Investigating and Applying Universal Design: A Partnership Between a University and an Art Museum

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Abstract. Community settings allow individuals to connect and interact socially with others, and engage in new learning experiences. One type of community setting, public art museums, provide rich, cultural experiences for individuals that are distinctive and often repeated, due to changing exhibits. Unfortunately, for individuals with disabilities, these settings can have a negative impact if the physical environment or the social interactions with docents impede individuals' abilities to function and benefit from this type of community engagement. The principles of universal design (UD) can transform these negative experiences into positive ones that benefit the individuals and the community settings. One public institution of higher education in the United States, Worcester State University in Worcester, Massachusetts has a unique partnership with a nearby art museum. This partnership allowed two separate projects from two health-related professions to be conducted using the principles of UD. One project from the Occupational Therapy Department examined the physical environment in the context of an undergraduate course, and the other project from the Communication and Sciences Department investigated the delivery of docents' presentations for individuals with communication disorders, such as hearing loss. Although each project examined different aspects of the same museum experience, the recommendations benefit all museum visitors and increase community engagement.

Keywords. Universal design, community engagement, public university-museum partnership, Occupational Therapy, Communication Sciences and Disorders

1. Introduction

Universal design (UD) is based on the concept that the design of environments should benefit all individuals, regardless of their ability or age. The Center for Universal Design defines UD as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" [1]. By using UD, products and environments are accessible without stigmatizing individuals

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needing accommodations because the intention in the design was to embed accessibility. The seven principles of UD are as follows: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort and size and space for approach and use [1]. One well-known example of UD is an automatic door that opens as one approaches a commercial building (e.g. airport, supermarket, etc). Any individual in a wheelchair, using a stroller, or walking independently could access the entrance without difficulty.

Many public spaces in urban settings could benefit from an examination of ways in which to incorporate UD. Urban universities are in a unique position to partner with public spaces for such examination because of the expertise of faculty members. In addition, many urban universities have community engagement as part of their mission or strategic plan.

Jacob, Sutin, Weidman, and Yeager defined community engagement in higher education as "sustainable networks, partnerships, communication media and activities between higher education institutions and communities at local, national, regional and international levels" [2]. This partnership presents new opportunities and challenges to both parties. Innovative solutions, based on best practices and the uniqueness of each community site, can be jointly developed and implemented to increase or improve the usability of community sites so that more individuals could connect with the environment and socially interact with others. For example, a partnership between a public university and a local art museum can examine the barriers to usability that prevented individuals from participating in rich, cultural experiences and provided universally-designed solutions to increase engagement.

2. Worcester State University and Worcester Art Museum: A Partnership

Worcester State University (WSU) is a public university established in 1874. As such, WSU has a robust history of interaction with its urban community. WSU first established the institution as the Worcester Normal School in 1874, with the express purpose of preparing educators for public schools within the community. In 1963, the normal school became Worcester State Teachers College. In 1963, the teacher's college adopted a liberal arts and sciences focus, and the word "teachers" was removed from the college's official name. Due to its many graduate programs and offerings, it changed from "College" to "University" in 2010 [3]. WSU has a reputation for partnerships in the community that enhance students' ability "to lead, serve, and make a difference in the world" [4] and projects with the partners that improve the lives of the people in the community [5, 6].

The Worcester Art Museum (WAM), located in Worcester, Massachusetts, USA, is a nonprofit, art museum that was founded 1896. Similar to WSU, WAM is located in an urban setting. It has a collection of 38,000 objects and has the second-largest collection of arms and armor. WAM's mission is to "connect people, communities, and cultures through the experience of art" [7]. During the recent process of revising their mission, WAM stated that the museum is a "catalyst for building community" and that art is a, "universal language, art can be understood and enjoyed by anyone—regardless of background, knowledge, or physical abilities. Art thus functions as a 'social glue' that unites human beings with each other" [8].

Although the interactions between WSU and WAM are long standing, a deeper partnership was formed in 2012. At that time, the WSU president began working with

the WAM director. Faculty members at WSU were encouraged to develop projects with WAM. Over the past six years of this partnership, faculty members in more than 15 academic departments developed such projects and many WSU students have worked with faculty members at the museum in curriculum-based research projects. This paper describes two such departmental based projects that focused on UD and helped to strengthen the WSU-WAM partnership and enhance the experience of community members when they visit WAM.

