

UNDERSTANDING THE USER IN DESIGN:

PROMOTING ENGAGEMENT THROUGH INCLUSIVE DESIGN FOR INDIVIDUALS LIVING WITH INTELLECTUAL DISABILITIES

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PAPER ABSTRACT: Inclusive design uses the understanding of diversity in populations to create products that are accessible and usable by as many people as reasonably possible. Collaboration with interdisciplinary professionals and the users of the design products or environments are crucial partners in the inclusive design process to better understand design goals, criteria and needs, streamline the design process, and improve outcomes. A 15-week experience demonstrated the benefits and areas of friction in the design process through a collaborative design project with visual communication design students, occupational therapy doctoral students, and an organization serving individuals with intellectual disability. The design project aimed to increase engagement and participation in the cooking process for adults with intellectual disability through the creation of an accessible cookbook and user testing of prototypes to improve functionality of future iterations. Lessons learned from the experience are discussed to inform future design collaborations with users and professionals from different disciplines.

Keywords: Inclusive Design, Interdisciplinary, Collaboration, User Centered Design, Occupational Therapy

1. INTRODUCTION

Design of products and environments have the power to facilitate individuals' ability to perform tasks and engage in activities--influencing health, social participation, and participation in activities and tasks meaningful to the individual (Watchorn et al., 2021). Literature suggests disability is not inherent to the individual, but occurs when the environment and tasks do not match the individual's abilities (Watchorn et al., 2021). Inclusive design is a strategy that understands diverse abilities of users and responds with informed decisions in the design process (Waller et al., 2015). Inclusive design incorporates the user in the design process in order to account for heterogeneity of the user needs and professionals from other disciplines who bring a unique expertise to promote engagement and participation in the built environment and minimize disability (Bogza et al., 2020; Hitch et al., 2012). Users provide tacit knowledge to the design process that can only be gained through a lived experience resulting in increased ease of use for all (Ielegems et al., n.d.; Waller et al., 2015). Professionals who work with individuals with disability, such as occupational therapists (specialists who apply therapeutic interventions to help individuals develop or regain engagement in meaningful activity and tasks), are valuable members of design collaborations. Interdisciplinary teams with occupational therapists can

help to bridge knowledge gaps in the inclusive design process by providing a deep understanding of human factors, tasks, and environments and the impacts on function and disability (Hitch et al., 2012).

Intellectual disability is distinguished by significant limitations in intellectual functioning and adaptive behavior, which are the conceptual, practical, and social skills that are used daily (Falvo, 2018). In comparison to the general population, individuals with intellectual disability have more difficulty learning and applying skills needed to complete tasks and will require some level of support, ranging from intermittent to continual and intensive support in all environments. Individuals living with intellectual disability have different cognitive skills than the general population, impacting their ability to attend to a task, problem solve, process information, follow directions, generalize skills into unfamiliar contexts, initiate tasks, and be aware of safety concerns in environments designed for typical cognitive skills (Goldschmidt & Song, 2017).

This paper discusses an inclusive design project that is the result of a 3-way collaboration between an organization supporting the development of independent living skills for adults living with intellectual disability, visual communication design students enrolled in an inclusive design course (referred to as design students), and occupational therapy doctoral students to create a cookbook template for adults living with intellectual disability that encourages independence and participation in cooking. The cookbook was identified by the organization as a pertinent design problem as the formatting of typical cookbooks on the market are currently inaccessible for individuals living with intellectual disability. Typical cookbooks for this population can be challenging to use as they lack consideration for varying literacy levels, do not consider the entire user experience, use formatting that can be intimidating or overwhelming, and may not be intuitive without cognitive skills typical of the general population (Bogza et al., 2020; Krieger et al., 2018). Potential benefits to engaging adults living with intellectual disability in cooking include improved confidence, health and wellness, autonomy when making choices during the process, increased contribution to their household, and development of skills required for independent living and employment (Barnhart et al., 2019). With this in mind, the organization, design students, and occupational therapy doctoral students identified the need to include a wider range of cognitive skills for the revised cookbook design, including the amount of content displayed at a given time, the cognitive complexity of the content, how the content is displayed using visuals and text, and a friendly and intuitive user interface (Bogza et al., 2020; Latteck & Bruland, 2020).

