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User Authentication Security Assessment in Mobile Banking Applications: A Survey with Usability Design Approach in Dodoma, Tanzania

William George Malugu, Shuubi Alphonce Mutajwaa & Matendo Didas
Center of Information and Communication Technology
St. John's University of Tanzania
Email: mdidas@sjut.ac.tz

Abstract: *Usability is a key factor in the quality of the product, which includes ease of use, user satisfaction, and the ability of the user to understand the product without practice quickly. As smartphone usage increases, most organizations have shifted their services to mobile applications, such as mobile banking. However, it is crucial to evaluate the security of user authentication and determine how, in a heuristic, user-friendly setting, security features in mobile banking applications can affect different parts of the industry. Using a usability design approach, this study investigated user authentication in mobile banking applications in Dodoma, Tanzania. The study used a mixed research approach to collect data from respondents who utilize mobile banking applications in their daily aspects. The primary three themes of the study were: i) present usability problems and security flaws found in mobile banking applications; ii) user-initiated research on usability difficulties; and iii) recommendations for enhancing security without sacrificing user enjoyment. The study's practical significance is rooted in its ability to improve mobile banking security by integrating user-friendly authentication design guidelines. The implication of this study is summarized in the form of parties to be affected by the study findings that is to say, researcher and practical applications, improved security practices in mobile banking applications, enhanced user experience, and awareness about usability issues while utilizing mobile banking applications in any transaction and interaction.*

Keywords: *Usability, Security, Mobile banking applications, Customer satisfaction, User authentication, Online banking, 2FA*

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1. Introduction

The evolution of the information technology and communication (ICT) industry has brought an immense impact on cultural, political, and economic social lifestyles all over the world (Imamov & Semenikhina, 2021). In the banking industry, the integration of ICT has created significant changes (Awwad & El Khoury, 2024). Banks compete closely and try to attract more customers by facilitating them with more and more facilities (Awwad & El Khoury, 2024). The mobile banking business is booming and its consumers are growing steadily due to the availability of inexpensive telecommunication services (Porfírio, Felício & Carrilho, 2024; Fiocco, 2019; YIMAM, 2016).

The availability of mobile phones has made it possible for the under-banked to have access to financial services through Mobile Financial Services (MFS). "Mobile phones affect the lives of billions of people around the globe, including the poor. The increasing mobile technology affordances have allowed nearly 3 billion people without bank accounts" to take part in banking in any way in both Kenya and Tanzania (Mago, 2014). Furthermore, technology has increased, and technology now has an enormous impact on people's daily lives. Technology is crucial in the banking industry. As one of

the largest financial institutions, banking is always looking for new ways to use technology to improve customer experience and convenience. A mobile phone is a standard technological device that has become a part of everyone's life in the information age. Hence, the growth rate of financial transactions conducted through online platforms has increased. Mobile banking is a new alternative channel for delivering banking services (Devadevan, 2022; Kraiwanit & Srijaem, 2021).

The developing world, with Tanzania inclusive, has joined and is no longer an observer in development aspects but rather a key player in the process. As Goldstuck, Edwards & Singh (2014) and Martínez-Pérez et al. (2024) contributed to the Technology Banker electronic newsletter, "Despite Africa's lowly position in the world research and development rankings, there is one area where the continent is in the forefront of technology usage: mobile money transfer, which is typically the first step in mobile banking. While still not widespread through the continent, use of mobile banking applications on mobile devices for funds transfer in Kenya, South Africa, and Tanzania far outstrips that of most developed countries"(Aduda & Elizabeth, 2012). The explosive growth of Information and Communication Technologies (ICT) in the financial industry, particularly the banking sector, has transformed how banks deliver customer services. Customers perform banking activities Such as checking account balances, making payments, applying for credit, and conducting Transactions using hand-held devices through the mobile banking model, a dynamic Banking channel of banks (Aldiabat et al., 2019).

Despite having many inherent benefits, mobile banking suffered from low and slower customer adoption, making this a critical issue to be studied and explained by many studies worldwide (Aldiabat et al., 2019). Technological advancements have altered how ordinary citizens go about their daily lives and many activities are carried out via the Internet such as tax returns, online banking, job searching, and general socializing (Dlamini & Modish, 2020).

Security of our mobile baking applications is the most concerning issue because cyber threats and attacks are on the rise since the rise of cybercrime is alarming. The inherent tension between security and usability in mobile banking app design still exists. While robust security measures are essential to protect users' sensitive financial information, overly complex authentication processes can frustrate users and lead to abandonment of the app or risky behaviors, such as using weak passwords or disabling security features altogether. