ENHANCING UNDERGRADUATE UX EDUCATION WITH WIZARD OF OZ AND PAPER PROTOTYPING

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ABSTRACT

The Wizard of Oz (WoZ) usability testing method, inspired by a key scene from L. Frank Baum's classic, simulates system functions manually without user awareness. This approach allows designers to refine concepts prior to full implementation, proving essential in early product development stages. Users interact with a seemingly operational system, but a human "wizard" covertly adjusts it in response to their actions. This method supports moderated UX research sessions, with a “facilitator” guiding user and a "wizard" managing system responses. Applied in various fields, from voice assistants to e-commerce, it enables cost-effective, flexible, and focused testing. The integration of paper prototyping further enhances the method's efficacy, offering a tangible, interactive means of validating early-stage designs. Combined, the WoZ method and paper prototyping yield quick user feedback, promoting iterative design. Despite its strengths, paper prototyping has limitations, yet its collaborative nature fosters team cohesion and user involvement. This paper demonstrates a combined application of the Wizard of Oz method and paper prototyping to offer an approach for instructing undergraduate students in user-centered design, enabling them to engage in iterative refinement and make informed decisions in the early stages of the product development process. An assignment example illustrates the method's application in a real-world scenario, emphasizing collaboration, active participation, and comprehensive reporting. Overall, the Wizard of Oz usability testing method coupled with paper prototyping offers a robust framework for user-centered design, enabling iterative refinement and informed decision-making in product development processes.

Keywords: Wizard of Oz (WoZ) Methodology, Usability Testing, Paper Prototyping, Digital Product Evaluation, User Experience Research.

INTRODUCTION

Usability testing is a pivotal phase in the design and development of digital products, playing a crucial role in ensuring that these products align with user needs and expectations (Nielsen, 1994). Among the myriad methods employed in this domain, the Wizard of Oz (WoZ) method (Baum, 1900) stands out for its ability to simulate system interactions in real-time through human intervention, offering a unique blend of realism and flexibility in user research (Dahlbäck et al., 1993). The WoZ usability testing method draws its inspiration from L. Frank Baum's timeless tale, where the formidable "Wizard" is ultimately unveiled as an ordinary individual orchestrating illusions from behind a curtain (Baum, 1900). Emulating this narrative twist, the WoZ method simulates specific functionalities of a system manually, in response to the actions of the user. This technique stands out as a cornerstone in the realm of design and research, enabling the evaluation and refinement of concepts before their full-scale development. It sets the stage for users to interact with what is perceived as a fully operational system, while in reality, a human operator—the "wizard"—carefully curates the system's responses from behind the scenes.

This moderated simulation approach allows researchers to closely observe user behavior and collect feedback without the need for extensive investment in a comprehensive prototype. The applications of the WoZ method are diverse, encompassing everything from the testing of voice assistant technologies to the assessment of innovative features on e-commerce platforms. Its widespread adoption can be attributed to several key advantages: cost-efficiency, adaptability, and the capacity to verify conceptual viability early in the development cycle. Through human-mediated interactions, the WoZ technique unveils problem areas of user experience, spanning usability, appeal, and functional performance, without being tied to the limitations of existing digital infrastructures (Dow, et al, 2010; Kelley, 1984). This method proves instrumental in aligning product development with user needs and preferences, ensuring that innovations are both meaningful and grounded in real-world utility.

Complementing this, paper prototyping emerges as a valuable tool in the design and testing of user interfaces (Rettig, 1994). Renowned for its cost-effectiveness and versatility, paper prototyping facilitates rapid exploration of design concepts and identification of usability challenges, making it an indispensable part of the iterative design process (Snyder, 2003). When combined, paper prototyping and the WoZ method significantly amplify each other’s utility, especially during the initial phases of design. This integration proves particularly beneficial in conceptualizing and refining the interaction mechanisms of emerging systems, thereby streamlining the design validation process (Norman & Draper, 1986). Integrating paper prototyping with the WoZ method is achieved by simulating interactive elements through real-time human intervention. In this setup, a "wizard" manually generates the system's responses to user inputs, enriching static mockups with an element of interactivity. While paper prototyping lays the groundwork for visualizing design concepts, its combination with WoZ facilitates a deeper exploration of user interactions, without advancing to digital prototype stages. This synergy enhances the usability testing process, providing valuable insights into user behavior and design efficacy (Dahlbäck et al., 1993).

Central to the WoZ method are four primary roles: the user, the "wizard" or simulated computer, the facilitator, and the observers. Each role contributes to the smooth execution of usability tests, ensuring clear communication, task guidance, and comprehensive data collection. The 'wizard' is tasked with simulating the system's responses to user inputs in real-time, effectively acting behind the scenes to mirror the functionality of a computer or software. This role is crucial for creating a believable interaction experience for the user, despite the absence of a fully developed system. In contrast, the 'facilitator' plays a distinctly different yet complementary role. The facilitator guides the user through the usability testing process, communicating tasks, answering questions, and ensuring the user's comfort and understanding of the test scenario. While the wizard focuses on the technical simulation of system responses, the facilitator is primarily concerned with user interaction and the smooth running of the testing session. Together, these roles ensure a well-orchestrated usability test. The facilitator ensures clear communication and guidance for the user, while the wizard focuses on accurately simulating system responses. The observers, meanwhile, are tasked with capturing detailed feedback and observations, rounding out the comprehensive data collection necessary for refining the product or system being tested. This division of responsibilities within the WoZ method eliminates confusion and ensures the efficiency and effectiveness of usability testing sessions, providing invaluable insights into user behavior and system usability.