This collaborative experience spanned from the problem discovery phase to the user testing phase, implementing user feedback and observations to inform future iterations, and ultimately promote equitable use of the environment for adults living with intellectual disability through a semester-long design project focused on cooking. Evidence suggests meaningful and deliberate engagement in interdisciplinary collaboration is required to achieve successful partnerships around the built environment (Thompson et al., 2014). Additionally, literature purports collaboration with professionals from different disciplines and users lead to better outcomes when initiated early in the design process

with equal interest and on equal footing (Gill et al., 2018). Knowing this, the collaboration sought to incorporate users and occupational therapists in the design process to promote an understanding of which features were most important, clarification of design goals, and interpretation of findings (Hitch et al., 2012; Ielegems et al., n.d.).

2. DESIGN PROJECT LAUNCH AND PROCESS

Discussions between stakeholders prior to the start of the design project determined the occupational therapy doctoral students would serve as liaisons between the design students and the organization in order to accommodate COVID-19 restrictions.

Demographics of Users that Participated in Prototype Testing	
User Participants (adults living with intellectual disability that the organization serves)	User Mentors (support providers from the organization)
n= 4; Age range: 18-30	n=3; Age range: 20-30

Table 1. Demographic of sample group

2.1 RESEARCH

The occupational therapy doctoral students conducted an informal needs assessment through observations of the participants cooking and completing everyday activities in their homes and in the community, held in-depth discussions with the user participants and user mentors on pain points they experienced in the cooking process, and conducted literature reviews to determine current evidence on supports and benefits to cooking, inclusive design, and designing for adults with intellectual disability. Information gathered from their research was shared and discussed with the design students during virtual class sessions and via Slack until the occupational therapy doctoral students felt saturation was reached, providing the design students with an assumed understanding for user participant and user mentor needs, potential design directions, and the scope of the design project. Those findings led to the designation of several design project goals, including improving communication of information, increasing safety awareness, promoting positive sensory experiences during the cooking process, motivating and affirming the user participant to make the experience enjoyable, and personalizing the recipes to encourage autonomy and flexibility. Before ideating and using the research gathered, design students created strategies and roadmaps, comparing existing products that were intended to serve similar functions. In their virtual class sessions, occupational therapy doctoral students and design students then collaborated to challenge the feasibility and viability of ideas. The initial discussions with the user participants and the user mentors indicated many pain points to address in the design. However, as time progressed, it was found the initial design goals identified for the project required

refinement to fit within the time frame, which led to friction with the user mentors and user participants, as it was not aligned with their expectation to address all pain points.

2.2 USER TESTING AND PROTOTYPING

User testing of early prototype iterations supports a mutual understanding between all stakeholders, reveals incorrect assumptions made by the design team, and informs any changes or modifications early in the process before the product is too far in the process and would require costly resources (Waller et al., 2015). Collecting valuable information from user testing is commonly done through asking the user questions about the design; there is also a significant advantage in observation of user behavior during product interaction. Typically, observation during user testing provides knowledge on aspects the user has difficulty articulating, features that the user may not know is available, and can avoid biases due to poor self-awareness, or verbalizing what they believe the design students want to hear (Waller et al., 2015). Due to varying cognitive abilities, user participants were not able to consistently answer questions about the user testing experience. As a result, information from user participants was primarily collected through observation, since post-test questions for user participants did not provide the level of qualitative information that is typically desired from user testing. The occupational therapy doctoral students implemented the first round of prototype testing with the user participants; user mentors were present, but not directly involved (Figure 1). In these sessions, the occupational therapy doctoral students observed confusion from the user participants on how to use the arrows included in the formatting, which were intended to direct attention. As a result, a larger highlighting tool replaced the arrow and was more intuitive to use; demonstrated by the user participants' ability to initiate moving the highlighter with minimal verbal prompting (Figure 2). The occupational therapy doctoral students also observed the user participants skipping and combining steps in the recipe, indicating that the instructions could be combined and could be more complex for the user than originally anticipated. The occupational therapy doctoral students were new to user testing in the design process, which often resulted in over-cueing and asking targeted questions that may have unduly influenced or biased the information gathered from the sessions.

