temperature change.

Service life
• The design will be used on average 4 times a week

Manufacturing Cost
• The design will cost no more than $15 to manufacture
• The design concept will cost no more than $30 to make

Market price
• The product will cost no less than $25 or the relevant equivalent depending on countries currency.

Environment
• To be used in a bath
• May be used in jacuzzi
• May be used outdoors
• Withstands water and humidity
• Will not deform under temperatures 122F-212F
• Durable
• Withstands temperate environmental conditions

Ergonomics
• Easily visible in the bath
• Easy to hear warning beeps in the bath
• Colors are easy to distinguish
• Colors can be seen from vertical and horizontal positions
• Product gives useful visual feedback to stroke victims and people with poor vision

H₂**AID**

Entry 510
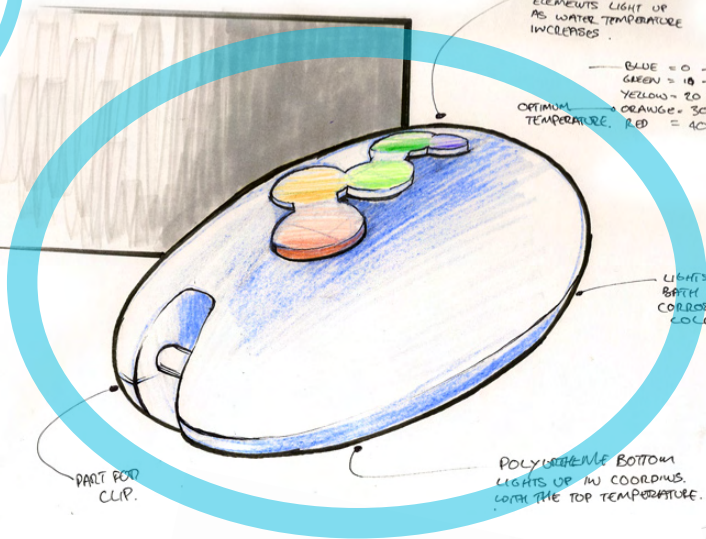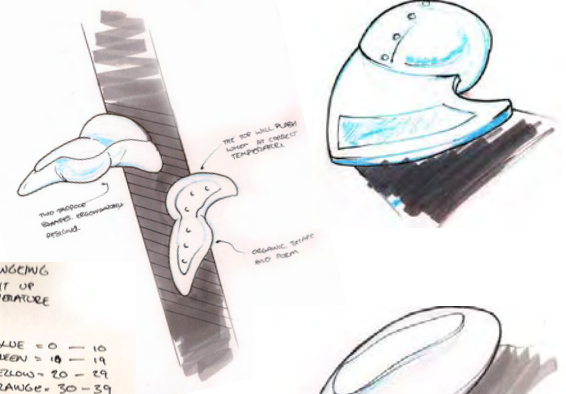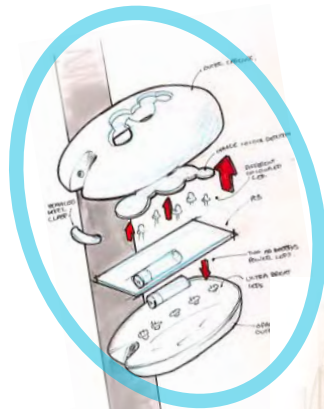
COLOUR CHANGING
ELEMENTS LIGHT UP
AS WATER TEMPERATURE
INCREASES

BLUE = 0 — 10
GREEN = 18 — 19
YELLOW = 20 — 29
ORANGE = 30 — 39
RED = 40 +

OPTIMUM
TEMPERATURE.

LIGHTS UP
BATH WITH
CORRESPONDING
COLOUR.

PART POD
CLIP.

POLYURETHENE BOTTOM
LIGHTS UP IN COORDING.
WITH THE TOP TEMPERATURE.

AARDVARK SHAPE
CHILDISH?

PROFILE OF
AARDVARK
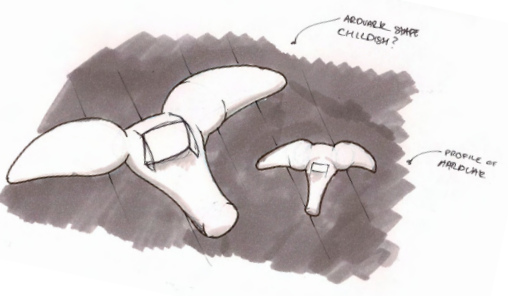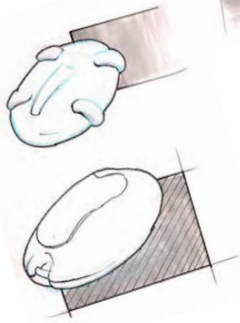
CONCEPT MODELS

MODEL 1
Simple clean design, lights protrude above the design.

MODEL 2
Ying and Yang. The design is aimed primarily at children due to the simple forms

MODEL 3
This is the model chosen to further the development process. It is clean and sophisticated.

01

02

03

H₂ **AID**

08

WORKING MODEL

The working model shows the principle of design. When the heat sensor is placed in water, the lights indicate the relative temperature of water. As the temperature increases, so does the number of LED lights that are illuminated. In the final product, this principle will apply, with one additional light illuminating with each increase in temperature interval.

H₂**AID**

Entry 510
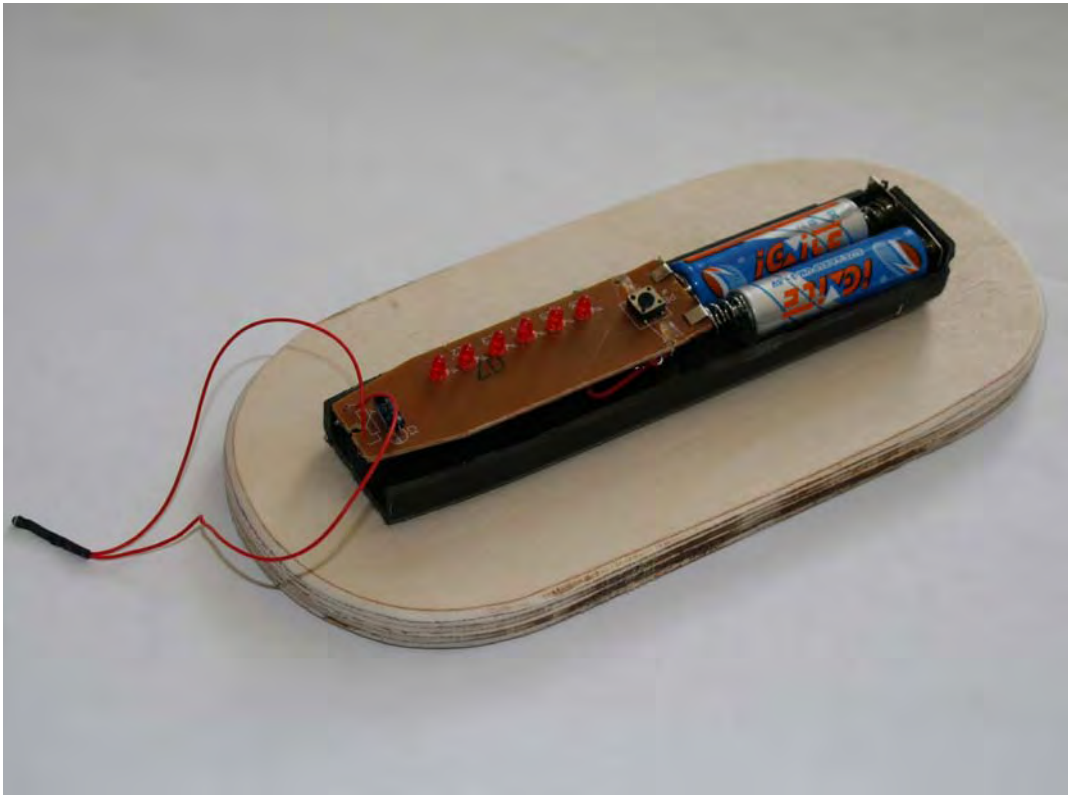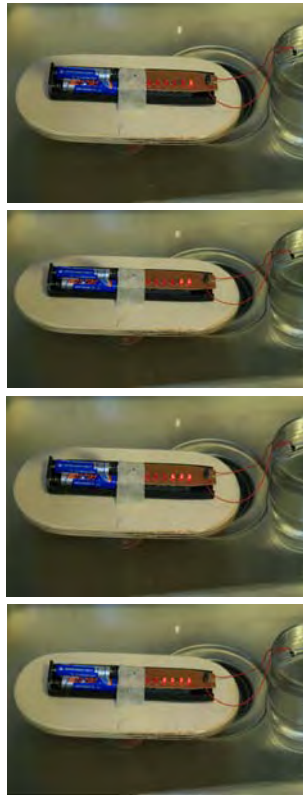
09

THE LIGHTS

This series shows how the additional LED lights will illuminate for each incremental increase in temperature. The small blue light indicates a cold temperature, and the large red is a warning to indicate the water is too hot. The middle, yellow and orange temperatures are optimal for bathing. At this point, I named my product the H2Aid to indicate how it helps people to gauge water temperature.
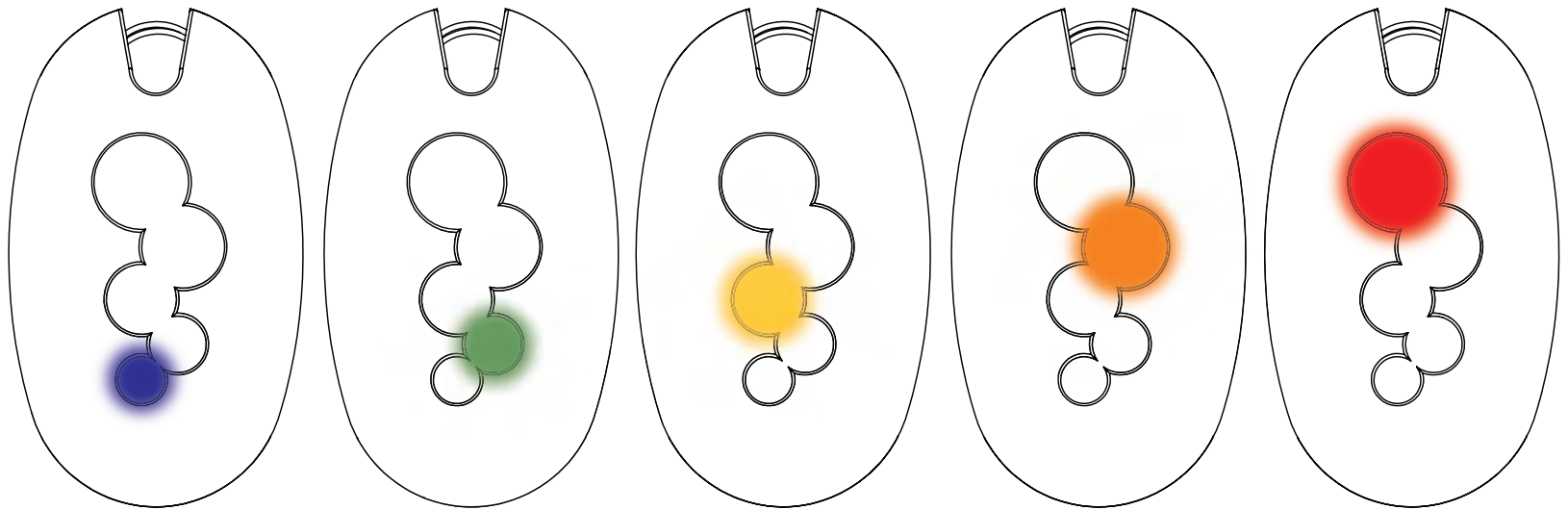
- 77 F	78 F - 85 F	86 F - 94 F	95 F - 104 F	104 F +
Too cold	Luke Warm	Optimum for a Child	Optimum for a Adult	Too Hot

H₂**AID**

Entry 510

10

WORKING MODEL 2

STAGE 1

As the H2Aid enters the water it will immediately start to read the temperature. It will glow blue when the temperature is below 68F

STAGE 2

As temperature of the bath water increases different lights will light up, Here the H2Aid is indicating the water is at optimum temperature for bathing

STAGE 3

If the water temperature increases above 104 F then then the red light will turn on indicating the water is too hot to enter
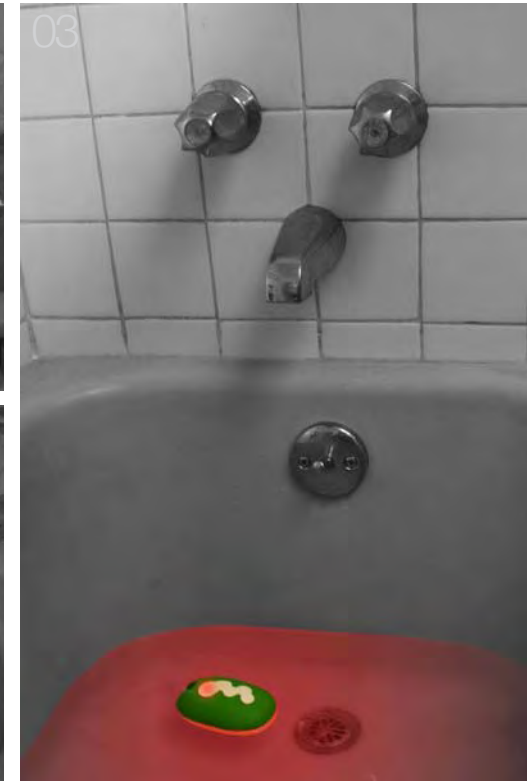
H₂ **AID**

Entry 510

EXPLODED DIAGRAM

TITLE	Exploded Drawing
PROJECT	Universal water temperature device
DESIGNER	Tom Etheridge
COMPANY	H2AID

1	HDPE
2	Opaque HDPE
3	Stainless steel grade 301 1mm
4	PCB
5	Rubber seal
6	Ultra bright cluster LEDS
7	LEDS
8	AAA Batteries

TOLERANCES

Unless otherwise stated tolerances are:
Linear ± 0.005
Angular ± 0.005

All diameter tolerances to be
◎ Ø0.005

DRAWN	Tom Etheridge	DATE	12/09/2008
		DRAWING No.	1_6
		SHEET	1/1

H₂**AID**

12 GA

TITLE	
	General Arrangement Drawing
PROJECT	
	Universal water temperature device
DESIGNER	
	Tom Etheridge
COMPANY	
	H2AID

1	HDPE
2	Opaque HDPE
3	Stainless steel grade 301
4	PCB
5	Rubber seal
6	Ultra bright cluster LEDS
7	LEDS
8	AAA Batteries
9	Heat sensitive sensor

TOLERANCES

Unless otherwise stated tolerances are:
Linear ± 0.005
Angular ± 0.005

All diameter tolerances to be
⌀0.005

All dimensions in millimeters (mm)
Not too scale

DRAWN	**DATE**
Tom Etheridge	12/09/2008
	DRAWING No. 1_1
	SHEET 1/1

Dimensions shown: 25, 70, 120, 60, 15

13

ERGONOMIC ASSESSMENT AND PROFESSIONAL PERSPECTIVE

I solicited feedback from occupational therapists and designers throughout the design process. It was gratifying to receive the following feedback about the H2Aid concept from my collaborators:

"It would be *useful for people who have lost sensory function* this maybe stroke victims whose neuro pathways have been damaged or elderly individuals when there sensory (visual and tactile) feedback is reduced."

"This piece of equipment can help overcome the difficulties caused by the visual and tactile sensory deficits and ensure individual maintains an *independent lifestyle*."

" By implementing aids to ensure individuals can maintain as much of their normal routine and *independence is important*. This will reduce the amount of change the individual will have to face and therefore reduce stress and *maintain wellbeing*."

- E. Manning, Occupational Therapist, Brunel University, London, United Kingdon.

"The form factor of the H2Aid is really appropriate for almost anybody, from children to older people. *It fits nicely in the hand, floats in the bath*, and gives clear visual feedback which is accentuated by the color and size of the indicator lights. I think it would be as welcome in a bathtub as in a jacuzzi*; it's a clean, attractive, approachable, and usable form*."

- H. Chu, Professor, San Francisco State University.

H₂**AID**

Entry 510

WHY SHOULD UNIVERSAL DESIGN BE CLINICAL?

The goal of this project was to create a user-friendly device to aid people of all ability levels to safely enjoy a bath. By concentrating on the needs of stroke victims and working with therapists, I was able to more deeply understand the types of feedbacks that would be appropriate to stroke victims and other users with sensory challenges. An underlying goal of this project, for myself as a designer, was also to create a device that was aesthetically pleasing and friendly, rather than cold or clinical looking as many heathcare devices can appear. In the end, design can achieve both therapeutic function and aesthetic interest, and I feel that the H2Aid speaks to both these needs.

H2**AID**

Chapter 2.5

Univeral Design:
Elementary School Curriculum Design

Hiroki Takeshita

Hiroki Takeshita is currently pursuing an M.A. in Industrial Design from San Francisco State University. His current passions are human-centered design and design education. He excels in the areas of graphic communication, design research and product design. In 2005, he received a B.A. in Interior Design from California State University, Chico, where he studied spatial design and human factors. Hiroki was born and raised in Japan and has lived in California for the last 9 years. He can be reached at hiroki@sfsu.edu

Introduction

This booklet represents a semester-long project, which involved developing a curriculum. It is for a graduate level course titled, "Seminar in Design Topics: Case Study Design Education" taught by Professor Martin Linder.

I was inspired by Hitachi Japan Universal Design Program, which teaches middle school students Universal Design. I decided that I would teach 5th and 6th graders Universal Design as well. This book covers research, planning, class materials as well as testing of the curriculum.

UNIVERSAL DESIGN

Hiroki Takeshita :: San Francisco State University :: Seminar in Design Education :: Fall 2008

table of contents

Introduction

This booklet represents a semester-long project, which involved developing a curriculum. It is for a graduate level course titled, "Seminar in Design Topics: Case Study Design Education" taught by Professor Martin Linder. Below is a description of the class:

> Product and Visual Communication Designers are often in a position to educate others about their profession, methods, skills, tools and value. "Seminar in Design Topics: Case Study Design Education", is intended for students whom anticipate opportunities in secondary, community college, university and professional education and training. Most often designers are selected to teach based on interest and success in their design profession. Rarely do these professional designers have any background in developing a curriculum that would enhance their ability to be effective as an educator. This course will help prepare students to be successful educators both in industry and academia.
>
> "Seminar in Design Topics: Case Study Design Education" will bring the student though the process of planning learning experiences for high school, college or industry students. Because we are preparing you to engage in thoughtful and scholarly teaching, this course involves both reading theory and writings about classroom practice and nuts-and-bolts work on careful, thoughtful lesson and unit planning. You will learn to plan lessons with reference to classic and current scholarship about teaching and learning.

I was inspired by Hitachi Japan Universal Design Program, which teaches middle school students Universal Design. I decided that I would teach 5th and 6th graders Universal Design as well. This book covers research, planning, class materials as well as testing of the curriculum.

Only by wrestling with the conditions of the problem at hand, seeking and finding their own solution (not in isolation but in correspondence with the teacher and other pupils) does one learn.

~ John Dewey, How We Think, 1910 ~

research / survey and results /

Survey and Results

At first, I conducted survey to find out 5th and 6th graders' education levels of art, design as well as on universal design. I had a sample of 18 students who were at the age of 10 to 13 and attended middle schools in the San Francisco Bay Area. Questions in the survey includes if the students have taken any art classes, how it affected their interests in school, if they have participated in any design class, how they took the class, and lastly not least, if they are familiar with the term and the idea of universal design. On the next page, the actual survey is shown.

The results are shown the following pages. Approximately 90% of the students have participated in art classes. Of the 90%, 31% said the class was taken place in school and 44% of them said it was held outside of the school, including art center and art camp. Over 56% of the 90% said the art classes had a positive influence on their interests in school. None of them said it affected negatively. Only 17% of the 18 students have taken a design class, most of them were held outside of the school.

To my surprise, eight students said they have heard the term "Universal Design". When asked if they were familiar with the concept of "Universal Design", seven students said yes. Of the eight people who have come across with the term, over a half of them said they are familiar with both the concept and the term.

This survey was helpful in understanding of the middle school students' knowledge. I did not anticipate over 40% of them have heard the term in the past. Universal Design may not be an unfamiliar topic to teach to middle school students.

Student.Survey

Student's Name: **Age:**

Have you taken any art classes?

1. Yes
2. No

If yes, how did the art class affect your interest in school?

1. Positively
2. Negatively
3. Not much effect

Have you taken any design classes?

1. Yes
2. No

If yes, did you take the class as required, elective or outside of school?

1. Required
2. Elective
3. Outside of the school

Have you heard of a term "Universal Design"?

1. Yes
2. No

"Universal Design" is an idea that everything is designed easy for everyone to use. Are you familiar with this concept?

1. Yes
2. No

Thank you for your time.

This survey is used to examine the students' education levels of art as well as universal design.

a) Have you taken any art classes?

11%

89%

● YES
● NO

b) Where were your art classes held?

13%

13%

31%

44%

● In School
● Outside of Schol
● Both In and Outside of School
● Location Unknown

c) How did the art classes affect interests in school?

44%

56%

● Positively
● Negatively
● Not Much Effect
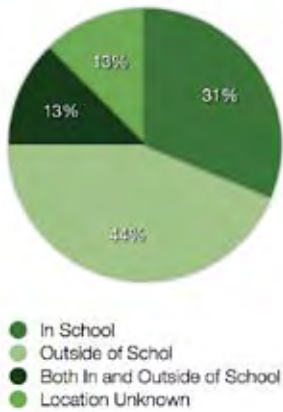
d) Have you taken any design classes?

17%

83%

● YES
● NO
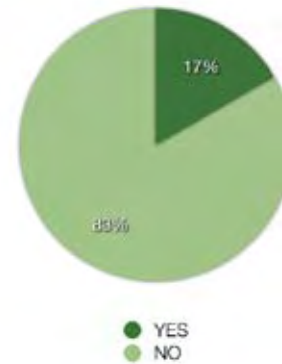
e) How did you take the design class?

- Required
- Elective
- Outside of School
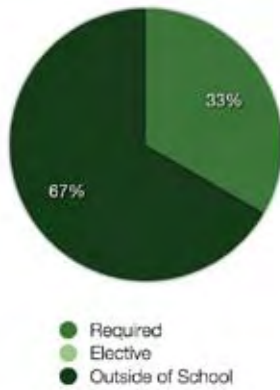
g) Are you familiar with the concept of "Universal Design"?

- YES
- NO
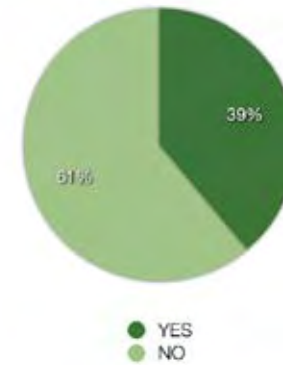
f) Have you heard of a term "Universal Design"?

- YES
- NO
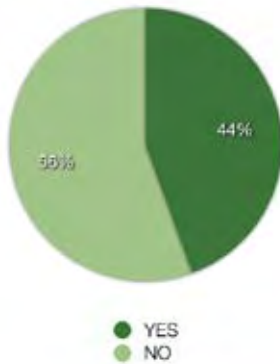
h) Are you familiar with both the term and the concept?

- Both Term and Conceppt
- Only Concept but not Term
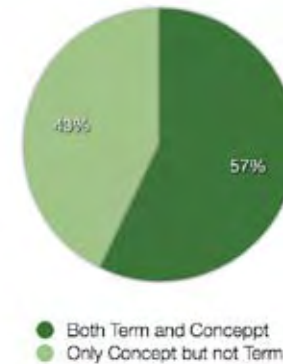
Persona

Josh

Josh goes to elementary school in San Francisco and is in the 6th grade. He plays soccer but not very well. He likes to play video games at home with his friends and his older brother. He is into role-playing games like Final Fantasy. He also likes to read science fiction books. In the classroom, he is usually quite; however, his extensive knowledge about technology and astronomy impresses his classmates.

Nick

Nick is a 5th grader who likes to play all kinds of sports. He attends public school in San Francisco. His favorite class is P.E. He grew up in San Mateo and moved to San Francisco when he was 5 years old. He lives with his mom and his younger brother who goes to the same school. He doesn't enjoy classes very much but loves hanging out with his friends.

Katie

Katie is in 5th grade and attends elementary school in San Francisco. She lives with her mom and dad in the Pacific Heights. She is the only child in her family. She is shy. She likes to draw animals. On weekends, she likes to play with her bunny rabbit named Fluffy. She also enjoys going shopping with her parents.

Project Learning Goals

To learn about
Universal Design

To understand other
people's needs

To appreciate design
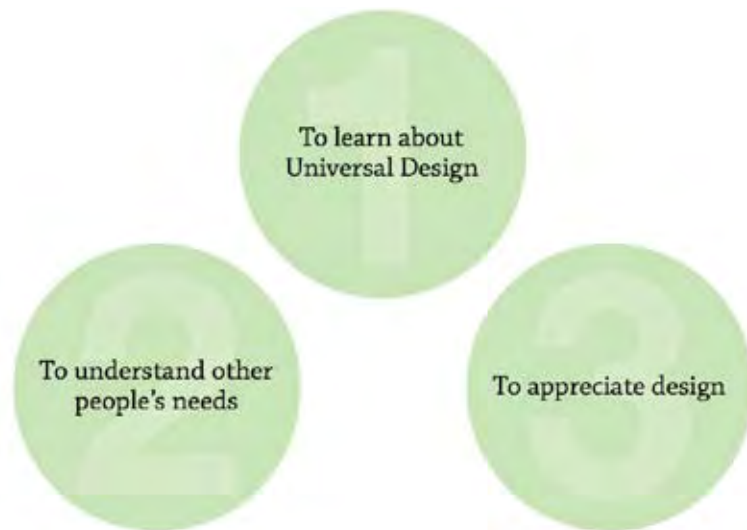
Goals of my Universal Design curriculum are for students to:

1. be exposed to Universal Design principles
2. build understanding of other people's needs and points of view
3. appreciate the knowledge and passion designers put into designing products

Schedule

There will be a total of 10 classes. Each session lasts for two hours. The class meets twice a week. The curriculm is designed to last five weeks.

Week 1	Introduction to Universal Design
	· What is Universal Design? · Why is Universal Design important to us? · Finding good/bad examples of Universal Design around yourself
Week 2	Visual Impairment
	· Experience being blind · Guest speaker · Designing for people with visual impairment
Week 3	Mobility Impairment
	· Experience being in wheelchair · Guest speaker · Designing for people with mobility impairment
Week 4	Hearing Impairment
	· Experience being deaf · Field trip · Role play
Week 5	Creating "The Perfect World" for Everyone
	· Discussion on what and how to create products and environment that make life easy for everyone · Conclusion

Desired Results Matrix

STAGE ONE - Desired Results -

ESTABLISHED GOALS
Students to;
1. be exposed to Universal Design principles.
2. build understanding of other people's needs and points of view.
3. appreciate the knowledge and passion designers put into designing products.

UNDERSTANDINGS
Students will understand;
1. perspectives of people who live with disabilities.
2. the importance of being considerate of other people
3. the concept that everything should be made intuitive to use and understand for everyone.
4. "human centered" design approach.

ESSENTIAL QUESTIONS
1. Why is Universal Design important to us?
2. What products can you find in your everyday life that is easy for everyone to use?
2. What are the elements that make a product easy for everyone to use and understand?
3. How can you design a product and environment that can make life easy for everyone?
4. What kind of assistance from other people would you appreciate if you had disabilities?

KNOWLEDGE AND SKILLS
Students will gain knowledge and skills in:
1. other people's point of views.
2. brainstorming.
3. sketching.
4. communicating his/her ideas.
5. listening to others.
6. working with a group of people.
7. thinking critically.
8. building self-esteem.

STAGE TWO - Assessment Evidence -

DIRECT EVIDENCE
1. Photo Documentation: Students are tasked with finding examples in their everyday lives. They need to take pictures of good and bad examples of Universal Design. This is done as either in-class assignment or homework. This offers the students to observe their surroundings and share their finding with class.
2. Workbook: Students each get a workbook, which they have an opportunity to look at images of products and think and answer critically about if they are good or bad examples of Universal Design and why.

INDIRECT EVIDENCE
Students will have;
1. Quiz: What are three main ideas of Universal Design? Examples?
2. Prompt: How many senior citizens and people with disabilities live in US?

STAGE THREE - Learning Experiences -

1. Lectures on Universal Design principles, the importance of it and good/bad examples.
2. Photo documentation to find good/bad examples.
3. Sharing photos of their discoveries and discussion.
4. Guest speakers: listening to the experience of people with disabilities.
5. Discussion and questions on guest speaker's experience.
6. Field trip to City Disability Center.
7. Role play.
8. Empathetic modeling activities: stimulation of being disabled.
9. Guessing what is inside the bag.
10. Thinking critically and discussing with the class what makes product or environment easy to use for everyone.
11. Brainstorming, sketching and constructing a new remote control.
12. Presenting their ideas.

COURSE DESCRIPTION

The society is changing. There are increasing populations of elders and people with physical disabilities in the United States. Universal Design is a concept that everything should be made easy to use for everyone. The course aids students in understanding the principles and the importance of Universal Design. It examine our everyday products and environment that give barriers to diverse people. It also provides students with insights in perspectives of people with disabilities and in designing for Universal Design. From this course, the students learn to apply what they have learned to brainstorm, sketch and construct a product which is easy to use for everyone.

Lecture 1 . *Introduction of Universal Design* .

The first lesson will introduce the principles of Universal Design. Universal Design is the idea of making products and services easy to use for all people, whatever their age, gender, or physical condition. Understandings of this lecture are; general knowledge of Universal Design (what is universal design and who is it for?), the importance of Universal Design, and good/bad products and services based on Universal Design principles.

This lecture will help the students for the follow up assignment to test their understanding. The assignment is photo documentation. The students are tasked to take pictures of good and bad products, based on universal design principles, they can find at their school.

NOTES: First, explain what is design by taking a water bottle as an example.

NOTES: Ask the students if they have heard of the term "Universal Design".

NOTES: Refer to the picture and explain that not everything is made easy for everyone.

NOTES: Ask the students if they are familiar with this concept.

NOTES: Ask the students why it is easy to use for everyone.

NOTES: This slide shows 3 main ideas of Universal Design.

NOTES: Pass around conventional and this medicine bottles and have the students compare them.

NOTES: Ask the students to explain the image and state the reason why this is good.

NOTES: This slide shows people who tend to be impacted with environmental barriers.

NOTES: First ask the students to think why Universal Design is important in our community.

NOTES: Quiz - ask the students what age group are senior citizens and how many there are in US.

