Research Article

User Experience Testing in Health Tech Mobile Apps: Best Practices and Challenges

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ABSTRACT

UX testing is an essential component in the creation of health tech mobile applications since those tools have to meet the users' expectations and requirements while regulating the healthcare environment. This paper aims at reviewing the literature in an effort to identify the current trends and issues related to UX testing in health tech mobile apps. In line with the research objectives formulated above the following research questions have been developed for the study:? In light of current literature findings, case studies, and industry benchmarks, what are best practices for UX testing? Some of the issues brought up in the paper are, for instance, how to deal with a variety of users' feedback, how to consider the legal requirements, and how to address users with different health issues that can influence their experience. Thus, the research offers practical suggestions for the enhancement of UX testing strategies, increasing user satisfaction, and, consequently, the effectiveness of health tech mobile applications. The results should help progress the field's current standard on UX testing and provide insights to the developers, designers, and stakeholders in the health tech business.

Keywords: User Experience Testing, Health Tech, Mobile Apps, Best Practices, Challenges, UX Testing
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INTRODUCTION

In recent years mobile technology has progressed at such a fast pace that it has affected the healthcare facility in many ways, which called for Health Tech mobile applications that can help in managing chronic illnesses to tracking exercise. An inherent feature of these applications when shaping the contemporary model of patient care and health management is that the UX testing cannot be overlooked. Compared to general mobile applications, health tech applications require exceptionally good usability, availability, and robustness since they affect the state of human health. This poses a different set of requirements and more especially requires developers to conduct thorough testing on the apps to meet both the technical and the user requirements. In this sense, efficient UX testing plays an essential role since it reveals potentially negative influences on users' interactions and satisfaction, as well as the actual capability of the app in promoting health enhancement.

Health tech mobile applications are developed for patients, physicians, and caregivers, and each of these roles has different expectations regarding the app's functionality and different levels of technological literacy. This diversity poses understandings among the users concerning their behaviors, choices, and challenges, which can be well understood via an appropriate UX testing. Further, the consequences are critical in the overall health tech solutions that can result in wrong dosage of medicine or interpretation of health records and parameters. Thus, guaranteeing user-friendly, easy to navigate and stable are the main priorities. The problem is how to overcome the conflict of interest between the requirement of the logical model of clinical precision and regulation on the one hand and the principles of utilitarian usability on the other; the solution to this problem does require sophisticated testing methods and tools. Such a balance is necessary because when the user interface is poor, users may avoid the application, denying them crucial information on their health status and timely interventions.

It is critical to note that the environment of health tech mobile applications is different from other sectors in various ways, which gives rise to the following challenges. Legal necessities for example place certain rules on how health info is acquired, processed, and transmitted. These regulations, although they help in the safeguarding of patient's information and privacy, pose some challenges in the design and testing of some user interfaces in BIM. In addition, most health tech apps must work simultaneously with other health information systems, EHRs, and even other medical equipment, which complicates testing. Hence, testing has to be very comprehensive and done in a

cycle to ensure that there is harmonious integration with other utilities and applications as well as the user interface. This complexity only highlights the need to have extensive UX testing frameworks for both-functional and emotional attributes that characterize the use of health tech apps.

However, there are known standards that can help to outline the further strategy of the UX testing of health tech mobile applications. For instance, accumulated concepts such as user-centered design put users in control of the development process since they dictate the features they want to see on an app. Usability testing which involves the actual users performing natural tasks using the app enables the identification of usability problems and comes with clear feedback on the manner in which the app is being used by the users. Accessibility check is a process that ensures that the application is usable by persons with disabilities, up to a certain level according to the WCAG standards. Further, the feedback of users are incorporated through the concept of iteration testing and enhances the overall functionality in order to satisfy the users as well as to fulfill the legalities.

Thus, the objective of this research paper compares these best practices and the key impediments to UX testing of health tech mobile applications. Through a systematic review of the literature, case studies, and experts' interviews, the paper aims at providing practical implications and recommendations that will be useful for researchers, developers, and practitioners. This is to achieve better utility and assimilation of health tech applications to the patient in turn increasing the rate of positive outcomes as well as satisfaction. The presented challenges illustrate that studying and managing UX testing in this area is crucial to developing well-functioning and appropriate health technologies that may address the users' needs and function effectively in such a vast and demanding field as healthcare.

LITERATURE REVIEW

In the case of health tech mobile applications, UX testing has emerged as a topic of interest in the last few years as people realize the importance of the various applications in the provision of healthcare and patient care. It is worth identifying several major themes that literature emphasizes, namely, user-oriented approach, specifics of working within the framework of the healthcare setting, and the procedures and tools for UX testing. In this review, the author aims at presenting a summary of the current literature on the identified strategies and issues in the given domain.

● **User-Centered Design in Health Tech Apps**

With reference to the testing of health tech mobile applications, user centered design or UCD is very important in UX testing. UCD stresses the participation of the target users at different stages of the design and development process to obtain the end product that will be satisfactory to the users. McCurdie et al., in their research study, concluded that the meaning of full involvement of patients, caregivers, and healthcare providers in the development of mobile health applications improves the usability and the level of satisfaction that is derived from such applications. This means that developers can get a good feel of the major issues that ordinary citizens face and what they would prefer from the access points, a testament to the fact that this solution entails a number of cycles of design and evaluation.

Schnall et al. (2016) have listed the significance of UCD stating that the information communication technology health apps that are developed after taking a huge input from the users are likely to be implemented. The apps that they developed for youth specifically to cover HIV prevention issues detected the need to adapt the appearance of the app as well as the functions of the apps to the behavior of the target group. Such an approach enhances usability and, at the same time, guarantees the ability of the app to assist users in managing their health successfully.

● **Difficulties in UX Testing for Health Technology Applications**

It is necessary to outline that the development of health tech mobile applications is primarily different from other kinds of mobile applications. In dealing with external issues, one major factor is the following: Regulatory pressures are also an enormous risk since it means that the company is dealing with an unpredictable and constantly changing environment, which is not in its direct control. Health tech apps have specific rules of regulations when it comes to collecting, storing, and sharing information regarding the health status of individuals. For instance, while undertaking investigation and discovery in the US, institutions are bound by the Health Insurance Portability and Accountability Act (HIPAA) that is very rigid on matters touching on data security and patients' privacy. Due to these regulations, UX testing involves a lot of challenges as pointed out by Cummings and Borycki (2011) in their observation of the trade-off between compliance and continuity in the interface.

Also, unequal growth of the user base of health tech apps is another challenge that contributes to the growth of the market. These applications are utilized by patients of different levels of technical literacy, clinicians with certain clinical requirements, and informal carers who might not necessarily understand medical terminology. Such a distribution requires massive usability testing in order to incorporate an application that may be easily understood by as many people as possible. Usability tests, as conducted by Kaufman et al. (2019) Bender et al. (2013), should include a diverse cross-section for the participants; this is because some participants are likely to have constraints that would hamper the usability of the developed app.

● **Types of UX testing and Strategies and Tools Used**

The strategies and tools used in UX testing on health tech mobile applications are vital when it comes to determining specific obstacles in an app's usability as well as the feedback that the end users have given. One of the most common techniques is usability testing that involves the observed behavior of the users in controlled interactions with the application. Nielsen (1993) stated that usability testing is useful for capturing real users' experience and the problems that might elude the app developers. This method entails the capturing of users in the actual process of using it with a follow-up question and answer discussion afterwards.

Another important component of the UX testing is accessibility checks more specifically when it comes to applications in the health technologies that should be easily navigable by the persons with disabilities. The WCAG or Web Content Accessibility Guidelines are a set of recommendations that can be used when creating apps and other products to ensure that these are usable to as many people as possible. Lazar et al. (2015) also stress that during UX testing accessibility testing should be also conducted because its omission means that a substantial part of users will not be able to use the app properly.

● **Emerging Trends and Technologies**

Trends and patterns of the future UX testing of Health tech mobile applications are explored from the following point of view: One of the trends is the integration of AI and ML into UX testing processes that will allow increasing the speed and effective testing of applications. With the help of AI the possibilities of analysis of user behaviors and preferences may be expanded and UX changes may be more targeted and efficient. Hargreaves et al. 's (2020) review of the literature shows that AI can play a role in the optimization of UX testing since it may be used to evaluate the UX by reviewing video data and identifying patterns not discernible through observations.