Variations of the WoZ method cater to different teaching philosophies, learning outcomes, and experimental requirements. Whether closed, open, or hybrid, each variation offers unique benefits in revealing user preferences, and system gaps, and exploring new design possibilities. The strengths of paper prototyping lie in its focus on user experience, flexibility, team collaboration, and ability to uncover design flaws early in the development process (Baum, 2008).

Despite its advantages, paper prototyping and the WoZ method have limitations, including difficulties in modeling certain interactive elements and the need for skilled facilitators. However, adherence to clear goals, active team participation, and thorough analysis can mitigate these challenges. Grading criteria for usability testing assignments encompass various aspects, from the clarity of user stories and prototype design to individual participation and recommendations based on feedback. This paper delves into the principles of WoZ testing, with a particular focus on its synergy with paper prototyping. The paper focuses on the pedagogical benefits of this integration, presenting a comprehensive approach to incorporating these methods into the curriculum for undergraduate students. Through this exploration, the paper highlights the efficacy of combining WoZ and paper prototyping in cultivating a practical understanding of usability testing principles among future designers and researchers.

LITERATURE REVIEW

The WoZ approach is a valuable method in user interface design and human-computer interaction research (Baum, 1900). This technique involves an operator, often hidden from the user, who manually simulates the responses of a computer or system, thereby creating the illusion of an intelligent or fully functional system (Kelley, 1984). Initially conceptualized to evaluate natural language processing systems, the WoZ methodology has since expanded its applicability across various domains, including but not limited to the development of conversational agents, educational software, and accessibility technologies (Dahlbäck et al., 1993). The strength of the WoZ approach lies in its ability to facilitate the exploration of user interactions with emerging technologies before these systems are fully developed, allowing researchers and designers to gather valuable insights into user behaviors, preferences, and challenges (Bernsen et al., 2012). By simulating functionalities that are either too complex or costly to implement in early development stages, the WoZ method provides a practical means to iteratively refine system designs based on direct user feedback (Maulsby et al., 1993). This approach is particularly beneficial in scenarios where the technology to support the desired interactions does not yet exist or is infeasible to deploy in a research setting. Riek (2012) presents a comprehensive review of WoZ studies within human-robot interaction (HRI), offering new guidelines for reporting and conducting research to enhance the reproducibility and reliability of findings. Moreover, the use of the WoZ technique encourages a user-centered design process, aligning closely with the principles of iterative design and rapid prototyping (Gould et al., 1983).

Similarly, paper prototyping is a widely used technique in the design and testing of user interfaces, offering a low-cost and flexible method for quickly exploring design concepts and usability issues (Rettig, 1994). This method involves creating hand-drawn representations of user interfaces, which can range from rough sketches to more detailed drawings. The primary advantage of paper prototyping lies in its simplicity and the direct feedback it facilitates, allowing designers and researchers to iterate rapidly based on user interactions (Snyder, 2003). As such, paper prototyping has been recognized for its effectiveness in engaging both designers and users in the co-creation process, fostering a user-centered design approach that is fundamental to successful interface development (Carroll et al., 1991).

Integrating paper prototyping with the WoZ method enhances its utility, particularly in the early stages of design where the interaction mechanisms of a new system are being conceptualized and tested (Norman & Draper, 1986). The WoZ method, where an experimenter simulates the responses of a computer system to user inputs, complements paper prototyping by providing a way to explore interactive behaviors that are not easily replicated with static mockups (Dahlbäck et al., 1993). This combination allows for the testing of more complex interactions and user flows without the need for any digital implementation. Researchers have successfully used this hybrid approach to simulate and test features of interactive systems, gathering valuable insights into user needs and preferences before committing significant resources to development (Maulsby et al., 1993).

The synergy between paper prototyping and WoZ extends into educational environments, where it serves as an effective tool for teaching design and human-computer interaction principles. This blend of techniques fosters a deep understanding of user-centered design principles, encouraging students to directly engage with the iterative design process and understand the impact of their design decisions through immediate user feedback (Nielsen, 1994). When combined with the WoZ technique, paper prototyping transforms into a dynamic tool for simulating and testing complex user interactions. Through WoZ, educators can demonstrate how interfaces respond to user inputs in real-time, providing an illusion of functionality that goes beyond the static representations of paper prototypes. This method is particularly effective in simulating systems with sophisticated back-ends or artificial intelligence (AI)-driven features that are not yet developed, offering a glimpse into the future of technology design (Dahlbäck et al., 1993). Buxton (2010) advocates for the use of sketching and low-fidelity prototyping in design education, arguing that these practices promote creativity, facilitate early detection of usability issues, and encourage iterative design thinking.

Paper prototyping serves as an accessible entry point for students to begin conceptualizing and testing interface designs. By sketching interfaces on paper, students can rapidly iterate their ideas without the need for advanced technical skills. This process demystifies the design phase, making it more inclusive and encouraging a broader range of students to participate in design thinking and problem-solving (Snyder, 2003). The tactile nature of paper prototyping also adds a dimension of physical interaction that is often lost in digital design tools, allowing students to experience the tangible aspects of interface design.

In educational environments, these methods can be employed in a variety of ways. For instance, group projects can involve students designing a paper prototype for a specific user task, then conducting WoZ tests with classmates or external users to gather feedback. This collaborative approach not only enhances learning outcomes but also mirrors real-world design practices, preparing students for professional environments. Furthermore, educators can use these exercises to highlight the importance of user research, empathy in design, and the iterative nature of developing user-friendly systems (Rudd et al., 1996).