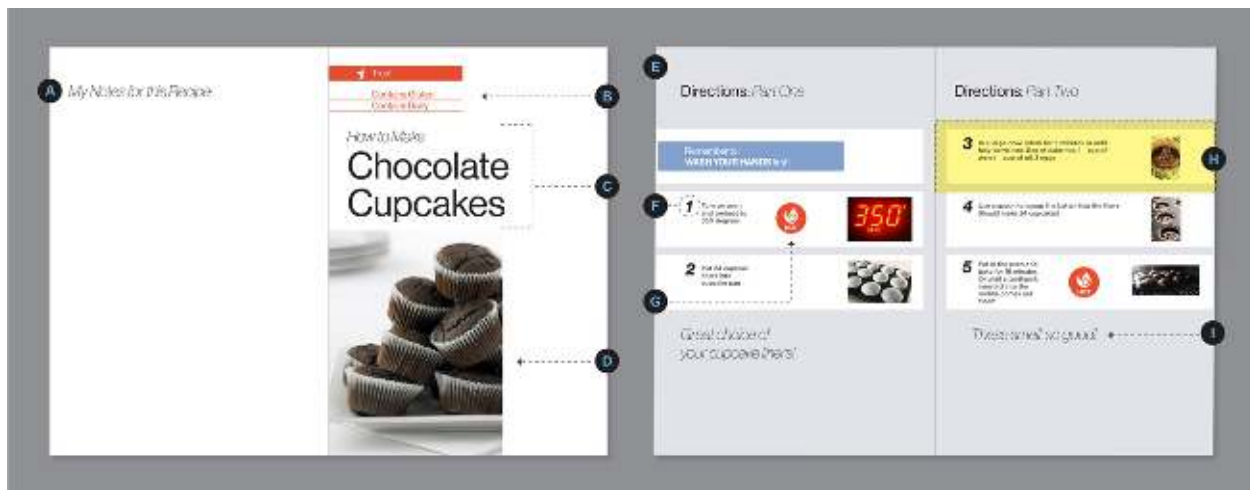


Figure 1. First iteration of cookbook prototype: **A. Steps for notes:** Area to personalize the recipe and encourage autonomy and flexibility **B. Always/Sometimes/Treat:** An educational component to encourage a balanced diet while respecting autonomy **C. Typeface:** Chosen to ensure text readability and legibility **D. Clear Visuals:** Communicates information for different literacy levels **E. Organization of Instructions:** Larger sections were broken down and organized into manageable chunks **F. Steps:** Simple text instruction paired with clear visuals for different literacy levels and preferences **G. Icons:** Indicate steps that require increased awareness or attention for safety **H. Highlighter:** Physical highlighting tool to maintain or redirect attention **I. Motivators:** Encourage a positive sensory experience.



Figure 2. **A.** Arrows and highlighting tools used to direct attention. **B.** Occupational therapy doctoral student conducting user testing, implementing the larger highlighting tool.

User mentors led the remainder of user testing sessions with the occupational therapy doctoral students observing and the design students reviewing the recorded sessions. The user mentors were asked post-test questions, were encouraged to think-aloud during the process to gauge usability, intuitive use, emotions or feelings associated with using the prototype, and were asked to indicate whether features included were valuable in supporting the user participant through their cooking process. The user testing sessions led by user mentors were encouraged to be as organic as possible, in order for the occupational therapy doctoral students and design students to understand how their cooking process typically occurs. The sessions highlighted the variability with roles and routines depending on each user mentor and user participant relationship, leading to difficulty refining the design to suit all user

relationships. For example, some user mentors naturally took the lead when going through the recipe and other user mentors waited to step in, contingent on the typical level of assistance required by the user participant. User participants were observed forgetting to wash their hands after touching raw meat or uncooked egg, indicating a need for a stronger, attention-grabbing prompt. Additionally, user participants did not always have the correct ingredients on hand, requiring “on-the-fly” adaptation provided by the user mentor while using the prototype.

Observation of the user mentors during the sessions provided the occupational therapy doctoral students and design students with knowledge on what features were overlooked, unused, or potentially confusing that required further assessment via follow up questions. However, there was some friction experienced with the implementation of feedback into the design iterations. The occupational therapy doctoral students typically address any feedback from clients with solutions that can be implemented immediately, whereas the design students typically assess the feedback with a zoom-in, zoom-out approach that is not as fast-paced as the occupational therapy doctoral students are used to.

Through ongoing user testing, observations and feedback with the user participants and user mentors, the design students and occupational therapy doctoral students were able to identify incorrect assumptions and determine the direction for subsequent iterations of the cookbook. User testing contradicted the prior assumption that user mentors would thoroughly review recipes prior to cooking. Due to the busy and dynamic nature of the environment, the user mentors did not have time to review the recipes beforehand, resulting in certain features of the prototype being overlooked or unused. To address this finding, beneficial features that were overlooked or unused were reformatted to capture the users’ attention (Figure 3a). Some user mentors carried the prototype while cooking to maintain the user participants’ attention, demonstrating the need for portability and modified mechanics of the book to facilitate ease of use. Additionally, many recipes indicate turning on the stove before adding ingredients; however, this sequence of steps could be dangerous for individuals who may not remember to turn off a hot surface or may not understand that food will burn if left on an open flame. This discovery led to the occupational therapy doctoral students and design students revising the sequence of steps to improve safety while cooking. Another element that required reconsideration was the icon intended to caution user participants and user mentors on a step that required working with a hot surface. User participants communicated that the icon indicating a hot surface was “scary” and did not convey the intended message. This icon was changed to an image that user participants recognized as an oven mitt used for hot surfaces (Figure 3b).