3. Community-Based Universal Design Projects

Individuals with physical and/or perceptual disorders form a large population for whom the museum experience may not be accessible [9]. According to the 2016 U.S. Census Bureau [10], approximately 13% of the adult population (or 39 million adults) reported some type of disability involving mobility, vision, or hearing. Results of a recent survey indicated that this group of adults were less likely to visit an art museum than able-bodied adults [11]. In addition, 46 million people in the USA have communication disorders that negatively impact their ability to hear, understand, or talk [12]. These individuals may have a hearing loss and have difficulty hearing speech or they may have a language disorder and have difficulty understanding or formulating a message. A particularly common communication disorder is hearing loss that affects individuals of all ages, especially middle-aged and older adults [13].

3.1. Occupational Therapy Project: Professor and Students

The Occupational Therapy (OT) Program at Worcester State University prepares students to be generalists with an entry-level master's degree (MOT) education. Occupational therapy is a profession which focuses on the use of occupations to enhance function of individuals across the lifespan. Occupational therapists are employed in a variety of hospital, school, and community settings.

One specific course at the OT senior level, Assistive Technology I, introduces OT students to various related content including: legislation, adaptation, and UD. Prior to UD, The American with Disabilities Act (ADA) of 1990 had a major effect on accessibility. This civil rights law, which passed through the United State Congress, required all public buildings to be accessible to all users [14]. Since the WAM building was opened to the public in 1898, multiple wings have been added and structural changes have been made. Changes WAM made after 1990 were likely driven by the ADA.

For this project, students evaluated the accessibility of various aspects of the WAM, applied the UD principles to the environment, and recommended solutions. Prior to conducting the evaluation, students were educated on the principles of UD and accessibility, intervention strategies to optimize function, and standards related to the Americans with Disabilities Act Accessibility Guidelines. Depending on their assigned area, students researched checklists, websites and related literature to determine best practices.

When OT students examined the WAM for ADA compliance, they expected a mix of the level of accessibility due to the historical aspects of the building as well as the more than 20 years since the passage of ADA. The OT students and the faculty member primarily examined the physical accessibility of the building, but also included other aspects that affected people with disabilities.

Results of this project showed that the WAM was fairly accessible to all ages and abilities, but recommendations were provided to improve different aspects of the museum experience for all visitors (Table 1). Overall, the recommendations made to WAM benefits the museum achieve its mission, specifically regarding enhancing community engagement. For example, some recommendations, including larger print on the café menus, adding sensors to the elevator doors, and using the accessibility features on the iPads, enhance the experience but do not add significant cost to the museum.

Table 1. Problems and Solutions Identified by OT Students and Faculty Member

Area of WAM	Problem	Solution
Parking Lot	Van accessible parking not marked	Repave and repaint
	Poor signage for accessible parking and entrance	Use larger signage on ground and on poles to identify spaces
Elevator	Elevators doors did not reopening efficiently when obstructed	Add sensors to increase safety
	Elevator panel buttons are too high, cannot be reached in a wheelchair	Lower the panel or add a device that would help reach the buttons
	No audible sound in elevator when changing floors	Add an audible component
	No emergency phone in elevator	Add telephone and include Braille signage
Gift Shop	Body mirror in too high	Change to a full-length mirror
	Middle counter is too high (~3.5 feet), wheelchair users unable to reach	Use a clipboard with a pen to obtain signatures for credit card purchases
	Price tags very small, hard for customers to read	Use larger tags with dark ink
Café	Menus have small print	Provide menus in different formats (larger font, braille)
	From outside entrance, pull doors could be difficult for any individual	Replace with automatic doors
Restrooms	Map was not accurate for all locations	Update map
	Signage was sparse, did not have braille	Revise signage
	Exterior doors to bathroom are difficult to open	Change to lever handles
	Counters and mirrors are too high	Lower counters
	Paper towel holders are difficult to operate	Change style to motion detector or air dryer

Audio Tour	Device was difficult to use and hear recording	Provide earphones
	Device was difficult to operate, buttons small and needed force to push w	Switch to lighter devices or create a smartphone app
iPads	iPads used with general functions	Accessibility feature could allow greater use
Blind/Low Vision	Lighting dim in some areas	Increase lighting
	Print on captions are small	Increase font or use iPads
Limited Mobility	Doors are heavy to open	Change exterior doors to automatic opening
	Lockers are too high	Lower lockers and add signage

The students' feedback was positive in terms of real-life application of classroom learning and providing a service to the community. Students also were able to evaluate the differences between accessibility and UD. Students demonstrated how these changes based on UD principles could enhance the museum experience for all visitors, not only those with disabilities. Students realized that better signage and easier access to the restrooms improved the museum experience for mothers with strollers and elders, as well as people in wheelchairs. This powerful learning provided the students with an understanding of concepts that were meaningful because of their engagement with this specific site and the students responded favorably.