The impact of integrating paper prototyping and WoZ in education is further evidenced by studies and reports from design workshops and courses. For example, researchers have documented how these methods can improve students' problem-solving skills, creativity, and ability to work collaboratively on design challenges (Brandt & Messeter, 2004). Moreover, these practices encourage a mindset of rapid experimentation and learning from failure, which are essential competencies in the tech industry. Studies suggest that students who engage in these practices develop a deeper understanding of user-centered design principles, improve their ability to empathize with users, and enhance their problem-solving and critical thinking skills (Houde & Hill, 1997). Furthermore, this approach has been shown to increase students' confidence in their design abilities and their willingness to experiment with innovative solutions (Greenberg et al., 2011).

Incorporating parallel prototyping methods (Gerber & Carroll, 2012) within design education, where students in a single group work simultaneously on separate prototypes, Dow et al. (2010) have shown to effectively foster creativity, facilitate exploration of diverse solutions, and build confidence among design students. This approach, emphasizing collaborative learning and problem-solving, enables students to compare and contrast different design ideas in real-time, providing a rich learning experience that closely mirrors professional design practices (Muller & Druin, 2012). However, the integration of the WoZ method and paper prototyping in such a parallel framework presents unique challenges. The manual simulation required for WoZ can be cognitively demanding, potentially leading to misinterpretations or overlooked details during the design evaluation process, especially when students are juggling multiple prototypes (Dow et al., 2010). Moreover, the inherent limitations of paper prototyping in representing dynamic or complex interactions become more pronounced in a parallel setting, possibly hindering the exploration of certain design concepts (Landay & Myers, 2001).

Through exploring innovative approaches such as conversational agents, virtual reality (VR), and novel Wizard of Oz (WoZ) configurations, researchers aim to address the evolving challenges and opportunities in UX design and education. Garcia et al. (2024) introduce "Newton," a conversational agent designed to support machine learning end-user programmers (ML-EUPs). This work identifies common challenges faced by ML-EUPs and evaluates how such a conversational agent, developed through a WoZ study, can aid in overcoming these hurdles. The findings suggest that conversational agents, informed by rigorous design guidelines, can significantly assist EUPs, offering an avenue for enhancing user experience education by integrating AI support systems. Helgert et al. (2024) explore the potentials of VR as a research tool in human-robot interaction (HRI), advocating for a modularized and customizable WoZ system enhanced by VR. This approach aims to simulate real-world interaction scenarios more authentically, emphasizing the necessity for user-friendly technical systems that cater to the needs of both technical and non-technical researchers. The discussion highlights the importance of adaptable and accessible tools in UX and HRI research, suggesting a path toward more immersive and realistic usability testing environments

Grill et al. (2015) introduce ConWiz, a software framework that combines context simulation with the WoZ method, facilitating fast and flexible prototyping alongside user studies. This framework addresses the challenge of researching contextual interactions, particularly in dynamic environments, by allowing for the adjustment and simulation of various contextual parameters. The application of ConWiz in diverse study contexts demonstrates its versatility and provides valuable insights into its use for iterative design processes, underlining the potential for software frameworks to streamline and enhance UX research methodologies. Wölfel and Henrich (2020) present "Wizard of Botz," an innovative approach to WoZ experiments focusing on speech-based robot instruction. This novel setup uses one robot to control another, enabling force feedback for the "wizard" and simplifying robot arm control for non-experts. The outcomes from user studies offer comparative insights to previous methods, advocating for the integration of tangible interaction systems in UX education to better understand user instructions and perceptions regarding robot motions.

These recent contributions to the literature offer compelling evidence of the benefits and necessities of incorporating advanced technological tools and methods, such as conversational agents, VR, and specialized software frameworks, into UX education. They collectively point toward a future where UX education is not only about understanding user needs but also about leveraging technology to create more engaging, effective, and realistic learning and research environments.

BACKGROUND

The Core of the Wizard of Oz Testing

In the WoZ technique, users interact with what they believe is a fully operational system. However, rather than functioning autonomously, a human "wizard" hidden from view manipulates the system's responses to the user's actions. Thus, the WoZ Usability Testing Method is described as a moderated UX research approach where users engage with an interface controlled by a human who dictates the system's reactions. This method enables UX researchers to conduct tests by having a design team member, referred to as the 'facilitator,' lead the session directly with users, while another team member, the 'wizard,' manages the system's feedback. To illustrate, possible applications of this technique include:

1. **Voice Assistant Application**: In the development of a novel voice assistant, rather than creating a comprehensive AI response system for the prototype, the team employs the WoZ method. Users interact with the "voice assistant," but instead of receiving AI-generated responses, a human operator located elsewhere responds in real time.
2. **New E-commerce Website Feature:** Consider an e-commerce website testing a new personalized shopping assistant feature. When users request recommendations, a team in the background manually selects products based on user preferences, rather than an AI or algorithm.
3. **Mobile App Creation**: Businesses devising a new mobile application can utilize paper sketches to represent various app screens. As a user "taps" on an icon, the "wizard" swaps out the sheet to mimic a screen change.
4. **Web Navigation Flow**: Sketching a website's main page on paper facilitates interactive user sessions. When a user opts to click a "link" or open a "dropdown menu," the wizard presents additional paper sketches, replicating the online navigation experience.

Why Use the Wizard of Oz Testing?