Figure 3. A. Modified design elements after applying user feedback and observations. A. **Reformatting of dietary restrictions:** Rearranged on the cover to capture the users' attention B. **Evolution of the "hot" icon:** Image revised to clearly convey need for increased safety awareness without appearing "scary"

Due to end of semester time constraints, there was only one opportunity to user test the final prototype, including formatting and style updates, which indicated that the modified colors and stylized formatting did not impair the user participants' ability to use the cookbook. Subsequent iterations involved reorganization of recipe content, increasing clarity in visuals depicting the steps, modifications of icons, addition of a safety and sanitary introduction and a writing space to support flexibility, and color and formatting changes to add aesthetic appeal (Figure 4).



Figure 4. Refined prototype after implementing user feedback. A. **Modification of icons:** Bring awareness to safety concerns without being overwhelming or intimidating B. **Addition of safety tips:** Reminders for users to encourage safe and sanitary practice while cooking C. **Chef's Choice:** An additional area to write in modifications to the recipe under the ingredients and tool to encourage flexibility and autonomy

2.3 PROJECT SUCCESSES

According to user mentor reports, user participants who engaged in the user testing of the cookbook demonstrated improvement through increased participation in the cooking session and improved problem solving with fewer cues from the occupational therapy doctoral students or user mentor in comparison to prior cooking sessions where the prototype was not available. While using the prototype, user participants required assistance for 50% of the task in contrast to requiring assistance for 75% of the task, demonstrated via fewer verbal cues and physical prompting from the user mentor. Steps that required a higher level of assistance from the user mentors were typically more physically demanding, such as chopping ingredients with precision.

User participants reported enjoying the cooking process as a result of the motivating and affirming elements of the cookbook, and liking the cookbook due to the increased ease of use. Family members of user participants were able to use the cookbook easily and appreciated the clarity of directions and pictures over previous recipe formats. User mentors were motivated to participate, excited to use the prototype, and able to identify other participants whom they believed would benefit from the design. User mentors also noted the benefit of the content organization and presentation to make the steps easier to follow for the user participant.

The display of visuals and text for ingredients and tools made the process of gathering tools simpler for the user participants, requiring fewer verbal or visual cues from the user mentor. The icons, indicators for hand washing, and safety/sanitary tips were identified as helpful reminders for the user mentors as they support the user participants in a dynamic process requiring adaptation to unexpected changes. The appearance of the cookbook was described by the user mentors as “clean” and appealing, and was identified as a format that could be used by any individual regardless of cognitive ability. Data gathered during user testing supported that the cookbook helped increase engagement during the cooking process, adequately scaffolded complex directions, reduced the level of cueing required from user mentors, and provided effective reminders for safe and sanitary practice.

2.4 PROJECT LIMITATIONS AND CONSIDERATIONS: THE IMPACT OF COVID-19

Logistical challenges secondary to the pandemic (limited in-person interactions, virtual learning and therapeutic environments, social distancing, masking requirements) caused friction and created ongoing difficulties with communication and limited ease of understanding and application of relevant information gleaned between the occupational therapy doctoral students, design students, and user mentors. Other collaborative limitations included a 15-week time frame from the start to the end of coursework and design class sessions held once weekly. Collaboration occurred mainly through video calls, with few experiences available in person. This created an additional obstacle while developing an understanding of the user during the research phase. The limited in person interaction led to protracted misunderstandings for all stakeholders during all processes as opportunities for natural conversation and observation with both sets of users was severely restricted. The pandemic also greatly limited the

number of user participants available to work in person with the occupational therapy doctoral students and design students, consequently limiting the diversity of user participants available for user-testing. Class discussions between occupational therapy doctoral students and design students were primarily held virtually, restricting opportunities to work with physical items or communicate in a more natural, spontaneous in-person collaborative format.

