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Interdisciplinary Design Teaching: A Pedagogical Approach to Train Hands-on UX/UI Designers

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ABSTRACT

An interdisciplinary pedagogical approach to design education can help students connect the practices of psychology, human factors, and graphic design. The demand for smart devices in medicine and patient care has created a significant opportunity for a UX design workforce with knowledge and experience in user-centered design. These new emerging designers need to be familiar with practical design research methods while delivering competitive visual results. This paper discusses a practical method of forming an interdisciplinary design research team to develop hands-on experience designing and testing these specialized medical devices. The challenges involving forming teams of students from design, psychology, and other areas of academia will be discussed regarding the design and usability testing by a diverse team of student and faculty researchers.

Keywords: Interdisciplinary research, Human-centered design, Hands-on UX/UI design, User experience design

INTRODUCTION

This design research project aims to enhance the usability of Environmental Control Units (ECU) in the Veterans' Administration (VA) healthcare system (Figure 1). An ECU is a digital control, multi-purpose assistive technology with specific functionality to help patients with spinal cord injuries or disorders to perform daily routine tasks such as calling the nurse, adjusting the bed's head or foot positions, answering phone calls, getting access to email accounts, watching television, etc. Users can control the ECU through four modes of interaction: touch-based, eye-tracking control, sip-and-puff (pneumatic tube), and voice-control. Previous research has found ECUs helpful with primary stakeholder users (SCI/D patients), but numerous usability issues ranging from aesthetics to catastrophic errors were also observed (Bidassie et al., 2017). This multidisciplinary research project is ongoing between California State University Long Beach, the Spinal Cord Injuries and Disorders (SCI/D) Center at the Long Beach VA Hospital, and the device manufacturer, Accessibility Services, Inc.

This research started in 2019 with heuristic analyses of the touch-based and eye-tracking modalities of the ECU device (Hancock et al., 2020a; 2020b).

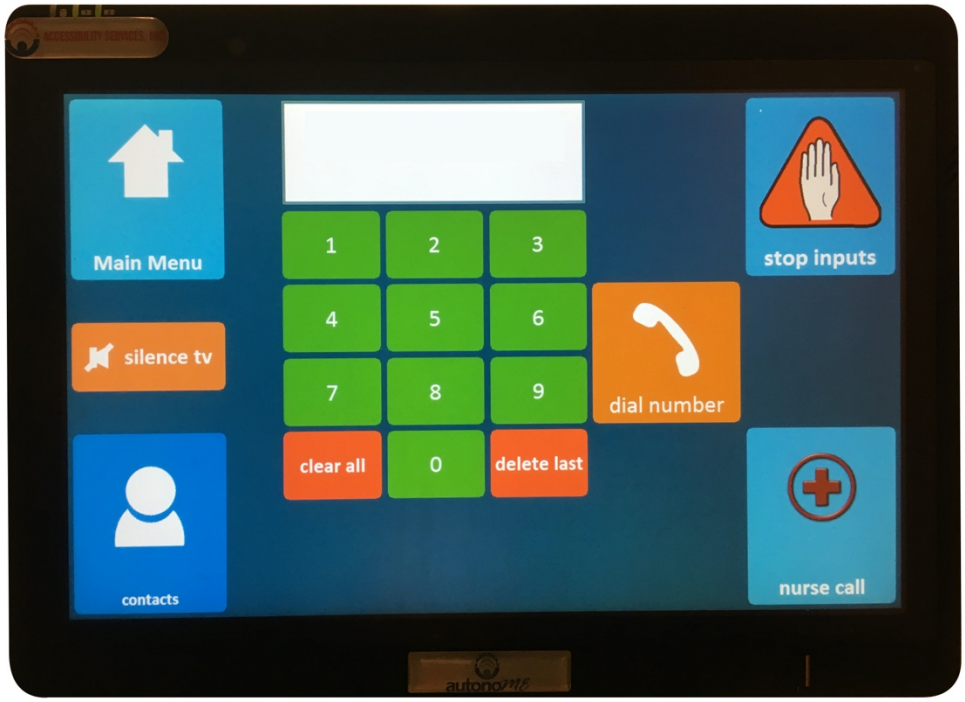

Figure 1: Screenshot of ECU device.

The heuristic evaluations were based on Shneiderman's Eight Golden Rules for Interface Design and Nielsen's 10 Heuristics for Interface Design (Shneiderman, 1998; Nielsen, nd). Based on the findings of these evaluations, the team designed and digitally constructed a Beta version that addressed the issues most detrimental to effective usability and user experience (Figure 2). The next phase was to empirically investigate the effect of this more user-friendly interface by conducting A/B usability testing with actual end-users. However, due to the COVID-19 Pandemic, access to the veteran residents of the VA facility was rightly suspended until it is safe to resume. In the summer of 2020, the design team consequently developed a fully online digital prototype of the ECU interface to conduct remote A/B usability testing with a neurotypical population (i.e., CSULB students) for comparison. Currently, the team is post-processing over 90 hours of user-testing data from its ongoing usability testing between the Alpha and Beta versions of the interface. Also, the team has begun to draft a new design (Omega version) based on the current and emerging findings to propose design improvements to the device manufacturer.