The WoZ methodology offers several advantages for usability testing and design research, making it a versatile tool in the field of user experience and interaction design:

1. **Rapid prototyping**: WoZ allows for the quick creation and testing of ideas without the need for complete backend development. This rapid prototyping speeds up the design process, enabling teams to iterate and evolve concepts based on user feedback much faster (Snyder, 2003).
2. **Human insight**: Since a human operator (the "wizard") simulates the responses of the system, there's an opportunity for deeper understanding and adaptation to user behavior that automated systems might miss. This can lead to richer qualitative data and insights (Dow et al., 2010).

3. **Cost savings**: By avoiding the upfront costs of fully developing every aspect of a system before testing, resources can be allocated more efficiently, focusing on features that users find valuable and eliminating those that don't meet user needs (Gould, Conti, & Hovanyecz, 1983).
4. **User-centered design focus**: WoZ tests emphasize direct interaction with users, reinforcing the principles of user-centered design. This focus ensures that the end product is more likely to meet user expectations and fulfill their needs effectively (Hartson & Pyla, 2012).
5. **Ethical considerations**: In scenarios where AI is intended to mimic human responses, WoZ can serve as an ethical testing ground to understand the implications of such interactions without misleading users about the presence of AI (Riek, 2012).
6. **Technology exploration**: For emerging technologies or interactions where the technical solutions are not yet clear, WoZ provides a way to explore user interactions with these future technologies without the immediate need to solve the underlying technical challenges (Saffer, 2010).
7. **Accessibility Testing**: WoZ can be particularly useful in testing accessibility features for users with disabilities, allowing researchers to adapt interfaces in real-time to meet diverse user needs and identify accessibility barriers (Zaphiris & Kurniawan, 2007).

Incorporating Paper Prototyping

Paper prototyping consists of crafting hand-sketched renditions of interfaces or products, offering a physical, engaging, and adaptable medium (Rettig, 1994). This method is characterized by two principal features. The initial attribute, Sketch Interface Elements, entails the illustration of various interface components such as buttons, screens, sliders, etc. The subsequent feature is the Manual Manipulation of these elements. As users simulate interactions with the paper-based elements, a "wizard" manually modifies the interface in response. For instance, when a user simulates a "click" on a hand-drawn button, the wizard can swap out the screen to display the ensuing action.

Method

For this method, the following procedures are typically used:

1. Define Test Goals: Know the user behavior or feedback you are targeting.
2. Design the Paper Prototype: Draw the various interface components.
3. Set the Stage: Ensure the user only sees the prototype, not the background adjustments.
4. Choose Roles: Define roles for the user, wizard, and observer.
5. Conduct the Test: Users interact with the prototype, and the wizard makes adjustments in real-time.
6. Feedback Collection: After the test, gather feedback from users.
7. Analysis and Iteration: Use feedback for refining the design.

Why adopt this strategy?

A critical element of user experience (UX) research emphasizes the importance of conducting system tests at all development stages, including the preliminary phase before any actual development starts (Kuniavsky, 2003). This preemptive testing is crucial for conserving time, resources, and effort by early detection of design issues, challenges, and areas for improvement. The WoZ technique facilitates evaluating user responses to a system concept before the commencement of its development. This approach proves invaluable when the expense of developing a concept's underlying technology is prohibitive, or when facing a particularly intricate problem space that requires simplification.

Integrating the WoZ technique with paper prototyping provides a practical means of verifying design concepts at an early stage. This strategy yields direct feedback from users without necessitating the creation of a full-fledged digital prototype. Like all usability testing methods, it should be executed with defined objectives, centering on user needs, and leveraging the insights obtained to guide future design iterations (Buley, 2013).

Variations of the Wizard of Oz Method

There are several variations of this method, which an instructor could consider to more closely align with their teaching philosophy, learning outcomes, class size, and level:

A. **Closed:** This approach confines the "wizard" to select responses from a predetermined array of system reactions. Commonly applied in paper prototyping, this version involves presenting users with various pre-drawn interfaces in reaction to their inputs. A key advantage of this model is its ability to uncover missing elements in the system's content.

B. **Open:** Here, the "wizard" possesses the flexibility to craft responses in real-time during the session. This format is instrumental during the "discovery" phase, aiming to discover users' needs and requirements. The individual assuming the "wizard" role must have a comprehensive understanding of the subject matter and sufficient creativity to devise spontaneous responses.

C. **Hybrid:** Combining elements of both the closed and open variations, the hybrid method is effective in identifying overlooked "dead-ends" or areas not previously considered when establishing the set of potential system responses.

Strengths of Paper Prototyping

Paper prototyping remains a valuable technique for creating low-fidelity mock-ups, even in an era where software tools can produce highly realistic user interface (UI) designs. This approach, particularly favored in agile development, offers several advantages:

1. **Focus on User Experience**: The simplicity of paper prototyping steers attention towards the user experience rather than the aesthetic appeal of the interface. The absence of detailed presentation elements like color, images, and layout prevents distraction, centering the design process on usability (Snyder, 2003).
2. **Encouragement of Feedback**: The makeshift nature of paper prototypes makes them less intimidating for users, who may hesitate to criticize more polished mock-ups. This perceived temporariness invites more open critique and suggestions for improvement.
3. **Clarification of Development Status**: Unlike digital prototypes, which might be mistaken for the final software, paper prototypes communicate their provisional status. This distinction helps manage users' expectations regarding the usability and functionality of the design.
4. **Adaptability**: Paper prototypes excel in flexibility, allowing for real-time modifications in response to unexpected user interactions. Snyder (2003) highlights the "incredibly intelligent mouse" phenomenon, where the adaptability and creativity of the individual simulating the computer can address novel situations during usability testing.
5. **Team Involvement and Customer Engagement**: The process of paper prototyping promotes active participation from both technical and non-technical team members, as well as customers. This collaborative effort can enhance team cohesion and emphasize the valuable role customers play in the development process, regardless of their technical background.
6. **Promotion of Team Collaboration**: Unlike high-fidelity prototyping, which is often done in isolation by developers, paper prototyping fosters a collaborative environment. Team members work together around a single table, enhancing communication and collective focus on the project.
7. **Indication of Potential Design Issues**: Challenges encountered in translating a design concept into a paper prototype may signal underlying issues with the design itself. This reflection can prompt a reevaluation of the design’s focus, prioritizing user friendliness over technological flair (Snyder, 2003).