NOTES: There are 39 million senior citizens in the US currently. So, it is 39 times more of this.
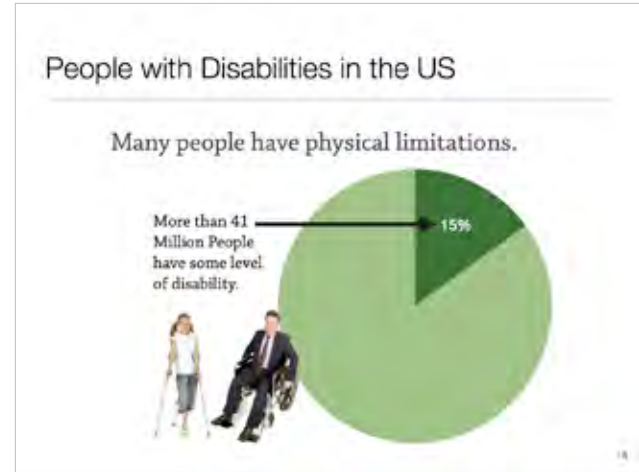
NOTES: 15% of the US population has some level of disabilities.
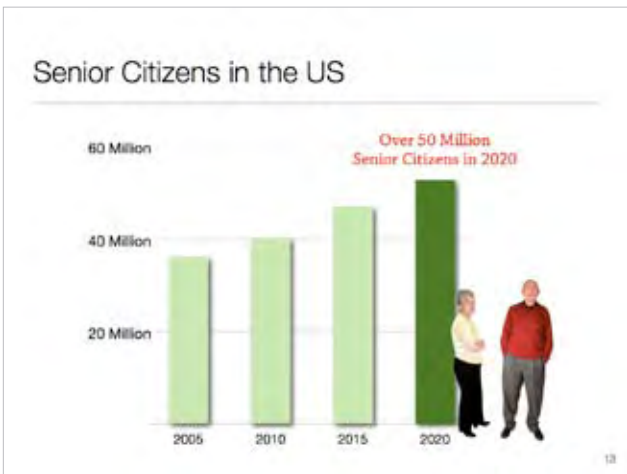
NOTES: The population of senior citizens in US is increasing.

NOTES: Ask the students what it is and why this is a good example of Universal Design.

NOTES: Explain why this is not good example of Universal Design.

NOTES: After the students share the answer, tell them why it is not good.

NOTES: Have the students pair up with a student next to them, and have them think the answer.

NOTES: Refer to the picture and explain why this design of a house is good.

NOTES: Have the students pair up with a student next to them, and have them think the answer.

Lecture 2 . *Visual Impairment* .

The lecture reviews the concept of Universal Design and present more examples specific to address products and environment that give freedom or barriers to people who live with visual impairment. The quizzes and questions also are asked to increase class participation as well as the students to think critically about their surroundings and other people's needs. Understandings of this lecture are; people with visual impairment, good/bad products and services particularly helpful for people with visual impairment, and how to design an everyday product that is easy to use for everyone.

NOTES: This summarizes the goal of this lecture.

NOTES: Ask the students what they remember from the previous class.

What is Universal Design?

The idea of making products and services easy to use for all people, regardless of their age, gender, cultural background or/and physical condition.

NOTES: Review of the previous lessons. Ask the students why Universal Design is important.

3 Main Principles of Universal Design

Easy to Use

Easy to Understand

Attractive

NOTES: Ask the students to explain each principle with possibly an example they can think of.

Good Universal Design Examples

metlink

Platforms 4 & 5

Lift

City/Flinders St. Exit

NOTES: Explain the students nice features such as braille, raised letters, high contrast and icons.

Good Universal Design Examples

NOTES: Explain that color coding and large handle with nice grip make it easy to use for everyone.

NOTES: This slide shows a shampoo with small prints on the back that are difficult to read for all.

NOTES: The students have to feel an object (radio remote control) inside the bag and guess.

NOTES: This phone is good for the large buttons with high contrast numbers and braille.

NOTES: First, have the students to consider examples and principles of Universal Design.

Lecture 3 · *Mobility Impairment* ·

The focus of this lecture is on mobility impairment. It reviews the concept of Universal Design and present more examples specific the needs of people with mobility impairment. The students have an opportunity to listen to the experience of a guest speaker. The questions that follow the guest speaker's sharing will address how to think deeper on how we can create environment that makes life easy for everyone. Having presented to good/bad examples of products and being exposed to people with mobility impairment, the students are able to work on group work activity to develop a ideal school bus for them with confidence.

NOTES: "What is Universal Design?"

NOTES: Ask the students what they learned in the previous lessons.
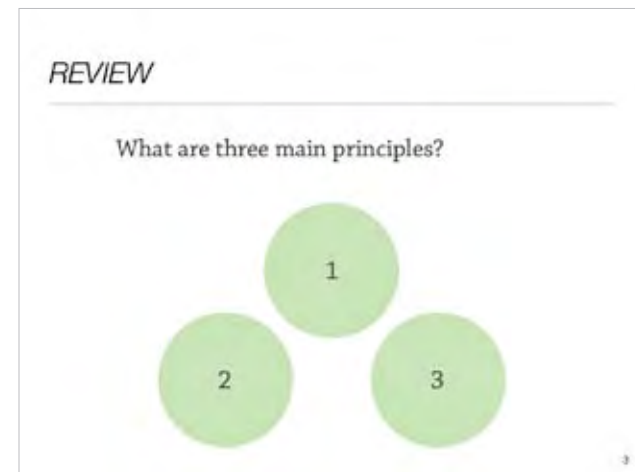
NOTES: Ask the students to name three main principles and also bring an example of each.

NOTES: Ask the students what they see in the slide and have them think if this is a good example.

NOTES: "How about this?"

NOTES: "Is this a good example of Universal Design?" "Why? Or why not?"

NOTES: "How about this?"   *(credit: James Mueller, Universal Design)*

GUEST SPEAKER

Let's listen to the experience of
people who have mobility challenges.

NOTES: Guess speaker with mobility impairment will share his/her everyday experience.

DISCUSSION

If you were on a wheelchair, what kind of
assistance would you need?

NOTES: The class is divided into groups. The students discuss and share their ideas in their groups.

DISCUSSION

What kind of environment would you
appreciate if you were unable to walk?
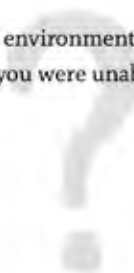
NOTES: The students use their workbook to write down the answers. Then share with the class.

GROUP WORK

Let's redesign our school bus!

Consider the following:
1. Experience of diverse people.
2. Good examples of Universal Design.
3. Features that make it easy to use for everyone.

NOTES: In the same group, the students spend time to come up with one final idea per group.

Demo 1 · *Crafting a Model with Crayola Model Magic* ·

This demo is introduced to the students when they are assigned to construct a prototype model of their ideal remote control. The modeling material is Crayola Model Magic. This demo is presented by Crayola. It reviews good techniques to use to craft a remote control with ease and safety.

Roll and flatten strips of Model Magic.

To create a shape you want for a remote control, first crumple the foil into a ball for a base.

Then, wrap the strips around it.

class materials / demo /

Roll balls of the modeling material and press them to attach. This technique is useful for buttons.

To form a brand new color, marble two different colors and knead them together.

For creating small pieces, you can use a plastic knife to cut the modeling material.

Other techniques to demonstrate:

- Use a marker to write on the modeling material.
- Use a comb to add texture.
- Use a skewer to poke a hole.
- Use a pen or marker to roll to flatten the modeling material.

Workbook Sample

Each student gets a workbook. The workbook is used to evaluate their under-standings. This is part of the direct evidence in the desired results matrix, which is presented in the previous chapter.

The workbook has questions they can fill in. The questions include; are they good or bad examples Universal Design?, why?, how can we create products and environment that make life easy for everyone? Also, it has designated pages where they can sketch out their ideas for a new remote control and an ideal school bus they are tasked to redesign. It is collected after each class session for evaluation purposes.

Inside the workbook, students can fill out questions and sketch out their ideas.

The cover of the workbook each student get.

Project Testing 1

I had an opportunity to test most of my lesson plans with Dana Bali, who is 10 years old and attends local middle school. She is from Saudi Arabia and English is her second language. In this first test, I tested the first lecture, which introduces the concept of Universal Design and also two empathetic modeling activities, including visual and hand control impairments.
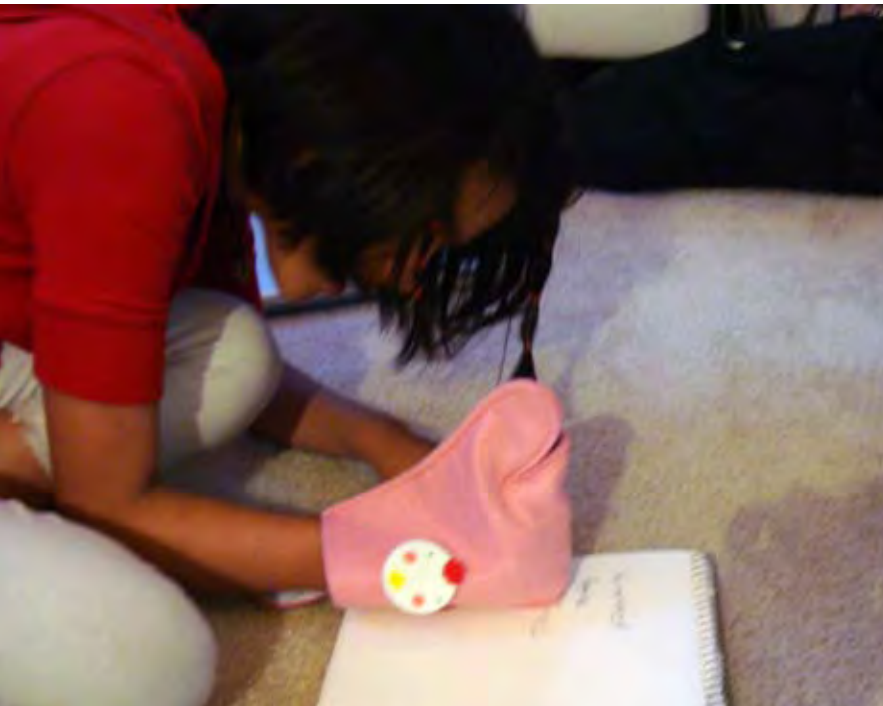
Dana, 10, is writing down her favorite fruits with a glove on to experience poor hand control.

Her sister (left) also joined and experienced difficulty in writing with poor hand control.

They are feeling raised letters with their fingers to guess words like "lion" and "monkey."

Project Testing 2 . *With Dana* .

In the second test, I tested the follow-up lecture, which showed more examples of products, services and environment that were designed with Universal Design concept in mind. Also, I tested three activities. The first one was guessing an object (TV remote control) inside a bag without looking the object. Then, she had to evaluate different remote controls and was tasked to redesign one.

Dana is sketching her second idea of her ideal TV remote control.

She is trying to guess what is inside the bag by only feeling the object without looking.

She is comparing seven different remote controls to identify good/bad features of a remote control.

Project Testing 3 · *At Presidio Hill School* ·

I also had a great opportunity to test out my curriculum at Presideo Hill School in San Francisco. I taught an hour-long class at the after school program with help of two other graduate students, Ikue Enomoto and Thomas Deckert.

The class materials, lecture as well as activities, were revised, which brought a success to the class. The students seemed engaged as shown.

5th grader, Dov (left), says writing with a glove on was "super hard!"

Students writing their names with a glove on to experience having difficulty with hand control.

Comparing two different medicine bottles as good and bad examples of universal design.

Almost each slide has at least one question so the students stay engaged with the lecture.

In a workbook, students can record their experience after experiencing being visually impaired.

Dov is trying to guess a word "mango" with raised letters while covered with eye mask.

Zev and Dov are sketching their ideas of products and services that make life easy for everyone.

Project Testing 4 . *With Dana* .

In this test, the class was focused on mobility impairment. After the lecture, Dana answered a few questions to test her understanding on how Universal Design could aid people with mobility impairment. After Ikue demonstrated how to use a wheelchair, Dana also had an opportunity to experience if she was to be physically disabled. It helped her to gain insights on the disability.

Dana fills out questions relating mobility impairment.

Dana used a wheelchair for the first time in her life to experience mobility impairment.

Ikue Enomoto demonstrates the use of wheelchair.

Project Testing 5 . *With Dana* .

At the 5th meeting with Dana, I tested out an activity, which was to photograph good and bad examples of Universal Design. Dana borrowed my camera and we both went out to find well/ill designed products and environment in her apartment complex. She was able to find as many as five good and 4 examples, which she thought were difficult to use for her and everyone.

The staircase right when you enter the building doesn't accommodate everyone with easy access.

As Dana points out, the wide entrance with level floor makes it easy the building for everyone.

The elevator buttons have both braille and raised letters for people with visual impairment.

Project Testing 6 • *At Presidio Hill School* •

I went back to Presidio Hill School to test out another lesson plan with Ikue Enomoto and Angelina Engler who came to assist me with the class. We had 12 students who were 10 to 12 years old. The class was focused on mobility impairment and the students were assigned to redesign a public bus with Universal Design principles in mind.

Angelina is passing out candy to the students.

In the beginning of class, students are making their name cards.

Looking at good and bad examples of Universal Design.

Students are engaged with the class with many opportunities to share their ideas.

Angelina and Ikue help the students with redesigning a bus in-class assignment.

Examining the current public bus and discussing an ideal bus.

Some of the students' work on redesign of a bus.

Project Testing 7 . *With Dana* .

In the final meeting with Dana, I tested out follow up lesson plan on redesign of a TV remote control. Dana sketched out her ideal remote control again improving upon one of the original ideas. She also made a list to evaluate the importance of each button. Then, I demonstrated how to use Crayola Model Magic so she could make a final model of her ideal remote control.

She writes down features she thinks are important to her ideal remote control.

Dana holds up her final model of her ideal remote control and her sketch in her workbook.

Using Crayola Model Magic, she forms her ideas toto a three dimensional model.

Student Work 1 *• Redesign of a TV Remote Control •*

This lesson of redesigning a TV remote control was split into two classes. First, Dana had an opportunity to look at seven different remote controls. She spent time analyzing each of them and listed out elements she thought were good and bad. Then, she considered features to include in her new remote control, sketched her ideas and eventually, made a clay model.

What features do you want for your new remote control?

two sided and no shape singles gits Big, Bradee Braille with every Thing.

What features do in your new remote control make it easy to use for everyone?

make a soft grip and Braille for every Thing

Dana wrote down features she wanted for her new remote control.
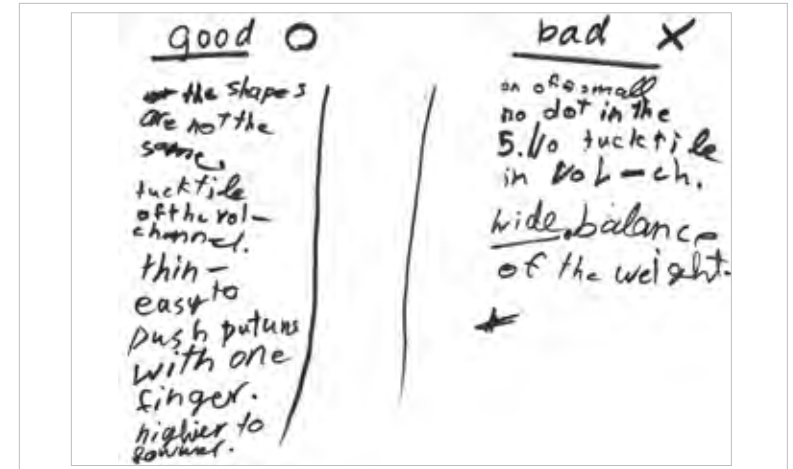
She compared seven remote controls and evaluated each of them to list good and bad features.
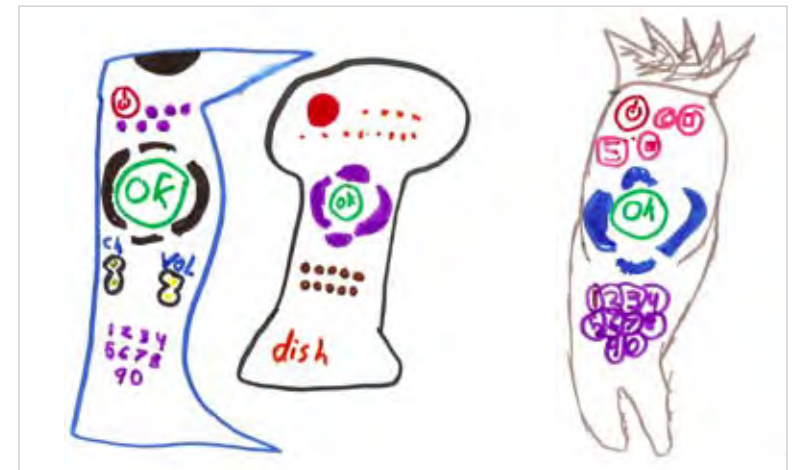
She sketched three distinctive ideas. She selected the middle one to refine her ideal remote control.

On the list next to her sketch, she determined that On/Off button was the most important.

Final model, which revealed a nice size for her and also had a good grip as she planned.

Student Work 2 · *Quiz* ·

Inside the workbook, students were asked to look at images to think if they were good or bad examples of Universal Design. Most students were successful in answering the questions and the lectures, which included good and bad examples helped them to write down the reasons why they were good or bad.

One of the students at Presidio Hill School, Drew, wrote down the questions as shown.

Student Work 3 · *Imaging a World that Easy to Live for Everyone* ·

After two empathetic modeling activities, which involved the students to experience having physical disabilities, the students were tasked to think how they could create products and communities that make life easy for everyone. First, they wrote down their ideas of what that would look like in words. Then, they drew out their ideas on the following page.
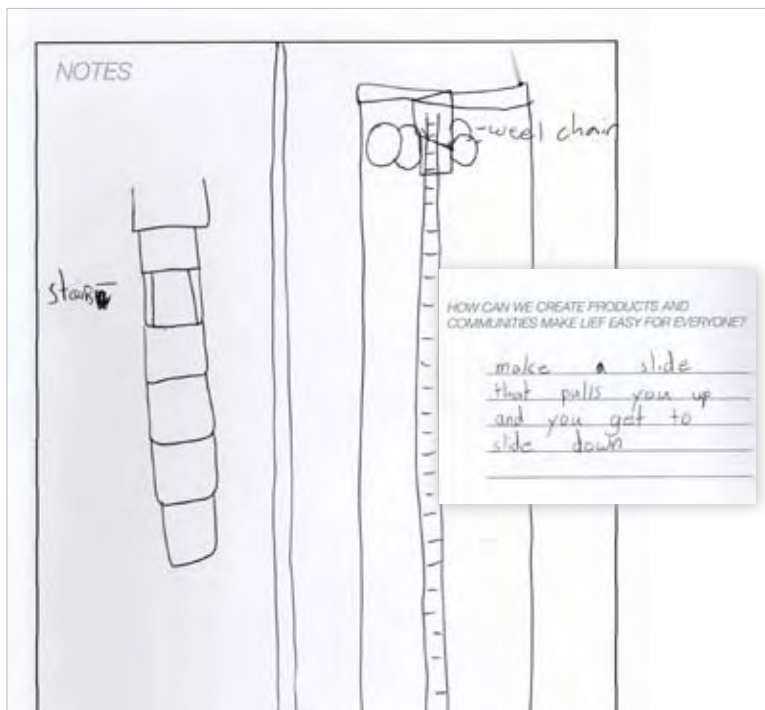
One of the students, Zev, had an idea of a "slide" which can carry people up and down the stairs.

Student Work 4 · *From Wheelchair Activity* ·

At the 4th meeting with Dana, I brought in a wheelchair to stimulate the experience of mobility impairment. Before the stimulation, I had her answer a few questions in which she had to think what she would appreciate and what assistance she would need if she was on a wheelchair. Then, after the experience, she was asked her experience differed from her expectations.

a) What kind of products and environment would you appreciate if you were unable to walk?

b) What kind of assistance would you need from people if you were in a wheelchair?

This question was answered verbally instead. Here are her answers;
- Opening a door
- Picking her up from places to places
- If she was unable to move her hands, she would need help in pushing her wheelchair.
- Getting on and out of her wheelchair.

c) How was the experience for you being on a wheelchair?

d) What did you learn from this experience?

Student Work 5 • *Redesign of a Public Bus* •

This is a lesson focused on mobility impairment. The students of Presidio Hill School had an opportunity to redesign a bus. First, they made a list of features they want to add to their ideal bus, and then, they each drew out the ideas. Many of them considered wide as well as flat level door entrance as ideal features they wanted for their new bus.

Lindsey, student of Presidio Hill School, listed out features she wanted to include in her new bus.
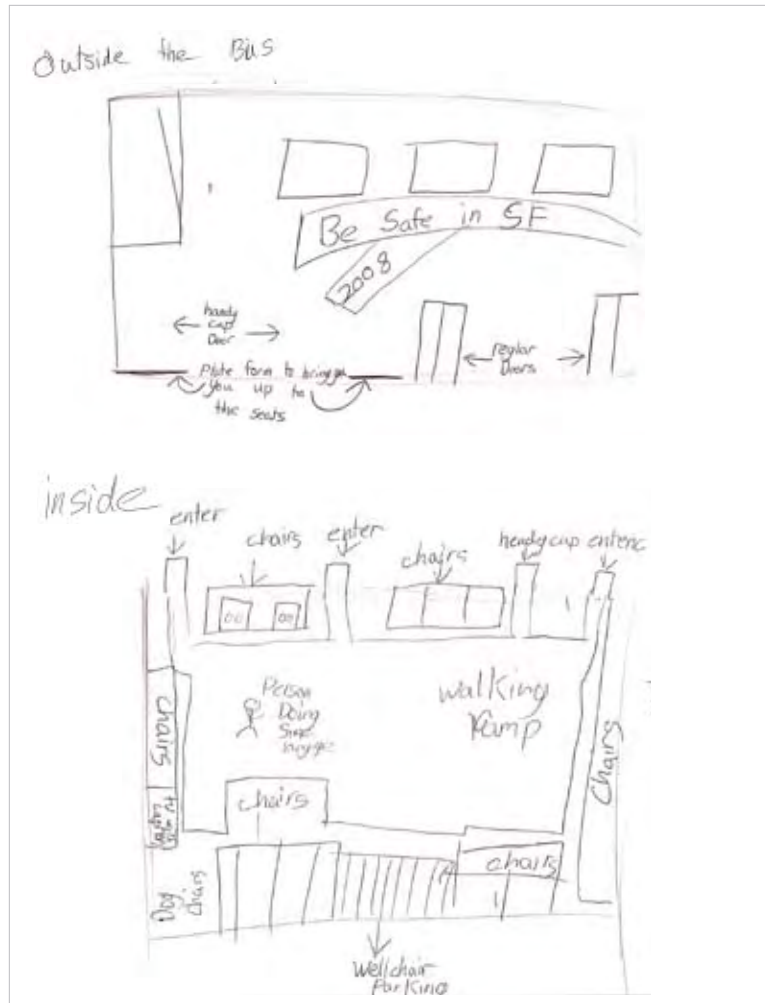
"What do you want your new bus to look like?" She sketched out her ideal bus.

Survey and Results

At the end of the second testing at Presidio Hill School and two of the testings with Dana, I gave a survey for students to complete. The survey included five questions and was utilized to evaluate the class on whether it was fun/boring, and easy/difficult to follow, what they felt of the class, and what they learned from the class. 63% of the students thought the class was very fun. 57% of them felt it was very easy to follow the class, with a few thought the difficulty was about average; yet, none perceived it was difficult or very difficult. Lindsey from the Presidio Hill School liked "seeing (in the class that) people are caring about people with disabilities."

a) How fun or boring was the class?

- Very Fun
- Fun
- Average
- Boring
- Very Boring
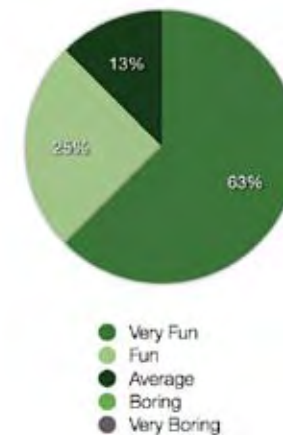
b) How easy or difficult was the class?

43% 57%

- Very Easy
- Easy
- Average
- Difficult
- Very Difficult
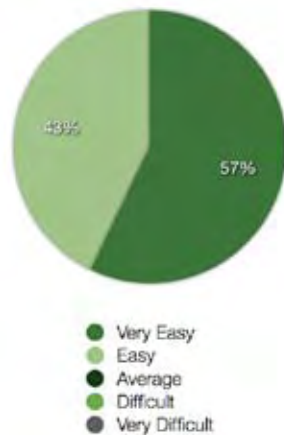
c) How was the experience of the class?

- *"Cool."*
- *"It was the best because we worked with clay."*
- *"Entertaining."*
- *"I like seeing people are caring about people with disabilities."*

d) What did you learn from this experience?

- *"I learned that you can design anything when you set your mind to it."*
- *"Designing for blind people."*

e) Additional comments or question.

- *"Thanks!"*

Student.Survey

Student's Name: **Age:**

How fun or boring was the class?

1. Very fun
2. Fun
3. Average
4. Boring
5. Very boring

How easy or difficult was it for you to follow the class?

1. Very easy
2. Easy
3. Average
4. Difficult
5. Very difficult

Please briefly describe your experience of the class.

What did you learn from this class?

Please write down any additional comments or question.

Thank you for your time.

This survey is used to evaluate the class.

Assessment 1 · *Feedback from Thomas and Ikue, As Assistant Teachers* ·

Thomas Deckert and Ikue Enomoto came with me to Presidio Hill School to assist me with the first test. After the class, I asked them to write down how they felt about the class and how it could be improved. They both had some positive comments to share. Also, their suggestions on how it could be improved are valuable for the next class.

What did you think of the class?

"The children were Curious and active. They did not seem to relate much to the discussion of "senior citizens" and disability until it was put into contexts they were personally familiar with (e.g. Andre's relative in wheelchair and the 2nd activity."

- Thomas

"Kids lost focus during the presentation. But the questions helped to get them back to focus on the lecture. They don't or can't expand on discussion by themselves. We need to help them in discussion within the group or the class. It seemed like the (empathetic modeling) activities were fun for them. But I am glad that the kids brought up the point of being blind would be hard (if it was permanent)."

- Ikue

Assessment 2 · *Feedback from Ikue and Angelina, As Assistant Teachers* ·

Ikue Enomoto and Angelina Engler came to assist me with the second test at Presidio Hill School. Again after the class, I asked them to write down how they felt about the class and how it could be improved.

What did you think of the class?

"They [the students] looked interested in what they were hearing about, and loved answering questions. I think it was good we put a lot of questions so we kept them focused. I noticed that the images of good examples at the end of PPT did not work well.. Especially the measuring spoons was hard to lead students to the answer "color-coding is helpful". Also, redesign a bus was a little hard because there are a lot to do with. It was really difficult to keep them on track."

- Ikue

"I think that your concept of teaching young children about universal design is really great. I liked that you had all of the materials prepared for the students and hand outs and other such hands-on materials. I really liked that you used the picnic table example, the kids seamed to respond very well to that. I think one of the most challenging things I found was working with the one boy on the creative task at the end. I wanted to make comments that wouldn't hinder his creative spark but also bring his focus back to the task at hand. I think it would be good to come up with an action plan for yourself to keep the students focused on the goals of the assignment when doing a creative exercise."

- Angelina

Exit Interview 1 *. With Cherie, Director of After School Program •*

I conducted an interview with Cherie Lockwood, who is a director of After School Program at Presidio School in San Francisco. Although she did not have the chance to observe the entire two classes I taught at the school, she managed to watch some of them. She articulated her thoughts on how she felt about the class and the impact two of my lessons had on the students if any.

Dana wrote down features she wanted for her new remote control.

a) What did you think of the class?

"Anytime, students have an opportunity to learn something outside their curriculum, especially when they have people outside the school come in and teach a class, it's an eye-opening experience for them. The class was fun for them. It really allowed them to think critically about their surroundings. It is an important age for them when they can make observations and see what's around them. But unless they are asked to think deeper about why the things are the way they are or how they got that way or what consideration was put into their surroundings, I don't think they would have thought about it before this class."

b) What kind of impact did the class have on students?

"I know that all the kids that took the class enjoyed it. I heard a lot of positive things afterwards. I think in general, it gave them a better understanding of design. A few of them when I first told them about the class, they were like, 'design? is that just drawing?' or 'what is that?' So, the class definitely allowed them to learn more about design in general. It also helped them to think about why design is important to them, everyday, all the time, all around them, you know how design affects them. You know, it also helped them to think about not just themselves, but get a better understanding of how design affects everybody, especially those who are not like themselves. Those people who may have difficulties with things that they don't have difficulties with."

Exit Interview 2 · *With Lindsey, 6th Grade* ·

I conducted another interview with Lindsey, who is a 6th grader at Presidio School in San Francisco. She participated in the second testing I did at the school. She showed interests in sketching out her ideas. When I asked her after the class what she wanted to become in the future, she said "architect". She was one of the most engaged in the class. I learned from this interview that the class affected her very positively.

a) How did you feel about the class?

"It was very interesting. I liked designing the thing, putting down a floor plan of the bus, designing the outside, and making the name for the bus. That was really fun - to see how I could help other people."

b) What would you like to learn more?

"I would like to learn more about what are the teaching - how you can get involved in this and come as a career like this. And also, different designs too, not just buses that'd help people, but like everyday products that can help people. Not just transportations but how you can help - like when you go to a Great America or something, if there's a ride that has a wheelchair access and stuff like that. That'd be cool to see."

c) What did you learn about Universal Design?

"I learned many things. I learned that you can be an architect or a designer, and you can design a thing that will help people with different needs. Like a bench at a park, for a wheelchair, that was like amazing, coz my grandpa is in one. So, I could get him out the house for one [smile]."

I went back to the school to conduct an interview with Lindsey, 6th grade at Presidio Hill School.

Acknowledgements

Chapter 3.1

Designing to Live:
The Value of Inclusive + Universal Design

Ricardo Gomes

Ricardo **Gomes** received a BFA in Industrial Design from the Massachusetts College of Art in Boston, MA (1980), an MFA in Industrial Design: Design for Low-Income Economies (1984) and an MA in Architecture: Alternative Building Technology & Materials (1993) from the University of California, Los Angeles.

He is a Professor and Chair of the Department of Design and Industry (DAI) at the San Francisco State University (SFSU) where he has been a faculty member since 1991. Prof. Gomes is the Director of the Design Center for Global Needs, a non-profit international research and development center dedicated to promoting responsive design solutions to local, regional and global issues such as universal design, health care, the aging, community development and sustainability.

For nearly 25 years, Prof. Gomes has presented at national and international conferences and seminars and served on juries related to Inclusive Design, Universal Design, Design for Social Responsibility, Global Design and Cultural Identity. He has lectured at universities throughout the U.S., Africa, Europe, Latin America, Japan and Taiwan.

Chapter 3.1

Designing to Live:
The Value of Inclusive + Universal Design

Ricardo Gomes

Introduction

Over thirty years ago the British pop artist Richard Hamilton published a text entitled, "Popular Culture and Personal Responsibility," in which he defined an ideal culture as, "one in which awareness of its condition is universal" [1]

Good design can be achieved by focusing the efforts of designers to develop products and environments that will be more inclusive - as opposed to preferential, in enhancing and facilitating the areas of urban community development.

How do designers work with communities, respond to constraints, and maximize ownership by users and other stakeholders? The new paradigm shift in expanding the role of designers in the 21st Century must continue to promote exemplary projects with an emphasis on participatory design, universal design and social responsibility.

Design expresses the economic, social, political and cultural complexion of our society. It renders an image of the conditions of our society and the communities that directly profit, or are contingent to its benefits. In this sense, it communicates a vast amount about the priorities and values of our society. Nigel Whitley's Design for Society (1993) critically asserts this observation in an attempt to establish a foundation for a more socially-responsive development of design. [2]

This design sabbatical research investigates the role of design and designers within various social, economic and political contexts. It explores our values and ethics as designers to better understand what, why, and for whom we are designing.

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[1] Hamilton, Richard, "Popular Culture and Personal Responsibility,"(1960) Material Culture and Everyday Life, Theories and Documents of Contemporary Art, Editor, Kristine Stiles, Peter Selz, pr. 298, University of California Press, Apr 18, 1996
[2] Whitely, Nigel, Design for Society, Reaktion Books, London 1993, p. 158

Historically, the principle role of the designer was to increase the sales and profitability of a product. However, in today's society there is a paramount need to broaden the awareness of the designer with respect to the economic livelihood and sustainability, of urban inner-city communities in Asia, Europe, and U.S, as well as the emerging nations in our global society.