3.2 Speech-Language Pathology Project: Professors and Student Project

While OT faculty member and students examined the WAM building for physical accessibility, the goal for Speech-Language Pathology (SLP) Program professors and students was to provide training for docents to optimize access using the principles of UD. The Master of Science in SLP at WSU provides graduate students with knowledge and skills to be entry level speech-language pathologists. Speech-language pathologists work in a variety of educational and health-care settings with individuals with communication disorders such as hearing loss, fluency, and voice disorders, difficulties expressing and understanding language. Speech-language pathologists not only work with individuals with communication disorders, but also assure that all those who interact with these individuals know how to facilitate access by adjusting their speech and language.

To examine the questions of accessibility and UD, the SLP faculty members and students focused on perceptual access for visitors with communication disorders, including hearing loss. Docent-led tours provide excellent opportunities for the community to engage in learning about the artifacts in an art museum. Docents receive rigorous training and know their subject matter well but are not often trained in best practices in communicating with audiences. Communicating information and adapting to the audience can only be achieved if the docents have the skills to convey the content

in an accessible and engaging manner [15]. To create an accessible museum experience for individuals with perceptual difficulties such as hearing loss, adjustments in communication must be made.

Individuals with hearing loss may be specifically discouraged from attending events at museums due to difficulty previously experienced with listening in public spaces [16]. Thus, they may avoid museums, especially docent-led tours. Adults with hearing loss avoid listening in public spaces because hearing loss makes listening in a noisy or reverberant background difficult [17, 18]. Unfortunately, the listening environment in a typical art gallery has those negative characteristics. The size of the galleries and the height of the ceilings result in noise levels and reverberation that make listening with a hearing loss a challenge. Listeners with hearing loss also find listening in a group challenging, especially when they are not in front of the speaker. The docent's face may not always be visible, reducing access to speech cues even further [19].

Most individuals, with or without communication disorders, benefit from an unobstructed, well-lit view of the speaker's face. Facial expressions, eye movements, and lip movements complement auditory information, eliminate confusion, and reduce listening effort [16, 20]. For example, it is important for docents to face the audience members so they can use visible lip movements and facial expressions. The docent's face should have good lighting and the docent should use natural gestures to provide additional contextual cues. Individuals with hearing loss should be part of smaller groups so that the docent can consider his/ her position relative to the audience and provide these individualized adjustments. These visual cues can only be useful if docents speak naturally and do not distort speech movements by exaggerating or speaking too loudly. All of these adaptations represent UD, thus can benefit all museum visitors.

Adjustments in the presentation can easily be incorporated in a docent-led tour. It has been shown that these changes result in measurable improvements in understanding a message, especially in a noisy background [21, 22, 23, 24].

The principles of UD were implemented in the instruction of the group of docents who were non-traditional learners [25]. Clear speech training began with discussing communication disorders and describing the effect of communication disorders on hearing, understanding and speaking. Clear speech occurs when the speaker attempts to express every word and sentence in a precise, accurate, and fully formed manner [24]. Clear speech consists of a slower rate, increased pauses, and longer durations than conversational speech. It is accurately and fully formed, naturally slower, naturally louder with emphasis on key words, but with natural intonation patterns. Clear speech also contains pauses between phrases and sentences [24].

The need for clear speech and its characteristics were demonstrated and discussed with the docents. The positive effects of using clear speech and additional visual cues were highlighted and experienced by the learners. Training included providing instructions, spoken examples and finally guided feedback and practice in group activities [22, 26, 27, 28, 29]. Using clear speech training procedures, positive changes in the use of speech to deliver information was accomplished, facilitating access to all museum visitors.

The training resulted in significant changes in the rate, duration, and use of pauses in speech. Another feature docents changed significantly after the training was that they made sure their faces remained unobstructed. They maintained eye contact and did not turn away from the audience. These behaviors facilitate the use of facial expressions and visual cues that make listening less effortful [13, 16]. These changes improve understanding of content for all individuals especially those with communication

disorders on tours led by the trained docents due to their alignment with the principles of UD (Table 2).