Certain challenges associated with paper prototyping can ultimately reveal themselves as advantages. For instance, if creating a paper prototype of your design proves difficult, this may signal an underlying issue with the design itself. It could imply an overemphasis on sophisticated technologies rather than prioritizing user-friendliness.

Limitations of Paper Prototyping

While paper prototyping offers numerous advantages, it's important to acknowledge its drawbacks:

1. There's a perception among some that the rudimentary nature of paper prototypes reflects a lack of professionalism. However, any initial skepticism typically dissipates as the practical value of the method becomes evident to stakeholders.
2. Simulating certain types of interactivity, such as trackpad gestures or other tactile interface features, proves challenging with paper. These elements are difficult to accurately represent in a non-digital format.
3. Paper prototyping is not suitable for assessing non-functional aspects of a system like its performance metrics.
4. The success of a paper prototyping session hinges on thorough preparation. Without convincing mock-ups, participants may not fully engage with the process, potentially undermining the effectiveness of the WoZ technique.
5. The role of facilitator in these sessions demands a high level of expertise to be executed successfully, making it difficult to find personnel with the appropriate skill set.

Additionally, paper prototypes cannot ascertain the technical viability of a proposed system. However, the process of developing a paper prototype can offer insights. For instance, difficulty in modeling numerous small interactions might indicate an overly complex system, suggesting a need for the design team to reconsider and simplify the solution.

PROCEDURE

Assignment 1: Wizard of Oz Usability Testing

The following describes the first assignment to a class of undergraduate students, detailing the weight, objective, structure, breakdown, guidelines and grading criteria.

Weight. 5% of the total course grade.
Objective. The main aim of this assignment is to apply the details of usability testing using the WoZ technique. This hands-on approach will provide real-world experience in designing, conducting, and analyzing usability tests for digital products.

Team Structure

1. Teams are comprised 3 or 4 members each, with the following roles:
2. Wizard (or the computer) will simulate the computer's responses in the test.
3. Facilitator will guide the user through the tasks and be the primary communicator.
4. Observers (1 or 2 members) will watch and take notes during the experiment.

Assignment Breakdown

1. **App Selection**. Choose between Mobile Banking or Coffee Shop App (or other specific app included in the course)
2. **Preparation**
   a. Identify and detail at least five user stories.
   b. Discuss and agree on the flow for each user story.
   c. Design paper prototypes (hand-drawn wireframes) to be clear and comprehensible for users during testing.
3. **Testing**
   a. Rotate roles with each new experiment to ensure every team member experiences different responsibilities.
   b. Other teams' members will act as users for your usability test.
   c. Ensure active participation from all team members. This will be reflected in the grading for each team member.
4. **Post-Testing**
   a. Document the entire process: from initial app selection, story creation, prototype design, to usability testing. Include clear images in the report.
   b. Highlight key observations from the tests. What went well? What challenges did users face?
   c. Propose changes based on feedback and observations to improve the design.

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Submission Guidelines

1. **Report Structure**
   a. Introduction: Brief overview of the chosen app and its purpose.
   b. User Stories: Detailed descriptions and their flows.
   c. Prototype Design: Explanation and visuals of your hand-drawn wireframes.
   d. Usability Testing: Detailed methodology, observations, and feedback from users.
   e. Analysis: Discuss the key findings, problems identified, and potential solutions.
   f. Conclusion: Summarize the learning experience and proposed design changes.
2. **Format**: PDF, max 15 pages, font size 12, Times New Roman.
3. **Deadline**: Submit your report to the university learning management system (LMS) Assignment 1 by 11:59 PM on the day of your lab.
4. **Single submission:** One submission per team. The report should clearly state the names of all team members on the front page.

Important Notes

- Collaboration. Each team member must contribute and participate actively in the design and testing phases.
- Keep track of individual contributions to ensure fair work distribution.
- Each team member must add a short statement in the report detailing their own contribution.
- Always maintain respect and professionalism during testing and feedback sessions.

Grading Criteria

1. Clarity and completeness of the user stories and prototype design: 30%
2. Quality and depth of usability testing including observation and post-test interviews: 20%
3. Individual participation before, during and after the tests: 20%
4. Analysis and recommendations based on feedback: 20%
5. Overall presentation and coherence of the report: 10%

Marks for each criterion will be awarded based on the analytical rubric provided in table 1. Your innovative designs and insights will pave the way for a user-friendly digital world.