Today, in the global paradigm shift that is currently in flux, we are looking at a "majority" designer and marketplace that does not design for the "majority" world. The majority of the design world largely facilitates in urban contemporary society, but the majority of the world lives outside of that urban "westernized" contemporary sphere of influence. So the question and objective of design should be how can we better design and respond to the basic well being of the majority world in an inclusive and sustainable manner, from an environmental, economic and social level?

The field research study which was conducted between November 2003 and February 2005, evaluates the various approaches and resources utilized by various universities, research centers, government and non-governmental agencies concerned with Accessibility and Universal Design issues in the U.S., Brazil and Argentina.

This study examines the objectives, resources and applications of these centers in respect to what distinguishes, as well as characterizes, their research and practical approaches to universal design, accessibility programs, policies and implementation. The research also assesses the diverse and equitable approaches to universal and inclusive design that will be more responsive to the inherent needs and sustainable implementation of indigenous society's cultural values, resources, and economies of scale. The objectives of establishing such resources are to formulate a network of compatible linkages that are interested in sharing common interest and consonant goals.

The results of this study will be utilized to establish the Design Center for Global Needs (DCGN) at SFSU as a viable center for Universal Design Research and Inclusive Environments. The DCGN seeks to promote academic and applied research projects in this domain in the western region of the U.S. in conjunction with neighboring interest in Latin America and Pacific Rim.

During this one year research period, meetings, lecturers, presentations and workshops were conducted at 17 universities and schools; 22 government and non-government agencies; and 10 professional design centers and organizations throughout the United States, Brazil and Argentina. These organizations and agencies were comprised of:

- Institutional – NGO
- Institutional/Professional – NGO
- University/Institutional – NGO
- Government Agency

The study offers visual abstracts of successful outcomes which integrate three key components of any successful, socially-sensitive design endeavor. All the solutions respect:

(1) local context (culture & identity)
(2) community partnerships (inclusive)
(3) seek sustainable & universal solutions

Universal Design Centers and Agencies in Brazil
(University/Institutional – NGO's)

Center of Independent Life, Rio De Janeiro (CVI-Rio)

CVI-Brasil 6th National Meeting, Salvador, Bahia, July 22-23, 2004

The Center of Independent Life of Rio De Janeiro (CVI-Rio), established in 1988, is an extremely dedicated and influential non-government organization with modest financial resources that are bolstered by an abundance of dedication, commitment and valor. As a leader in the independent living movement, it was the first "flagship" CVI organization in Brazil. Currently, there is a nationwide network of 22 CVI organizations throughout the urban centers in Brazil.[3] These centers are led by outstanding UD

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[3] Centro de Vida Independents do Rio de Janeiro (CVI-Rio), http://www.cvi-rio.org.br/cvi.asp

luminaries such as Regina Atalla of CVI-Salvador and Romeu Kazumi Sassaki of CVI-Araci Nallin.

Today CVI-Brasil continues to trailblaze the burgeoning independent living movement in many countries of Latin America. CVI-Rio, led by Lilia Pintos Martin and Veronica Camisao, is affiliated with the Catholic University in Rio de Janeiro (PUC-Rio) and located on the campus. It is an NGO and one of the more active and productive independent living centers in Brazil with a well experienced and professional staff and personnel. The center has a direct association with the Industrial Design Department, its faculty and students who contribute to the wide range of publications and partnerships that have been established with the city government in Rio de Janeiro.

CVI-Rio publications for the City of Rio de Janeiro, "Manual for Acccessibility Residential Homes in the City of Rio de Janeiro."

Many of the efforts that have been made in Brazil relative to accessibility and universal design have been led by organizations such as CVI-Rio through some of the publications that have initiated. These informative and educational guidelines that have focused on making the urban environment more accessible, particularly in regards to the urban commercial center in Rio de Janeiro.

In addition to the outstanding efforts that have been established as a result of the CVI organizations, there are a host of equally dedicated and prevailing NGO associations that are either have direct partnerships with academic institutions; design professional organizations, such as:

- Pro Nucleo Acceso located within the School of Architecture and Planning at the Federal University in Rio de Janeiro led by Regina Cohen
- The Universal Design Center in the School of Architecture & Design Federal University of Santa Catarina Florianopolis, Brazil, led by Professors Vera Moro Bins Ely and Marta Dischinger.
- VIDA Brasil, is an NGO organization in Salvador, Bahia whose objectives is to engage and disseminate information to design professionals, architects and engineers regarding accessible and equitable built environments. In this effort VIDA Brasil seeks to guide and raise the awareness of the public and private sectors to inclusive and universal design measures.

For this the organization executes research, training, workshops, lectures, public policy campaigns. For the past three years, they have had a partnership with the Commission of Accessibility of Salvador - COCAS.

Some agencies, such as the Comissao Permanente de Acessibilidade (CPA), which was led by Edisson Passafaro, are part of the Municipal Government of Sao Paulo.

Despite the broad network of CVI organizations, university-affiliated and government agencies, communications amongst these individual organizations needs to be better facilitated and disseminated. Although the CVI groups maintain a supportive network, some groups are often so overwhelmed with their local constituencies, that they often do not have the time, or resources to look beyond their immediate locale. There is no question that the motivation, efforts, and objectives of the independent living community in Brazil are well integrated and representative of the vibrant, and unabashed festive fabric of Brazilian life, spirit and exuberant ambiance.

CPA – Permanent Commission on Accessibility for the Sao Paulo City Municipality
SEHAB – Secretary of Habitat and Urban Development

One of the most effective, constructive, visionary and resourceful agencies with the potential for the greatest influence in Brazil was the Comissao Permanente de Acessibilidade (CPA). The agency put together a series of very resourceful guides for public buildings, streetscapes, transportation and the overall urban built environment.

CPA employed a successful identity branding and marketing scheme through the design and application of its "A" logo, as a way to promote accessibility awareness and compliance. The bold black capital "A" in the center of a bold red circle outline was used as a symbol of certification for publicly recognizing buildings, offices, stores, restaurants and establishments that had met the CPA codes. The letter "A" symbolizes A-quality, awareness, accessibility and acceptance for ALL!

One of the very constructive projects that CPA has conducted in Sao Paulo region under the design direction of former CPA architect Gustavo Partezani was the development of the pre-fabricated concrete ramp for the improved access of to and from the street corners of Sao Paulo metropolis. This collaborative and resourceful venture was done in partnership with the Portland Cement Association of Brazil. In order to effectively move forward the agenda and goals of universal design beyond the voice of the advocates, one must identify and promote the benefits of universal design to potential stakeholders and beneficiaries in the government, business and the manufacturing sectors. Such is the case with the partnership of a pro-active agency like CPA in aligning itself through its government affiliation in establishing profitable and beneficial municipal contracts with industry.

The megalopolis of Sao Paulo, is a city of over 18 million people, the third largest city in the world. Do you think the Portland Cement Association is not aware of how many potential cement street corners with curb cut ramps that such a mega-city of this size will yield? As one can easily see, everyone benefits from Universal Design in the improvement and upgrading of the urban streetscape and built environment.

"Rua 24 Horas" (24 Hours Avenue): 24 hour city street mall in Curitiba, Brasil. The street mall and its services is available and "accessible" to the public 24 hours, 365 days of the year. Street mall contains "accessible" public toilets, free internet service, "Inclusive Digital" for persons with disabilities, the poor and the homeless, cafes, bookstore, etc. Mall pathway and surrounding city sidewalks feature tactile "caning" surfaces to facilitate the visually-impaired

In the area of Outdoor/Public environments, the city government of Curitba leads the way from its legendary hallmark urban transportation, city planning, streetscapes and recycling system through its Institute for Research and   Urban Planning of Curitiba (IPPUC) and Urbanizacao de Curitiba S.A. (URBS). As admired as the accomplishments and revered models of equitable social democratization have been established and documented in Curitiba, the city continues to strive to improve beyond its achievements.

In many of the older, historical and tourist areas of urban centers, such as in Salvador (Pelhourino) and Rio de Janeiro (Corcovado and Sugar Loaf Mountain)the streetscape and building access problems of older buildings need to be upgraded to better facilitate general access for all users of varying physical abilities. This problem is certainly not unique to Brazil, but is a more common dilemma in older, historical centers in Europe, the U.S. and Asia. Because the tourist industry is more economically developed and established in the traditional and more popular U.S., European and Asia venues, there tends to be a more structured and regulated standard.   Since many baby

boomers, retirees and older persons have more leisure time and disposable income, they comprise a significant and influential segment of tourist travelers. In addition, many families travel together, which may be comprised of small children to grandparents. Such diverse trangenerational needs must be accommodated in an inclusive and universal manner. Consequently, there is a greater need to accommodate these users if you desire to attract visitors, tourists and businesses in your city. So there's a challenge to make these cities more accessible. Barcelona and Valencia, Spain has established themselves as "accessible" tourist and business environment. Their tourist bureaus promote how the city is as a tourist attraction because of its appealing accessibility, which makes the city more inviting, attractive environment for all users.

Community Partnerships

Publication for the City of Rio for Slum improvements,   Monte Azul Slum, Sao Paulo
Federal University of Rio de Janeiro, School of Architecture & Planning

The physical features and aspects of inclusive design are improving the quality of life. Well-being is only the beginning: Infrastructure and facilities programming offer opportunities for earning income which, in turn, enhance the general economic health of a community. But, the most important element for success is commitment by all, resulting in a true sense of partnership. The benefits are that people obtain an improved, healthy and secure living environment without being displaced. Experience has shown that urban upgrading projects are associated with strong social and economic benefits.

The point-of-view of the study affirms what the renowned economist-philosopher and author of Small is Beautiful--E.F. Schumacher--believed when he called for a reassessment of the role and status of design in society. Schumacher states:
"What is at stake is not economics, but culture; not the standard of living, but the quality of life"[4]

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[4] Eliahoo, Rebecca, Designer Ethics, *Creative Review* (March 1984), p.44

Urban upgrading customarily provides a package of improvements in streets, footpaths and drainage as well.[5] It is an "inclusive" approach to the overall and sustainable improvement of the environment for all. When one refers to the "sustainable" factors in a project, this reference is not only environmental, but also economic in respect to the investment, growth, supervision and maintenance of the project.

Urban Upgrading is an area which you have not customarily seen addressed in the conventional concept of Universal Design. How does Inclusive, or Universal Design relate to low-income economies of the "Majority" World? How does Inclusive, or Universal Design relate to the informal sector of our society; the slums, the non-industrial, or rural areas? How does a conventional designer, address and unconventional basic environmental infrastructure? So when you package the basic services in respect to access, clean water supply, adequate sewage disposal, this is where you can begin to establish an inclusive, universal Design process with accessible measures.

Such an "unconventional" design process is a very distinct approach that goes well beyond the conventional design process of passive brainstorming, sketching, visualizing and prototyping. It is not an esoteric, stylized design approach, but a more applied and essential approach that celebrates efficiency, comfort and environmental well-being.

It may be as simple as designing a sustainable urban pathway that can optimize the creative and feasible use of ramps. The physical improvement process is only the beginning of what must be a holistic and comprehensive process that incorporates income-generating opportunities and social incentives in terms of dealing with the economics and the health of the community. Essentially, upgrading is an inclusive and participatory design development process that embarks the end-user on a path to becoming a recognized or regularized citizen.

Some of the basic infrastructural services and developments that are taking place, in terms of urban upgrading, are both feasible and practical in respect to the improvement of the community environment and means of accessibility. So, what is needed to make upgrading work? One must first identify the stakeholders and beneficiaries of the projects, as well as the incentives that will stimulate their interest and commitment to the project. You have to keep people informed, and you have to be clearly defined the roles and responsibilities of the various agencies that are working together.

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[5] *http://www.thinkcycle.org/dtm/

Monte Azul Favela (Slum), Sao Paulo

A classic case study that best exemplifies this development application has been conducted by the Monte Azul Community Association in the Monte Azul favela, probably one of the more well-known urban developments in Sao Paulo, or in Brazil. The Monte Azul Community Association is a NGO community development project that was established in 1979 by a German Waldorf School teacher, Ute Craemer. The mission and goals of the association is to promote equal opportunities through education, culture and health, especially to under-privileged people. The association's objective is to develop the material, social, conscience and spiritual well being of its constituents.

The association currently works on basic hygiene, environment and sanitation programs. In the favela (slum), pathways, bridges, clean water and sewage systems are built in association with the urbanization program of the City of São Paulo. One of the most positive results and indicators of the success of the community efforts in all sectors of local life is a significant decline of the rate of crime and violence. Monte Azul is not only physically visible but is also a place where people of different social levels and different cultures and countries meet to start transformation programs and improved way of life. [6]

Some of the services and resources that the association facilitates in the Monte Azul community are:
- Education and Skill Development (Technology/Computer lab)
- Primary Health and Dental Care Facility
- Food Store and Bakery
- Children's Furniture/Toy Store, Design, Production and Facility   (Community Entrepreneurship and Professional Development)
- Community Theatre and Art Center
- Cultural Exchange Program

[6] http://www.southerncrossreview.org/9/monteazul.htm, June 15, 2006

"Inclusive Design in the "Majority World"

       Progressive designers are beginning to respond to the demographic, environmental and economic realities of the 21st Century. Designers, educators and students should be encouraged to work and function outside of their "comfort zone" or sphere of influence.

       In an effort to realize this dynamic, practical and participatory concept to a more "inclusive" universal design approach was implemented to the overall objectives of an international student design competition. This design competition was formulated in conjunction with Adaptive Environments in Boston, MA, the convener of the "Designing for the 21st Century III: International Conference on Universal Design" in Rio de Janeiro, Brazil, held in December 2004. This international design competition, which was one of the key drivers for the D21 conference. It is a model for expanding the global perspective of universal design beyond the established mainstream convention. The objectives of this design mandate was to advocate designers, educators, students and policy-makers to address the evolution of universal, inclusive and sustainable design in diverse cultures and economies-of-scale.

What's Next?

1- How do designers work with communities, respond to constraints, and maximize ownership by users and other stakeholders?

By promoting exemplary projects with an emphasis on participatory design, universal design, and social responsibility.

2- Find ways to mobilize the resources to promote the creation of job skills training, mentoring, and capital recycling in low-income communities.

Designers can influence change and redefine the priorities and values of our society through such indirect methods.

3- Conduct workshops and symposia that address these issues...ones that are ideally sponsored by local industry and design offices.

Additional professional design and business organizations could endorse the idea and act as an executive advisory board for the planning and development of such an event.

In 1963, the late Selby Mvusi, a prolific Black South African industrial designer, wrote:

"The truly excellent designed object is not the object that is rare or expensive... This rightness of form and function before and after the object is made is both individual and social. It is in this sense of that society and culture [form] intrinsic elements of design.

We do not therefore design for society or for that matter design in order to design society. We design because society and ourselves are in fact design.

We do not design for living. We design to live" [7]

Bibliography

Centro de Vida Independents do Rio de Janeiro (CVI-Rio), http://www.cvi-rio.org.br/cvi.asp

Eliahoo, Rebecca, Designer Ethics, Creative Review (March 1984), p.44

Hamilton, Richard, "Popular Culture and Personal Responsibility,"(1960) Material Culture and Everyday Life, Theories and Documents of Contemporary Art, Editor, Kristine Stiles, Peter Selz, p. 298, University of California Press, April 18, 1996

MIT Media Lab, http://www.thinkcycle.org/dtm/

Monte Azul Community Association, http://www.southerncrossreview.org/9/monteazul.htm, June 15, 2006

NextDesign Leadership Institute http://nextd.org/front.html

Popular Culture and Personal Responsibility, 1982/1960, n.p

Shapira, Nathan, Design for Developing Countries: selected readings, Selby Mvusi 1963, South Africa, reprinted, University of California, Los Angeles, 1991

VIDA Brasil, http://www.vidabrasil.org.br/ssa.htm

Whitely, Nigel, Design for Society, Reaktion Books, London 1993, p. 158

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[7] Selby Mvusi, Design for Developing Countries: selected readings, 1963, South Africa, reprinted, Dr. Nathan Shapira, University of California, Los Angeles, 1991

Chapter 3.2

Designing for the 21st Century III: International Conference on Universal Design Student Design Competition

Ricardo Gomes

Introduction

The Designing for the 21st Century Student Design Competition was a call to design visionaries who appreciate the creative power of design for real people in real places. The purpose of this competition and exhibit was to exemplify the theme and focus of the Designing for the 21st Century III: International Conference on Universal Design that was held in Rio de Janeiro, Brazil from December 8 – 12, 2004. This extraordinary conference brought together over 400 thought leaders from more than 32 nations to exchange knowledge, best practices and the latest advances on Human-Centered/Universal Design. The event expanded bridges between the developed nations where much of the interest has been concentrated to date, and the developing nations where almost all growth will occur in this century. Within the language of sustainable development, organizers promoted the integration of universal design into the common understanding of social sustainability

As the Competition Chair, I had established an international jury of 14 members from Africa, Asia, Europe, Latin America and North America. The overall objective of the competition was to generate innovative, resourceful and responsible design concepts and solutions to the designated sites in the "majority world" regions of Africa, Asia and Latin America/Caribbean.

In preparation for this student design competition, research was conducted through the Design Center for Global Needs at San Francisco State University to collect data profiling design programs at universities and colleges around the world. Research was conducted to identify and compile a comprehensive listing of over 600 design programs at universities and colleges around the world. All of these schools were sent information regarding registration for the student design competition. As a result over 200 student teams registered for the international student design competition from 41 countries.

The student teams had a choice of designing a designated community center for one of three in a nation within the continents of: Africa, Asia or Latin America; or designating a site of their choice in the same regions. A site specific program for each community was made available through the competition web site with details and images of the neighborhood or village culture, demographics, local norms of design and materials, economic conditions, assets, needs, and local resources.

Teams consisted of a minimum of two students that were enrolled in a degree-granting college or university. Team project proposals were encouraged to be multidisciplinary in their consideration of more than one design discipline from the areas of: architecture, environmental design, industrial design, interior design, graphic design, landscape architecture, regional planning and design.

The entire project submissions and jury process was conducted on-line through the Adaptive Environments/D21 Competition web site. Team project submissions included the project site information, written and visual documentation. All submissions were required to meet four criteria:

1- Universal Design: the design must be usable by a wide range of people across the spectrum of ability and age in the widest variety of circumstances without separate or special features.

2- Sustainable Design: the design must incorporate practices and products that have long life and durability; that maximize the use of recyclable, reclaimed or salvaged products; that minimize the use of energy, including the energy and resources required to transport; and materials that enhance human health and well-being.

3- Low Cost: the design must be possible to construct and finish with low-cost construction materials, finishes and minimally skilled labor. Applicants should note strategies for supplementing outlays of cash with donated goods and services.

4- Design Excellence: the design must incorporate both visual and sensory (tactile, auditory, etc.) appeal appropriate to the cultural and physical context.

The Competition Schedule began in December 2003 with On-Line Registration and concluded with the final submission of work in August of 2004. We had received nearly 200 registered projects from over 34 countries for the Designing for the 21st Century Student Design Competition. The jury review and selection process began August to October 2004. We had received over nearly 50 completed submissions from 31 universities and 16 countries from Japan to South Africa. A Preliminary selection of 14 Student Finalist were announced in September 2004.

The international panel of jurors selected a very diverse and unique international pool of 14 Finalist. In reviewing the jurors evaluation scores and comments as the competition chair, I was very pleased to see a wide range of perspectives and viewpoints. The jurors comments were well appreciated and a valued articulation and insight to their critique and overall assessment of the project submissions. After the jury process has been completed, it was wonderful to be able to oversee the formulation of what I believe was the selection of very divergent, yet inclusive concepts and approaches. The submissions that the jurors selected to be the Finalist and pool for selection of the Top Three Competition Finalists, validated the need to recognize and embrace the expanded scope and applications of universal design, particularly as it relates to the practical needs of the "majority' world on an equitable scale.

The Top Three Finalist were selected student design teams from the Universidade de Mayor, School of Architecture; the University of New Mexico, USA; and San Francisco State University, USA. These teams were awarded the "Premio Award Finalist" from the pool of 14 Finalists. The Premio Award Finalists submission were selected as one of three most comprehensive, responsible and creative approaches to universal design solutions for the 2004 Designing for the 21st Century III: International Conference on Universal Design Student Design Competition.

Working with these talented students has been a remarkable experience for me. The quality of their projects simply surpassed all of our expectations I am extremely proud of the outstanding commitment, efforts and contribution provided by our international jurors to the success of this competition! We are indebted to their services and professionalism in advancing the principles and applications of universal design.

Of the 50 completed entries, the jury selected three teams as the **Premio Award Finalists** and 11 teams as **Honorable Mention Finalists**.

Premio Award FINALIST (3)
Student Teams:

- **Cavada Team**, Universidad Mayor, Chile

- **Rabanal Team**, San Francisco State University, USA

- **Zahed Team**, University at Buffalo, USA

Honorable Mention FINALIST (11)
Student Teams:

- **Chausson Team,** ecole d'architecture de toulouse, France
- **Comper Team,** Universidade Lusiada de Lisboa, Portugal
- **Edwards Team,** University of New Mexico, USA
- **Gallagher Team,** Curtin University of Technology, Australia
- **Geldenhuys Team,** University of the Free State, South Africa
- **Lynch Team,** University of Technology Sydney, Australia
- **Mescam Team,** Kyoto University, Japan
- **Nuarta Team,** Industrial Design San Francisco State University, USA
- **Stich Team**, University of New Mexico, USA
- **Teixeira Seisdedos Team,** Osaka University, Japan
- **Weaver Team,** University at Buffalo, USA

JURORS:

1- Toshiharu Arai (Industrial Designer/Educator, Kanazawa College of Art, Japan) arai@kanazawa-bidai.ac.jp

2- Taide Buenfill (Architect, Mexico City, Mexico) tbuenfil@presidencia.gob.mx

3- Silviana Serafino Cambiaghi (Architect/Educator, SENAC Interior Design Program, Sao Paulo and Member of Comissao Permanente Accessidable, Brazil) <silvana@nvcnet.com.br>

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6- Dr. Mario Marino (Industrial Designer/Educator, Centro de Investigacion de Diseno Industrial(CIDI), University of Buenos Aires, Argentina) <cidimm@fadu.uba>

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9- Abir Mullick (Environmental Designer/Educator, IDEA/RERC, University of Buffalo, USA) <amullick@ap.buffalo.edu>

10-Abhishek Ray (Architect, India) abhishekray@yahoo.com

11-Dr.Camilla Ryhl (Architect/Educator, Royal Danish Academy of Fine Arts, Denmark) acryhl@yahoo.dk

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Chapter 3.3

Water and Play: A Rainwater Harvesting and Playground Design for a Community Center in Haiti

Jane Rabanal

Jane Rabanal is an alumnus of the graduate program in product design at the Design & Industry department at San Francisco State University (SFSU). She believes that design is inherent to human nature and society, and should embody intent for common good. Jane participated in various professional and volunteer design programs while at SFSU. Jane has worked for Knoend, a tight-knit start up whose focus is on sustainable, responsible approaches to design to enhance human experience. At Knoend, Jane collaborated on the Lite2Go, an innovative packaging/product solution that won an IDEA bronze award in 2008. She currently designs packaging and products at a small design and manufacturing company based in Emeryville whose clients include Sur la Table, Cost Plus, and Williams-Sonoma. Jane holds a Bachelor's degree in Architecture from UC Berkeley. Jane is a native of northern California and has lived in the Bay Area for over twenty years.

Chapter 3.3

Water and Play: A Rainwater Harvesting and Playground Design for a Community Center in Haiti

J. Rabanal, L. Magpiong and C. Bloome

Introduction

In 2004, Adaptive Environments sponsored its third *Designing for the 21ˢᵗ Century*, an international conference on Universal Design held in Rio de Janeiro, Brazil. Adaptive Environments (which has now become the *Institute for Human Centered Design*) is a 30-year-old international non-profit organization, based in Boston, MA, committed to advancing the role of design in expanding opportunity and enhancing experience for people of all ages and abilities. As part of that year's scope, the program also sponsored an international student competition. The project was focused on universal and sustainable design in a multi-purpose structure to meet the needs of a real community in the "majority" or "developing" world. Chair of the competition was Ricardo Gomes, Chair, Industrial Design, and Director of the Center for Global Design.

Three students at San Francisco State University submitted a proposal for a community center in Bolosse, Port-Au-Prince, Haiti. Their proposal centered on water collection as a means for practical use, but also for juvenile play and entertainment. Their project was one of three projects selected for presentation at the conference in Rio de Janeiro. Over 65 projects were submitted for review. The San Francisco team consisted of Cory Bloome, Larice Magpiong, and Jane Rabanal.

Design Process

Research: The project began with a thorough investigation of the physical and social conditions of Haiti, the proposed site location. Haiti has a severe water shortage. Only half of its people have access to safe drinking water and millions of people die each year from water-related disease. Abject poverty is rampant and the average life-age expectancy is 54. Thus, Haiti's youth population is very high, with 42% of Haitians under 15 years old.

Design Direction: The lack of safe domestic water and the high proportion of youth drove the project team to consider ways to combine the theme of water with the need for youth activities. Two general concepts emerged: provide a rain water harvesting system to acquire safe domestic water; and provide a children's playground/environment to augment

the deteriorating school system. The children's activities can be educational, if not simply a safe alternative to street life.

Many different playground concepts were generated, driven by universal design factors, including: accessibility, age range, adventure, safety, cost, sustainability, and feasibility. Simultaneously, ideas were generated for a system for collecting rainwater, which included rooftop collection, as well an extensive landscape scheme to maximize surface area for collection.

Design Ideation & Development: Once the general project direction and objectives were established, each team member focused on a particular part of the design. These included:

1) Site: rainwater collection (domestic use), landscape, architecture
2) Playground: Playground composition, playground objectives, playground features
3) Playground Details and Engineering: Overall playground engineering, Tower element (Turtle), playground water collection (playground use)

The Design - A Community Center for Port-au-Prince, Haiti: A Design for Water and Play

The team's proposal is a design that integrates landscape features and a community center to harvest rainwater and promote inclusive play among children, thereby bringing an essential sense of vitality to the community. Sustainable rainwater harvesting addresses the community's lack of safe domestic water. Inclusion is achieved through wheelchair access at playground elements (like Turtle Tower and the Sandpit), the plaza, and the amphitheater. Patrons of varying abilities, including the blind and deaf, will enjoy the multi-sensory Sandpit, Water Table, and an auditory waterfall chime. Site pathways use texture for directional cuing, while maintaining compatibility with wheelchair use.

The Community Center Building

The building is constructed from reinforced concrete masonry blocks, an affordable material that is easy to erect. Façade fenestration patterns provide generous natural daylighting and permanent ventilation. The front façade receives sun exposure and access to the plaza, with sliding doors that open up to a collection pool and fountain.
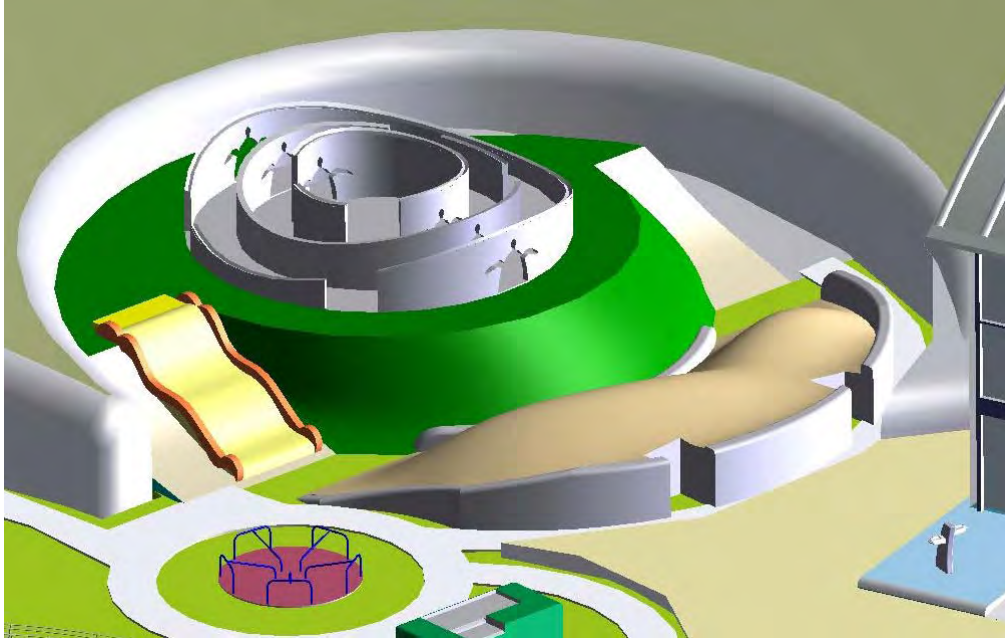
Universal Playground: A Playground for All Children

The playground design is meant to bring children of all levels of ability together and provide a variety of activities that encourage exercise, learning, fun, and challenge. Ramps, accessible pathways, multiple entrance/exit ways, and appropriate space and visibility for adult supervision were included to create a play environment that respects and values diversity.

The Maze and Sand Pit: The fortress-like Maze provides space for interactive strategy games. Water channels along the top of the walls create a wet sensory environment. Two wheelchair accessible sand tables allow interaction among all children.

The Slide: Two to three children at a time can slide down the extra-wide bumpy slide.

The Water Table: Children can get their hands wet as they watch water trickle down from the Water Table. A shallow basin lets them float objects while learning about concepts such as is "empty and full" and "heavy and light".

The Tunnels: Various winding accessible tunnels are enclosed within this structure that children can play in and around. This large mound-like structure provides a safe textured surface to climb on with varying levels of challenge.
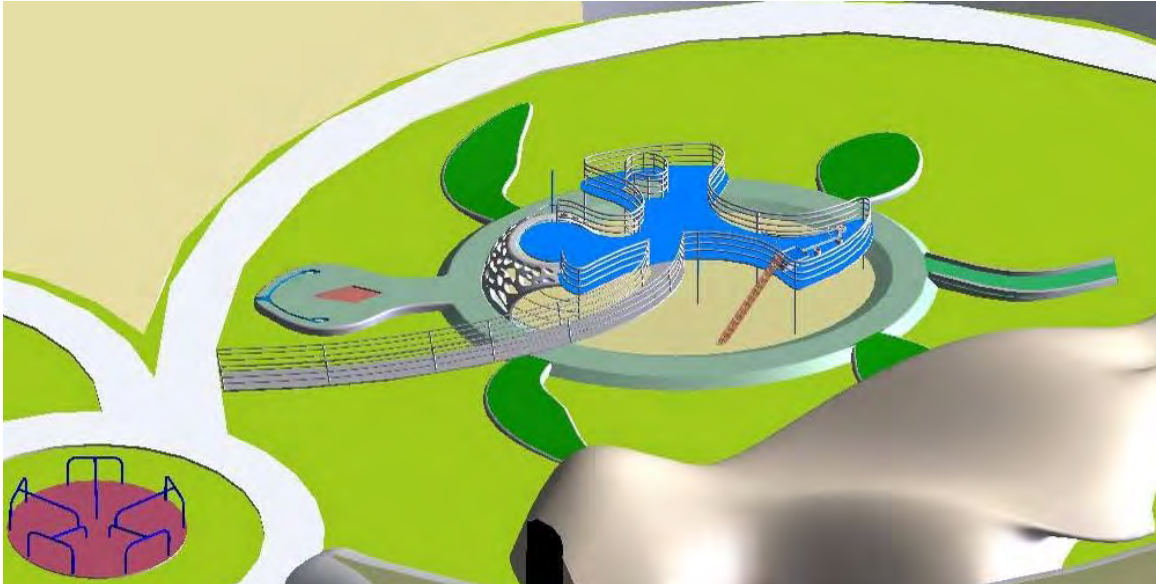
Turtle Tower: An Accessible Play Feature
Turtle Tower provides an adventurous and safe environment for all children, with wheelchair access to both the elevated platform and the sand pit. The sand pit serves as a play area, as well as a filtration system for rain water as it passes through to an underground cistern.