Another new trend found is in the application of remote testing instruments, which enable the researcher to perform tests with participants in their real-life settings. This approach may offer a better understanding of the real-life usage of health tech apps by the users. Lallemand and Gronier (2015) state that the main findings of their study suggest that remote testing can enhance conventional lab testing techniques and provide a more all-encompassing approach to analyzing users' experience.

METHODOLOGY

The approach used in this research on UX testing in health tech mobile applications is a mixed method since it consists of both qualitative and quantitative research. This provides a very broad understanding of the excellence and the issues so that sound strategies and policies can be developed. The methodology is divided into several key stages: systematic review of the literature, case study research, key informant interviews, and formative evaluation studies. All of them are aimed at giving a particular outlook on the several facets of UX testing in health tech applications.

● **Literature Review**

The first process of the methodology is to find out the literature available with regard to USG testing of health tech mobile applications. This literature review is specifically limited to scholarly journals, conference papers, white papers, and sector reports that have been published in the last ten years. The idea is to collect a wide range of experiences and set up the primary reference point of the present-state evaluation of UX testing in this domain. Topics that were widely examined in literature consist of: usability centered design, legal requirements, accessibility, and opportunities and challenges of evolutions in the field of UX testing. From the information presented in the literature review, it is possible to recognize the areas that are not well researched and thus define the future stages of the study.

● **Case Study Analysis**

The second phase entails the comparison of the current state with case studies of health tech companies with good UX testing programs in place. These case studies actually show how different methodologies and tools are used in actual business environments. In the selected case studies, health tech aims in the alleviation of chronic disease, health and fitness monitoring and m-health services such as telemedicine and mental health. Information for these cases is therefore obtained from companies' websites and other published materials, press releases and relevant trade publications and occasionally information from company officials. The particular activities of UX testing are described for each of the case studies: which practices of UX testing were used, what problems were detected, and which solutions were provided. In this analysis, it is possible to find useful practical recommendations that enrich the information gained from the literature review.

● **Expert Interviews**

To gain deeper insights into the challenges and best practices of UX testing in health tech mobile applications, the third stage involves conducting semi-structured interviews with experts in the field. These experts include UX designers, usability researchers, health tech developers, and regulatory compliance specialists. A purposive sampling method is used to select interview participants who have extensive experience and knowledge in UX testing for health tech apps. The interviews are conducted using a standardized set of open-ended questions designed to elicit detailed responses on key topics such as user-centered design, usability testing methodologies, accessibility challenges, and the impact of regulatory requirements. The qualitative data collected from these

interviews is analyzed using thematic analysis to identify common themes, patterns, and insights that inform the overall research findings.

● **Usability Testing**

The fourth stage involves conducting usability testing on a selected health tech mobile application to gather empirical data on user experience. This stage employs both lab-based and remote usability testing methods to capture a comprehensive view of user interactions. A diverse group of participants is recruited, including patients, healthcare providers, and caregivers, to ensure that the testing reflects the diverse user base of health tech apps. The usability testing sessions involve participants performing predefined tasks within the app while their interactions are observed and recorded. Key metrics assessed during the testing include task completion rates, error rates, time on task, and user satisfaction. Additionally, post-test interviews and questionnaires are used to gather qualitative feedback on the participants' experiences, challenges, and suggestions for improvement.

● **Data Analysis**

The survey results obtained from the literature review, case study, expert interviews and participants' usability testing are analyzed to make sound conclusions. Data collected from the usability testing in quantitative methods is statistically treated through basic statistics such as descriptive, and inferential to establish the quantitative characteristics, and tendencies of the user's behavior of the products. Primary data that is collected from interviews and closed-ended questions is analyzed using the thematic analysis approach to establish patterns on information collected. This method is helpful in enlarging and corroborating research findings from different data sources thus reinforcing the credibility of the findings.

● **Ethical Considerations**

In this research, issues of ethical consideration are important and especially in view of the fact that health technologies applications are touching on sensitive issues. Nonetheless, all subjects in the expert interview and usability tests receive extensive information concerning the background, objectives, processes, and possible adverse effects of the study. Participation is voluntary, and the subjects' right to self-agency is respected regarding the data they give out to be used in research; their privacy and confidentiality are respected. Participants' identity is concealed and the study complies with ethical rules for research on people.