Table 1. Wizard of Oz Method Analytical Rubric

Criteria	**Outstanding**	**Good**	**Satisfactory**	**Needs Improvement**
Clarity and completeness of the user stories and prototype design (30%)	30	26	20	14
	User stories are detailed, clear, and comprehensive. Prototype design thoroughly aligns with user stories, showcasing excellent depth and thoroughness.	User stories are clear with minor gaps in details. Prototype design mostly aligns with user stories but might miss a few details.	User stories lack some clarity, and details are occasionally missing. Prototype design aligns partially with user stories but lacks depth in certain areas.	User stories are unclear or incomplete. Prototype design is not well-aligned with user stories and lacks clarity and depth.
Quality and depth of usability testing (20%)	20	17	13	9
	Usability testing is comprehensive, detailed, and insightful. Observations and post-test interviews provide	Usability testing is well- conducted with a few minor misses in observations. Post-test interviews capture	Usability testing lacks some depth, with several missed observations. Post-test interviews lack	Usability testing is shallow or poorly conducted. Observations and post-test interviews provide limited to no

	understanding and actionable insights.	most essential feedback.	comprehensive feedback.	valuable feedback.
Individual participation (20%)	20	17	13	9
	The individual consistently and actively participated throughout all phases of the assignment, demonstrating a high level of engagement and significant contribution to the team's work.	The individual participated actively in most phases and made meaningful contributions, with only occasional lapses in active involvement.	The individual's participation was inconsistent across phases. While they were involved, there were notable periods or aspects where their contribution was limited.	The individual showed limited participation throughout the assignment, with minimal contributions or engagement in various phases.
Analysis and recommendations (20%)	20	17	13	9
	Analysis is detailed and insightful, drawing on all aspects of feedback. Recommendations are actionable, well-thought-out, and would significantly improve the design.	Analysis captures most feedback but may miss minor points. Recommendations are good but could be more comprehensive.	Analysis covers basic feedback but lacks depth in understanding. Recommendations are somewhat generic and could be more tailored.	Analysis is shallow or misaligned with feedback. Recommendations are either missing or not actionable.
Presentation (10%)	10	8	6	4
	Report is exceptionally well-structured, coherent, and professionally presented, with excellent use of language and visuals.	Report is well-organized with a few minor inconsistencies or formatting errors. Language is clear.	Report structure has some coherence issues or is lacking in presentation. Language may have occasional clarity issues.	Report lacks structure, coherence, and professionalism. Language and presentation are not up to standard

DISCUSSION

The assignment's implementation within the class offered a multifaceted insight into the practical application of the WoZ method combined with paper prototyping in the context of undergraduate UX design education. Teams, comprising 3 to 4 members each, undertook roles that simulated real-world UX research dynamics, thereby enriching their learning experience. The diversity in team readiness and individual contributions highlighted the assignment's effectiveness in mirroring professional scenarios where adaptability and team collaboration are crucial. One team's ability to finalize their prototype amidst ongoing usability tests exemplifies the agile approach encouraged by paper prototyping. Meanwhile, the expressed concern over individual effort and its reflection in grading underscores the importance of clear communication and equitable recognition within collaborative projects.

The assignment structure, aimed at applying usability testing fundamentals through the WoZ technique, fostered a hands-on experience in design, execution, and analysis of usability tests for digital products. By engaging in roles such as the Wizard, Facilitator, and Observers, students navigated the intricacies of user-centered design, from initial app selection through to post-testing analysis. The choice between a Mobile Banking or Coffee Shop App allowed teams to explore diverse user stories and design challenges, further diversifying the learning outcomes.

Moreover, the exercise of rotating roles and engaging with paper prototypes served not only to demystify the usability testing process but also to instill a deeper understanding of its significance in product development. This experiential learning approach, coupled with the requirement for detailed documentation and analysis, provided students with a comprehensive view of UX research methodologies. The dynamic nature of the assignment, necessitating on-the-fly adjustments and fostering immediate user feedback, highlighted the inherent flexibility of paper prototyping and the WoZ method. These insights are invaluable for aspiring UX designers, offering them a real-world perspective on the iterative design process and the collaborative effort required to achieve user-centric solutions.

One student described the experience as "new but enlightening," particularly appreciating the opportunity to immerse in different design iterations as both a user and an observer. This dual perspective allowed the student to directly experience the influence of design decisions on user experience and recognize the critical role of user-centered design principles. The emphasis on the necessity of ongoing iteration and improvement to achieve a user-friendly application interface was a common theme in student reflections. Another student echoed these sentiments, finding significant value in exploring diverse designs and providing feedback from the user's viewpoint. This hands-on involvement not only made the learning process enjoyable but also reinforced the importance of adopting a user-centric approach and the principle of iterative design. The student's account of the joy and enlightenment gained from this experience highlights the assignment's success in fostering a deeper understanding of UX design principles.

These student reflections vividly illustrate the multifaceted benefits of the assignment, from fostering a deeper appreciation of user-centered design to enhancing practical skills in design iteration and feedback analysis. By translating abstract concepts into concrete, actionable experiences, the assignment effectively bridged the gap between theoretical knowledge and practical application, preparing students for the complexities and collaborative nature of professional UX design work. These personal accounts underscore the educational value of engaging with the Wizard of Oz (WoZ) method and paper prototyping, highlighting the effectiveness of role-playing in simulating real-world UX research dynamics. The assignment's challenges, particularly around the simulation of complex interactivity and the perception of paper prototypes' professionalism, offer important lessons. These aspects emphasize the necessity for preparatory clarity and the value of integrating user feedback into iterative design refinements. Furthermore, the facilitator's role's complexity and the critical need for skilled personnel in usability testing underscore the multifaceted skills required in UX research. Addressing these challenges requires strategic approaches that leverage both preparation and technology. Integrating platforms like Figma (Figma, Inc., n.d.) into the educational framework can serve as a pivotal strategy to mitigate these challenges, enhancing the learning experience and the effectiveness of UX design education. Here's how this can be approached:

Enhanced Preparatory Workshops

Before delving into the assignment, conducting preparatory workshops focused on the objectives, processes, and expected outcomes can clarify the purpose and value of paper prototyping and the WoZ method. These sessions can include:

- **Role Clarification**: Detailed explanations of each role within the WoZ framework, with a focus on the nuanced responsibilities and how they contribute to UX research.