Additionally, the design research team is preparing to conduct a qualitative design survey with SCI/ID patients at the Long Beach VA Hospital after receiving the necessary permissions in the Fall of 2022. The A/B testing and secondary design research findings will provide a pathway to design improvements on the ECU device. This research has brought together graphic design and psychology students to engage in a hands-on user-centered design project.

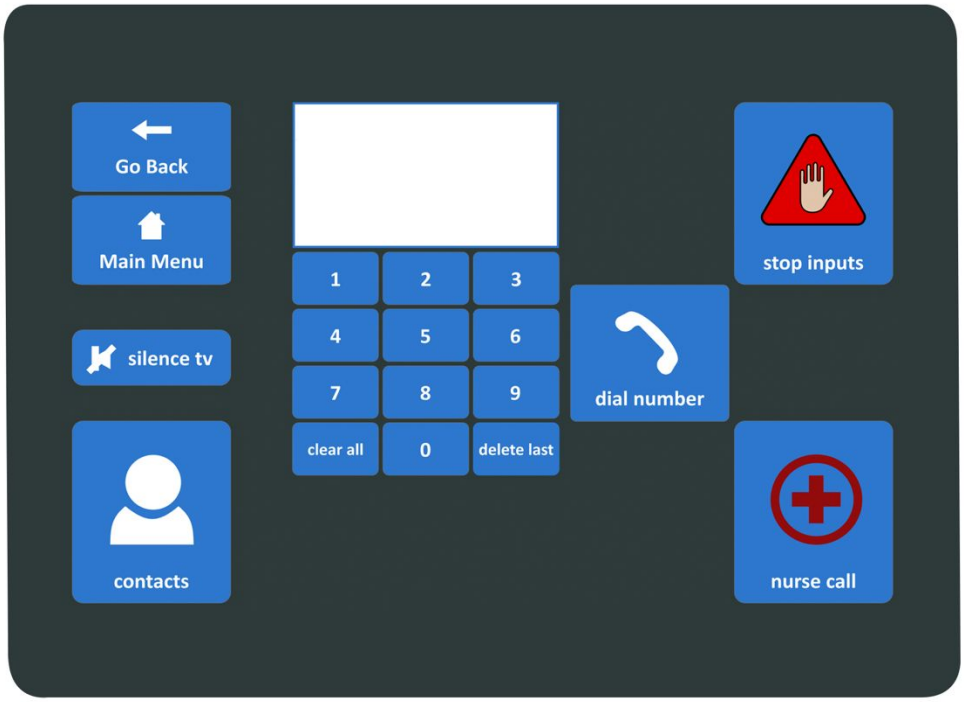

Figure 2: Screenshot of ECU beta version prototype.

BUILDING THE DESIGN RESEARCH TEAM

As the focus of this design research project is to improve the usability of medical devices, it was essential to combine expertise from human factors psychology and graphic design to address the perceptual, cognitive, and behavioral aspects and to assess and modify the user interface in ways that synergistically enhance the visual communication and usability of the device, respectively. Therefore, two faculty leaders from the Graphic Design and Psychology Departments at California State University Long Beach worked together with a combined team of student researchers from each department.

The research began in 2019, after following all necessary government protocols and with the support of the Director of the VA Hospital at Long Beach. To obtain the expertise necessary to complete the project, undergraduate and graduate students were recruited from a variety of academic areas including graphic design, psychology, human factors, and natural health and science disciplines. However, between these disciplines represented in the team the research strategies and workflow processes varied dramatically. Therefore, it was necessary to train the team in the required hands-on research, evaluation, and design methods to be used in the project.

TRAINING A MULTI-DISCIPLINARY STUDENT RESEARCH TEAM

Each phase of the research required a specific set of research skills in the areas of research methods, human factors, psychology, and design. Students in graphic design have a solid knowledge base in visual communication design

through hierarchical information layouts such as typography, image-making, and color theory. These students are receiving training in human-centered design research methods and digital prototyping tools and developing presentation skills. On the other hand, students in human factors psychology receive education in various user experience research methods and usability evaluation techniques such as remote user testing and the quantitative analysis of various performance and self-report data. An interdisciplinary collaborative, hands-on project, such as this research, can serve as an incubator to allow students from both disciplines to develop an in-depth understanding of their training application. An in-class defined project can always help students understand the theory in an applied strategy. In contrast, a realistic project within the cross-disciplinary framework can provide hands-on experience and push students to think of solutions from different perspectives.