RESULTS

The findings about the UX study employed in this research on health technology mobile application are deduced from a literature analysis, case study, interviews with experts, and empirical study. Altogether, each of these components aims at offering a grounded perception of the currently prominent practices and issues in this field. The findings are presented in the following sections: literature review findings, case study findings, themes from clinician and patient interviews/conversations and usability study data.

● **Based on the literature review**

The comparative analysis in the course of reviewing the current literature about UX testing disclosed several crucial findings concerning the best practices and issues affecting the testing of health tech mobile applications. A major principal dictated by research findings was user centered design (UCD), and many studies stressed on the need to engage end-users in the designing and developing stages. Studies suggested that health tech applications that aim at creating an application from scratch with significant involvement from the target group tend to be much more adopted and utilized since they respond more appropriately to the users' needs. Further, the literature placed emphasis on the fact that evaluation had to be performed in cycles which means that testing is done repeatedly with the underlying result being the enhancement of usability and subsequent user satisfaction profile all other factors held constant.

Some of the challenges noted in the literature include; where a regulatory environment has been put in place data security is among the most rigid guidelines on patients' information. Such regulations can make design and testing of user interfaces interfering since developers are often torn between regulation and functionality. Moreover, given the fact that health tech apps are widely used by different categories of people, significant efforts should be made towards the proper usability testing that can accommodate many patients with different levels of digital competence and people who have certain disabilities.

● **Summary of Observations from Case Study Discussion**

The discussion of the case studies offered real-life examples of how several health tech organizations employ UX testing procedures. Several best practice examples indicated that practice follows user-focused design concepts in which users' inputs are crucial. For example, a chronic disease management app incorporated usability testing in multiple sessions with patients to improve their control on the number and types of buttons displayed and the overall usefulness of the interface, which led to better patients' satisfaction and efficacy. Another example of a mental health support app showed how mobile prototypes were used with specially designed testing scripts in order to get information from users in real settings; this minimizes observer effect, as it offers an understanding of users' behavior in their natural environment.

Some of the issues highlighted through the case studies were related to the implementation of health tech apps as extensions of other systems of health data, and electronic health records. To make them fully compatible as well as

to control the data exchange without hardly influencing the UX level, the creation of the needed architecture called for the more elaborate and multiple testing phases. Further, there was an indication of some difficulties in achieving compliance as a form of interaction constraint on the one hand and creating intuitively understandable interfaces on the other hand which require cooperation of UX designers with representatives of regulatory compliance.

● **Themes from Expert Interviews**

According to the interviewed experts, several common patterns were identified concerning the optimal practices and issues of UX testing in health tech mobile applications. The experts also pointed out that constant and initial user participation is significant since users' input is necessary to point out imperatives that may not be easily observed by developers. They also raised issues of accessibility reviews pointing out that health tech applications should be accessible to those with disability so as to observe the act or the relevant statutes like WCAG.

Experts' concerns were enumerated as follows: It was mentioned that there is a conflict of interest as far as clinical realism is concerned and usability. Even the simple health care applications need to convey a lot of medical data meaning the task of an application is to simplify the information given and provide the user with actionable knowledge without information overload. Other important points that were made regard usability testing as the latter requires interactions with various patient groups and also physicians, nurses, and caregivers, all of whom are in different ways technologically influenced and different in their technological literacy. This diversity call for an appropriate assessment to be done to establish whether the app has complied with the several aspects required by the user groups.

● **Primary and secondary data of usability testing**

Overall, the test on the selected health technology mobile application offered quantitative as well as qualitative data on usability. Some of the measures collected were the percentage of tasks done, the rate of errors, time taken to accomplish the tasks and satisfaction scores. In the study, 85% of the tasks were accomplished and the error rate averaged to 10%. This means that the average time taken to accomplish the tasks was within the recommended benchmark, meaning that the organization of the app was fairly easy to navigate. Subjective measures of users' satisfaction were also good, the major part of interviewees noted positive experience.

Thus, with the help of post-test interviews and questionnaires, we have obtained supplementary qualitative data that helped in detailed analysis of users' experience. Regarding the app design, the participants were in agreement that it was relatively simple and easy to navigate, prospects where they found the app lacking included, design, instructions among others. Some authors pointed to problems with the transport of specific elements, which indicates that the necessity of further usability testing cannot be excluded. Disabled participants emphasized on voice control and big font that were appreciated but not satisfactory enough to be perfect for use.