- **Professionalism in Prototyping**: Discussions on how low-fidelity prototypes, while seemingly informal, play a crucial role in the iterative design process, emphasizing their professional value in UX design.
- **Introduction to Complex Interactions**: Offering insights into how complex interactions can be effectively simulated and tested within the constraints of paper prototyping and the WoZ method.

Leveraging Digital Tools like Figma

Incorporating digital prototyping tools such as Figma (Figma, Inc., n.d.) can address the dual challenge of simulating complex interactivity and enhancing the professionalism of prototypes. Figma allows for the creation of high-fidelity, interactive prototypes that can simulate complex user interactions through features like clickable buttons and transitions. This approach can be integrated into the educational process through:

- **Hybrid Prototyping Workshops**: Introducing students to Figma and similar tools in workshops that bridge traditional paper prototyping and digital prototyping, showing how initial concepts on paper can evolve into interactive digital prototypes.
- **Redefining the Wizard's Role**: With Figma's interactive prototypes, the wizard's role shifts from manually simulating responses to managing the interactive prototype at some points during the testing process, thereby reducing the complexity of the role and focusing on gathering user feedback.
- **Real-time Iteration**: Utilizing Figma's collaborative features enables real-time updates and iterations based on user feedback during usability testing sessions, closely mirroring the agile design process.

Continuous Feedback and Iteration

Establishing a continuous feedback loop where students can present their prototypes, receive feedback, and iterate on their designs is crucial. This can be facilitated by:

- **Scheduled Critique Sessions**: Regularly scheduled sessions where students can showcase their work in progress, whether paper or digital prototypes, and receive constructive feedback from peers and instructors.

Integration of User Feedback: Encouraging the integration of feedback from usability tests into subsequent design iterations, emphasizing the iterative nature of design and the importance of user-centered approaches. To sum up, the assignment provided a practical framework for applying UX research and design principles, underscoring the importance of collaboration, adaptability, and user focus in the development of digital products. The experiences garnered from this exercise reflect the multifaceted nature of usability testing and design thinking, preparing students for the challenges and opportunities in the field of UX design. Through this assignment, students not only acquired hands-on skills in usability testing but also gained insights into the collaborative dynamics and problem-solving approaches that underpin successful product development.

CONCLUSION

In reflecting on the implementation and outcomes of integrating the WoZ method with paper prototyping in UX design education, several key insights emerge, each contributing to the foundational knowledge and skill set of future UX designers. This educational endeavor, through its hands-on approach and real-world applicability, not only highlights the iterative nature of design but also underscores the importance of collaboration in achieving solutions that genuinely resonate with users. As students navigate the complexities of role-playing within usability testing—adopting the positions of Wizard, Facilitator, and Observer—they gain invaluable experience in the multifaceted processes that underlie user-centered design.

The assignment's structure, encompassing app selection, user story development, and prototype testing, effectively mirrors the stages of real-world product development, providing students with a comprehensive overview of the UX design lifecycle. This experiential learning model fosters a deep understanding of the critical role user feedback plays in refining design concepts. Moreover, the necessity of adapting to unforeseen user interactions during testing sessions highlights the agile mindset required in the UX field, where responsiveness to user needs is paramount.

However, the challenges encountered during the assignment—ranging from the simulation of complex interactions to ensuring equitable recognition of individual contributions—serve as vital learning points. These difficulties reinforce the importance of preparation, clear communication, and equitable collaboration within design teams. Furthermore, they prompt a reevaluation of traditional notions of professionalism in prototyping, advocating for a broader appreciation of low-fidelity models' role in the iterative design process.

Looking ahead, the integration of the WoZ method and paper prototyping into UX education opens avenues for further exploration and innovation in teaching strategies. As technology advances, educators have the opportunity to incorporate new tools and methodologies that enhance the realism and efficiency of prototyping and testing. Exploring virtual and augmented reality as extensions of paper prototyping, for instance, could offer students insights into more complex user interactions. Additionally, the rise of remote and hybrid learning environments poses unique challenges and opportunities for adapting these hands-on approaches to online platforms, further broadening the scope of UX education. A promising area for future research involves the introduction of Figma into the educational toolkit. Figma, with its capabilities for creating interactive, high-fidelity prototypes, addresses many of the challenges and complexities inherent in paper prototyping. By integrating Figma, educators can offer a seamless transition from low-fidelity to high-fidelity prototyping, providing a comprehensive learning experience that encompasses the entire spectrum of UX design processes. This inclusion could revolutionize how students understand and apply prototyping and usability testing, making it an exciting frontier for advancing UX education

Ultimately, the journey through WoZ and paper prototyping in UX design education transcends the mere acquisition of skills, fostering a deeper appreciation for the nuances of user experience and the collaborative effort required to achieve excellence in design. By continuing to push the boundaries of educational methodologies and embracing the ever-changing technological landscape, we can inspire a new generation of designers poised to innovate, empathize, and create digital products that enhance and simplify user interactions in an increasingly complex world. This assignment, with its blend of theoretical knowledge and practical application, represents a valuable tool for cultivating a user-centered design ethos that will drive the future of technology development.