Additionally, the occupational therapy doctoral students' role as a liaison between design students and user mentors resulting in the occupational therapy doctoral students acting as the primary relationship manager of all stakeholders, a role they were unprepared for. This was an ongoing point of frustration for all stakeholders, as the user mentors had unrealistic expectations of frequent updates and continual progress that were not always available or possible due to the nature of the design process working within an academic timeline with students who were novices in a collaborative process.

3. DISCUSSION

3.1 UNDERSTANDING DISABILITY AND THE POPULATION

At the start of the collaboration, each stakeholder brought a different skill set to the table. The design students had limited experience working with individuals living with intellectual disability; whereas the occupational therapy doctoral students were unfamiliar with the iterative design process. The user mentors were considered the experts in their organization and brought a deep understanding of the user participants, their goals, strengths, and supports. In order to bridge knowledge gaps for the design students regarding intellectual disability, the occupational therapy doctoral students led didactic discussions on disability, theories used to support the interaction between individuals, the environment, and the task, observations of the user participants, and cognition and its impact on user experience, providing a foundational understanding of disability and needs of adults living with intellectual disability. In turn, the design students helped the occupational therapy doctoral students experience the iterative design process, user testing, and creative brainstorming which allowed thoughts and ideas to become real, tangible products.

3.2 UNDERSTANDING THE USER

As this was an inaugural collaboration, both the occupational therapy doctoral students and the design students were new to working with the organization. To gain insight on the diverse needs, goals and abilities of the user participants in the community organization, the occupational therapy doctoral students and the design students engaged in observations of skill building, supported employment, and behavioral support sessions to construct a comprehensive knowledge of the user participants. Observations demonstrated how the user participants routinely cooked, the relationship and interaction between the user participant and user mentor, specific human factors that impacted their performance in cooking, tools that the user participants were familiar with and aspects of the environment that created additional challenges for the user participant. This information shaped the goals and

considerations of the design project and what elements were vital to meet user participant and user mentor needs.

3.3 UNDERSTANDING THE DESIGN PROCESS

The occupational therapy doctoral students and the user mentors lacked understanding of the design process and the complexities that accompany user testing; both were unfamiliar to the pacing of each stage, the expectation of the unexpected, and the nuances in decision making required. Points of friction arose when the user organization wanted to expand the scope of the project outside of what was feasible for the 15-week timeline and resources available. To address the disjointed understanding of the project, the occupational therapy doctoral students and design students presented progress updates clarifying the scope; however, the organization continued to have ongoing difficulty grasping the iterative problem process that occurs in design. The occupational therapy doctoral students and user mentors had to learn to adapt to a more open-ended and unstructured process in contrast to clinical experiences that tend to be more procedural and controlled. Additionally, the occupational therapy doctoral students had difficulty distilling the information down to what was most pertinent to the design and communicating this clearly to the design students. Determining the essential information was a crucial step in refining the design project goals, allowing the stakeholders to move forward with a feasible prototype that could be user tested and refined.

The occupational therapy doctoral students were entrenched in the design process through regular communication with design students, class discussions, and opportunities to establish clear expectations and goals. This was beneficial in developing an understanding of the pacing of the design process, the rationale supporting design choices, and multiple perspectives to challenge and push ideas. The user mentors' communication with the design students was limited to the four check-ins; impacting the level of understanding of the design process and leading to frustration from the organization that the process was taking too long. Unclear roles in the decision-making process on the part of the organization also caused unanticipated friction. In hindsight, both occupational therapy doctoral students and design students recognized the importance of establishing clear expectations of the design process early to develop trust and communication between design students, other professionals, and users, who may be unfamiliar with the pacing and uncertainty involved in the iterative process.

4. CONCLUSION

The occupational therapy doctoral students brought expertise and a unique perspective of an individuals' interaction with the environment to streamline the research process, critically analyze and challenge design ideas, and implement user testing with the user participants from an occupational therapy vantage point. The design students provided the creativity, flexibility, and ideation needed to create the products and modify them based on feedback obtained from user testing. The ongoing collaboration between the occupational therapy doctoral students and design students provided for an increased and shared understanding of user participants' and user mentors' needs, eventually allowing a

design that could potentially be accessible to user participants in the organization beyond those who participated in user testing. Including the organization as an equal member in the collaborative design process proved challenging. Interdisciplinary, user-centered, collaborative approach to inclusive design between all stakeholders is vital for development of an effective design. With an established foundation of knowledge and consistent expectations from all stakeholders, different perspectives and skills can comprehensively address a complex design problem to encourage use from diverse individuals.

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