The Archimedes Screw: The playground employs two Archimedes screw pumps, which children can crank to bring water to the surface to play with.
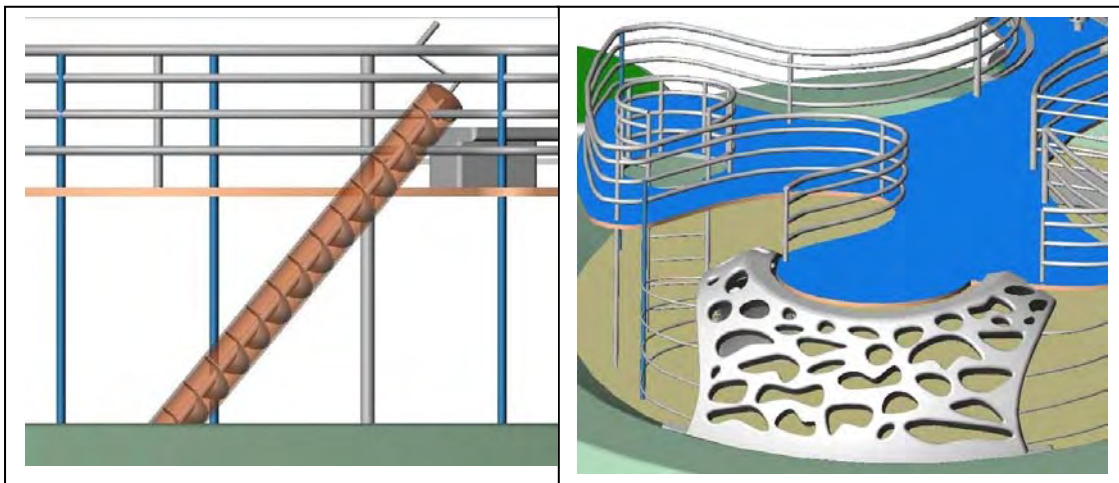
Climbing Wall: A concrete climbing wall serves as a challenging alternate route to the tower platform. Railings are spaced closely for safety.

Rainwater Harvesting

Rainwater Harvesting is the activity of collecting rainwater, to be stored for direct use or recharged into the groundwater. Since the project site is located on a hill, groundwater acquisition is not feasible. This project proposes a solution incorporating rainwater collection for storage and direct use. During the non-rainy season, enough water is stored to serve the Community Center's domestic and drinking water needs for 100 people each day.

Applications include

- Drinking
- Clothes washing
- Sanitation

- Irrigation
- Toilet flushing
- Cleaning

Rainwater is collected for the Community Center's drinking and domestic water needs. Rainwater run-off from the Community Center rooftop, the paved plaza and the amphitheater are collected via the stream and collection pool. The Playground also collects rainwater for its water-play features.
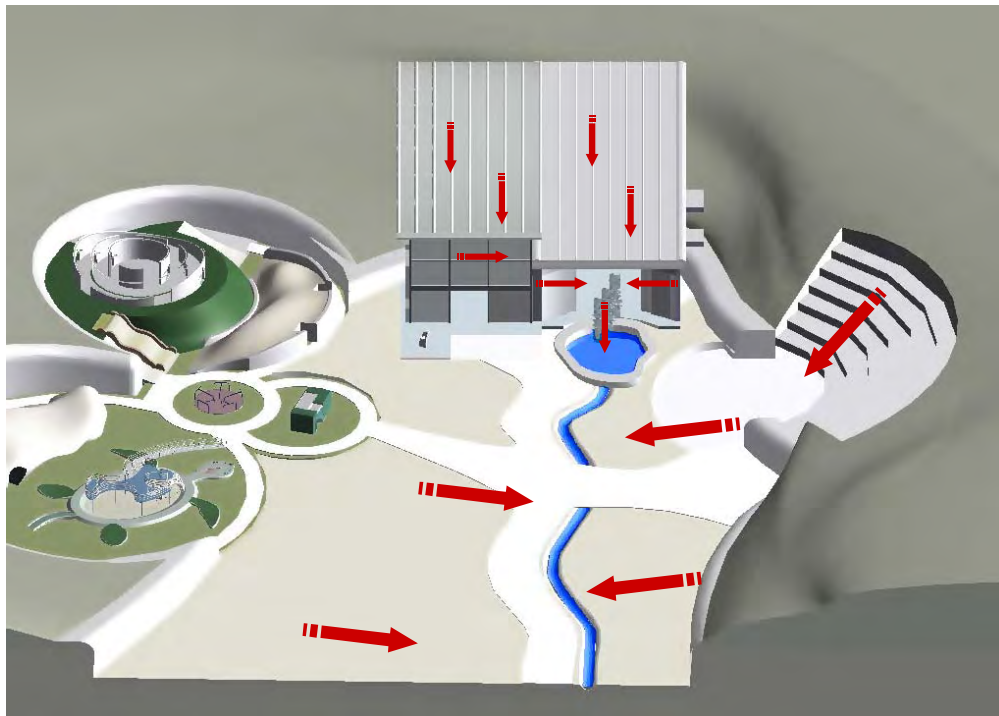
Affordability and Local Economy

Wherever possible, the project employs recycled or reclaimed products. For instance, the Tunnels are made from a composite of mulch from recycled tires. When recycled materials aren't feasible, local materials and labor are used to minimize transportation costs and to provide revenue to the community.

Conclusion

Once the design proposal was completed for submission to the competition, looking back, the design team felt confident that the goals of the design competition were met by addressing the needs of the community from a Universal Design and Sustainable Design perspective. We thought the design direction was feasible and directly addressed our main objectives:

- Provide a rain water harvesting system to acquire safe domestic water;
- Provide an inclusive children's playground/environment to augment the deteriorating school system.

Clearly, this conceptual design proposed by the team is really a starting point in terms of researching a real world problem and generating solutions that could be materialized. However, the project's broad interdisciplinary approach would need further extensive research and design development to really begin to assess the feasibility and potential success of this proposal. Most importantly, it would be critical to have firsthand direct interaction with the community and landscape that this project is based on, to validate the facts and assumptions that drive this proposal. Furthermore, in order for the design to be developed successfully, direct involvement with the community would be essential to develop a community center that has meaning to its constituents.

Chapter 4

Lifespan Furnishings: Before and After

Edited by Ricardo Gomes

Introduction

Prior to his nearly 10 year career as a faculty member Design and Industry (DAI) department at San Francisco State University (SFSU), Brian Donnelly worked for an industrial design firm in the Silicon Valley. During his active dual career as a product designer/furniture entrepreneur and professor at SFSU, Donnelly began exploring design for people with physical, visual and cognitive impairments.

As the co-founder of the Design Center for Global Needs (DCGN), which was established at SFSU in 1992, Donnelly authored many grants, which greatly assisted the initial research and development efforts embarked upon by the Center. In this capacity, Donnelly was instrumental in the initial acquisition of R & D seed grants from the Hess Foundation and Wyss Foundation which facilitated in developing many successful projects and consequent marketable universal design products. It was during this period that Brian Donnelly initiated a university research project that focused on learning more about the needs of the aged and disabled users in respect to developing an easy-access chair that not only met the physical needs of the user, but their domestic aesthetic appeal. Some of Donnelly's initial research and development efforts that were generated through the DCGN have evolved into home and outdoor seating concepts and accessories through the formation of the company, LifeSpan Furnishings.

Lifespan Furnishings

Donnelly, who has a background as a professional furniture maker and craftsman founded Lifespan Furnishings, a company that was formulated to design furniture for the elderly, the pregnant and the ill. After caring for his aging father, Brian Donnelly says he recognized a need for seating products that could provide better leverage for people with limited strength and balance. The "lifespan" seating designs of Brian Donnelly are

intended to assist people who have difficulty with sitting and rising from a seated position. Donnelly's goal was to create a design that would address this functional limitation while creating seats that can be used by anyone and would visually compliment a range of environments. The signature arms of the chair are designed to extend out beyond the edge of the seat and the legs stabilizing the base of the chair. Consequently in using the chair the user is provided with a sense and feel of a secure, solid and comfortable seating foundation.

The lightweight, stackable chair features wide arm rests to aid people when they grip them to stand up. For Donnelly, this points out how important it is for him to constantly engage the user in the product development process in regards to capitalizing on the feedback he gets from participatory design through community interaction. "Working with focus group really exposed me to the real problems people have with physical environments," Donnelly says.

"Some of the most interesting feedback we have received has been from the care givers," says designer Donnelly. "The chairs really reduce the physical strain that accompanies getting patients or loved ones in and out of a chair." "Such a simple thing, as a longer chair arm that allows seniors to hold on to, push themselves up with, can provide a much better sense of security."

Donnelly has created a style in his chairs that ranges from traditional to contemporary, in his efforts to establish selling points that appeal to the aesthetical quality and visual stimulus of the user. In this regard, the traditional style chair features upholstered floral prints that is framed in cherry wood suitable for any living room or even formal dining room. Their wood frames and upholstery are designed to cater to people who "enjoy the look of Queen Anne furniture, but not the discomfort." In the realm of health care facilities—as well as the home – removing the stigma of furniture with a sterile, medical appearance proves very attractive to many institutions and private consumers. A lot of furniture and devices for people with disabilities is very institutional-looking, usually very plastic or with lots of metal because they need to be adjustable and strong," says Donnelly. "No matter how old you are, no matter what condition you're in, you want to maintain dignity, and one way you can impact dignity is through your environment," he says. "It's important that home feels like a home and not a hospital."

Donnelly advocates, "For me one of the greatest challenges is creating effective designs while avoiding conveying a visual stigma of intended use by 'old people' or 'disabled' people. The bottom line is that universally inclusive designed products have to fulfill a range of functional criteria while remaining aesthetically attractive to the entire population. The intriguing aspect of this philosophy is that if these objectives are met, you consequently create designs that have strong commercial viability."

Some of Donnelly's initial research and development efforts that were generated through the DCGN have evolved into home and outdoor seating concepts and accessories. These products have received numerous design awards from the National Endowment of the Arts (NEA) Universal Design Excellence jury, as well as the American Society on Aging (ASA) New Products and Designs for the Mature Markets.

The successful development and marketability of Donnelly's practical and appealing approach to universal design, has left an indelible mark on the contributions of products and environments that have sustained independent living, while simultaneously enhanced the well-being of our society.

During its operation, Lifespan Furnishings had provided seating at various assisted living facilities, retirement communities and medical offices. Donnelly no longer formally runs his company, Lifespan Furnishing, although he still maintains the design patents.

Today, the current "lifespan" of Brian Donnelly is pre-occupied with multi-tasking a demanding daily program that encompasses the following broad-based educational ventures:

- Instructional coordination of the Career Technical Education program in the area of Middle School Industrial Technology and Engineering in the Davis, CA public school system.

- Design Education Consultant for the Autodesk Education Program since 2003, where, as one of the lead authors, he has developed innovative approaches to science, technology, engineering, and math education in conjunction with the Autodesk Corporation's Student Engineering and Design Community. One can find evidence of Brian's work in the 2008 and 2009 editions of Autodesk DesignKids.

- Completion of his Doctorate in Educational Leadership at the University of California, Davis.

Reference Sources Cited:

- Donnelly, Brian, Davis CA, March 2009

- Fulton, Jennifer S., **"C'mon in and sit for a spell,"** Living, The Davis Enterprise, Davis CA, September 30, 1999

- Goldsmith, Diane, **"Slowly, design is catching up with the needs of the disabled,"** Home & Garden, Chicago Tribune, Knight Ridder Newspapers, Chicago, IL , 2000

- McDade, Stephanie McKinnon, **"Chair's design makes it appealing, stable for seniors,"** The Sacramento Bee**,** Sacramento, CA, 2001

Chapter 5.1

Whirlwind Wheelchair International (WWI):

Marc Krizack, J.D.

Marc Krizack

Lawyer, organizational development specialist, and activist for disability rights. Currently Whirlwind Director of Operations since 2003 at San Francisco State University. Marc has worked on and off with Ralf Hotchkiss since their initial collaboration in Nicaragua in 1983. A former wheelchair mechanic at the UC Berkeley Disabled Students Program in the late 70's and early 80's, throughout the 90's he worked closely with the disabled community in the Siberian city of Novosibirsk, Russia where he helped transform a disabled sports club into Russia's first independent living center, helped set up a wheelchair factory, and helped establish the first university level disabled students program in Russia at Novosibirsk State University.

Chapter 5.1

Whirlwind Wheelchair International (WWI):

Marc Krizack, J.D.

Whirlwind Wheelchair International **whirlwindwheelchair.org**

Mission Statement

Whirlwind Wheelchair International works to make it possible for every person in the developing world who needs a wheelchair to obtain one that will lead to maximum personal independence and integration into society. In order to fulfill this mission, WWI seeks to give wheelchair riders a central role in all of its projects and activities.

Program Description

Whirlwind Wheelchair International is a program of the Center for Civic and Community Engagement at San Francisco State University (SFSU). Founded in 1989 as the Wheeled Mobility Center by SFSU Engineering professor Peter Pfaelzer and paraplegic engineer and wheelchair designer Ralf Hotchkiss, Whirlwind grew out of Hotchkiss's work since 1980, traveling the globe designing wheelchairs that could be built in developing countries from locally available materials.

Whirlwind technology has been taken to 45 countries. Hotchkiss's pioneering work has led to many innovations that are integral to wheelchair models produced by many workshops and NGOs around the world. All of WWI's designs are placed in the public domain in order not to add to the cost of village wheelchair shops using these designs.

From its inception, Whirlwind mostly concentrated its efforts on establishing small shop production in Africa, Asia, and Latin America. In 1998, Whirlwind formed a partnership with Physicians Against Land Mines (now Center for International Rehabilitation) in Chicago and later developed a plan to get wheelchairs to Afghanistan. The newest Whirlwind, the RoughRider[tm], is now being made at the Worth Trust factory in Vellore, India, at the Kien Tuong Factory in Ho Chi Minh City (Saigon), at the Corporacion Regional de Rehabilitacion del Valle in Cali, Colombia,

In early 2003, Whirlwind formed a strategic consortium with the Arthur B. Schultz Foundation in the U.S., the HandiNor wheelchair factory in Fetsund, Norway, and the Atlas Alliance in Norway for higher volume production of high-quality Whirlwind-style wheelchairs in developing countries in Africa, Asia, and Latin America.

The consortium, known as the Whirlwind Industrialization Project (WIP), starts with Whirlwind-generated designs based on years of experience as well as on continuous feedback from wheelchair riders in the field, called the Whirlwind Network. Whirlwind designers then work with HandiNor's engineers to retain the important design characteristics of the Whirlwind wheelchair while making it easier and cheaper to produce in large volumes in small to medium size shops with a capacity of up to 300 wheelchairs per month. HandiNor also uses its expertise in manufacturing wheelchairs for the European market to design and produce advanced jigs and fixtures that the project supplies to the local shops. Whirlwind provides on-site training in wheelchair assembly, production, and fitting. The Arthur B. Schultz Foundation funds startup costs, and along with the Atlas Alliance provides funds to support local wheelchair markets.

Whirlwind is committed to the development of wheelchair standards appropriate to local conditions and to the adoption of such standards by the governments of developing nations. To further that effort, Whirlwind now attempts to build a Standards and Testing component into each of its projects.

Whirlwind offers consulting services to private wheelchair manufacturers and individual designers and inventors. Each semester, Whirlwind gives a hands-on wheelchair design and construction class at San Francisco State University to students and interested members of the community

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Chapter 5.2

Wheelchair Riders in Control:
WWI's Model of Technology Transfer

Peter Pfaelzer, Ph.D. and Marc Krizack, J.D.

(This article is a summary of a more extensive article on technology transfer currently in progress. Comments and suggestions solicited; please send to: WWI Program Director Dr. Peter Pfaelzer at pfaelzer@sfsu.edu, or by fax at 415-338-1290.)

NOTE: In this article, Whirlwind's design process is described as being "Descriptive Design." Although Whirlwind continues to design and test through multiple design prototypes, we are now heavily using CAD in our design process. For an update on our design process see Whirlwind-SolidWorks-AMD. The remainder of this article retains its relevance.

When **Ralf Hotchkiss** began designing wheelchairs in Latin America in 1980, there was no one else designing state of the art wheelchairs at a low cost for active use in developing countries. Today, there are at least four other non-profit organizations promoting wheelchair production around the world. Yet Hotchkiss's model, since expanded and now institutionalized at Whirlwind Wheelchair International, remains unique in its approach. For unlike other organizations, WWI ascribes to the wheelchair rider -- as designer, trainer, mechanic, tester, and even marketer -- the central role in the technology transfer process. This model has made the Whirlwind Network of independent wheelchair producers the highly productive source of new ideas in wheelchair design that it is today.

Design Methodology

The most common design methodology used in modern manufacturing today is the prescriptive design process. This methodology is characterized by a multi-step linear process of problem formulation, idea generation, and prototype production. It presumes that most significant relevant information and resulting solutions can be learned prior to production, and it relies on highly educated experts in every stage of a centralized design process. The prescriptive process is employed to minimize the risk before large amounts of capital are invested in the production of costly prototypes. The process itself requires the expenditure of significant amounts of capital.
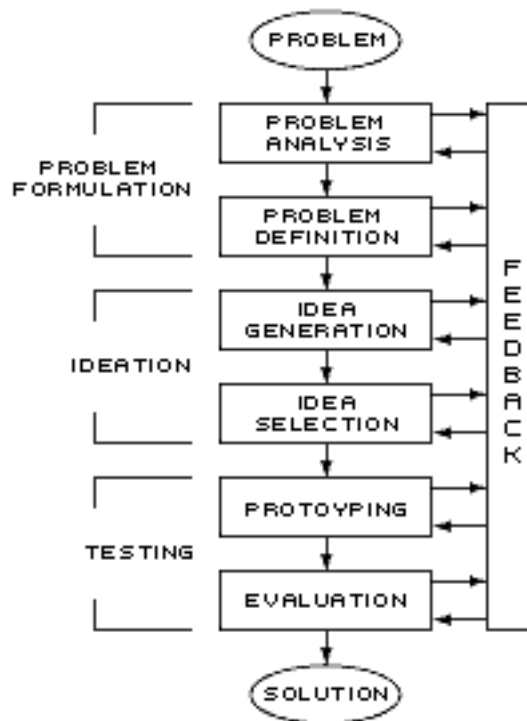
Prescriptive Design: The time and money spent on problem formulation and ideation prior to prototype construction may reduce the number of prototypes necessary to produce a successful design.

WWI's design methodology is based on a method more common in small business known as the descriptive design process. This process was the primary design process utilized prior to the turn of the century when engineers learned their craft on the shop floor rather than at specialized technical colleges and universities. In contrast to the modern engineering prescriptive design process which requires a substantial amount of early work on paper or the computer, the descriptive process is characterized by the early production of a prototype. The design is refined through repeated prototype/evaluation/prototype cycles. The designer learns about the problem through the generation and evaluation of sequential prototypes.

The descriptive process relies to a large extent on the craftsperson in a more decentralized design process and may require more prototyping cycles than the prescriptive method. However, for a product like a wheelchair, that can be prototyped quickly and inexpensively, the descriptive design process is efficient and cost-effective. For WWI, use of the descriptive design process derives naturally from the socio-economic situation in developing countries and from the complex nature of disability itself.
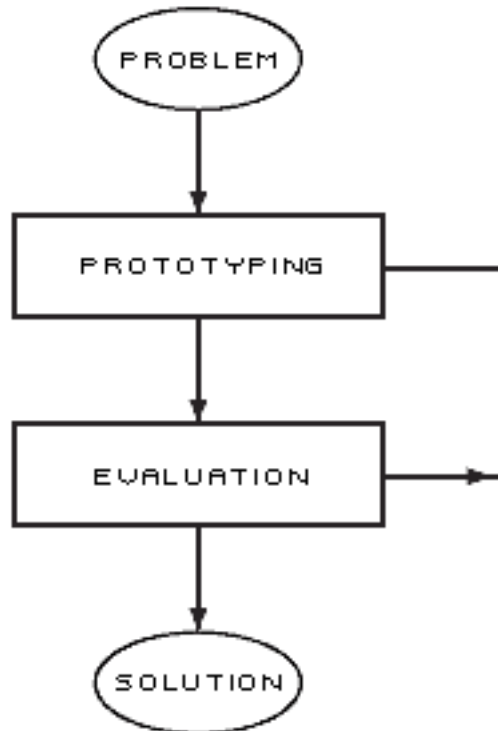
Descriptive Design: Numerous prototyping cycles are required to refine the design, but this method can be effective when prototypes are built quickly and inexpensively.

Unlike general product design, which is aimed at the population at large who within a certain range can all be accommodated by a single design, product design for people with disabilities is difficult because it requires multiple solutions. A wheelchair is not merely a chair with wheels. Different wheelchair riders, even with the same nominal disability such as paraplegia, quadriplegia, multiple sclerosis, cerebral palsy, or post polio, can have widely different ways of sitting and pushing which need to be considered in the design process. The mobility equipment needs of disabled kids also change as they grow. One only has to look at the wide range of wheelchairs available in industrialized countries to understand fully how complex designing for disabilities really is.

What Difference Does the Setting Make?

The design problem is made even more complex for designers of mobility equipment in the developing world. As a matter of course, wheelchair design must also include consideration of diverse uses and geographical conditions. Wheelchairs can be for indoor use, outdoor use, long distance travel, urban use, rural use, and quite often must function well in dirt, in mud, in fields, on gravel, through bomb craters, etc. WWI's wide rubber caster, known as the "Zimbabwe Wheel," is the result of design for the most rugged conditions.

The absence of even the most basic accessibility in the architectural infrastructure and public transportation must be considered in the design process. As an example, the extremely narrow bathroom and elevator doors in Russia gave rise to the Siberian wheelchair frame which can be narrowed by the rider while sitting in the chair.

Cultural factors can also affect wheelchair design. In many countries in the Near East and Asia, for instance, much social activity, including cooking and eating, occurs at floor level. Wheelchairs in these settings must be designed to allow the rider to participate in these activities. The newest Whirlwind allows some users to sit near the floor by incorporating a jump seat at the level of the footrests.

Wheelchair design must also take into consideration such factors as the type of toilet facilities available, which can often be little more than a hole in the ground or floor. The wheelchair rider/builders in the Whirlwind Network wish to achieve the greatest degree of independence, mobility, and social integration possible. Thus, their wheelchair designs must be capable of responding to these multiple needs. The prescriptive design methodology, working as it does at some distance from the wheelchair riders in developing countries, is unlikely to produce the range of solutions necessary to answer these local needs.

Wheelchair design in developing countries is also limited by cost considerations. Because most people who need a wheelchair cannot afford an imported one, low price is a primary design criterion. The two main ways of keeping wheelchair prices low are through low initial capitalization of wheelchair shops and by the use of materials readily available where the wheelchair is to be built.

All plant and equipment costs must be amortized and included in a wheelchair's retail price. When initial capital funds are borrowed, the cost of repaying the loan must be included in the chair price as well. Low per shop capitalization costs make it easier to raise start-up capital and establish more production facilities. These multiple producers can form a competitive marketplace for wheelchairs keeping quality high while forcing prices down. At the same time these producers can act cooperatively, each becoming part of a design network. This is how the Whirlwind Network came to be.

The use of readily available materials is necessary to keep costs low and ensure that the chair will be locally repairable. For Third World wheelchair design this often means that a single model will have multiple design variations.

Even within a single country, political and economic factors can either limit the availability of existing materials or create a situation where previously costly materials become available and affordable. The placing or lifting of trade barriers to the importation of bearings, for example, has had a big impact on the design of wheelchairs.

In Africa where bearings were too expensive, WWI designed roller bearings using steel nails or welding rod. In 1983 in Nicaragua, the price of acetylene used in welding skyrocketed as a consequence of the Reagan administration's economic embargo. Wheelchair rider Omar Talavera responded by designing a caster fork made from a single piece of bent steel rod that did not need to be welded. Although only meant as a temporary innovation, it nonetheless kept the price of caster forks affordable until the embargo ended and the cost of acetylene dropped. The lesson is that wheelchair designers must be capable of producing rapid solutions as the local availability of component materials changes.

Wheelchair Riders Integral to Design Solutions

Historically, these many needs have been best understood and dealt with by wheelchair riders involved in every aspect of a continually evolving design and production process. WWI at San Francisco State University nurtures this process by acting as the hub of a network of wheelchair builders now spanning more than 25 countries. WWI's role is to energize and extend the network, promote and coordinate activity, serve as the communications center, and stimulate and cross-fertilize the design process. The WWI design teams have always included at least one wheelchair rider. Our wheelchair rider-designers use the chairs they design during their daily activities to understand exactly how they perform in real conditions.

Both at San Francisco State University and around the world, WWI wheelchair building courses always include a significant number of wheelchair riders among the training participants. These participants become active collaborators in the design process. They ensure that WWI is kept aware of all the factors which affect their real mobility needs and often provide the design answers themselves. We term this process "Collaborative Design."

Phillipe Mazard (Handicap International, France) discusses marketing schemes with David Mukwasa from Disacare (Zambia).

Although theoretically there is no reason why wheelchairs can't be built exclusively by non-disabled designer/mechanics relying on information supplied by wheelchair riders, the reality is that very few non-disabled persons fully believe and understand what people with disabilities say, even about matters which a disabled person can be expected to know most.

Wheelchair designs, once translated into prototypes, must be tested. WWI uses inexpensive shop floor strength tests and obstacle course performance tests to simulate real conditions. But the only way wheelchairs can be tested under the full variety of actual conditions and for every conceivable purpose is by wheelchair riders who use the chairs every day. Over time wheelchair riders provide the feedback which is essential for going to the next level in the design process. They have the added benefit of a good wheelchair during this evaluation process, and unlike the evaluation process in the prescriptive design method, the cost of testing and evaluation is minimal and design changes can be made rapidly.

The involvement of wheelchair riders in wheelchair design and production also affects the technology used in wheelchair building. Many of the wheelchair riders we train have only basic mechanical experience and little formal schooling. Production methods and training techniques must be kept simple to facilitate the training process. The practical strength tests and obstacle courses, along with the use of full-size drawings, pictures, and similar techniques facilitate the participation of people who by and large are without formal advanced educations. We have sometimes learned this the hard way. Ten years ago WWI abandoned a nicely compact footrest design whose compound angles were so difficult to bend properly that even the trainers wasted a lot of time and tubing trying to get it right.

Marketing Advocates

A critical area in which wheelchair riders can play a decisive role is wheelchair marketing. Because most wheelchairs in developing countries are purchased by government and private charities rather than the end user, the wheelchair rider/consumer has not had the ability to influence quality and price to the same extent as purchasers of general consumer products. But wheelchair riders can play an effective role in gaining increased government funding for good quality, locally built wheelchairs. In Novosibirsk, Russia, activists from the Finist (Phoenix) Disabled Sports Club demonstrated the Whirlwind wheelchair made in Novosibirsk to government officials in charge of wheelchair purchases. They made these officials realize that wheelchair riders are the real experts when it comes to wheelchairs, and they educated the officials about the Whirlwind's advantages for active use. That effort led to a government order for 500 Whirlwind wheelchairs.

Wheelchair rider/advocates also play an important long term role in developing the wheelchair market. The removal of architectural barriers and the increase in accessible transportation open up new opportunities, especially for people with more significant disabilities. This will create a need for improved wheelchairs so that, to paraphrase Star Trek, they may go where no wheelchair rider has gone before.

Conclusion

The most efficient use of development funds for promoting the design and production of wheelchairs in developing countries is through a decentralized international network of small to medium sized production shops, coordinated through a central hub which facilitates communication and collaborative design through newsletters, wheelchair design congresses, technical exchange visits, web pages, and other means. Most importantly, because someone has to be responsible for making the difficult choices involved in balancing design features against cost, the wheelchair rider, who knows the problems best and is most affected by the prescribed solutions, must play the leading role in wheelchair design.

The authors wish to thank Joan Rogin for her contributions in both the conceptual and editorial phases of this article.

Chapter 5.3

It's Not About Wheelchairs

Marc Krizack, J.D.

"Building an Inclusive Development Community: A Manual on Including People with Disabilities in International Development Programs", Heinicke-Motsch, Karen and Susan Sygall, editors, Mobility International, USA, 2003 Chapter 4.1. 8 pages

People wanting to provide wheelchairs to those in developing countries who need them are most often guided by their hearts. The problem, however, is vast and complex, and unfortunately, things are not always as simple as they appear.

Many well-intentioned people donate old hospital style wheelchairs that granny used before she died to one or another charitable organization which more likely than not merely stuffs them into a container paid for under U.S. Humanitarian Assistance. Many, many chairs still need to be refurbished upon arrival, and will sit collecting dust and rust in some warehouse or storage yard waiting in vain for a local volunteer to clean them up and repair them. Those in good condition are not accompanied by instructions or spare parts to keep them in working order, so even if they start out being usable, they soon end up collecting dust or rusting away like the others. Providing free wheelchairs is likely to be a waste of money without there being a system or mechanism in place (both in the U.S. and in the target country) to ensure that only good quality wheelchairs will be sent and that they will be appropriate for each person who will use them.

Providing wheelchairs is not about wheelchairs. It is about providing people with the one thing they need to move out into their own communities – to go where the action is. It is about integrating people with disabilities into their society.

As long as wheelchair donors focus on the wheelchair and not on the end user, people with disabilities will remain dependent and unproductive, a drain on society's resources. When the needs of the end user are considered first, the most appropriate wheelchair (not merely the cheapest) can be provided, and with other targeted assistance, the wheelchair rider can go to school, get a job, and become a net contributor to society.

The underlying problem is that the usual market forces are not present in any significant way when it comes to the purchase of wheelchairs in developing countries. The end user most often cannot afford to pay for his or her wheelchair. The market for wheelchairs is made primarily by government agencies, development organizations, and charitable and religious institutions. Historically, the end user has been a mere object of charity, with unfortunate human and economic consequences. People who could be active with the right wheelchair for their situation receive an inappropriate chair that does not provide any significant improvement in their mobility, independence, or integration into society. A chair that is too wide, for example, is difficult to push and may be impossible to get through doorways. Besides the human cost, it is a waste of money.

The key player that is most often overlooked is the wheelchair rider him/herself. Or, rather, it is the local and national self-help service and advocacy organizations of people with disabilities. These organizations are in a position to advocate on behalf of those who need wheelchairs before the government agencies and charitable and development organizations which purchase wheelchairs to ensure that the recipient of a chair receives one that is appropriate for his or her situation (physical condition, age and size, geographic setting, personal goals, etc.).

With organizational development assistance, such as training in grant writing and management, the disability organizations can increase the local market for wheelchairs, which not only benefits a greater number of end users, but can also provide market stability for local wheelchair manufacturers, who are also likely to be employers of people with disabilities.

It Works in Siberia. The scenario just described has worked, and is currently working in Novosibirsk, Siberia. In 1993, with grants from U.S.AID, a disabled sports club transformed itself into an Independent Living Center, a service and advocacy center run by and for people with physical disabilities. At the same time, an Aeroflot helicopter repair facility and a newly established local small private company went into the wheelchair-building business. At the time, the government was buying wheelchairs from Russia's only then-existing wheelchair factory located near Moscow. In fact, there was no mechanism for buying wheelchairs anywhere else.