In the first phase, students received training to perform a heuristic evaluation of the ECU device's touch-based and eye-tracking modalities on the operational in-patient ECU system at the VA Long Beach SCI/D Center (Hancock et al., 2020b; Etingen et al., 2017). This hands-on task created an opportunity for students in human factors psychology to put their formal education into hands-on practice. At the same time, it shed new light on the human side of design service for graphic design students by teaching them about design evaluation beyond subjective aesthetics. At the evaluation stage, the team combined strategies from psychology regarding the testing and observation of human behavior in response to a designed product and interface. In this regard, the team had to understand the relationship between the psychology-based test and observation method of evaluation and the interpretation of the data to be used to inform the design of an improved interface. Based on the heuristic evaluation findings, the team designed a Beta version with improvements.

In Phase 2, conducted in the summer of 2020, the design team developed a fully online digital prototype of the ECU interface to conduct remote A/B usability testing with a neurotypical population (i.e., CSULB students). Once again, this research brought together students from graphic design and human factors psychology to engage in a hands-on user-centered design project. Based on documented photos and videos collected during the heuristic evaluation of the ECU device, students deconstructed its user interface logical flow. This process taught students from both disciplines to practice the design deconstruction method and reverse-engineer the device's usability flowchart. The team began making interactive prototypes based on the heuristic evaluation scenario tasks. In order to accomplish the task, students began developing an identical digital prototype of the device. In this process, they learned various design prototyping tools such as *Figma*®, *Sketch App*®, *ProtoPie*®, *Invision-Studio*®, and *Adobe Xd*®. Students in psychology learned design methods and digital prototyping tools in this process, and students in graphic design put their design knowledge into a practical hands-on experience. Students from both disciplines learned about each other's expertise. They helped the team as a whole to overcome practical challenges such as seamless communication and documenting the process, frequent meetings,

brainstorming on usability evaluation methods, and learning prototyping tools.

During Phase 3, students from both practices received training to conduct remote user-testing sessions and post-processing the resulting data. Currently, the team is collecting data from its ongoing A/B testing between the Alpha and Beta versions of the interface. In the meantime, the team has begun to draft a new design (Omega version) based on the current and emerging findings to make design improvement suggestions to the device manufacturer. Students in human factors psychology receive education on user-testing methods and usability evaluations. Their collaboration with graphic design students created an opportunity to cross-pollinate knowledge and applied methods across design and psychology disciplines. Students received training on conducting a systematic user-testing session via Zoom using the interactive prototype developed in Phase 2 of the research. Additionally, the team utilized and gained experience in post-processing multiple pre and post-test questionnaires to evaluate user performance and experience. These psychometric assessment tools included the NASA Task Load Index, the Borg Rating of Perceived Exertion (RPE), the Dundee Stress State Questionnaire (DSSQ) to evaluate distress, task engagement, and worry; and the System Usability Scale (SUS). Students from both disciplines received training on data analysis and post-processing.

DISCUSSION AND IMPLICATIONS

This interdisciplinary design research project created unique opportunities for students in graphic design to learn about human factors psychology methods and how various design choices for interface features such as color, font, size, etc. will affect its usability and user experience outcomes. In addition, students in human factors psychology learned about design systems and problem solving methods associated with user interface design. As the resulting systems are for actual use by veterans with spinal cord injuries and disorders in collaboration with a government partner (the VA), the students also gain valuable service-learning experience.

CONCLUSION

Academic interdisciplinary research has its challenges and requires faculty leaders who are willing to go above and beyond the standard practice of each discipline. As the research team grows, the simple team communication and progress documentation becomes a task of their own yet create an opportunity for students to learn about team collaboration, project management, and professional practices. The interdisciplinary design research team can act as an incubator to pave the way for students to land on future careers in more industry-aligned ways. Students learn the relationships between products, use-cases, and natural user environments. It helps them gain deep knowledge of user personas to connect and capture important human-scale information about the users regarding patients, staff, and product manufacturers (all stakeholders). Students learn how heuristics and surveys can best

develop to align with actionable data in service design in medical environments and usability and human factors for persons with varying skills and abilities. The surveys, questions, and observations directly lead to improved product performance and measurable improvements in customer safety and satisfaction. Participating in an interdisciplinary design research project can train students in human factors psychology to gain hands-on experience in conducting user-testing and data analysis in direct interaction with students in graphic design to enhance the usability and effectiveness of the product design. This collaboration also prepares students in graphic design to learn about design effectiveness metrics and overlook the design challenges from a broader perspective of human-centered design. Therefore, aligning the research with the product and interface design based on improving the customer experience is critical knowledge for training students in psychology, human factors, design, and UX as they are preparing for careers in these areas. It is necessary to note that proper training at each phase of the research improves the performance of the team members by enhancing the quality of the data collection through better tools and closer alignments with the end user for product improvements and customer safety and satisfaction. The research team is currently processing over 90 hours of recorded user-testing sessions to make design improvement suggestions. The next phase is designing the Omega version based on the heuristics and A/B testing results from the alpha and beta versions.

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