Table 2. Principles of Universal Design: Adapted Docent Presentations

Principle (Burgstahler, 2008)	Methods to Benefit all Visitors
Principle 1: Equitable Use	Provide clear speech and good presentation habits.
	Provide hearing assistive technology (HAT).
Principle 2: Flexibility in Use	Provide a choice of HAT with headphones or with neck loops.
	Present using slower speech rate, more pauses, stress on important concepts, slightly louder speech with precise enunciation.
Principle 3: Simple and Intuitive Use	Eliminate unnecessary complexity.
	Use clear, short sentences with correct grammar.
	Point to artifacts.
	Use natural gestures and facial expressions.
	Provide effective feedback by repeating the audience's questions or comments.
Principle 4: Perceptible Information	Use redundant presentation of essential information.
	Use pointing, gestures, and facial expressions to supplement slower rate of speech, stress important words and pauses.
	Provide written information for supplemental and redundant information.
	Offer HAT for a comfortable level of speech and less interference from background noise and reverberation.
Principle 6: Low Physical Effort	Provide option of HAT and adapting docents' presentations.
Principle 7: Size and Space for Approach and Use	Provide a clear line of sight of the docent so that all visitors can see the docent's well-lit face.
	Ensure small groups of visitors so that all visitors are in close proximity to the docent.

4. Conclusion

The benefits of visiting a museum are manifold and include increased sense of well-being, strengthened feelings of belonging, connections with people who share interests

and values, and time spent with family and friends [30]. These benefits must be available to all visitors, including those who have physical or perceptual disabilities. Adults with disabilities may assume that museums are not accessible to them. Therefore, they often avoid participating fully in contemporary cultural discourse. A partnership between a university and an art museum to examine and implement the principles of UD can lead to improvements in museum accessibility for individuals with disabilities. Additionally, once improvements are made, all art museum visitors will be able to experience increased community engagement and improved quality of life.

When the partnership between WSU and WAM was first proposed, the focus was on the relationship between the humanities and arts at WSU and their interface with the possible educational value of the WAM. Interestingly, one of the first projects developed through this partnership was with the WSU Physics Program. The partnership was broadened with the inclusion of OT and SLP who may not have been thought of as natural partners with a museum. OT and SLP students learned about the importance of UD, and how these future professionals can be effective advocates for individuals with disabilities. Their awareness of their discipline as a change agent in the community increased, and they learned to apply principles of research in their investigations.

In the cases discussed in this paper, the partnership between WSU and WAM resulted in work that benefited the community by improving access to all visitors, with and without disabilities, through the principles of UD. The partnership allowed students and professors to be involved in quantitative research, which benefited all involved: WAM received ideas about accessibility and UD, WSU students received educational experiences, and the community at large received a more accessible museum.

References

[1] Center for Universal Design. (1997). *The Principles of Universal Design (Version 2)*. Raleigh, NC: North Carolina State University. Retrieved on April 3, 2018
https://projects.ncsu.edu/design/cud/about_ud/udprinciplestext.htm

[2] Jacob, W. J., Sutin, S. E., Weidman, J. C., & Yeager, J. L. (2015). Community Engagement in Higher Education: International and Local Perspectives. In W. J. Jacob, S. E. Sutin, J. C. Weidman, & J. L. Yeager, *Community Engagement in Higher Education* (pp. 1-25). Boston, MA: Sense Publishers.

[3] Worcester State University. (n.d.). *Our History.* Retrieved from https://www.worcester.edu/Our-History/

[4] Worcester State University (n.d.) *Strategic Plan*. Retrieved from https://www.worcester.edu/Strategic-Plan/

[5] Boehm, L. K., & Larrivee, L. S. (2016). Promoting a culture of engaged scholarship and mentoring junior faculty in the reappointment, tenure, and promotion process at a teaching first university. *Metropolitan Universities, 27,* 7-18.

[6] Larrivee, L.S., Chalupka, S.M., Cleary, M.A., & Comeau, C.L. (2018). Direct care workers pathway program: A strategy for seamless academic progression. *Metropolitan Universities*, 29, 104-117.

[7] Worcester Art Museum. (2018). *Information.* Retrieved from http://www.worcesterart.org/information/

[8] Worcester Art Museum. (2018). *WAM Updates – New Mission Statement Defines WAM's Purpose*. Retrieved from http://wamupdates.worcesterart.org/

[9] Proctor, N. (2013). Museum visitors; Museums and technology; Museum buildings-barrier-free design. *Curator: The Museum Journal, 56*, 349-351.