The activists from the disabled sports club convinced local rehabilitation administrators to make the case with Moscow to allow them to buy wheelchairs made locally, and they were successful. The rider-activists also convinced the local rehabilitation administrators to allow them to choose whether they wanted a chair from the Aeroflot factory or from the private company, whose wheelchairs were better built.

Today, the Novosibirsk Regional Center for Independent Living "FINIST" (Phoenix) is a sales agent for the private wheelchair company (the Aeroflot facility stopped building wheelchairs) and receives commissions. When it writes grants for job training programs, for example, it makes sure to include some amount for the purchase of appropriate wheelchairs so that each of the program participants will have a suitable wheelchair. FINIST also is involved in the annual Novosibirsk Regional budget process. In these ways, FINIST helps maintain a market for locally built wheelchairs.

Getting bang for your buck. Assuming no increase in available funding, spending money on the development of an organizational infrastructure in the target country will mean less money now for wheelchairs. In the long run, however, it will prove to be a more efficient use of resources. Wheelchairs that are sent will be used, not left to collect dust or rust. The average life of a wheelchair will be prolonged through proper maintenance andrepair. Wheelchair recipients will have increased mobility and independence with all the benefits that that implies. A well-supported infrastructure can mean jobs and income for those least likely to be employed. If all of this is integrated into a comprehensive program of physical, social, and vocational rehabilitation, it can become sustainable.

Pooling resources and efforts with other international aid organizations.   In almost every place where there is an international aid organization, there are two or more such organizations. Often, there are a half dozen or more. These organizations can share resources, such as a warehouse and the costs of maintaining a repair shop. Each can also provide a separate, non-duplicative function, with one providing wheelchairs, others training physical therapists, others providing organizational development assistance, etc. The ideal situation would be a sharing of some resources on the one hand and the continuation of individual activities on the other, even if these would be duplicative, in order to promote a healthy "competition" and give wheelchair users a choice of service providers.

Finding a Partner. The first step a donor organization must take is to secure a capable and reliable counterpart in the target country. That counterpart can either be a branch of the donating organization, another international development agency, or it can be a purely local organization. The ideal local organization is one that represents the interests of people who use wheelchairs. Preferably, this is an organization run by wheelchair users themselves because no one knows the problems wheelchair riders face better than wheelchair riders themselves.   Where this is not possible, or in the case where the international development agency chooses to partner with a non-disabled run organization, such as is the case with many church-affiliated programs, wheelchair users and/or local disability groups that represent wheelchair users should be actively involved to ensure that the needs of the end-user will be met.

The local partner needs to have the capacity to gather and relay accurate information to the US-based office. It needs to be able to handle all customs paperwork, and have a place to store the wheelchairs until they are distributed. It will need to be able to make final adjustments to the wheelchairs before they are distributed so they will best fit the recipient.   Depending on the arrangement with the US-based office, the local group may also need to have the capacity to refurbish the donated chairs.

Assessing the Need. The second step in any wheelchair donation program is an assessment of the actual need. It is not enough to simply send down wheelchairs with the idea that any wheelchair is better than no wheelchair. Important information to be gathered in an assessment includes:

a) Identifying the individuals who need wheelchairs;

b) Evaluating each prospective recipient's personal needs, including age, size, physical condition, geographic setting (rural or urban), personal goals, etc.). This is best accomplished through the services of a qualified physical or occupational therapist who can accurately measure and assess each prospective recipient and make appropriate recommendations for the type of wheelchair the individual needs. Local non-professionals, however, especially other people with disabilities, can be trained for this purpose.

c) Determining how the wheelchair rider will get his/her wheelchair repaired. Issues include 1) the availability of a person (usually a family member or a wheelchair or bicycle mechanic, but it could be the wheelchair user him or herself) who is able to maintain and repair the wheelchair; 2) the availability of spare parts, especially those parts that wear out most often, including tires, inner tubes, and bearings; and 3) the source of adequate funds to repair the wheelchair. The life expectancy of the wheelchair (usually between 2 and 5 years for active use) and the annual cost of wheelchair repairs must also be estimated.

There are currently three organizations worldwide that specialize in appropriate wheelchair design for developing countries. They are a) Whirlwind Wheelchair International, based at San Francisco State University; b) Motivation, based in Bristol, England; and Handicap International, based in Belgium. Depending on the target country, the assessment phase should include consultations with at least one of these organizations.

Setting up the program. The simplest situation is one where new wheelchairs are sent to a city or region that has a parts distributor who sells parts very cheaply. Of course, the simplest situation is rarely ever the real one. This is because most donated wheelchairs are likely to be used wheelchairs. These chairs need to be cleaned and often adjusted or repaired. Because of the difficulty in acquiring replacement parts in

many places around the world, it is often best to have the chairs cleaned and repaired before shipment. (On the other hand, a big advantage to repairing the chairs once they reach the target site is the creation of local job opportunities, and of course, it will be more cost-effective to have the chair repaired in the target country where labor is considerably cheaper.)

Standardization is a good idea. The wide variety of wheelchairs, not only of different types but from different manufacturers, makes the spare parts problem all the more difficult. Rather than accept any wheelchair that is donated to it, the U.S. organization might want to concentrate on only a few types of wheelchairs from only one or two different manufacturers. This strategy has the advantage of making it easier to acquire spare parts. Chairs that cannot be repaired can be stripped of their parts, which can be sent along with the shipment of complete wheelchairs. For the wheelchair users in the target country, standardization means that a broken down old wheelchair will still be useful as a source for spare parts. Funds raised to purchase new spare parts can also take advantage of bulk pricing. Standardization should not be confused with the one-size-fits-all model. Here we are referring only to standardization of types and models of chairs. Different sizes and customization remain indispensable options.

The Problem of electric wheelchairs. Extra careful attention should be paid when considering the donation of an electric wheelchair. All of the problems discussed above are multiplied many times over with an electric wheelchair. Parts are expensive, almost always unavailable, and special training is usually required to diagnose and repair problems.   Although an electric wheelchair can increase a person's range of mobility and allow for independent travel, the lack of accessible architectural features such as curb ramps, building ramps, and elevators, not to mention kneeling buses and the like, can make it more difficult for the rider with a heavy electric wheelchair.

Seat Cushions are indispensable. One area that is usually overlooked by wheelchair donors is the critical need for adequate seat cushions. Far from providing new life to a previously immobile person, a wheelchair without a proper cushion can mean death from pressure sores. Pressure sores, also known as decubiti, are breakdowns of the skin caused by continuous pressure of the underlying bones against a hard surface. People with full feeling in their buttocks and legs frequently and automatically adjust their sitting, lying and standing postures in order to relieve the pain and discomfort that can be caused by these pressures even after only a few minutes in one position. A person with a spinal cord injury, however, does not feel pain from sitting in one position, and general discomfort may arise only after a long time when the body's internal mechanisms try to cope with an injury that has already occurred. The best possible cushion, correct posture, and awareness of techniques to frequently relieve pressure and adjust weight distribution are necessary if the spinal cord injured person is to avoid pressure sores.

In a paper entitled "Coordinating Wheelchair Provision in Developing Countries, presented at the RESNA 2000 conference (Rehabilitation Engineering Society of North America – now known only by its acronym) Matt McCambridge, MSE, discussed principles of "responsible wheelchair provision."

"The rider must receive training in pressure ulcer management and the use and care of a wheelchair," writes McCambridge. "Provisions must be made to ensure that the chair can be repaired, and follow up assessment should be done to determine whether the equipment meets the person's needs."

Three basic choices are available when providing a cushion. One is to provide a standard foam or air-filled cushion with each donated chair. Another is to send a cushion that has been custom made for the recipient. The third is to have cushions made in the target country using available low-cost materials. This last alternative has been the subject of an annual international competition sponsored by RESNA beginning in 1996. "Over the years, many innovative and successful designs have been entered into the competition. The winning designs for each year of the competition from 1996 to 1999 were: (a) Bicycle inner tubes tied into individual semi-inflated segments, arranged in rectangular pattern 3 layers deep; (b) Foam rubber sheet over contoured coconut coir (scooped out under ischials and tailbone), rubberized cloth; (c) Buckwheat hulls in a bag sewn from a T-shirt; and (d) Foam block scored in checkerboard pattern to minimize shear, cavity under tailbone filled with coconut fibers, linen cover with zipper." (From RESNA 2000 Proceedings – For more information contact Beneficial Designs, Inc. Website: http://www.beneficialdesigns.com

THE UNSEEN DANGERS OF DONATED WHEELCHAIRS

Unfair Competition. If one of the goals of international aid organizations is to develop sustainable programs, that is, to help people to help themselves, then free imports of used wheelchairs from the U.S. defeats that purpose in an important way: it undermines the development of local wheelchair manufacture. If any foreign company, in any other industry, sold its products below cost in another country, it would be accused of unfair competition and dumping, in violation of international trade agreements. Yet we applaud the free distribution of wheelchairs that cost a lot to refurbish, ship, and distribute, even if these costs are hidden because they are paid for through donations, volunteer labor, and 100% subsidized shipping.

To avoid competition with an existing wheelchair manufacturer, it is not enough that a person who gets a free wheelchair lives far from the factory, or that his or her family could not afford to buy a wheelchair anyway. In a free market, wheelchairs, like all goods, will insinuate themselves into the marketplace. There are many, many examples of wheelchair users with perfectly good chairs who have learned that a quick buck is to be made by crawling in to the local church wheelchair giveaway site, or showing up in a

decrepit old wheelchair, in order to receive a free chair, which he later sells to a trader at the flea market. And a family that lives hand to mouth will sell its donated wheelchair, trading any advantages the wheelchair might give, so it can survive for the next few months. Is this any wonder when you consider that in India there are beggar families that maim and disfigure their children in order to make them more successful at begging?

Of course, for every wheelchair sold, there must be a buyer. But since the buyers of wheelchairs are principally government agencies and charitable and development organizations, there is pressure on these organizations to buy cheaper chairs on the open market, rather than from the local manufacturer. In at least one case, a wheelchair manufacturer himself bought the imported, donated wheelchairs at the flea market and included them in a batch of wheelchairs purchased by the international funding source. The manufacturer may not have lost money, but his employees, some of whom were wheelchair riders themselves, lost an opportunity to earn their wages.

The right tool for the right job. There are many wrong, even if well-intentioned, reasons to be involved in providing wheelchairs to people with disabilities in developing countries. There is only one right reason: To provide the wheelchair user with real mobility that will improve his or her opportunities to be an active, integrated member of the local community and of society in general, by being able to leave the confines of home or hospital in order to go to school, get a job, shop for food, and engage in all those other activities independently mobile people do every day. The wrong wheelchair won't help its rider do any of that.

Note: Special Thanks to Alicia Contreras, Director, Whirlwind Women, for the ideas she contributed to this paper.

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Chapter 6.1

Applying Universal Design for Learning in a Graduate Management Information Systems Course:

P. Beckman, PhD.

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Chapter 6.1

Applying Universal Design for Learning in a Graduate Management Information Systems Course:

P. Beckman, PhD.

Introduction

The concept of Universal Design (UD) arose from the efforts of architects who tried to "design in" architectural features that would provide the easiest and widest possible use to the largest audience of users. Prior to this concept, attempts at widening the usability of an architectural feature were typically made after the final construction of, for example, a building. The results of these after-the-fact changes were often not in congruence with the original architectural design, not as usable as a similar feature that had been designed-in from the start, and more costly than a completed design that had incorporated a similar feature from the beginning. The generally-accepted founder of both the concept and the term "universal design", Ron Mace, worked most of his life in promoting the greatest accessibility to the widest audience.

Universal Design is now a common aspect of architectural design and its use is accepted and promoted as a standard method of design and a way of allowing the largest number of users of a building to access its features most readily. The general concepts associated with universal design have made their way into other fields of architecture beyond building design and construction. One commonly cited example of universal design that has been adopted in cities around the world is the "curb cut". A curb cut is sloped reduction in the curb height at the edge of a street, typically at a corner or intersection. Without a curb cut, it is very difficult for individuals using wheelchairs to move from the level of the street to the level of the adjacent sidewalk. Proponents of universal design point out that curb cuts enhance the usability of the sidewalk not only for those who use wheelchairs, but also for those pushing baby strollers, those moving large appliances like refrigerators when moving into a new home, bicyclists, the blind, skateboarders, roller-skaters, and the elderly. It is possible in some cases to alter the original design of the sidewalk after-the-fact by placing some type of ramp against the curb that provides some of the features of a curb cut. However, such modifications typically protrude into the street, are not as smooth to traverse, and almost always are not as integrated aesthetically as the solution of originally designing the sidewalk with a curb cut right from the start.

Proponents of universal design argue, therefore, that it is much better for all involved to attempt from the very start to incorporate into the design process, any mechanism or feature that will most widely accommodate the largest number of users. Leaving this type of thinking to modifications after the construction is completed will not nearly accomplish the goals to the extent of understanding universal design and applying them from the start of an architectural project.

Universal Design for Learning
Universal Design for Learning (UDL) takes the general features of universal design and applies them to a learning environment. This implies that a learning module of any size from a single assignment to an entire course should be design from the start with one goal of accommodating the widest possible audience of learners. As in the application of universal design, designing in those features from the start of the process should yield a final learning module that is more highly integrated and accessible to a wider range of learners, both of which should result in better learning for more learners.

The field of UDL was first formalized in a set of principles proposed by Arthur Chickering and Zelda Gamson (1987). They described their seven practices of UDL principles as:

> 1. Encourages contact between students and faculty.
> 2. Develops reciprocity and cooperation among students.
> 3. Encourages active learning.
> 4. Gives prompt feedback.
> 5. Emphasizes time on task.
> 6. Communicates high expectations.
> 7. Respects diverse talents and ways of learning.

Other individuals and groups have also played a large role in the advancement of refining appropriate actions to take to promote and implement UDL. The Center for Applied Special Technology (CAST), founded in 1984, has as a central purpose "development of innovative, technology-based educational resources and strategies". CAST has played a leading role in the academic study of UDL, as well as in changing industry practices and governmental policies related to UDL.

Numerous academic institutions have also participated in the promotion of UDL. One of those academic organizations that has supported research into the application of UDL is Sonoma State University (Ayala, 2005). It entered the UDL domain of study through applying for and winning a U.S. federal grant called the EnACT grant, to support students with disabilities complete their post-secondary goals in the California State University system. One early result of the EnACT grant was the creation of a set of four high-level UDL principles, each of which was broken down into 3-4 "UDL Elements".

The four high-level UDL principles are and their associated elements are:

<u>*General*</u>

1. A statement or information is contained in my course syllabus that specifies campus-based student support services, including disability support services.
2. I provide a comprehensive syllabus that clearly specifies all course requirements, course expectations and due dates.
3. I offer multiple forms of contact information so students have varied ways to contact me with questions or concerns.

<u>*Representation*</u>

4. I utilize multiple methods of expressing general course content utilizing different modes (visual, graphic, verbal, auditory, etc.) so students have varied ways to access the course content.
5. I provide multiple ways of clearly identifying and explaining essential course concepts (lecture with guided notes, etc.).
6. I ensure accessibility in all course content and materials (accessible websites, captioned videos, e-textbooks, etc.).
7. I provide examples and/or illustrations of all major course assignments or activities.

<u>*Engagement*</u>

8. I offer varied instructional methods to involve students in the learning process throughout the semester (lecture, small group work, online assignments, class discussion, etc.).
9. I encourage natural support systems (study buddy, partner work, study groups, etc.) in and outside of class.
10. I provide alternatives for students on how they can participate or complete all major course assignments or activities.

<u>*Expression*</u>

11. I offer clear and specific feedback on assignments and encourage re-submission of assignments as appropriate.
12. I allow students to demonstrate their knowledge of subject matter through a variety of means (oral presentation, written report etc.).
13. I encourage the use of assistive, adaptive or other technologies to ensure that students can accurately express what they know.
14. I provide clear guidelines and/or evaluation rubrics for all major course assignments or activities.

Since Sonoma State University is part of the California State University (CSU) system, one condition of the EnACT grant was to invite other CSU campuses to participate and expand their own understanding and applications of the principles of UDL. By the end of the third year of the EnACT grant, that expansion ultimately included eight campuses of the CSU system. San Francisco State University (SFSU), a member institution of the CSU, and a second-year participant in the EnACT grant, took several actions to increase the visibility of UDL concepts. One of these actions was to create a "Faculty Learning Community" (FLC) in which interested faculty members met once per month to talk about their own attempts at adopting UDL concepts. Another action SFSU took was to create "case stories" wherein interested faculty members told, through text and sometimes video, their own academic and personal reasons for adopting UDL principles. Those faculty members were encouraged to explore their reasons for adopting UDL and to document their UDL applications and the results of those applications. The research project documented in this article is one outcome of SFSU's participation in the EnACT grant, and describes one faculty member's adoption, documentation, and qualitative analysis of applying very specific UDL concepts in the teaching of a graduate course in information systems.

Methodology

For this particular project, the first step in applying UDL concepts in a classroom required finding literature that described previous attempts at applying UDL concepts. Although there is some prior research that discusses applying UDL concepts in a classroom, almost all pertains to K-12 education, education for students with special needs, or only speaks to UDL issues at a very high level. For a college instructor trying to apply UDL concepts in a classroom, there is almost no guidance about very specific actions that one can take to broaden the accessibility of learning modules.

The results of a lengthy literature search resulted in a very inconclusive, over-lapping, and non-independent set of classroom actions. The value of this list, however is that it contains a very specific set of actions, most of which can generally be implemented quickly and will have a direct impact on expanding accessibility of education and learning. While a few elements on the list may be more effective or appropriate for some academic fields of study, none are exclusive or particular to any academic domain.

Note also that some of the elements on the list have been practiced for years and/or may be fairly obvious. In alphabetic order, the elements of that list are:

- "Alt" tags for images
- Alternative access to teleconferences and videoconferences
- Appropriate use of color
- Audio output
- Avoid page elements that flicker
- between 2-55 Hz: seizures
- Bulletin boards
- Captioning of video
- Case studies
- Choice in appearance of content
- Choice in content
- Choice in level of support
- Choice in method of response
- Choice in speed and distractors
- Choice in type of support
- Community service
- Consistent web page layout
- Contact via email
- Contact via listserv
- Contact via online forums
- Email
- Email distribution lists
- Face students when talking
- Flexible images
- Flexible-use furniture
- Games
- Hands-on class demonstrations
- Hyperlinks to related material
- Multiple forms of distribution of
- course materials
- Nearby restrooms; telephones; parking
- Note-taking by several alternating students to be posted for all students
- Notes: "blanks" in notes that students fill
- in from class discussion
- Notes: posted online prior to class
- Possibility of one-on-one interaction with
- students
- Read aloud and describe text
- Real-time chat
- Small group discussions
- Speak clearly
- Supply visual outlines
- Text captioning
- Text of printed materials available online
- Text that is compatible with speech generators
- Text that has hyperlinks
- Text with accompanying background
- information
- Text with flexible font sizes
- Transcription
- Uncluttered web pages
- Use HTML validators
- Usenet discussion groups
- Video
- Virtual reality
- Wheelchair accessible

From this starting point of possible specific actions to take, the next step was to select those items that would be most appropriate for a graduate course in Information Systems. Also, an attempt was made to select items that would yield the greatest impact on expanding accessibility of learning. For example, adding "alt tags" to images is fairly simple to do, but if the learning module does not contain many images, this particular action will not likely have much impact on increasing the accessibility of that learning module. Conversely, posting course notes on-line prior to the start of class can increase the accessibility of learning to every student in the class, presuming that all students have access to the Internet and the notes are posted in an accessible format.

While it would be most valuable in increasing accessibility by adopting every element on the list, resource limitations prevented that option. Also, characteristics of the section somewhat constrained selection of which list items to choose. The section was an evening graduate overview course on Management Information Systems comprised of about 30 students. Given these considerations, the elements that were chosen to adopt were:

1. **"small-group discussions:"** meaning, at points during a class session, lecture and general discussion would be halted and the class would break up into smaller groups to discuss some aspect of the topic at hand and answer some questions. After 10-15 minutes, the groups would reconvene and each group would offer their solutions and insights. The comments from all groups were then posted back to the notes that had been posted prior to that class session.

2. **"notes: blanks in notes that students fill in from class discussion:"** meaning, one some class presentation slides, words or sections of text were deleted and replaced with underlined blanks. When that point was reached in the class session, students would fill in those underlined blanks with the correct answer as determined by a discussion of that topic during class.

3. **"hyperlinks to related material:"** meaning, at several points during the semester, reference was made to some on-line resource that could further describe or expound on a topic that was simply too large to complete in class. Students could write down the URL of that on-line reference, or they could link directly to that reference if they were perusing the notes that were posted prior to the start of that class.

Some of the more obvious list elements for a graduate information systems course, such as "Notes: posted online prior to class"; "Multiple forms of distribution of course materials", and "E-mail" were already in place. In general, list elements were chosen to have the greatest impact on increasing learning accessibility while being possible to implement in a single semester without having to re-construct the entire course.

After the three UDL concept elements were chosen, deliberation was needed to determine at which points in the class those actions should be taken. Since the course was about management of information systems, an attempt was made to select topics in the course that most closely fit with the three chosen UDL elements.

For UDL concept #1 (small-group discussions), the specific IS topics chosen were:

1. Selecting Michael Porter's competitive strategies
2. Identifying Marshall McLuhan's elements of communication
3. Identifying data generated in each SDLC stage
4. Choosing user-interface designs
5. Pairing e-commerce processes with e-commerce types

For each of these 5 topics, the class was divided into small groups of about 5-6 students. Each small group was then tasked with investigating some aspect of that topic, determining a solution for that task, and reporting their solution back to the class as a whole. Because each of the topics concerned a different area of information systems, the tasks associated with each topic was different (See Appendix for details of each topic small-group discussion task).

For UDL concept #2 (notes: blanks in notes that students fill in from class discussion), there were numerous options from which to select. In fact, almost every presentation slide discussed during the semester contained some relevant piece of information that could be removed and filled in with a blank. To make it easier for students to use this process, PowerPoint slides of the days lecture were posted several days prior to class. Also, specific relevant IS concepts had been deleted from some slides and those deleted pieces of text replaced with underlined blanks. Students could therefore print the class lecture notes before class, wait for the class discussion pertaining to a missing discussion point, and then simply "fill in the blank" on their notes after hearing the correct point. As one example, when discussing the different types of knowledge that organizations might choose to store in a knowledge management system, the following text was displayed:

Types of knowledge:
_____ knowledge: data, documents, things written down or stored on computers
_____ knowledge: the "how-tos" of knowledge, which reside in workers

When this point in the lecture was reached, there was a discussion in class about different types of knowledge, and the point made that explicit knowledge is likely much easier to capture and store but also likely of less value to the organization whereas tacit knowledge is likely much more difficult to capture and store but likely of greater value to the organization. There are, of course, numerous possibilities during any one individual class session where relevant text can be blanked out.

For UDL concept #3 (hyperlinks to related material), there were also numerous points in the semester where on-line resources could be referenced. Because of the wide-ranging nature of the study of information systems (from detailed technology to broad theories), it was possible to choose different types of on-line resources. A conscious decision was made to try not to reference materials that were similar in nature to what was presented in class. Therefore, most on-line references were to multi-media resources instead of to textual resources. For example, to illustrate the relationship between using the power of information technology to perform complex tasks and the ability to create a viable business model from such a system, students were referred to a robotic device that performs as a bartender (DeLeon, 2006). There are numerous information technologies in such a robot, but there are also numerous questions about whether such a device could sustain a viable business. Another example used in the class was a reference to an on-line resource that graphically described how relational databases function. As with UDL concept #2 described above, there are many instances during a course where references could be made to on-line resources.

Analysis and Results

Thus far, only a qualitative analysis has been made of the results of applying UDL concepts in a graduate information systems course.

With regard to UDL concept #1 (small-group discussions): Students who were reluctant to speak to the whole class would often and more comfortably make comments in the small groups. Since each small group discussed a slightly different aspect of the main topic, the class as a whole was able to delve more deeply into that topic. By re-posting notes with the small-group discussion results, students could see the fruits of their labor. Students also seem to like the break from sitting and listening to my lecture and the larger class discussions. Their level of animation also changes immensely when the class switches from whole-class discussion/lecture to small-group discussions.

With regard to UDL concept #2 (notes: blanks in notes that students fill in from class discussion): Students have a greater incentive to attend class which might help some instructors who are hesitant to post their notes beforehand for fear that students will no longer attend class. This also forces students to pay more attention in class if they want to put the correct answer into the blank space in their notes. It is simply human nature that people in general do not like gaps in a continuous series of anything, so students were more closely focused on the class discussion so they could complete their collection of notes. Students were focusing more precisely at these points in time as evidenced by a much higher percentage of forward-facing heads, as compared to times in class where the presentation slide had no blanks.

With regard to UDL concept #3 (hyperlinks to related material): This process allowed students to get deeper descriptions or examples of the topics that were discussed in class. There is only so much time that an instructor can spend on academic topics in class; typically there are many other topics that the instructor wishes to cover but cannot due to time constraints. It is difficult to gauge the effectiveness of this particular UDL concept since students were not required to submit any graded material based on those on-line resources.

Conclusions

This experiment involved applying specific concepts of UDL in a graduate management information systems course. Many detailed actions were extracted from an analysis of the existing literature. From that list of specific UDL elements, three were chosen to implement in a classroom setting. The particular places to apply those concepts were selected based on the characteristics of the concepts, the topics covered in the class, and the resources available to the instructor. Qualitative results of the application of UDL concepts were presented.

One of the most time-consuming tasks associated with this project was collecting the very specific UDL elements that can be applied. There currently exists no such single source of detailed actions that an instructor can perform to apply UDL concepts in their classroom. After that list was created, it was a much more simple matter to select appropriate UDL elements and pair them with appropriate information systems topics.

A qualitative analysis of the results of applying UDL concepts suggests that small-group discussions give students increase engagement with the course material and a different representation of that material. Inserting blanks in place text for relevant topic concepts seems to increase student engagement of the material, and providing access to on-line resources for appropriate information systems concepts gives students a different representation of course material.

The concept of UDL is a relatively new but rapidly growing field. It is also one that post-secondary instructors in all academic areas can apply to increase the effectiveness of their teaching while also increasing the accessibility of their instruction. This research project attempts to first gather into one document very specific actions that the interested instructor can apply and secondly present some initial evidence applying those specific actions.

References

Ayala, E. *Ensuring Access Through Collaboration and Technology*, 2005, Sonoma State University website, found at: http://enact.sonoma.edu/, accessed February 1, 2008.

Chickering, A., and Gamson, Z. "Seven Principles for Good Practice in Undergraduate Education", *The American Association for Higher Education Bulletin*, March 1987.

DeLeon, N. "Bartending Robot Mixes Drinks, Helps Ruin Lives", *GIZMODO*, September, 2008, on-line, found at: http://gizmodo.com/gadgets/robots/bartending-robot-mixes-drinks-helps-ruin-lives-203955.php, accessed February 1, 2008.

Hitchcock, C., Meyer, A., Rose, D., and Jackson, R. "Providing New Access to the General Curriculum: Universal Design for Learning", *Teaching Exceptional Children*, 35 (2), November-December 2002, pp. 8-17.

Connell, B., Jones, M., Mace, R., Mueller, J., Mullick, A., Ostroff, E., Sanford, J., Steinfeld, E., Story, M., and Vanderheiden, G. "The Principles of Universal Design", North Carolina State University, Center for Universal Design, College of Design Poster, 1997, found online at: http://www.design.ncsu.edu/cud/pubs_p/docs/poster.pdf; accessed February 1, 2008.

Rose, D. "Walking the Walk: Universal Design on the Web", *Journal of Special Education Technology ejournal*, 15 (3), Summer, 2000.

Rose, D., and Meyer, A. "Teaching Every Student in the Digital Age: Universal Design for Learning", (ISBN: 0-87120-599-8), Published by the Association for Supervision and Curriculum Development, Alexandria, VA, 2002, 228 pages

Spooner, F., Baker, J., Harris, A., Ahlgrim-Delzell, L., and Browder, D. "Effects of Training in Universal Design for Learning on Lesson Plan Development", *Remedial and Special Education*, 28 (2), March/April, 2007, pp. 108-116.

APPENDIX

Small-group discussion tasks:

Task 1: **Michael Porter's competitive strategies task:**

Break into 5 groups

Each group: consider one competitive strategy

Group 1: Cost leadership
Group 2: Differentiation
Group 3: Innovation
Group 4: Growth
Group 5: Alliance

Think of two firms that use that strategy
        For each of those two firms
Which competitive force (threat) is greatest (competitors, new entrants,
        substitute products, customers, suppliers)? Why? And is either of your firms
        being attacked by one of those competitive forces?

Task 2: **User-interface design task:**

Break into 5 groups, one for each of the operating systems functions:

1. Resource Management
2. Task Management
3. File Management
4. Performance Monitoring
5. Security Monitoring

Each group answer the following question:
        Which type of user interface would you propose (command-driven, menu-
        driven, or graphical user interface) for that operating system function? Why?

Task 3: **Marshall McLuhan's elements of communication task:**
Break into 5 groups, one for each of the communication elements:

1. Sender
2. Encoder
3. Channel
4. Decoder
5. Receiver

Each group answer the following question:

What are ALL of the parts of your group's element for communication in:

A. Calling a dog to "heel"
B. Discussing a classroom topic in BUS 782
C. Talking to a friend via landline telephones
D. Connecting your home computer to eBay

Task 4: E-commerce processes task

Break into 5 groups

Each group choose one of the 9 essential e-commerce processes and tell me which one

Answer the following questions:

1. What general data is created in/by that process?
2. Which e-commerce type (B2C, B2B, or C2C) is this process most relevant to? Why? (Be sure to consider the users of your chosen process.)

Task 5: SDLC stages task:

Break into 5 groups, one for each SDLC stage:

Group 1: Stage 3 - Design
Group 2: Stage 2 - Analysis
Group 3: Stage 5 - Maintenance
Group 4: Stage 1 - Investigation
Group 5: Stage 4 – Implementation

Answer the following question:
In general, what data would you pass on to the next stage?

Chapter 6.2

Accessibility and Universal Design

Kevin Kelly

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Chapter 6.2

Accessibility and Universal Design

Natasha Boskic, Kirsten Bole, Kevin Kelly, Nathan Hapke
(Repurposed by Kevin Kelly)

Introduction

Most of the content written in this chapter was originally based on the work performed at the University of British Columbia (UBC) as a part of the "Web Content Accessibility" project in the period September 2005 – August 2006 (Boskic, Bole, Kelly, & Hapke, 2008). The content of this chapter has been repurposed to correspond to work performed at San Francisco State University (SF State) and in the California State University system. There are several references to chapters from *Education for a Digital World* (2008), as the original chapter was written in conjunction with these other authors' chapters.

Great efforts have been made to give every student equal access to high-quality learning, and to remove barriers for people with disabilities. However, most of these efforts are focused on the traditional, face-to-face classroom experience. Less attention is devoted to those taking courses fully online, and their ability or inability to cope with web-based interactive content. While standards and guidelines have been developed to support and assist with accessible web design, their primary focus has been on technical specifications, assistive technologies, or legal issues. Fewer studies have been conducted to investigate how that "accessible" content is perceived from a learner's perspective, and how helpful it really is.

As distance learning adapts to new technology, instructors should be innovative in their relationship with students and in the methods for developing educational content, accommodating the diverse needs and learning styles which will be beneficial for all, regardless of their (dis)abilities.