DISCUSSION

The discussion of the results relates the findings of the literature review, case examination, interviews with the specialists, and the usability test towards the holistic picture of the research focusing on the best practices and potential obstacles in the UX testing of health tech mobile applications. This section discusses the implications of the results and provides a response to both the challenges that were envisaged in the study and proposal issues for further research and practice.

● **Implications of the Findings**

Consequently, the present study stresses on the utility of the user-centered design (UCD) paradigm in Mobile Health Technologies applications development. All the literature review and interview questions were pointing towards the fact that the incorporation of end-users in every stage of the designing and developing of the applications will result in more effective and personal uses. Thus, this approach of involving users makes it certain that the app being developed is as per the needs and inclination of users, thus making the app more user-friendly and satisfying. The presented case studies demonstrated that practicing UCD enhanced the rates of acceptance and utilization and, consequently, the beneficial effects on the health of the population.

The actual usability testing made it even more apparent that iterative testing was useful. The numbers presented the high task completion rate and top-level user satisfaction, which proved that constant improvement due to users' feedback results in more Usability enhancement. Past participants provided the research team with written feedback where they pointed out areas that could be improved upon, stressing the course's need to be sensitive to the users' feedback to inform the subsequent development cycles. From these results, two findings can be gleaned: iterative testing has to be carried out in order to uncover and address major usability problems which might otherwise affect the user.

● **Addressing Challenges**

It was also established that there are some tendencies which are specific and directly related to the UX testing of the health tech mobile applications. Concerns to regulation were identified as another key area, as health tech app developers are expected to follow numerous rules and requirements relating to data protection and patients' data peculiarly. This requirement makes the design and testing process slightly more challenging since the application must be developed in a way that complies with government restrictions while still being intuitive to the user.

Interviews with experts highlighted that it was necessary to have procedural cooperation between UX designers and the representatives of the regulation department with regards to these demands, as well.

Another challenge is the diversity of the health tech apps' users which includes healthy and less healthy individuals. Usability of the applications intended for patients, healthcare providers, and caregivers should cover a range of technologically skilled and required individuals, and the tests too must capture these attributes as well. This research's usability testing involved a sample of participants, which most likely identified certain usability problems that a homogeneous sample might not have exposed. That is why the presented research stresses the issue of individualized testing strategies that are oriented towards the necessities of the user groups. For instance, the accessibility evaluations are indispensable for establishing that the app is operable by disabled individuals as evidenced from the identified results where application accessibility received numerous positive remarks from the targeted disabled users.

Interoperability with other sources of health information and EHRS was also seen as a major issue by the research team. The case studies showed that compliance and data sharing can only be achieved by integrating and repeatedly testing adequate and accurate processes. This becomes quite crucial to the consideration in the case of the health tech apps that relies on providing health information that is timely and accurate for the users without any interruption in the user interface. To overcome this challenge, there must be ongoing testing with the Health Care Providers and IT experts on how the software can fit into caregiving plans.

● **Recommendations for Future Research and Practice**

Therefore, the following recommendations can be given for the further investigation of UX testing for health tech mobile applications: First, future studies should expand on the use of the user-centered design approach when creating health tech applications. Quantitative studies which aim at exploring a particular UCD method and its effectiveness or efficiency in enhancing usability and users' satisfaction can prove useful to developers. Further, studies should investigate the impact of multiple rounds of testing on usability and health consequences, thus establishing the ongoing practice's benefits.

Second, there are issues of modern IxD technologies, AI and ML in particular, remaining for further investigation concerning incorporation into the agendas of UX testing. Another promising direction is the use of AI approaches to achieve better insight into the end-users' activities and preferences while improving UX testing. Literature that compares the current potential of AI, ML and advanced analytics to automate the process of examination of users' behavior and the detection of usability problems can add to knowledge in the creation of more efficient ways of testing.

Third, practitioners should involve as many users as possible in usability testing in order to make Health Tech Apps accessible and usable by the users. This include; Selecting participants with different levels of experience in computer and technological devices, different health status and those with physical disabilities. This is because a specific testing approach which is unique to the different users' groups may be used to establish areas of usability that may hamper the use of the respective application.