[10] United States Census Bureau. (2016). *American Fact Finder.* Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S1810&prodType=table

[11] National Endowment of the Arts. (2015).   A matter of choice? Arts participation patterns of Americans with disabilities. Retrieved from https://www.arts.gov/sites/default/files/Arts-Participation-Among-Adults-with-Disabilities-v3.pdf

[12] National Institute on Deafness and other Communication Disorders. (2015). Health Information. Bethesda, MD: Author. Retrieved from http://www.nidcd.nih.gov/health/Pages/Default.aspx

[13] Dubno, J.R. (2015). Speech recognition across the life span: Longitudinal changes from middle-age to older adults. *American Journal of Audiology, 24*, 84-87.

[14] United States Department of Justice – Civil Rights Division. (n.d.) *The current ADA regulations.* Retrieved from https://www.ada.gov/2010_regs.htm

[15] Grenier, R.S. (2005). How museum docents develop expertise. Unpublished PhD Thesis. The University of Georgia. Retrieved from: http://athenaeum.libs.uga.edu/bitstream/handle/10724/8129/grenier_robin_s_200505_phd.pdf?sequence

[16] Lisney, E., Bowen, J.P., Hern, K., & Zedda, M. (2013). Museums and technology: Being inclusive helps accessibility for all. *Curator: The Museum Journal, 56*, 353-361.

[17] Hazrati, O., & Loizou, P.C. (2012). The combined effects of reverberation and noise on speech intelligibility by cochlear implant listeners. *International Journal of Audiology, 51*(6), 437-443.

[18] Molis, M.R., Kampel, S.D., McMillan, G.P., Gallun, F.J., Dann, S.M., & Konrad-Martin, D. (2015). Effects of hearing and aging on sentence-level time-gated word recognition. *Journal of Speech, Language, and Hearing Research, 58*, 481–496.

[19] Van Engen, K.J., Phelps, J.E.B., Smiljani, R., & Chandrasekaran, B. (2014). Enhancing speech intelligibility: Interactions among context, modality, speech style, and masker. *Journal of Speech Language Hearing Research, 57*, 1909-1918.

[20] Picou, E.M., Ricketts, T.A., & Hornsby, B.W.Y. (2011). Visual cues and listening effort: Individual variability. *Journal of Speech, Language, and Hearing Research, 54*, 1416-1430.

[21] Bradlow, A.R., & Bent, T. (2002). The clear speech effect for non-native listeners. *Journal of Acoustic Society of America, 112*(1), 272-284.

[22] Koslowski, L., & Gagne, J. (2002). A training program designed to improve the speech intelligibility of persons who interact frequently with elderly individuals who have a hearing loss: Evaluation of the efficacy of the program. *Geriatrics Today, 5*, 183-186.

[23] Payton, K.L., Uchanski, R.M., & Braida, L.D. (1994). Intelligibility of conversational and clear speech in noise and reverberation for listeners with normal and impaired hearing. *Journal of the Acoustic Society of America, 95,* 1581-1592.

[24] Schum, D.J. (1996). Intelligibility of clear and conversational speech for young and elderly talkers. *JAAA, 7*, 212-218.

[25] Burgstahler, S.E. (2008). Universal design in instruction. From principle to practice. In Burgstahler, S. E. & Cory, C.C. (Eds) Universal Design in Higher Education. From Principles to Practice. Cambridge,MA: Harvard Education Press.

[26] Caissie, R., Campbell, M., Frenette, W.L. Scott, L., Howell, I., & Roy, A. (2005). Clear speech of adults with hearing loss: Does intervention with communication partners make a difference? *Journal of the American Academy of Audiology, 16*, 157-171.

[27] Meyer S.E., Veneziano-Korzec, A., Larrivee, L., Stacy, K., Weiss, K., & Hickey, A. (November, 2014). Improving Museum Docents' Speech Intelligibility through Clear Speech Training. Presentation at American Speech Language Hearing Association, Orlando, FL.

[28] Schum, D.J. (1997). Beyond hearing aids: Clear speech training as an intervention strategy. *Hearing Journal, 50*, 36-39.

[29] Tye-Murray, N., & Schum, L. (1994). Conversation training for frequent communication partners. *Journal of the Academy of Rehabilitative Audiology, 27,* 209-222.

[30] Everett M.C., & Barrett, M.S. (2011). Benefits visitors derive from sustained engagement with a single museum curator. *The Museum Journal, 54*, 431-446.