At the beginning of this chapter you will find a brief description of the situation at post-secondary institutions, regarding adjustments of their online materials to students with disabilities, as well as legal and ethical framework for making modifications. You will find information about, and examples of, applying principles for universal design for learning o the online environment for the benefit of everyone. A description of various disabilities will follow, where we will focus on specific student needs. Next, you will learn about legal requirements and existing standards for creating web content. We will describe practical steps and procedures and explain them with respect to different elements of online material design, together with several ways for testing and assessing accessibility. At the end of the chapter you will find a list of additional resources for further exploration.

> 'If the basics of **usable design** are ignored all users can be disabled by the inappropriate use of technology'. (P. Jeffels, 2005*).*

Framework

Accessibility at higher education institutions

Universities are increasingly becoming involved in technology-based education programs. The level of sophistication of such offerings (cohort organizations, electronic learning) is accelerating rapidly. However, persons with disabilities, taking courses off campus, do not always have the same rights of access and program accommodation as those on-campus. In some cases, slow Internet access is a problem, and in other cases, electronic course offerings have not been coded to support adaptive technologies such as screen readers, Braille display, enhanced print size, voice-over, and sip and puff control. The end result is an unfair imbalance in academic access.

Conformance with the **World Wide Web Consortium**'s (W3C, an international organization for developing Web standards) and its **Web Content Accessibility Guidelines** 1.0 enhances the market share and audience reach of programs by increasing their general **usability**. Adoption of WCAG 1.0 recommendations demonstrates a commitment to social responsibility and equity of access to education, information, and services.

These changes do not have to be substantial to be successful. Web accessibility is usually achieved by careful planning and attention to details. This all translates into **universal design for learning** (UDL), a practice of designing web pages so that they can be navigated and read by everyone, regardless of location, experience, or the type of computer and technology used. In addition, it means providing educational material with flexible goals, instructional and assessments strategies that apply to different learning styles and practices. We will talk more about universal design in section 3.2 of this chapter.

With an increase in life-long learners, as well as those who are returning to school for their professional development or upgrade, removing barriers to web access becomes even more pressing.

Legislation

In the United States, a law called **Section 508** requires federal agencies to ensure that people with disabilities have the same access to information in electronic systems as people without disabilities.

> *"Section 508 requires that when Federal agencies develop, procure, maintain, or use electronic and information technology, Federal employees with disabilities have access to and use of information and data that is comparable to the access and use by Federal employees who are not individuals with disabilities, unless an undue burden would be imposed on the agency. Section 508 also requires that individuals with disabilities, who are members of the public seeking information or services from a Federal agency, have access to and use of information and data that is comparable to that provided to the public who are not individuals with disabilities, unless an undue burden would be imposed on the agency"* (Section 508, 2006, Subpart A – General, para. 1).

In the United Kingdom, there is a similar law known as SENDA (Special Educational Needs and Disabilities Act) that applies specifically to students.

Canada has no such law at the moment, but the Canadian Human Rights Act and the Charter of Rights and Freedoms both deal with discrimination on the basis of disability. A failure to provide information in an accessible manner could be considered discrimination if no reasonable attempt is made to accommodate the disabled person.

The Human Rights and Equal Opportunity Commission (HREOC) in Australia published World Wide Web Access: Disability Discrimination Act Advisory Notes. All government websites are required to follow these policies and guidelines.

Around the world, accessibility and information access issues are being addressed at different levels. The Report on Developments World-Wide on National Information Policy (2001) gives a nice overview of what a number of countries are doing to support all online users, including those with special needs.

Background

The term "disability" is very broad, and can include persons with sensory impairments (blind or visually impaired, deaf or hard of hearing), learning disabilities, motor functioning problems, or neurological impairments. The number and severity of challenges increases with the age of the population served, especially in the area of sensory impairment. For example, while the Canadian Federal government reports that the overall disability rate in the total population is about 12.4, for persons between the age of 65 and 74 it increases to 31.2% (Statistics Canada, 2001, para. 2).

The main goal is to improve usability and to provide academically qualified online learners with disabilities with full, fair, and equal access to all university services and programs. This means either redesigning the existing electronic content or developing a new one with accessibility in mind. Usually, you need to do both.

The first step is to carefully look at the courses or modules and determine their level of accessibility. Consultation and collaboration with users, advocacy groups, other university and government agencies, and various experts is very helpful. In the case of the project described here, all the procedures were tested by making adaptations and necessary changes inside WebCT. During this process, it is important that the work does not entail any modification of the academic standards of the university or elimination of the academic evaluation of students.

Making online courses accessible to students with disabilities, i.e. providing easy and consistent navigation structure, and presenting the material in a clear and organized way, benefits all students, regardless of their physical and mental condition. Every student is different; everyone has different levels of comfort with new technology, from computer-shy technophobe to web-savvy expert. We are all in the process of adapting to new tools. In a survey conducted at Renton Technical College in Renton, Washington, in 2002, the highest number of participants (31%) reported difficulties in studying and troubles with computers (Microsoft, 2005). It will take a lot of time for computers or similar devices to become as invisible and user-friendly as books, for example. Universal design for learning **principles** attempt to reach that "easiness" by improving usability for non-disabled and disabled users alike, supporting persons with low literacy levels, improving search engine listings and resource discovery, repurposing content for multiple formats or devices, increasing support for internationalization of courses, and assisting access for low-bandwidth users.

An inaccessible site in a corporate world may lose clients. In an educational setting, the quality of a learning experience is much more difficult to measure, since it is not only a matter of numbers and physical access. With this awareness, content should be presented in a variety of ways to meet the online learners' needs. Material that is inaccessible to a student with a disability can be offered in an alternative format. However, tnot everything can be made accessible without compromising the value of the learning experience. Teaching visual concepts and explaining different colour schemes, for example, is not fully adaptable for students who are blind. The materials should be made as accessible as possible for most groups of disabled students, but some people ultimately may still be excluded. In those cases, you will need to offer alternative exercises for the affected student, although producing such materials can be time consuming. The choice of different delivery methods can exist, but only "in an ideal world" (Draffan & Rainger, 2006).

Every effort made to increase accessibility will help to disseminate information on accessibility issues and provide a basis for raising awareness not only in British Columbia, where this project was conducted, but in wider academic communities as well.

Accessibility at San Francisco State University

After the California State University (CSU) Board of Trustees issued Executive Order 926, Policy on Disability Support and Accommodations, all twenty-three CSU campuses began or continued existing actions to meet the requirements.

> In the Fall of 2006, San Francisco State University (SF State) launched the Accessible Technology Initiative (ATI) in order to develop a work plan, guidance, and resources to assist the campus-at-large in ensuring full and equal access to electronic and information technology to individuals with disabilities. The SF State ATI is a reflection of the University's ongoing commitment to equity and social justice. (http://www.sfsu.edu/access)

In a separate but related activity, SF State joined Sonoma State University as part of the Ensuring Access Through Collaboration and Technology (EnACT) Grant. Led by the Center for Teaching and Faculty Development (CTFD) and the Disability Programs and Resource Center (DPRC), the grant coordinators held workshops and began creating online resources about universal design for learning, facilitated faculty learning committees, and began collecting case stories about how SF State faculty have accommodated the needs of students with disabilities.

Universal Design

The other sections of this chapter discuss how to address accessibility issues for an online environment, along with resources, activities, and assessments used with face-to-face coursework or a fully online course. If you are just starting out, you can address these issues and numerous others from the beginning by using **Universal Design for Learning** (UDL) principles. UDL builds upon universal design concepts from other fields, such as architecture and urban planning, and applies them to learning situations.

The "curb cut" is a common urban planning example used to demonstrate the fundamental idea of UDL. Since the Americans with Disabilities Act of 1990, curb cuts—ramps extending from the street up to the sidewalk—are mandatory. Curb cuts allow people who use wheelchairs or who have low mobility to go from sidewalk to street and back again more easily. However, to add a curb cut to an existing sidewalk requires a jackhammer and a lot of extra work. Making a sidewalk that was designed with a curb cut from the beginning is much easier. Similarly, it is often easier to accommodate different learning needs by designing the course with those needs in mind.

As we will see with accessibility solutions for online learning, the curb cut accommodates everyone, not just the intended audience. Parents with strollers, children walking their bicycles, skateboarders, and more benefit from curb cuts as much as people in wheelchairs. Along the same lines, the Center for Applied Special Technology (CAST) refers to UDL as "Teaching Every Student," stating that universal design for learning "calls for

- multiple means of representation to give learners various ways of acquiring information and knowledge,
- multiple means of expression to provide learners alternatives for demonstrating what they know, and
- multiple means of engagement to tap into learners' interests, challenge them appropriately, and motivate them to learn."

Almost every online accessibility accommodation strategy designed for students with disabilities also helps other students. For example, English second-language learners (ESL students) frequently use screen readers that were originally created for people who are blind or who have visual impairments. They benefit from hearing the text spoken out loud as they read. . Overall, UDL assists students with disabilities, certainly, but also assists students who are non-native language speakers, students with different learning styles, students with different levels of Internet connectivity and access to technology, and even students who require more assistance with self-motivation. Let's take a look at different ways to apply universal design for learning to your online course. We will use the comprehensive learning styles framework created by Richard M. Felder and Barbara

A. Soloman of North Carolina State University to structure the discussion about UDL strategies (http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSpage.html).

Multiple means of representation

You probably remember teachers whom you felt gave you everything you needed to succeed when you were a student. These teachers provided handouts in the classroom, links to resources on the Internet, copies of their presentations, and more. You may also remember teachers who did not provide many resources. The resources they did provide may have been text-only documents or handouts that helped a select few students in the class. Perhaps they made one copy of an important set of materials for checkout, requiring you to wait until someone else turned it in before you could review it. This section will give you ideas about ways in which you and, in some cases, your students, can provide alternative course materials and resources that increase the number of students who succeed in reaching the objectives.

Sensory input

First, we need to consider the different ways that people get information into their heads, and the types of resources that students prefer. Later, we will discuss ways to help students encode and retain any knowledge or skills that they need to succeed in your class or beyond.

Visual-verbal, or text-based resources, help learners who prefer to read. These are usually the most common type of online learning resource, ranging from documents and presentations to web pages. However, text-based resources must be made accessible to people with visual impairments, such as using Optical Character Recognition (OCR) to convert scanned documents to text.

Saving text-based files or documents in various formats also affects how many people can use them. Consider which technologies your students can access at home, school, or work. Some instructors conduct a short survey at the beginning of a school term to see which software applications their students use. Then they save their files in the most common format for that class. Others will save their course documents and text-based class assignments in multiple formats. such as accessible portable document format (PDF) files, rich text format (RTF) files, hypertext markup language (HTML) files, and Microsoft Word (Doc) files. Others choose a standard format for the class and inform the students that they will need certain software to read, edit, or save course documents.

Each document format listed above has its limitations, so choosing them may depend on what you want to accomplish.

- Any student can open PDF files with a free application called Adobe Reader, available for download at the Adobe website. If you choose this format, you should also provide your students with a link to the download page. However, if students are required to edit the document or to provide feedback on it, then they will require Adobe Acrobat, which is not free.

- Almost any word processing application can open RTF files, but saving as an RTF file may remove certain types of advanced formatting. Apart from this limitation, this format provides a great deal of flexibility with the types of tasks accomplished through the documents.

- Students with access to a web browser can open HTML files. If you want students to work on an HTML document, though, they will need a web-based HTML editor, an HTML editing application, or a simple text editor combined with knowledge of HTML code.

- Microsoft Wordfiles offer additional options, such as a feature called tracking that allows students to see feedback and suggested changes. Many people have a copy of Microsoft Word, but it is not universal. Student bookstores and some computer stores carry discounted educational licenses. If you are going to require students to use Microsoft Word, let them know of any labs at your school or university that make it available to those who cannot afford it.

Other text-based file types, such as spreadsheets, provide fewer options. The most common spreadsheet format is a Microsoft Excel (XLS) file. All spreadsheet applications should be able to save files as a comma separated values (CSV) file. However, this would strip out any formulas or calculations that you or the students use.

Looking at ways to spread out your workload over time, you can start with the first strategy, or saving files in one or two of the most common formats for your class, and work your way to the second strategy, or saving files in multiple formats, over time. This does not have to be done in a day, but to achieve universal design for learning it is important to consider these strategies from the beginning. The concept is not to try to accommodate all students with one strategy, but to provide alternatives. The key is to let your students know which formats you will use and provide them with avenues to get what they need to read and use the text-based resources.

Visual-nonverbal, or graphic-based resources, assist learners who prefer resources such as images, charts, graphs, flow charts, animations, or videos. Many software applications and some websites allow you to embed charts and graphs within the file itself. You can easily insert images in Microsoft Word. Microsoft Excel allows you to create different types of graphs from the data tables. If you use a complex image, such as a political map or a diagram of the digestive system, you must still provide a text-based description for students who use screen readers.

You can use different applications, such as Inspiration, to create stand-alone flow charts or concept maps. If you want young students to be able to interact with this type of file or to create their own, there is a version called Kidspiration as well. See their website) for more details. By pushing one button, students can convert Inspiration flow chart or brainstorm files to text-based outlines. This helps students with screen readers as well as visual-verbal learners who prefer text. Other applications like Inspiration include Microsoft Visio, a free application called SmartDraw, and others. For specialized applications, such as engineering, there are even more. Let your students know if they will need to download or buy any additional software for your course, and work with lab managers to install it at your school or campus if budget permits.

Auditory resources provide alternatives to learners who prefer to hear the information, rather than read it. Screen reader software and text-to-speech applications can be used by many students, not just those students with vision impairments. Schools and universities have different ratios or formulas for how many computer lab stations must have this type of software to accommodate special needs. These ratios usually range from one in twelve to one in twenty computers per lab environment.

In addition, there are other avenues to provide auditory resources to students. For decades, students have placed their tape recorders at the front of the classroom to capture what the instructor says for playback later. These days, the instructor can record him or herself and post the audio file online for all students. As with the other file types, it is important that the students can play and use the files you create. Common audio file formats include the Wave (WAV) file created by Microsoft, the Audio Interchange File Format (AIFF) created by Apple, and the Moving Picture Experts Group's Audio Layer-3 (MP3) file.

A recent, popular trend for creating and distributing MP3 audio files is called "podcasting." Different aspects of podcasts and the process of creating and distributing them are described in *Education for a Digital World* (2008). For our purposes here, it is important to note that you should provide a transcript for any audio files.

Video files also provide appropriate stimuli to auditory learners. Chapter 15 in *Education for a Digital World* (2008), "Understanding Copyright: Knowing Your Rights and Knowing When You're Right," discusses when it is or is not legal to use clips of copyrighted videos as course related resources. One important factor from a UDL standpoint is that streaming video files are often easier for all students to use than downloadable video files. Despite the progress related to high-speed connectivity, not every student has a digital subscriber line (DSL) or equivalent connection at their home, school, or workplace. For students using a dial-up modem, large video files present a very frustrating challenge. Many times the student will spend hours trying to download a large file with no success and will give up. For purposes of accessibility, caption the video or provide a transcript with timecode references to scene changes or other important points.

Tactile/kinesthetic resources create opportunities for learners who prefer to learn by doing. Resources that accommodate tactile/kinesthetic learners can take different forms. You can find or create interactive resources, such as CD-ROMs, websites, or Flash animations, and require the student to follow a linear or non-linear path through course-specific material. If you do not have time or know how to make these yourself, then you can search a variety of online clearinghouses and repositories for appropriate learning resources. The Multimedia Educational Resource for Learning and Online Teaching, (MERLOT, http://www.merlot.org) is a free website containing thousands of learning resources in the fields of art, business, education, humanities, math and statistics, science and technology, and social sciences. MERLOT is primarily for higher education instructors, but some materials would be appropriate for secondary school students as well.

You can ask your students to create the resource. In the online environment, this can be as simple as requiring all students to build a glossary of terms for a chapter or topic. You can ask them to send their terms by email, to post them to a threaded discussion, or to post them using a glossary tool that comes with a learning management system like Moodle. Other types of student-created resources include databases or spreadsheets containing results of experiments, student or class websites, and student videos.

More advanced resources act as a framework for student activity, described below. For example, a WebQuest (see http://www.webquest.org) is a web-based research activity that you can find or create for student group work. While most WebQuests are for K-12 students, it is not difficult to create one appropriate for college or university students. The WebQuest is highly interactive and collaborative, making it an ideal online resource for tactile/kinesthetic learners.

Keep in mind that not every resource for students must be stored in the online environment. Some of the most interesting and meaningful lessons require students to interact with the world and then to come back and reflect or report on what they learned. For all types of learners, this increases the number of possible resources to global proportions...literally! Structured activities might involve students performing lab experiments and then completing online lab notebooks; collecting scientific data and then entering it into a communal online database; observing master teachers at a school and then writing a reflective weblog entry; or interviewing an expert and then posting the text, audio, or video file.

Combining strategies means that you can accommodate greater numbers of learning preferences with one resource or activity. For instance, if you use an Excel spreadsheet to demonstrate how increasing and decreasing budgets affected the north and the south in the US Civil War, you can require the students to fill in the annual budget numbers themselves and then create a graph. This strategy accommodates visual-verbal (text-based) learners, visual-nonverbal (graphic-based) learners and tactile/kinesthetic learners.

Perception

Sensory learners prefer fact-based activities and resources. These resources are easier to provide, as most disciplines from the humanities to the sciences have some facts or details related to the topics within. The easiest resources to provide might be references to the textbook, or links to related websites. More in-depth resources could include optional readings, such as advanced articles that apply the concepts discussed in class.

Intuitive learners like reflective activities and resources that require imagination. If you have a topic that requires students to memorize facts to lay a foundation for later application, provide additional, optional resources that introduce the theories related to the facts. You can also encourage students to seek their own connections between theory and facts using an optional activity, such as a discussion forum devoted to a discovery learning approach.

Organization

Inductive learners prefer beginning with meaningful examples before extrapolating the main concepts or theories. In the online environment, you can accommodate inductive learners in both passive and active ways. You can provide a number of examples in a recorded lecture before describing the concept that they exemplify. In a more active

learning activity, you can provide a number of examples and require the students to create a generalization from them by defining patterns. The Biology Success! Project (see Resources section for details) encourages instructors to consider that while inductive activities have been proven to help students with learning disabilities, "it is essential that the instructor create clear guidelines for behavior, provide explicit directions from the outset of the activity, and be prepared to offer extra guidance as necessary."

Deductive learners prefer starting with more structure, deriving consequences and applications from the concepts and theories. These learners benefit from demonstrations and opportunities to practice what they have learned. Online "lab" experiences can further strengthen or confirm the learning by deductive learners.

To accommodate both inductive and deductive learners, you can provide case studies, results from previous experiments, and other inductive examples alongside descriptions of the general concepts and theories for the deductive learners. You can assign both in whichever order the students prefer, or alternate the order for different assignments whenever applicable. Another method to accommodate both types of learners is a "structured inquiry" exercise. Whichever approach and activity you choose, remember to be clear about what is expected or what students should do. Identifying the instructor's expectations is not a discovery learning exercise!

Processing

Active learners enjoy learning by applying knowledge or by working with others. Providing areas where students can interact online, such as instant message (IM) environments, discussion forums, or wikis, will give these students a way to do this. Learning management systems usually contain several of these tools for interaction. These tools can be used to create both general course spaces for coursework-related interaction and specific spaces for particular topics or assignments. It is important to create clear instructions and expectations for each space, so students know its purpose and whether or not participation is required.

Make sure that you test the true accessibility of any technology-based areas for interaction. While many companies state that their web-based tools are accessible or compliant, their products are sometimes difficult to use for students using adaptive technologies. You might want to work with a disability resource center to do some preliminary testing. Further, interaction tools that use Java-based applets or plug-ins do not work with some older browsers, excluding students with limited technology or limited access to technology.

Reflective learners prefer to ponder the concepts or topic before engaging with it. If you often use small groups in your course, provide opportunities for individual assignments, even if it is just a precursor to the upcoming group work.

People often see themselves as both active and reflective learners, just as they might consider themselves both sensory and intuitive. You can try to accommodate both types of learners by mixing up the types of activities. An active learner might prefer the immediacy of a chat. A reflective learner might prefer the asynchronous nature of a discussion forum, as it allows him or her to think about what they want to write before actually committing the words to print.

Understanding

Global learners prefer to see the "big picture" first. You can help these students by providing resources that summarize a concept before going into details. One of the simplest examples entails creating a table of contents for a presentation that you post online. If you are creating an audio file, take some time to give a brief introduction to the lecture or presentation before diving into the first section.

Sequential learners prefer a step-by-step approach, understanding each piece before seeing how it fits in a larger context. One way that you can help sequential learners involves referring to a numbered outline so students can keep track of where you are. Be sure to review flow charts, presentations, and other resources to make sure that you have not skipped or glossed over any steps. If creating audio readings, avoid jumping around from topic to topic. Instead, follow the outline that students will use to keep track of their place.

A common piece of advice for people delivering a presentation for the first time is "Summarize what you are going to say, say it, and then summarize what you said." This advice accommodates both global and sequential learners.

Preparing students to use multiple means of representation

If students are not prepared to use the variety of content choices you provide, then all your work could be wasted. Let them know how important it is for them to understand the concepts of learning preferences and learning needs, how to determine what their preferences and needs are, and how to adopt strategies that accommodate them. Many instructors ask their students to complete a learning styles survey. This idea is described in more detail below. We can include the learning needs of students with disabilities in

this same set of activities. Students with various disabilities also may not know what strategies will benefit them in the online environment. Encourage them to explore how they can succeed in the online components of your course, either on their own or with the help of a disability resource center.

Multiple means of expression

When we think about asking students to demonstrate what they know, we usually think that each student will take the same test, complete the same essay assignment, or perform the same skill(s). It is not too strange, though, to think that students could use different methods to show that they know the same concept. After all, instructors often ask students to choose one of several essay questions to demonstrate understanding of a major topic. These days, instructors are asking students to submit portfolio pieces, sometimes called "assets" or "artifacts," to show particular competencies. In this process, they may even let the students choose what type of asset they would prefer to submit, or how to best show their knowledge or skills. This last idea exemplifies the principle of "multiple means of expression."

Individuals

When asking individual students to demonstrate knowledge, skills, and/or attitudes using online mechanisms, it is important to determine to what degree of difficulty you are asking the students to achieve the objectives. There are numerous websites that list the different levels of difficulty related to the three learning domains: cognitive (knowledge), psychomotor (skills), and affective (attitudes) (see description of learning domains and degrees of difficulty at http://www.nwlink.com/~donclark/hrd/bloom.html). Once you determine what you want students to do, then you can determine how they will demonstrate it. *Education for a Digital World* (2008) contains more information about student activity and assessment.

The first step is to identify alternatives that are equivalent. Taking a multiple choice test does not usually demonstrate the same level of proficiency as writing an essay or performing a task in front of a video camera for evaluation later. Therefore, take a close look at the learning objectives, and then make a list of different ways that students could achieve those objectives. Consider the following example objective, "Students will translate Hamlet's famous 'to be or not to be' soliloquy into modern English (with or without slang)." Equivalent online assessment alternatives might include writing a translation in a discussion forum, posting a translation as an attachment, making an online presentation using Skype or other synchronous conference tool, making and posting an audio recording of the student reading their translation, or making and

posting a video presentation. The same evaluation guidelines or rubric could be used to evaluate each one. Hypothetically, then, students could choose how they want to show their ability to translate the soliloquy. This accommodates students with disabilities as well as students with different learning preferences. It also creates an avenue to engage students at a higher level, which is described in depth below.

Of course, you will find that certain alternatives may be less equitable. For example, technologies like video cameras and video editing software could be equally difficult to use due to limited access, unequal proficiency levels, or physical disabilities. This does not mean that you have to immediately remove it from the list of options. However, it might require that you identify a lab that checks out cameras to students and that has computers with video editing applications. Another option might be to have students work in small groups, so they can give each other feedback, share technology resources, and help each other with the skills that are not part of your course objectives. For an assessment strategy to be universally accessible, students must be able to attempt each alternative, so you may need to limit the options to those that you know all students can try if they wish.

Even within a standardized test format, there may be ways to offer options to students. In a face-to-face environment there are ways to accommodate different needs without giving test answers to the student. For example, on a test requiring students to identify the different bones in the skull, the instructor can provide a three-dimensional model of a skull for a blind student to use instead of a flat image (see Figure below). The same option is possible for an online test, but it would still require the student to have the model skull at an online testing location.

| 2-dimensional skull diagram | 3-dimensional skull model |
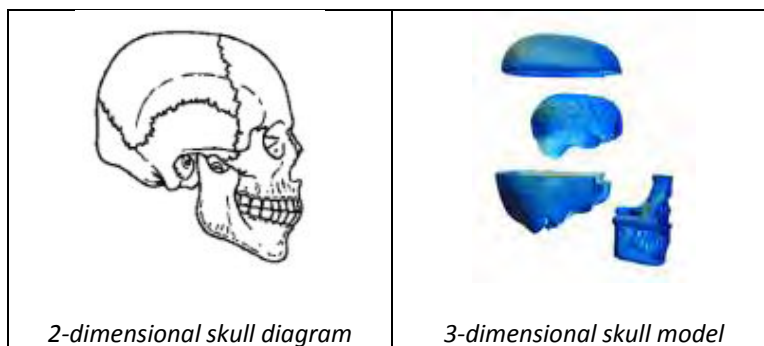
Figure 6.5 Test format options

As stated earlier in this section, activities that involve specialized software or online environments should be tested for accessibility and assessed related to how many

students have access to the software or environment itself. However, many of the tools go beyond the simple process of creating and automatically grading test questions. Learning management systems offer a variety of testing options, such as creating separate versions of a timed test to accommodate students who need extra time for exams. The Biology Success! Teaching Diverse Learners project (n.d.) gives us "Key Principles of Assessment as Applied to Students with Learning Disabilities" that we can use in the online environment to:

- clarify assessment criteria
- make frequent assessments
- allow for student revisions
- vary assessment methodss
- allow students to self-assess.

Groups

Group work in the online environment provides some real challenges and some tangible benefits. It is sometimes hard to keep track of which student has contributed to the team effort, but students will all gain team-related experience that will help them in research and work environments. One strategy to determine each group member's contributions is to have each student first perform each group task individually. Then each group member can share his or her work online, using a discussion forum, wiki, or other collaboration tool, to combine the best efforts from the team as a whole. Another strategy involves assigning specific roles to each group member. Most WebQuest exercises (briefly described above) require students to take a role and complete tasks accordingly. Then each student's work can be assessed individually, in addition to assessing the level of team or group success.

Entire class

The whole class can construct knowledge together in various ways. It is difficult to give the entire class multiple, simultaneous avenues to show it can achieve a certain goal. However, you can construct assignments and activities over the course of the term that gives the class different ways to achieve the desired goals. One way to do this is to assign small groups to make presentations about each week's content. As you go through a term, the entire class has an opportunity to add to a growing knowledge base of course-related material.

Multiple means of engagement

Just as students have different learning preferences and different learning needs, they have different motivations, and levels of motivation, to be successful learners. Some students may be the first member of their family to attend college, so they want to do well. Some may want to achieve financial independence, so they put in extra effort to gain high level skills and high quality products to show potential employers. Others may just have a passion for the discipline or specific course content. The UDL principle, "multiple means of engagement," tells us that we should find out what motivates our students and to challenge them to use those motivations to be successful online learners.

Involve students in the process
To whatever extent you feel comfortable, involve the students in the process of preparing and conducting the online portion of your course or your fully online course. Just as the chemistry of each face-to-face class is different—sometimes the group is energetic or rambunctious, sometimes the group is quiet and difficult to motivate— each online cohort is different. After defining the course objectives, provide a forum for the students to state their expectations. Most times, you will find that the student expectations are very similar to your objectives, but with a different focus, such as applying the knowledge to get a job or using skills from the course to create a portfolio demonstrating their abilities. Using your syllabus, an opening statement, or other strategy, encourage students with special needs to tell you what strategies they have found helpful for their success in past experiences with online coursework. They may already have accessibility or even UDL solutions that could save you countless hours of research.

Another way to engage students is to involve them in their own learning. In the Multiple Means of Representation subsection above, we cover different ways to accommodate learning styles, learning preferences, learning needs, and so on. However, as an instructor, there is only so much you can do before the student must take responsibility for him or herself. Ask your students to take an index of learning styles (ILS) questionnaire, such as the one created by Richard Felder and Barbara Solomon of North Carolina State University (listed in the Resources section) Then have the students report what they find about themselves and identify strategies that they will use to improve their own learning. Sometimes the questionnaire results do not match how we see ourselves. That is okay. Just let your students know that this exercise is to make them aware of different learning possibilities. They should try strategies that accommodate

their perceived learning styles as well as the ones that the questionnaire results identify for them.

Determine what students find meaningful

To keep students motivated to work in the online environment, they will need to find the objectives, topics, resources, and activities meaningful. An instructor-led approach could range from "This material is a prerequisite to other courses in this program" to "These skills will help you get jobs in this field." A student-led approach could range from "This is how these theories apply to real-world events" to "Some of you will find this really cool!" Both approaches have their merits, so use them together. To determine what real-world events interest students, or to find what they feel is really cool, talk to some of the students before the term gets rolling, or ask the class to send you one idea of each.

Ask for feedback

In "Evaluating and Improving Online Teaching Effectiveness," Kelly (2008) covers a number of ways to get feedback from students. Using those strategies, you can include questions about motivation or engagement to learn how well you are doing to get students more involved in their learning success. Go over the results with the class to come up with additional ideas or inspirations.

Bringing it all together

Looking at some of the concepts and suggestions in this section, you might be asking yourself, "This is helpful, but what does this have to do with accessibility?" For this book, remember that the term "accessibility" refers to the extent to which it is possible for all students to succeed in our collective online course environments.

About web accessibility

What makes a site accessible?

Accessibility is about making sure *all* the information on your website is available to *all* users, regardless of any disability they may have or special technology they may be using.

> **Accessibility** involves making allowances for characteristics a person cannot readily change'. (Building Accessible Website, Joe Clark)

Why bother?

Fairness and equality

The simplest and most direct answer to this is that if your site is inaccessible to users with disabilities, you are excluding a section of the population from your content. If your students cannot access the course materials, they could be placed at a distinct disadvantage and their coursework could suffer as a result.

Accessibility benefits usability

Many site designers and developers drag their feet and grumble when asked to make their site accessible. There is a mistaken perception that "accessibility" means "dumbing down" the site - that they won't be allowed to use any graphics or any multimedia. Frequently, websites address accessibility by making a plain, text-only version of every page and labeling it "accessible". This does no one any favours - it requires the webmaster to maintain twice the number of pages, and provides an inelegant solution that lumps all disabled users into the same category.

The reality is that accessibility is a way of enhancing your web page, and it can be done seamlessly without taking away from the design. Many accessibility recommendations and guidelines actually improve the integrity of your code and the overall usability of your interface. Usability is, simply put, how easy it is for people to use your site.

Anything you can do to improve accessibility can also improve usability for people <u>without</u> disabilities, for online courses or any other kind of website. Consider these examples:

- you have made the menus consistent on every page - now everybody has an easier time finding their way around your site, because the buttons are always in the same place;
- you have made sure your font size can be adjusted - now older readers with poor vision can increase the size of the text to see it better;
- you have set a unique page title for each page - now search engines can more accurately display your pages in their search results;
- you have added a text description for each image - now someone browsing with images turned off can tell if they are missing an important diagram;
- you have added captioning to a video - now a student using a computer in a public lab can watch it without needing sound;

- you have added an audio reading of an important passage - now a student who learns better aurally can enjoy the reading as well.

Legal reasons

As we have already discussed in Section 1, many institutions are obligated to provide accessible content according to national laws.