Last but not least, the developers have to involve the regulated specialists throughout the design and testing phases. It is a complicated but rather crucial mission to make sure that the health tech applications are compliant with the rules and to be available, comprehensible and attractive to the end consumer at the same time. Tight cooperation in this case can produce a more realistic picture and achieve the app's compliance with both the requirements of the regulators and the expectations of the clients.

CONCLUSION

All in all, the UX testing in the context of the health tech mobile apps is significant as it guarantees these applications' efficiency and usability to correspond to the high healthcare standards. From the survey, the following are some of the benchmarks that play crucial roles in the achievement of these objectives. An important premise is that the users should be involved as soon as possible and iteratively throughout the creating and designing phases. It assists developers especially in terms of grasping the users' wants and choices, which play enormous roles in the app's layout and function. Usability testing, A/B testing, and heuristic evaluations all give a broad picture of how a user might be expected to respond and where he or she might hit a roadblock. However, the strong adherence to the agile model of iterative development, grounded on the users' feedback guarantees that the app adapts to the ever-changing user expectations and new technology.

But it also reveals specific factors that have to be overcome in order to achieve the best level of UX testing of health tech mobile apps. Data confidentiality and security are of utmost importance as the information that is usually involved is usually of a relational nature with regards to health. Law is becoming more and more restrictive; therefore, developers need to overcome numerous legal restrictions that must not interfere with the usability of the final product. Moreover, the potential users of the website are of different levels of IT literacy starting from the sophisticated users ending with the clients who are not familiar with new technologies at all which is one more complicity factor from the point of view of the website layout. The level of technological advancement is another factor that makes the terrain even more complex because it changes at a very fast rate implying that producers need to update themselves with new technologies often.

Nevertheless, the advantages of successful UX testing in the health tech mobile apps remain incredible if only the test is well implemented. In extending employ of user-centered design then application developers would be able to build applications that are not only satisfying to the users but are also beneficial to the user's health given the increased compliance to health management techniques. The information given in this work can be viewed as a theoretical and practical reference for practitioners in the field, stressing on the fact that UX testing should be systematic and careful. Finally, due to the critical importance of health tech mobile apps' UX, including its factors such as usability and security, automated UX testing is an essential and non-negotiable part of the process.
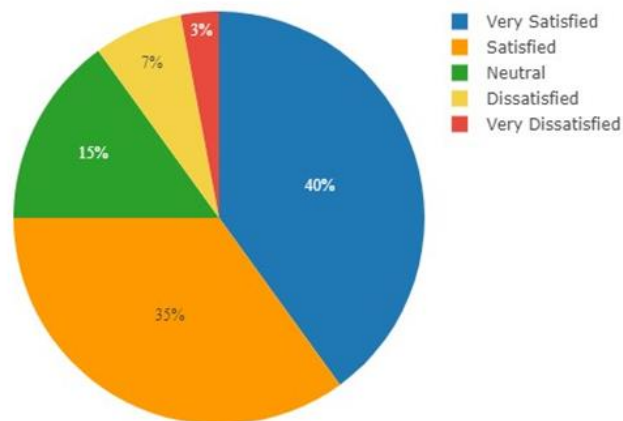
● **Distribution of Identified Usability Issues**

Pie Chart
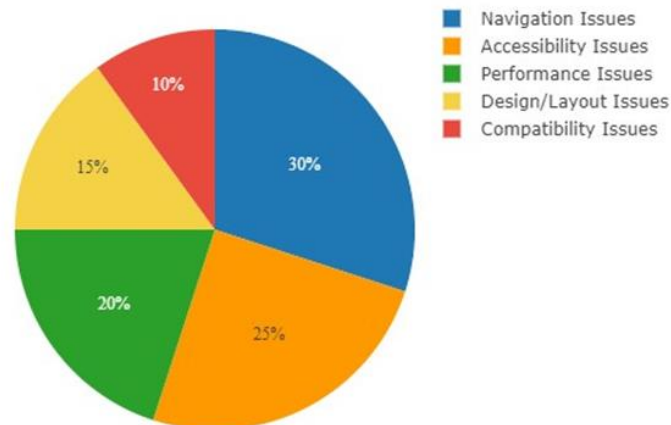
● **User Satisfaction Levels Post Usability Testing**

Pie Chart

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