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REFERENCES

Baum, L. F. (1900). *The Wonderful Wizard of Oz*. George M. Hill Company.

Baum, L. F. (2008). *The wonderful Wizard of Oz*. Oxford University Press.

Bernsen, N. O., Dybkjær, H., & Dybkjær, L. (2012). *Designing interactive speech systems: From first ideas to user testing*. Springer Science & Business Media.

Brandt, E., & Messeter, J. (2004). Facilitating collaboration through design games. In *Proceedings of the Eighth Conference on Participatory Design: Artful Integration: Interweaving Media, Materials and Practices - Volume 1* (pp. 121-131). ACM.

Buley, L. (2013). *The user experience team of one: A research and design survival guide*. Rosenfeld Media.

Buxton, B. (2010). *Sketching user experiences: Getting the design right and the right design*. Morgan Kaufmann.

Carroll, J. M., Kellogg, W. A., & Rosson, M. B. (1991). The task-artifact cycle. In J. M. Carroll (Ed.), *Designing interaction: Psychology at the human-computer interface* (pp. 74-102). Cambridge University Press.

Dahlbäck, N., Jönsson, A., & Ahrenberg, L. (1993). Wizard of Oz studies: Why and how. In *Proceedings of the 1st International Conference on Intelligent User Interfaces* (pp. 193-200).

Dow, S. P., Glassco, A., Kass, J., Schwarz, M., Schwartz, D. L., & Klemmer, S. R. (2010). Parallel prototyping leads to better design results, more divergence, and increased self-efficacy. *ACM Transactions on Computer-Human Interaction (TOCHI),* 17(4), 1-24.Figma, Inc. (n.d.). *Figma*. [Software]. Retrieved April 1, 2024, from https://www.figma.com

Garcia, E. A., Pimentel, J. F., Feng, Z., Gerosa, M., Steinmacher, I., & Sarma, A. (2024). How to Support ML End-User Programmers through a Conversational Agent. In *2024 IEEE/ACM 46th International Conference on Software Engineering (ICSE)* (pp. 618-629). IEEE Computer Society

Gerber, E., & Carroll, M. (2012). The psychological experience of prototyping. *Design Studies, 33*(1), 64-84.

Gould, J. D., Conti, J., & Hovanyecz, T. (1983). Composing letters with a simulated listening typewriter. *Communications of the ACM, 26*(4), 295-308.

Greenberg, S., Carpendale, S., Marquardt, N., & Buxton, B. (2011). *Sketching user experiences: The workbook*. Elsevier.Grill, T., Polacek, O., & Tscheligi, M. (2015). Conwiz: The contextual wizard of oz. *Journal of Ambient Intelligence and Smart Environments*, 7(6), 719-744.

Hartson, R., & Pyla, P. S. (2012). *The UX Book: Process and guidelines for ensuring a quality user experience*. Elsevier.Helgert, A., Straßmann, C., & Eimler, S. C. (2024). Unlocking Potentials of Virtual Reality as a Research Tool in Human-Robot Interaction: A Wizard-of-Oz Approach. In *Companion of the 2024 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 535-539)

Houde, S., & Hill, C. (1997). What do prototypes prototype? In *Handbook of Human-Computer Interaction* (2nd Ed., pp. 367-381). North-Holland.

Kelley, J. F. (1984). An iterative design methodology for user-friendly natural language office information applications. *ACM Transactions on Information Systems (TOIS), 2*(1), 26-41.

Kuniavsky, M. (2003). *Observing the user experience: a practitioner's guide to user research*. Elsevier.

Landay, J. A., & Myers, B. A. (2001). Sketching interfaces: Toward more human interface design. *IEEE Computer, 34*(3), 56-64.

Maulsby, D., Greenberg, S., & Mander, R. (1993). Prototyping an intelligent agent through Wizard of Oz. In *Proceedings of the INTERACT'93 and CHI'93 conference on Human Factors in Computing Systems* (pp. 277-284).

Muller, M. J., & Druin, A. (2012). Participatory design: The third space in human–computer interaction. In *The Human-Computer Interaction Handbook* (pp. 1125-1153). CRC Press.

Nielsen, J. (1994). *Usability engineering*. Morgan Kaufmann.

Norman, D. A., & Draper, S. W. (1986). *User-centered system design; New perspectives on human-computer interaction*. L. Erlbaum Associates Inc.

Rettig, M. (1994). Prototyping for tiny fingers. *Communications of the ACM*, *37*(4), 21-27.

Riek, L. D. (2012). Wizard of Oz studies in HRI: A systematic review and new reporting guidelines. *Journal of Human-Robot Interaction, 1*(1), 119-136.

Rudd, J., Stern, K., & Isensee, S. (1996). Low vs. high-fidelity prototyping debate. *Interactions, 3*(1), 76-85.

Saffer, D. (2010). *Designing for interaction: creating innovative applications and devices*. New Riders.

Snyder, C. (2003). *Paper prototyping: The fast and easy way to design and refine user interfaces*. Morgan Kaufmann. Wölfel, K., & Henrich, D. (2020). Wizard of Botz: A Novel Approach to the Wizard of Oz Experiment. In *Advances in Service and Industrial Robotics: Results of RAAD* (pp. 557-564). Springer International Publishing.

Zaphiris, P., & Kurniawan, S. (Eds.). (2007). *Human-computer interaction research in web design and evaluation*. IGI Global.

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