Accessibility standards

There is a set of guidelines developed by the World Wide Web Consortium (W3C), a group that establishes specifications, guidelines, software and tools for various aspects of the web including file formats and scripting languages. One W3C program is the **Web Accessibility Initiative** (WAI), whose mission is to help make the Web accessible to people with disabilities. The WAI has developed the Web Content Accessibility Guidelines (WCAG) to address the accessibility of information in a web site. These guidelines are what we will be using in this chapter, and should always be consulted if you are ever in any doubt of the best technique or the correct syntax of a tag. They are fairly technical, and not a quick read. However, two simplified versions of these guidelines organized by concept do exist as Appendices of WCAG 1.0 (1999a and 1999b), both as a checklist table and as a list of checkpoints. At the time of writing, the current version of the guidelines is WCAG 1.0, and WCAG 2.0 is under review.

These guidelines, relevant to online content developers, help to ensure that Web resources are accessible. However, there is a need to recognize the limitations of these guidelines as well as the available checking tools (Ivory & Chevalier, 2002). Kelly and Sloan (2005) talk about the difficulties of implementing the guidelines, summarizing the concerns in regards to ambiguity, complexity, logical flaws, and the level of understanding required to implement them.

Despite the difficulties with the guidelines' implementation and reliability, and the necessity of manual checking for accessibility, WCAG are very helpful in the initial stage of developing an online resource, as a quick checklist of obvious things that need fixing. The guidelines should not be taken as the only set of criteria that needs to be considered. A wider set of issues must be addressed, some of which could be in conflict with the guidelines.

Priority and levels of conformance

Each checkpoint has a *priority level* assigned by the working group based on the checkpoint's impact on accessibility.

- **Priority 1**: A Web content developer *must* satisfy this checkpoint. Otherwise, one or more groups will find it impossible to access information in the document. Satisfying this checkpoint is a basic requirement for some groups to be able to use Web documents.
- **Priority 2**: A Web content developer *should* satisfy this checkpoint. Otherwise, one or more groups will find it difficult to access information in the document. Satisfying this checkpoint will remove significant barriers to accessing Web documents.
- **Priority 3**: A Web content developer *may* address this checkpoint. Otherwise, one or more groups will find it somewhat difficult to access information in the document. Satisfying this checkpoint will improve access to Web documents.

Depending on which priority checkpoints a site meets, it can claim to meet a particular *level of conformance.*

- **Conformance Level "A":** all Priority 1 checkpoints are satisfied.
- **Conformance Level "Double-A":** all Priority 1 and 2 checkpoints are satisfied.
- **Conformance Level "Triple-A":** all Priority 1, 2, and 3 checkpoints are satisfied.

Testing for accessibility

There are a number of tools available to help you check some of the more technical aspects of your website to see if it meets accessibility standards. One of these is WebXact Watchfire (http://webxact.watchfire.com/), previously known as Bobby. It is a very handy tool for double-checking that all your images have **alt text**, or that your data tables are properly labeled.

But these tools are not the whole picture. An accessibility analyzer like Watchfire cannot tell you if the descriptions of your images make sense to a blind user, or if your page titles are meaningful. Your web site needs to be considered from a human perspective,

and many of the WAI guidelines ask you to examine the context and meaning of your content more carefully.

Students with disabilities

Who is affected?
When we talk about making the web accessible for people with disabilities, who are the people we are talking about? Before we can learn what to do with our web pages, we need to understand what we are doing and for whom we are doing it.

Tip: Simulations
To help you understand what web navigation is like for people with disabilities, some organizations have developed simulations.
Inaccessible website demonstration
http://www.drc.gov.uk/newsroom/website1.asp
WebAIM simulations
http://www.webaim.org/simulations/

Sight
The first group that most people think of when considering accessibility for the web is the blind and visually impaired.

Blind: Users have little or no usable vision. While a few users may use Braille, the majority use a **screen reader** - software that reads text out loud. Some people listen to the Web at speeds that sighted users find completely incomprehensible - the audio equivalent of "skimming" a page. Keep in mind that screen readers read everything that they encounter, and that they read it in the order they find it. In some cases, users with screen readers encounter online multimedia elements that start playing without warning. They must contend with two audio sources at the same time: the screen reader reading the webpage text and the multimedia audio.

Visually impaired: Users may have some sight, but difficulty focusing or distinguishing small text. They may use a **screen magnifier** - software that enlarges everything on the screen to a more manageable size.

Colourblind: Most colourblindness involves difficulties distinguishing red and green. A smaller percentage of people have difficulties with the blue-purple portion of the colour spectrum. Still others are completely colourblind. There is a misconception that accessibility means using only black and white text, and that colour should be avoided. This is not true. The point is not to rely on the requirement of colour perception to

reveal information. For example: asking readers (or learners) to "use only words in red to compose a paragraph", or telling readers while filling in the form, that only "blue" fields are required.

As we will find, making the web's highly visual content accessible is not as daunting a task as it might seem. There are methods in place for providing alternatives for nearly every type of web content, and for making sure your content works well with the specialized hardware and software used.

> **Tip:**
> Ever wondered what the world looks like to colour-blind people? Test out **Vischeck**, a colourblindness simulator, on your site or any image. http://www.vischeck.com
> **WebAIM simulations**
> http://www.webaim.org/simulations/

Hearing

Since the majority of content on the web is visual, students who are deaf or hard-of-hearing are not as likely to be affected. However, they often have communication and comprehension difficulties. If audio files or videos are a part of the curriculum, a text alternative should be provided. Many users will also benefit from easily understandable icons and clear terminology.

Ideally, videos should be **captioned**. Professional captioning can be costly, though for course materials requiring extremely high accuracy (such as math and physics equations), it may be the best choice. Software is also available to allow you to include captions in your videos yourself. If captioning is simply not an option, a text **transcript** of the video would be a reasonable alternative.

> **Tip:**
> Hearing people might assume that hard-of-hearing or deaf students would be reluctant to watch a video clip. But on the contrary, many find video and multimedia material entertaining and especially valuable because of all the other non-verbal communication that they convey. Samuel, a hard-of-hearing ESL student in our focus group, greatly preferred videos or webcam interactions to text so that he could see the emotions and gestures of the other person. For students who can lip-read, video is still helpful if the speaker's face is clearly visible at all times.

Mobility

Students with physical disabilities may be affected if their impairment hinders their ability to use a mouse or keyboard. This could be due to having little or no muscle control, nerve damage, or trembling; it could be a temporary problem, a lifelong condition, or the result of aging. Fine motor movements can pose a challenge, such as clicking on a very small icon.

Some users with mobility impairments will use a typical keyboard or mouse, but may take more time to perform tasks. Others use assistive input devices instead or in addition to a keyboard or mouse.

- A standard **trackball** is often easier to control than a mouse. Some students use a standard **graphics tablet** since touching locations directly with a pen is easier for them than sliding a mouse.

- **Alternative keyboards** allow users to position their hands more comfortably, or to press keys more accurately.

- For people who cannot use their hands at all, **headtracking** allows the user to control the pointer through head movements. Mouse clicks can be replaced with a breath-controlled **sip/puff switch** or tappable **headswitch**.

Learning & cognitive

While visual, hearing and physical disabilities are the most familiar forms of disability, the majority of students you may encounter who have a registered disability may in fact be learning disabled. **Learning disability** or "learning difficulty" is a broad term that includes dyslexia, brain injury, and aphasia.

"Dyslexia is the most commonly registered disability within the University and always features in the most commonly asked questions on accessibility issues by staff." (Jeffels & Marston, 2003)

Students affected by learning disabilities may encounter difficulties with some of the following activities, among others:

- spelling;
- reading aloud; stuttering;
- mathematical calculations;
- comprehension of large passages of text;
- effective time management or organization;

- rote memorization;
- concentration and focus.

Onoe udOn a tine, in teh m iddle of a tbick fcrests toood a smal cotte ge. I taws the hOme oP a qetty Iitte gr!l knoW n to veryecne a s Liitl e Red Ridiug Hooq, bceause ol the brighl!y cloored co at she wore. One baY, her nother yave her a voven dask kt full oP gelicious foob, aud said :

"Grandmais lll. Take her this baskot of ca kse, but de veyr careful!.Don't, strag form teh dath through hte woools."

Figure 3.1 Dancing letters

Try to read the passage in figure 3.1. It may give you an idea of the difficulty and frustration experienced by many dyslexic readers, as seemingly normal text requires extra effort and concentration to parse.

Learning and cognitive disabilities are a challenging group to address, as there is no one approach that will suit everyone. Some students may learn just as quickly or more quickly than typical students when information is presented in a different medium. Some use the same technologies used by the visually impaired, such as screen readers and speech recognition software. Nevertheless, clear presentation and good navigation is critical. A variety of multimedia options will apply to different visual, auditory and learning skills.

Traditional approach	Adapted
Lecture type content	chunks, include questions, statements of clarification and key points
Text-based content	alternative presentation: audio, video, hands-on interaction; scaffold for various resources (preselect them)
Reading from a textbook	offer vocabulary, issues to discuss in the forum, encourage note-taking, using graphic organizers, offer information prompts (self-tests with open- ended questions)
Assignments: written essay	offer a choice: written, oral, video, or visual presentation
Assessment	offer variety in responses: open-ended questions, oral response give clear scoring rubrics, be prompt and detailed in giving feedback

Table 3.1. Content developed using traditional approach and suggestions for adaptations

Aging users

When considering accessibility in education, most people assume they will need to prepare for a few isolated examples of students with disabilities: one blind student in a class, or a handful of young students with learning issues. As we age, we may be affected by *any* of these types of disabilities to various degrees. Instructors should be aware that some of their older students may also have problems such as fading eyesight, or difficulty with fine mouse movements.

Assistive technology

We have touched briefly on the idea of assistive technology, which is essentially any software or hardware that can be used to help overcome a disability.

Tip:
A pair of glasses could be considered assistive technology, as it helps the user overcome poor vision.

Instead of thinking about assistive technology in terms of types of disabilities it assists, let's look at it from the point of view of what kind of help it offers. Assistive technology could provide:

- help with accessing a computer
- help with reading
- help with writing (composing, spelling, typing)
- help with communication
- help with learning
- help with hearing and vision.

Figure 3.2 lists many of the computing issues for users with disabilities, and suggests some of the common hardware and software solutions used to overcome these problems.

Activity	Issue	Assistive Technology Examples
Computer Access	When a student cannot access a computer with a standard keyboard and a mouse, he may need special input devices. These devices are commonly used by students with physical, visual or cognitive disabilities.	**Software**: OS accessibility features, word prediction, keystroke reduction, voice recognition, on-screen keyboard **Hardware**: Keyguard, arm support, trackball, trackpad, joystick, alternative keyboard, switch with Morse code, switch with scanning
Communication	For many autistic people and some with learning disabilities, augmentative & alternative communication devices may be helpful. They use symbols, pictures and printed words.	**Software**: Symbol browser, art activities, games on the computer **Hardware**: Voice output devices or devices with speech synthesis for typing
Reading	The low resolution of monitors can cause fatigue and eye strain for all users. For those with vision or learning issues, reading onscreen can be an added deterrent. Keeping track, following a line of text, understanding and remembering can be problematic.	**Software**: Talking electronic device/software to "pronounce" challenging words, electronic books, mindmapping, talking calculator, voice recognition **Hardware**: Single word scanners, scanner with OCR and talking word processor, hand-held scanners, hand-held computers
Writing	There are two different accessibility issues when using computers for writing: 1) physical problems with typing; and 2) cognitive problems with composing and organizing ideas and converting them into written expression.	**Software**: Templates, word processors, voice recognition, talking dictionary, spelling & grammar checker, multimedia software for expression of ideas **Hardware**: Alternative keyboards and input devices used as for Computer Access (above)
Learning	Students with learning difficulties may have problems with attention and with organizing ideas.	**Software**: Multimedia software for expression of ideas, mindmapping, electronic organizers **Hardware**: Hand-held computers
Hearing & Vision	Assistive technologies for visually and hearing impaired students may either increase the signal or replace it with something else.	**Software**: Screen magnifier, screen color contrast, screen reader, captioning, computer-aided note taking **Hardware**: Braille/tactile labels, alternative keyboard with enlarged keys, Braille keyboard and note taker, signaling device, phone amplifier, personal amplification system/hearing aid, FM or loop system

Figure 3.2 Assistive Technologies

Designing and structuring online content

Design & structure

Don't throw away your art supplies

One of the most common misconceptions about accessible web design is that in order for a site to be accessible, it must have a simple, plain design with few or no images. Another myth is that an adequate, accessible site can be made by providing a "text-only" version of an existing website. This is a nuisance to maintain, as it requires you to keep not one but *two* versions of every single page.

Remember, not all disabled students are blind! People with mobility or hearing issues and even poor eyesight will certainly appreciate a well thought-out, aesthetically pleasing website as much as anyone. As you'll see, many of your accessibility changes will be tucked away in the code of your pages, where they will be a benefit to disabled users without detracting from your site in any way.

Structuring your content

Before you begin to write a single line of HTML or even start writing your course content, you should think about how your course is going to be structured. Will you have a lot of material to read, or just a little? Will there be many pages or subpages?

The easier you can make it for students to find and read your course material, the easier it will be for them to learn.

Menus and navigation

The way you plan your site's navigation will affect your site's usability for your entire audience. A good approach is to write down the different categories that apply to each of your pages, and then group the pages into these categories. The key is to find an intuitive balance between overwhelming the user with too many options, and burying important information too deep in the site.

For example, if your site is made up of these pages:

Course Content
Guidelines
Syllabus
Schedule
Messageboard
Chat
Mail
Submit Assignments
Assignment #1
Assignment #2
Assignment #3
Assignment #4
Grading
Help

you are running the risk of creating a very cluttered and busy navigation. You could try grouping your pages into these categories, and create subcategories within this structure:

About the Course	clicking reveals Guidelines, Syllabus, Schedule
Course Content	
Assignments	clicking reveals Assignments #1-4, Grading, Submit Assignments
Communicate	clicking reveals Messageboard, Chat, Mail
Help	

Now your students only have to sort through five links instead of fourteen.

Use common sense when defining categories - there may be some links that a student might use several times a day, so you might want them to sit on the top level for quick and easy access. Be careful when making exceptions to your rules, though - if you do this too many times, everything becomes an exception, and you have a cluttered site again!

When you are designing your site, and choosing where to place your navigation, keep these questions in mind:

- Are the links grouped together in one place, where they can be easily found?

- Are there so many links on the page that it becomes confusing?

Writing for the web

Typically, users viewing websites do not read text as thoroughly as they do when reading printed text. Monitors have a lower resolution than printed material, which makes it less comfortable to stare at for long periods of time. Most online readers develop the habit of skimming the screen looking for key points rather than studying in detail. If it is necessary to read lengthy, wordy passages or papers, many users will print out the information to read it in comfort offline.

You can make it easier for readers to find what they need by:

- keeping your **paragraphs short** - one idea per paragraph;
- using **headers** to announce and reinforce new themes;
- using **bulleted lists** to group ideas into a simple, easy-to-read format

Writing for learning-disabled students

Being learning disabled doesn't mean a student can't learn - it may just mean that traditional learning methods are particularly difficult for that individual. Some students with difficulty reading may learn the same material just as well upon hearing it, or after seeing a graphic that explains the concept. For this reason, it can be helpful to explain key ideas in multiple ways: text *and* a graphic or video that reinforces what is being taught.

The same principle applies to how you ask your students to express their understanding. For many students, the choice of whether to write a paper or give an oral presentation can make a huge difference in their ability to communicate what they have learned.

One of the biggest difficulties encountered by learning-disabled students is in interpreting academic demands and expectations. This can often be addressed by building checkpoints into assignments, such as "Submit a plan describing how you will approach this project." This allows the instructor to assess whether the student has understood what is expected of them, before the student has invested too much time into a project that may be on the wrong track.

Clear, explicit instructions are vital, but they alone are not the solution - the student must actively engage and interpret the tasks and requirements themselves.

Additional considerations

Some students with disabilities may require additional time to complete tasks such as self-tests and quizzes. A student using an alternative keyboard may not be able to type as fast as his classmates. Extend the allotted time for that student, or remove the time requirement.

Chat rooms are often inaccessible to users reading screen readers. Make sure that chat room participation is not a course requirement, or make arrangements for a disabled student to participate using other means such as a discussion room.

Using correct code: XHTML & CSS

HTML (hypertext markup language) is the code used to describe web pages so they can be rendered in a browser. When HTML was created many years ago, no one could have predicted the sorts of dynamic, interactive pages that they would eventually be used to create. While HTML was easy to learn and fairly flexible, it had some significant limitations: for example, objects could not be placed anywhere on a page, but had to flow in a linear fashion, one item before the next. Creative designers found ways around these limitations: the TABLE tag was manipulated to allow precise placement of text and graphics.

But these clever fixes came with their own set of problems. Redesigning a website meant rewriting and rebuilding every single page of HTML on the site. Visually simple designs often required complex, bloated HTML. If code was written inaccurately, the web browser had to interpret the code as well as it could, slowing down the rendering of the page.

> **Tip:**
> **Intermediate users:** We recommend using Macromedia Dreamweaver to assist you in writing accessible code.
> **Novice users:** If you're not comfortable writing HTML code at all, we suggest Course Genie, a package from Horizon Wimba, which allows you to convert a Word document into a well-coded, accessible website that can be uploaded to WebCT.

To address these issues, HTML was given a fresh start by rewriting it using *another* language - XML, or eXtensible markup language. The result is called **XHTML**. Superficially, XHTML is not terribly different from HTML: the syntax is stricter, and some tags and attributes have been removed, but much of it is the same. The key is in the "extensible". XHTML essentially lets you *define new classes of objects.*

What does this mean? Suppose you need all news-related images (but no others!) to be surrounded by a five-pixel blue border. Using old-style HTML, you would do this by wrapping every news image in a table tag.

```
<table border="5" bordercolor="blue">
  <tr>
    <td>
       <img src="images/news.jpg" width="200" height="100" alt="Top story: man bites dog">
    </td>
  </tr>
</table>
```

Every single image that needs a border would have to be treated this way.

Using XHTML saves you time and space. First define a class called "news" as having a five-pixel blue border.

```
.news {
   border: 5px solid blue;
}
```

Then add an attribute to any image tag that needs to be in class "news".

```
<img src="images/news.jpg" width="200" height="100" alt="Top story: man bites dog" class="news" />
```

How does this work? The classes are defined within **Cascading Stylesheets (CSS)** - stylesheets, because they define the style of a page; cascading, because you can apply multiple stylesheets. You can define any style once and apply it throughout your entire site.

Tip:
A site that may help you visualize this process is CSS Zen Garden (http://www.csszengarden.com). Every design on the site uses the *same XHTML code* to define the different areas of the page. By swapping out only the stylesheet, the appearance of the site changes dramatically.

So with a single CSS file, you can now define the look and feel of an entire web site consisting of hundreds of pages.

Why can't I do things the old way?

Feel free to skip this section if you are new to building web pages or are already familiar with XHTML and CSS.

Tables aren't meant for layout

If you ever built a website before CSS became widely accepted, chances are you built it using tables. You probably took a large image and chopped it up in an image editing program, then placed each chunk of the image into a borderless table to lay it out exactly where you wanted.

The first reason to avoid tables is that it'll make redesigning your site much easier in the future. You won't have to chop up new designs and recreate every page of your site any more - you can do it all with one change of your CSS sheet and maybe a few changes to the HTML.

But the main reason is that it simply isn't all that accessible. Screen readers approach tables in a linear fashion; that is, they read out each column, left to right, and each row, top to bottom. If your table-based layout doesn't correspond to this model, blind users may not receive the information in the order you intended it. They may hear the menu read out in pieces, in between parts of your main content, and as you can imagine, it is very confusing to navigate a page like this.

Many old tags have been deprecated

XHTML no longer contains several tags that address the appearance of a site. The FONT tag, which used to be the only way to set the font appearance on a page, has been removed from HTML. This is because fonts can be much more efficiently defined and updated using CSS. Similarly, the CENTER tag has gone away, to be replaced by CSS formatting.

Tip:
Learning XHTML and CSS
There are many excellent resources, both online and offline, for learning XHTML and CSS. Here are some tutorials to get you started.
Introduction to CSS
http://www.w3schools.com/css
Introduction to XHTML
http://www.w3schools.com/xhtml

Accessibility in XHTML

For the rest of this section, we will use XHTML and HTML interchangeably. The basic principles are the same, and most of the differences are in the accuracy and consistency of the code.

Text
Text makes the World Wide Web go 'round. The greatest amount of content on the web is basic, plain text. Text is the most accessible media format there is – it is easy for all browsers and screen readers to handle.

You need to be particularly careful about the **visibility of your text**. Aging users, people with poor vision, or even people using a small monitor may not see your site's text with the same clarity that you do. They may need to enlarge the size of the text to be able to read it better.

There are a few ways to do this. A **screen magnifier**, such as ZoomText, will make a screen behave much as if a giant magnifying glass has been placed between the screen and the user.. A simpler way is to use the text size settings in the browser to increase the font size on the page.

When you define the appearance of your text in CSS, you have a choice between absolute or relative font sizes.

- **Absolute font sizes** (pixels, points) should appear at the exact same size in every browser and every configuration. Text that is set to "12px" will appear as 12 pixels high. Designers often prefer absolute font sizes because they have greater control over the appearance of the text, and can dictate how much space a given block of text will occupy.

- **Relative font sizes** (percentages, "em") appear at a size relative to the user's font settings. Text that is set to "90%" will appear at 90% of the current text size. If the user changes their font size to "larger", the size of the text on the page will increase.

What is the implication here? **Use relative font sizes at all times.** Some browsers will allow absolute font sizes to scale up with the user settings, but not all. Your eyesight may be much better than that of some of your users, and what looks fine to you might cause problems for someone else. Make sure you give *them* the control of their screen.

Example

```
body, p {
    font-family: Arial, Helvetica, sans-serif;
    font-size: 0.9em;
    color: #333333;
}
```

This will make the text for a page 0.9 em, or 90%, of its default size.

Be careful with the **contrast and colours** of your text. Whether your text is light on a dark background or dark on a light background, you need to make sure there is enough contrast between the text and the background for users with weaker vision to distinguish clearly. Additionally, if any information is conveyed by colour alone, reinforce the information with another method. In the example shown in Figure 3.3, the required fields are marked not only by a change in colour, but by bold text and an asterisk.

* required field

* Name

Address

Figure 6.3

6.5-6   Images

Alt text

There is a very simple, built-in way to make sure your images are accessible: use **ALT text**. Figure 6.4 would be coded as follows:

When a screen reader encounters an alt attribute, it substitutes the text for the image, reading the text out loud. In order to make this as useful as possible for your users, you should choose text that is appropriately descriptive of the image. Include any details that are

Figure 6.4

necessary to make the image make sense; don't bother with trivial descriptions if they don't add useful information.

Empty descriptions

There are some cases where an image does not require a description at all, or where a description would clutter the audio reading of the page.

Spacer (or transparent) images are typically 1x1 transparent images that are used to control the layout of a table-based website by pushing elements of the site into place. If your site is entirely CSS-based, you won't really need these. If you are working on an older site, though, you may still be using them.

Decorative bullet graphics are often used in lists to illustrate a point.

Figure 3.5 Decorative bullet graphics

Figure 3.5 shows three decorative bullets, which many people would mistakenly code as follows:

```
<img src="bullet.gif" width="5" height="5" alt="Red bullet" />Marketing plan<br />
<img src="bullet.gif" width="5" height="5" alt="Blue bullet" />Promotion plan<br />
<img src="bullet.gif" width="5" height="5" alt="Yellow bullet" />Licensing plan<br />
```

With code like this, a screen reader user will hear: "red bullet marketing plan blue bullet promotion plan yellow bullet licensing plan".

Even though you don't want screen readers to attempt to describe these images, you still need to define their alt text, or the screen reader will read out the filename instead. The alt text on a spacer image or a decorative graphic should be empty, i.e. alt="".

> **Tip:**
> Visually impaired users aren't the only ones to benefit from ALT text - you will too! By describing your images, you'll make it easier for search engines such as Google to index your content, and it'll be easier for other users to find the content on your site.

Long descriptions

Alt text is good for a short sentence, but sometimes a complicated diagram or graph cannot be thoroughly described in one line of text. When this happens, use the ALT attribute for a quick summary, and the **LONGDESC** attribute:

The longdesc attribute is the URL for another web page, which should contain a complete description of the image in question.

Imagemaps

Imagemaps are just as easy to make accessible: add the alt text to the AREA tag for each clickable area within the map.

Links

We have already talked about menus and navigation and the importance of thinking about links. Here are a few additional considerations:

- **Link size**: If the images are graphic links, are they big enough so that users can easily click on them, even if they have poor motor control in their hands?
- **Descriptive link text:** If your link text is taken out of context, will it make sense? Many screen readers allow the user to pop up a list of *only* the links from the page. This is a useful way for a blind reader to navigate - unless your link text says "Click here"! Make sure your link includes enough text to clearly define the link, such as "Click here for the full schedule" or even "Full schedule".
- **Unique link names**: Similarly, if your link text is taken out of context, will a user see the same link text multiple times? Ten links that all say "Click here", but point to different pages, would be frustrating.
- **Link separators:** Link in a menu should be separated by more than just whitespace, for visually impaired users to better distinguish links from each other. Additionally, some older screen readers incorrectly read adjacent links as the same link.

Tip:

On the web, links are usually <u>underlined</u>. Most web users are accustomed to clicking on underlined links. To this end, it is best not to underline anything that is *not* a link unless conventional style requires it.

```
<a href="about.html">About</a> <a href="bio.html">Bio</a> <a href="contact.html">Contact</a>
```

This can be done by using a separator:

```
<a href="about.html">About</a>  | <a href="bio.html">Bio</a>  | <a href="contact.html">Contact</a>
```

Another alternative is to make each link into an item in an unordered list, and then use CSS to style the links. A screenreader will pause between list items, making the links more "listenable".

To do this, you will need this CSS:

```
ul {
    list-style: none;
}
ul li {
    display: inline;
    padding-right: 10px;
}
```

and this HTML:

```
<ul>
<li><a href="about.html">About</a></li>
<li><a href="bio.html">Bio</a></li>
<li><a href="contact.html">Contact</a></li>
</ul>
```

Setting list-style to "none" will remove the bullets that are displayed by default before each list item, and setting display to "inline" will place all the list items on the same line. You can continue to style the list items with margin and padding settings as needed.

The TITLE attribute

Similar to ALT text for images, the TITLE attribute can be used to make a link URL clearer. A person using a screen reader can set an option to read TITLE texts out loud instead of the link text. Most browsers display the TITLE text as a "tooltip", or small popup, that appears for a few seconds when the link is moused over.

The TITLE attribute can actually be validly applied to most HTML elements, but is best supported in the A (hyperlink) tag.

Javascript and DHTML

Many people are fond of "drop-down" or rollout menus, which appear when the user moves the cursor over a top-level category. For many users, they are a quick way to jump straight to the page they need.

Many of these menus create accessibility issues. Some are very sensitive to mouse movement and will "roll up" the instant the mouse drifts outside the box - which can be a serious problem for users whose hands cannot control the mouse precisely. In addition, some of the **Javascript** and **Dynamic HTML** (DHTML) code needed to generate these menus is not understood by screen readers, and will be ignored. This can prevent many users from using the menus at all!

This doesn't mean you can't use Javascript or DHTML, but if you are using it for important functions like navigation, be sure that you have a fallback plan for browsers without Javascript. You can usually test this yourself by turning Javascript off in your browser.

Popup Windows

Popup windows have their purposes:

- displaying extra information without making the user lose their place on the page,

- letting the user open a link to another site that they can look at later,

- advertising (often unwelcome).

Consider what happens when a screen reader encounters a new window. It will first announce that the new window has opened, and then shift focus to that window, reading out the new content. A blind user cannot quickly glance at the new window and put it aside for later; they must hear the content, decide whether or not it is relevant, and choose which window to continue reading.

Unexpected popups can also be a problem for users with learning disabilities, as the sudden appearance of a new window can be distracting and make them lose their place on the previous page.

As a general rule, warn the user if a link will open a new pop-up window. Additionally, consider whether the pop-up window is absolutely necessary. Traditionally, links to external sites were opened in new browser windows. This is preferred by many, but it is better to let the user choose: nearly all browsers let you right-click (or control-click, if you are a Mac user) a link to open it in a new window.

Data tables

We have established that you shouldn't use tables for graphic layout, but that doesn't mean you can't use tables at all. Tables are indispensable for their original intended purpose: displaying tabular data in an organized and legible format.

Sighted users can easily glance at a data table, see where the row and column headers are, and find the piece of data they are seeking. But when a screen reader encounters a table, it reads it out in a linear fashion: row by row, each cell in order. If the table is very large, it is easy to lose track of which column you are listening to. And if the table is very complex, with merged cells that overlap multiple rows or columns, it may not make much sense when read out loud. Figure 3.6 gives an example.

Figure 3.6 A table with a bus schedule

Table headers

Every table should have clearly labeled table headers. Often developers have done this just by colouring the background of the header cells or making the text bold, but as we know, this visual information will be lost when run through a screen reader.

So how can we tell the browser itself where the table headers are? This can be done with the <th> tag, which works exactly like the <td> tag except it makes the distinction that the cell is a header. Plus, you can still style the <th> tag using CSS to make the headers look however you want.

Caption and summary

The <caption> attribute gives all users a quick definition of the table. The <summary> attribute provides more detail for screen readers.

<table summary="The schedule for the westbound 99 B-Line, with stops at Commercial, Clark, Main, Cambie, Willow, Granville, Macdonald, Alma, Sasamat, and UBC.">
<caption>Schedule for the 99 B-Line</caption>
<thead>
<tr>
<th>...

Scope

The <scope> attribute goes into a table header to tell the browser which header is associated with a given row or column. This helps remove ambiguity and allows the screen reader to provide the user more information about the given table. Two of the options are scope="row" or scope="col".

Table 1: Student graduation data

	Graduation year	**GPA**
Bob Smith	2002	3.4
Sara Miller	2004	3.8

This would be written as follows:

<table summary="Graduation year and GPA for each student enrolled in the program.">
    <caption>Table 1: Student graduation data</caption>
    <tr>
    <td></td>
        <th scope="col">Graduation year</th>
        <th scope="col">GPA</th>
    </tr>
    <tr>
    <th scope="row">Bob Smith</th>
        <td>2002</td>
        <td>3.4</td>
    </tr>
    <tr>
    <th scope="row">Sara Miller</th>
        <td>2004</td>
        <td>3.8</td>
    </tr>
</table>

Complex tables

Tables with multiple layers of headers and categories can become quite complicated. XHTML does allow for further description of complex tables, including grouping sets of rows and associating cells with headings. These ideas may be of interest if you have many data tables. Here are some resources for complex tables:

- http://www.usability.com.au/resources/tables.cfm
- http://jimthatcher.com/webcourse9.htm.

Accessibility features

Most of the changes we have talked about will improve your site's accessibility without changing its functionality in any way. Now we are going to discuss a few things you can add to your site that will be of extra benefit to disabled users.

Skip to content

While many experienced screen reader users listen to web sites at very high speeds, there is still no audio equivalent to skimming the page. Sighted users can easily ignore any part of a website that is of no interest to them, or something they have seen before, such as the navigation.

One feature that will improve your website's usability is a **skip to content** option. This is a link, coded to appear invisible to sighted users, that screen reader users can click to skip any navigation menus that they have already encountered and don't need right now.

There are three steps to creating a skip navigation option.

1. Add an anchor link just before your main content starts:
   `<a name="maincontent"></a>`
2. Add a new class in your CSS:
   `.skiplink {display:none}`
   Now, anything that you assign to class "skiplink" will not be displayed in the browser.

3. Add this link right after the `<body>` declaration of your page:
   `<a class="skiplink" href="#startcontent">Skip over navigation</a>`

Keyboard shortcuts

The accesskey attribute allows you to predefine keyboard shortcuts to specific pages or form fields on your website. This is especially beneficial to anyone who navigates your site using only a keyboard, or whose use of a mouse is limited. Accesskeys are triggered by the user holding down ALT and pressing the specified key.

Simply define the key within an existing link to that page:

About This Site

Be careful not to override existing browser keyboard shortcuts that appear in the browser toolbar, such as F (File), E (Edit), V (View). To be certain, use only numbers as access keys; you are less likely to conflict with existing shortcut definitions. There is no automatic listing of what access keys are defined on a site, so you will have to list the keys that you have defined either on a separate page of your site or next to the appropriate links.

There are a few conventional shortcuts:

ALT-1: Home page
ALT-2: Skip to main content
ALT-9: Feedback

Not all browsers support accesskey yet, but those that don't will simply ignore the attribute.

Multimedia

We use the term "multimedia" to refer to audio, video, PDF and Flash: any content on the web that is not text, HTML, or a graphic.

> **Tip:**
> Different people have different learning styles; every time you present your content in a different medium, you *increase* the accessibility of your site. Developing accessible sites does not mean making every type of media usable, it means making all the *information* available to everyone.

Multimedia can create some of the richest and most engaging experiences on the web. For this very reason, it is also the most challenging aspect of web accessibility. The simplest rule to follow for rich media is: *provide an alternative*.

Audio

For audio, the accessibility alternative may be relatively simple; if the audio file in question is spoken word, it is sufficient to provide a text transcript. For music, provide lyrics and, if appropriate, a description of the piece and an explanation of its significance.

Audio can be used to benefit learning-disabled users. Consider offering a reading of key passages or especially difficult text. In returning to our original point that improvements made with accessibility in mind will help non-disabled users as well, consider how an audio reading will assist someone who is not fluent in the language. There are parts of language that are not well conveyed by text, such as correct pronunciation, and language flow.

Video

Video files are a great way to present information. These can be short video clips that you create yourself, or links to web-based videos that a peer has made. A chemistry professor at San Francisco State University has created a captioned video showing each step of his lab experiments. He reports fewer questions about the procedures and positive feedback from students. If you use a video file that has no audio track, let your students know that there is no audio right in the link to the file (e.g., "Video of amoeba movement via temporary projections called pseudopods – no audio"). That way the students will know that they do not need speakers and deaf and hard of hearing students will know that they do not need captions.

When adding video to your site, accommodations need to be made for both vision and hearing-impaired users. For visually impaired users, **audio description** (AD) of the contents of a scene is important. In twenty-five words or less, an audio description is a narrator providing a spoken context for anything that the viewer cannot understand by listening to the soundtrack. For hearing impaired users, any key information provided in the video should be represented in the text equivalent. Perhaps in the picture there is a sign placed prominently that the viewer is expected to read, or people in the video are reacting to a sound heard off-camera. These details affect the viewer's understanding of the material, and you need to ensure that all visitors to your site are able to get this information.

Transcripts vs. captions/subtitles

A transcript is one way that you can provide your audience with a second format for your content. Transcripts are easy, and can be created by anyone. If you are the creator of the video, chances are you have a script that you can provide. In some cases, a script may not need any modifications to be a full transcript. If you need to write a transcript from scratch, it isn't hard, but it is time-consuming. Load up the video, and your word processor and get typing. Before long you will have a transcript to publish.

A transcript usually consists of one file with the whole content of the video. On the other hand, captions and subtitles are synchronized with the video stream, and as such require more effort, and time to create.

> **Tip:**
> You may want to consider using speech recognition software such as Dragon NaturallySpeaking. The authors of this chapter have had very good results with NaturallySpeaking. One of the big advantages of using speech recognition is that it keeps your hands free to do other things while transcribing, such as control the playback rate, and replay a section of the video. In some cases, you will find that transcription using speech recognition can actually be faster than manual input via the keyboard!

Captioning vs. subtitling

Subtitles are a textual representation of the speech in a video clip. The focus of subtitles is to state what is said, not what is audible. Subtitling does not attempt to provide information about other aural cues, such as a ringing doorbell.

Tip:
If you wish to show a clip, which has dialogue in another language, consider captioning in your audience's primary language! By doing this, you can aid language comprehension, for students that understand some of the primary language. Students who don't speak the clip's primary language will be able to understand what is said in the video.

Captions attempt to provide a textual representation of all the audio in a video clip. This may include speech as well as sound effects (for example, a ringing doorbell) and background music. Writing video captions can come down to a matter of style. As with everything else in accessibility, you need to use common sense when making decisions about how much has to be captioned. Be thorough without overwhelming the user with unnecessary details.

If you are looking to provide a base level of enhancement, start with a transcript of the video. For a more interactive approach, subtitling or captioning can greatly increase the video's comprehensibility for people who struggle with the language spoken. Reading the text while hearing the dialogue can be very helpful when learning a language.

Tip:
Open vs closed captioning: Closed captioning is a technology that an individual user enables to see the captioning for a given video. Common applications of this include news broadcasts and on VHS/DVD movies. With open captioning, the video's picture has the textual representation directly ingrained into it. Users cannot choose whether they see the captions or not; they are always enabled. A common application of open captioning is for videos in another language.

Captioning is something that you can do yourself though it is time-consuming. It may be more practical to hire a professional captioning company. This can be expensive, but in the end you may find the price worthwhile. Video alternatives should be considered part of the cost of building and maintaining your site.

Flash

Tip:
Caution: Avoid building your entire website in flash. Yes, you can make some visually impressive pages doing so. Yes, Flash sites can have a certain cool-factor, unachievable with HTML. However, most Flash sites are not as accessible as HTML sites.

Like all other forms of multimedia, Flash can improve accessibility for some users and degrade it for others. It can be easier to demonstrate concepts with interactivity and animation than with text and images. A well-designed Flash demonstration can have enormous benefits for students, especially those with learning disabilities. Yet it can be a problem for users with visual or physical handicaps. Some problem areas include:

- representing information only as graphics - see the discussion regarding images without alternative text;

- small buttons, or buttons that cannot be navigated using the keyboard - users with physical disabilities may have trouble using the interface.

Flash and screen readers

Since Flash generally does not present text in a linear fashion, often screen readers cannot synthesize speech in a manner that makes sense to the user. Blocks of text can change over time, be randomized, and appear at differing locations of the screen. Users must also have an up-to-date screen reader that works with the current version of Flash.

When creating content in Flash for screen readers, keep the following questions in mind:

- Does the reading order make sense? Flash objects are read in the order in which they were created, rather than the order in which they appear visually on the screen.

- When an event occurs on the screen, does the screen reader start reading again from the start? You don't want to bombard the user with repeated information (recall the discussion on navigation in the XHTML/CSS section).

- Do you *need* to display your content in Flash, or will a standard webpage do just as nicely?

  Note: This doesn't mean you should *never* use Flash. It means that if your entire site consists of three buttons and a block of text, Flash is probably overkill. If you want some special animations, consider making them in a JavaScript-enabled HTML webpage. A screen reader will ignore the animations but can read any text-based information.

Adobe offers suggestions and best practices for accessibility in Flash and other products on their web site at http://www.adobe.com/accessibility/.

Portable Document Format (PDF)

The primary challenge of PDF files is to make sure that the text of your document is encoded as text, not as a graphic. If you scan a document onto your computer and directly output it to a PDF file, the contents of the file will be encoded graphically. If you want to create a PDF file from a text document you have scanned, be sure to use Optical Character Recognition (OCR) software. OCR software converts graphical lettering to text. PDF viewers (such as Adobe Reader) cannot analyze graphics for text, so this must be done when creating the PDF file.

The PDF format is used frequently online, but often unnecessarily. In many cases it is used to avoid creating a webpage, or to ensure that the layout of the information is exactly as the designer wants it. In these cases, the information could be better conveyed in simple HTML, without forcing the user to download and view an extra file.

Of course, there are valid reasons to use the PDF format, which we will consider here.

Footnoting

HTML does not provide support for footnoting, or referencing. If you only need to cite one reference, including that information at the bottom of the webpage may be sufficient. But if you are working on a document that requires extensive footnoting, the PDF format may be a better solution.

Annotating forms

If you require that other people fill out and return a form online, the PDF format has some extra features that may be useful. However, you should consider whether a web form with submission would accomplish your task.

Printing

The PDF format makes considerations for documents that are designed for reading on paper. HTML doesn't, as it was designed to be a web/online format. As a result, HTML has no concept of print margins, page sizes, etc. Even the most savvy web designers will tell you that multi-column web pages can be quirky at the best of times.

Uneditable content

For official documents, journal articles and copyright-sensitive materials, PDF is often preferred as the end user is unable to make any edits or changes to the document.

There is a difference between *wanting* and *needing* to format your document using multiple columns. If you just want to use multiple columns, but it is not crucial to the information in the document, go brush up on your XHTML/CSS skills, and stay away from PDF. However, there are situations where the columnar layout and print format of the document is crucial, (e.g.: academic articles, order forms) and in these cases the PDF format is fine.

Specialized notation

If you need to share a document with some specific notation (e.g., mathematics, or another language), there are some specific technologies you should consider before jumping to PDF.

In the case of mathematics, if you are working on a file with fairly standard math notation in it, you may not need to use PDF: MathML might be enough. MathML is a specialized markup language developed by the W3C for displaying mathematics. The downside of MathML, is that your target audience must install the MathML fonts on their computer.

In the case of other languages, the Unicode character-encoding format may provide the characters you need. Fortunately, modern operating systems (Windows XP, Mac OS X) have support for Unicode built in.

If you need to display some other notation, PDF is probably a suitable choice, since it has roots as a graphical file format. The primary advantage of these other technologies is that the user does not have to launch a different piece of software to view your document. MathML and Unicode can be drawn natively in your audience's web browser.

PDF and screen readers

Adobe Acrobat has been able to function as a screen reader since version 6. So for the purposes of testing your PDF files, checking what Acrobat says (literally) is the first point to test.

Tagging PDF files

Tags are extra information about the content of a document. Tags allow the document creator to specify alternative text or images, and to denote specific pieces of text as headings. Tags are similar to attributes in HTML - they provide extra information about an item in the document.

> **Quick Tip!**
> **Google for the URL of your PDF files.** The HTML output that Google outputs is usually a fairly good indication of the accessibility of your PDF files. You should also try using the search function in your PDF viewer. If the search function works, chances are good that a screen reader will be able to interpret the text of the document. As with all other methods of validation, use it to check for technical problems only, then rethink the problem areas.

Adding tags in Microsoft Word (2000 or newer)

To add alternative text to a graphic:
1. Right click on your image.
2. Format picture.
3. Go to the Web tab.
4. Type your text under "Alternative Text".

Specifying headings is also easy; just use the Word text style for headings. The added benefit for you, the document maintainer, is that now should you want to change the formatting of headers, you only have to change the formatting once. Using Word's styles is akin to using cascading style sheets (CSS) to format HTML pages.

When you are working on a document that requires multiple column formatting, use Word's column function. Acrobat will automatically recognize the columnar arrangement, and correctly generate the reading order for software such as screen readers.

Full procedures for tagging are beyond the scope of this manual. For more information, Adobe provides a how-to guide on creating accessible PDF files (both from your initial source, and retrofitting) on their website (http://www.adobe.com/enterprise/accessibility/pdfs/acro7_pg_ue.pdf).

As with many other forms of accessibility, spending the time to increase the ease of use for disabled people improves the accessibility for other users as well. By adding tags to your PDF documents, now your documents are viewable on other devices, such as PDAs. Joe Clark wrote a very solid article on PDF accessibility, which discusses the appropriate usage of PDF files (at: http://www.alistapart.com/articles/pdf_accessibility/).

Testing your site

Accessibility checkers and the human factor

There are some useful tools available for testing the accessibility of your site. They will examine your code and look for items like missing alternative (ALT) text or table headers, and make recommendations on improvements that will help your site meet each priority level. Accessibility checkers, such as Watchfire WebXact or UsableNet LIFT Machine, can be an invaluable help in identifying accessibility gaps in your web pages. Products or application plug-ins, such as UsableNet LIFT for Dreamweaver, allow you to check the accessibility before you even post the final page to the Web. You may notice that they will also issue a list of warnings, regardless of your website's actual accessibility results. Why is this?

There are simply too many accessibility standards that only humans can test. No software can tell you if your site's menu navigation is intuitive, or if the ALT text you have included is sufficient to describe the image. Use an accessibility checker *first* to make sure you have covered everything you can, and then work through the warnings it provides, looking at your site critically.

Tip:
XHTML/CSS Validators
If you are building your site from scratch as described in Chapter 4, you should test the validity of your code using an XHTML and CSS validator. This will help ensure that your site works well with all browsers, including screen readers.
XHTML: http://validator.w3.org/
CSS: http://jigsaw.w3.org/css-validator/

The best way to test your site for accessibility is to ask a user with disabilitiesto try it. Only a human, examining both the context and the content of a page, can fully assess your site's accessibility. It is hard for a sighted user to imagine navigating a website only by voice; as a user with full mobility, it is hard to imagine the frustration of trying to click on a link that is too small. If you truly want to know if your site is accessible, bring it to the people who experience the problems you are trying to address.

Evaluation chart

We have included a checklist of the most common and significant accessibility issues that you should look for when evaluating your site. Some of these guidelines can be tested using an accessibility checker as mentioned above; others you will have to look at objectively and decide for yourself whether they are adequately met.

You can use this chart to evaluate an existing website before making accessibility changes, or to see how well you have done after "accessifying" your existing site or building a new one.

Category	Description	Vision (V) Hearing (H) Motor (M) Cognitive (C)	Notes	Rating (1-5)*
Structure & appearance	Navigation links and placement consistent on each page.	M,C		
	Text good contrast to the background	V,C		
	Each page has a unique descriptive title	V,C		
	Valid XHTML/CSS used throughout the site	V,M,C		
Images	All images have ALT text that either clearly describes the image, or in the case of decorative images, contains a space (alt=" ") to prevent the screen reader from describing the image.	V		
	Images that cannot be adequately described in ALT text (charts, graphs) are further described on a LONGDESC page.	V		
	Links in imagemaps also have ALT text	V		
Text & links	Fonts use a relative font size (em, %), not absolute (px, pt)	V,M,C		
	Heading tags (H1, H2) used correctly as headers, not to format font	V,M,C		
	Ability to skip navigation	V		

	Links separated by more than just white space	V		
	Colour not used to convey information, or reinforced by other visual cues	V		
	Underline not used on non-linked text	C		
	Link text does not repeat on the same page (eg., "click here") but is unique to each link.	V		
	TITLE attribute added to ambiguous links.	V		
	Lists use the UL/OL and LI tags, not bullet images	V,C		
	Coding should not prevent user from changing colours with own stylesheets	V,C		
Tables	Tables used for data, not for layout	V		
	Table row or column headers indicated using the TH tag.	V,C		
	Table summary provided	V,C		
Forms	Forms can be navigated in the correct order using the TAB key	V,M		
	Each form field has an associated LABEL tag	V		
	Enough time given to fill out forms	V,M,C		
	Required fields noted as such before the form label, and marked with asterisk or bold	V		
Multimedia	Transcripts available for all audio	H		
	Transcripts or captioning available for all video	V,H		
	Content presented in Flash described in an alternative format as well	V,H,C		
	Avoid distracting animations, scrolling text	V,C		
	Links provided to download any necessary plug-ins	V,H,M,C		
	PDFs accessible or plain text made available	V		
	Content in applets and plug-ins accessible or else not required	V,M,C		

	If alert sounds are used, reinforce the sound using visual notification	H		
Javascript	Site navigation still works with Javascript turned off.	V,C		
	Drop-down menus do not require difficult, precise mouse movement.	M, C		
General	Passes automated accessibility validator such as Watchfire WebXact	V,H,M,C		
	Site can be navigated by keyboard only	V,M		
	User notified if pop-up windows are to be used	V,M,C		
	External windows do not open pop-up windows	V,M,C		
	No autoplay of music, or ability to turn off music easily	V		
	If frames must be used, they are clearly titled	V		
	Page still usable with stylesheets turned off	V,C		
	Site includes search engine	V,M,C		
	Distracting animations avoided	V,C		
	Pages do not automatically refresh	V,M,C		
General Notes				

Table 3.2 Accessibility evaluation chart

Rating scale

5. **Excellent**. Meets or exceeds the relevant accessibility guideline.
4. **Good**. Meets the guideline, but could be further improved for better accessibility.
3. **Incomplete**. Some effort has been made to meet the guideline, but not all instances

of this item have been addressed.
2. **Poor**. Guideline has been inconsistently or incorrectly applied.
1. **Failed**. Completely ignored or unimplemented.

Resources

Further Resources

During our research, we have collected a great number of online resources as guides and references. We hope that you will find them to be a valuable aid to your exploration of accessible course design.

Tip:
* Accessibility is vital for educational materials.
* Accessibility aids usability for all.
* Making your site accessible isn't all that difficult, and can be done in stages.
* Redundant media is a good thing.

Fundamentals

These sites are good general starting points when studying accessibility.

W3C Web Accessibility Initiative (WAI)
http://www.w3.org/WAI/
The Web Accessibility Initiative (WAI) works with organizations around the world to develop strategies, guidelines, and resources to help make the Web accessible to people with disabilities. They developed:
WCAG Guidelines 1.0
http://www.w3.org/TR/WAI-WEBCONTENT/
Accessify
http://www.accessify.com
News & articles, tutorials, discussion forum.
Dive Into Accessibility
http://www.diveintoaccessibility.org
Easy step-by-step guide to improving the accessibility of your site or blog.
Center for Applied Special Technology (CAST): Universal Design for Learning
http://cast.org/research/udl/index.html

"Founded in 1984 as the Center for Applied Special Technology, CAST has earned international recognition for its development of innovative, technology-based educational resources and strategies based on the principles of Universal Design for Learning (UDL)."

Technical

Introductions to creating valid XHTML and CSS, and how to use it in the process of creating valid, accessible websites.

XHTML Tutorial
http://www.w3schools.com/xhtml/default.asp
CSS Tutorial
http://www.w3schools.com/css/default.asp
Zen Garden
http://www.csszengarden.com/
Creating Accessible Page Layouts
http://www.utoronto.ca/atrc/tutorials/actable/index.html
How and why to avoid using tables for layout.
PDF Accessibility
http://www.alistapart.com/articles/pdf_accessibility
Editorial about specific purposes for which you should use PDF files, and reasons why you should leave it alone for everything else.
Flash Accessibility
http://www.webaim.org/techniques/flash/
IMS Guidelines for Developing Accessible Learning Applications
http://ncam.wgbh.org/salt/guidelines/
http://www.macromedia.com/resources/accessibility/

Tools & Validators

These handy assistants can be very useful for accessifying your site.
Watchfire WebXACT (previously known as Bobby)
http://webxact.watchfire.com/
"WebXACT is a free online service that lets you test single pages of web content for quality, accessibility, and privacy issues."
CSS Validator
http://jigsaw.w3.org/css-validator/
XHTML Validator
http://validator.w3.org/

Vischeck

http://www.vischeck.com/vischeck/

See what images and web pages look like to people with different types of colour blindness.

Lynx Viewer

http://www.yellowpipe.com/yis/tools/lynx/lynx_viewer.php

See what your webpage would look like in a text only web browser

Other

Developing sites for users with cognitive/learning disabilities

http://juicystudio.com/article/cognitive-impairment.php

Richard Felder – Index of Learning Styles

http://www.ncsu.edu/felder-public/ILSpage.html

"The Index of Learning Styles is an online instrument used to assess preferences on four dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) of a learning style model formulated by Richard M. Felder and Linda K. Silverman. The instrument was developed by Richard M. Felder and Barbara A. Soloman of North Carolina State University."

Biology Success! Teaching Diverse Learners

http://www.landmarkcollege.org/institute/grants%5Fresearch/biology%5Fsuccess/book.html

"Biology Success! is an innovative project based at Landmark College in Putney, VT and funded by the National Science Foundation's Research in Disabilities Education program (HRD No. - 0004264). Biology Success! asserts that students with learning differences can succeed in high school and college introductory biology courses when the curriculum has been designed to respond to their learning needs."

Summary

Web accessibility is especially critical in education to ensure that all students have fair and equivalent access to learning materials. Government institutions in the US and UK are required by law to make their web content accessible. Standards and practices for accessibility are agreed upon by the W3C and implemented by the WAI.

Sight, hearing, mobility, and learning disabilities can affect how your students access and interpret information on the Web. Assistive technologies can help with some of the difficulties faced; some must be addressed by your website itself. When making an accessible site, start by thinking about its design, structure, and content.

It is neither quick nor easy to create multiple pathways to reach learning objectives in the online environment. It will take time to build up a set of online materials, activities, and assessment strategies that accommodates the wide variety of learning needs of students with disabilities, and learning preferences of all students. Your efforts will create an inclusive space for everyone, including students traditionally marginalized by their needs in the online environment.

As the old saying goes, "You cannot please all of the people, all of the time." In our case here, we are just trying to increase the probability that each student will succeed in our online course area, regardless of his or her disabilities, learning preferences, or life situation. We do this by increasing the number of methods by which students get and use the content. We do this, whenever possible, by giving options to students regarding how we will evaluate their performance. We do this by taking the time to engage students in different ways and at different levels. We do this by applying UDL principles to online teaching and learning.

Once you have taken UDL principles into consideration when developing your course materials, use correct XHTML and CSS – or a program that can generate this for you – to build or modify the site according to the guidelines provided by the WCAG. This will help to ensure that the technology does not create barriers for students with disabilities.

Glossary

Accessibility. The practice of making web pages and other computer-based media accessible to all users, ensuring that those with disabilities have equivalent access to those without.

ADA. Americans with Disabilities Act.

Alt text. Alternative text, displayed in place of an image.

Assistive technology (or adaptive technology). Software or hardware that enables people with disabilities to perform tasks that would be difficult or impossible without the assistance of technology.

Audio description. An additional narration track for the visually impaired, accompanying television and movies. A narrator describes the action in the scene during pauses in the audio.

Caption. 1. On-screen description of all significant audio content in a video. 2. HTML attribute to describe a table, displayed with the table.

Cascading style sheets (CSS). Code used to define the presentation of a document written in HTML or XHTML.

CMS. Content management system, used to more easily maintain pages on a website.

Deductive learners. Students who prefer starting with more structure, deriving consequences and applications from the concepts and theories.

Dynamic HTML (DHTML). A collection of technologies, such as HTML and Javascript, used to create interactive or animated websites.

Headtracking. Controlling the mouse pointer by use of head motion.

Headswitch. A button that can be activated with light pressure from the head or any body part that can be moved accurately and reliably.

Hypertext markup language (HTML). A markup language used to create documents on the Web containing text, graphics, sound, video, and/or hyperlinks.

Inductive learners. Students who prefer beginning with meaningful examples before extrapolating the main concepts or theories.

Intuitive learners. Students who prefer reflective activities and resources that require imagination.

JavaScript. Web scripting language that can be used to create interactive content on a web page.

Learning disability. A psychological or neurological condition that affects a person's ability to communicate and/or learn effectively. Includes conditions such as dyslexia (reading difficulty), dysgraphia (writing difficulty), dyscalculia (difficulty with mathematics), and aphasia (problems comprehending language).

Longdesc (long description). A separate HTML document containing the description of an image or media when the description is too long to be contained in the alternative text.

Macromedia Flash. A multimedia authoring program used primarily for web content.

Portable Document Format (PDF). A platform-independent file format developed by Adobe Systems.

Predictive typing. Software that offers the user a choice of words at each point in a sentence, according to what words are statistically most likely to appear in a given context.

Screen reader. Text-to-speech software that reads aloud what is being displayed on the screen.

Screen magnifier. Software that displays an enlarged view of the current screen on a standard monitor.

Section 508. An amendment to the Rehabilitation Act of 1973, which states that electronic and information technology developed or maintained by any agency or

department of the United States Federal Government must be accessible to people with disabilities.

Sensory learners. Students who prefer fact-based activities and resources.

Sip/puff switch. A two-position switching device that can be activated by sipping or puffing and allows the user to control electronic devices.

Subtitles. On-screen translation of dialogue. On-screen text.

Tablet: An alternative pointing device where the user uses a stylus on a pointing surface, like a pen on paper.

Trackball. An alternative pointing device where the user rolls a ball in a holder.

Transcript. A textual version of audio- or video-based material, including speeches, conversations, television and movies.

Usability. The ease of interaction between a human and a computer interface.

UDL. Universal design for learning.

World-wide Web Consortium (W3C). A group that establishes specifications, guidelines, software and tools for various aspects of the web, including file formats and scripting languages.

WAI. Web accessibility initiative.

WCAG. Web content accessibility guidelines - developed by the W3C.

XHTML: Extensible hypertext markup language.

Appendix

The following is a short ten-point checklist that you can use to help guide your site towards better accessibility. This is not a complete list, but draws ideas from Priority 1 and Priority 2 checkpoints.

Examine each of the elements of your site as described in the chart. Decide for yourself how well they meet the criteria, then give each item a rating. Low rated elements should be revisited and improved in order for your site to be considered accessible.

Rating scale

5. **Excellent.** Meets or exceeds the relevant accessibility guideline.
4. **Good.** Meets the guideline, but could be further improved for better accessibility.
3. **Incomplete.** Some effort has been made to meet the guideline, but not all instances of this item have been addressed.
2. **Poor.** Guideline has been inconsistently or incorrectly applied.
1. **Failed.** Completely ignored or unimplemented.

	Description	Rating details	Rating (1-5)	Notes
1.	**Text alternatives** Text equivalent provided for every non-text element, including: images, graphical representations of text and symbols, imagemaps, animations, applets and programmatic objects, frames, scripts, graphical buttons, audio and video.	5: Complete and correct alternative text provided for all elements. 3: Alternative text available for some but not all elements. 1: Alternative text is missing, incomplete, or incorrect.		
	Assists Vision, Cognitive			
2.	**Text** Fonts can be resized using the browser. Text is high-contrast.	5: Text is easy to read and resize 3: Text can be resized, but may cause problems in layout when enlarged; some text may be hard to read 1: Text cannot be resized, and/or is hard to read due to size, colour or contrast		
	Assists: Vision, Cognitive			
3.	**Links** Link text makes sense out of context and does not repeat	5: Each link has clear and unique link text 3: Some link text repeats or is vague (e.g., "click here") 1: Links cannot be understood when taken out of context		
	Assists: Vision, Cognitive			
4.	**Colour** All information conveyed with colour is also available without colour, for example from context or markup.	5: Colour used appropriately 3: Colour used to convey information, but the content has alternative explanation/description. (e.g., a pie-chart with the colour and the percentage). 1: Colour used to convey information (eg., "click the red link")		
	Assists: Vision (colour blindness)			

5.	**Distraction** No screen flickering, refreshing or distracting animations. If pop-up windows must be used, user is notified in advance.	5: No flickering or distractions 3: Some animations may be distracting 1: Unexpected pop-ups; screen is distracting and chaotic		
	Assists: Vision, Cognitive			
6.	**Clarity & consistency** Clear and simple language used, as appropriate for site content. Navigation stays consistent across the site.	5: Content is written at the appropriate level for site visitors. Site is easy to navigate. 3: Some content or menus may be confusing 1: Language too difficult for site visitors to understand; menus change from page to page		
	Assists: Vision, Cognitive			
7.	**Data Tables** Row and column headers identified. For complex tables, data cells are associated with header cells.	5: Headers complete and complex cells associated with headers 3: Incomplete or incorrect headers 1: No headers provided		
	Assists: Vision, Cognitive			
8.	**Frames** If frames must be used, all frames clearly titled.	5: Frames correctly titled 3: Some frames titled, or ambiguously titled 1: Frames used without titles		
	Assists: Vision, Cognitive			
9.	Plugins, applets & scripts Pages are usable when scripts, applets, or other programmatic objects are turned off or not supported.	5: Turning off plugin/script leads to fallback alternative 3: Turning off plugin/script loses functionality, but site is still otherwise usable 1: Site cannot be used without plugin/script		
	Assists: **Vision, Cognitive, Motion, Hearing**			

| 10. | **"Last resort"**

If, after best efforts, the material cannot be made accessible, a link is provided to an alternative, accessible page that has equivalent information (or functionality), and is updated as often as the inaccessible (original) page. | 5: Original pages adequate, or alternative pages provided when necessary
3: Alternative page provided, but not equivalent
1: No alternative pages provided when needed, or alternative pages provided when original pages could be made accessible | | |
| | **Assists:**

Vision, Cognitive, Motion, Hearing | | | |

Table 3.3 Accessibility evaluation chart – detailed

References

A profile of disability in Canada, 2001. Retrieved May 16, 2006 from Statistics Canada web site: http://www.statcan.ca/english/freepub/89-577-XIE/canada.htm

Draffan, E. A., & Reinger, P. (2006). A model for the identification of challenges to blended learning. *ALT-J.*

Faculty & Staff Disability Resources: Accommodating students with disabilities. (n.d.) Retrieved May 16, 2006 from University of British Columbia, Student Services website: http://students.ubc.ca/facultystaff/disability.cfm?page=students

Hirtz, S., Harper, D.G., and Mackenzie, S. (Eds.). (2008). *Education for a Digital World: Advice, Guidelines, and Effective Practice from Around the Globe*. Vancouver, BC: BCcampus and Commonwealth of Learning.

Ivory, M., & Chevalier, A. (2002). A study of automated website evaluation tools. Technical Report UW-CSE-02-10-01. University of Washington, Department of Computer Science and Engineering. Retrieved March 2006

http://scholar.google.com/url?sa=U&q=ftp://ftp.cs.washington.edu/tr/2002/10/UW-CSE-02-10-01.pdf

Jeffels, P. (2005). Usability, the practical approach to accessibility. *ALT-N online 1*.

Jeffels, P., & Marston, P. (2003). Accessibility of online learning materials. SCROLLA Invited Paper

Kelly, B., & Sloan, D. (2005). Forcing Standardization or Accommodating Diversity? A Framework for Applying the WCAG in the Real World. Paper presented at International Cross-Disciplinary Workshop on Web Accessibility. Chiba, Japan on 20th May 2005. http://www.ukoln.ac.uk/web-focus/papers/w4a-2005/html/. Retrieved March 2006

Kelly, K. (2008). Evaluating and improving your online teaching effectiveness. In S. Hirtz, D.G. Harper, and S. Mackenzie (Eds.), *Education for a Digital World: Advice, Guidelines, and Effective Practice from Around the Globe* (pp. 365-377). Vancouver, BC: BCcampus and Commonwealth of Learning.

Microsoft Accessibility: Technology for Everyone (2005). Renton Technical College Pilot Project Provides Accessible Technology to Help Overcome Barriers to Learning. Retrieved June 2006 http://www.microsoft.com/enable/casestudy/rtc.aspx

Muir, Adrienne, & Oppenheim, Charles. (2001, September). Report on Developments World-Wide on National Information Policy. Department of Information Science, Loughborough University. Retrieved on 06 August 2006 from: http://www.la-hq.org.uk/directory/prof_issues/nip/universal.htm

Section 508 Standards (2006, January 23). Retrieved May 16, 2006 from: http://www.section508.gov/index.cfm?FuseAction=Content&ID=12

W3C. (1999a). Checklist of Checkpoints for Web Content Accessibility Guidelines 1.0. Retrieved on 05 August 2006 from: http://www.w3.org/TR/WAI-WEBCONTENT/full-checklist.html

W3C. (1999b). List of Checkpoints for Web Content Accessibility Guidelines 1.0. Retrieved on 05 August 2006 from: http://www.w3.org/TR/WAI-WEBCONTENT/checkpoint-list.html

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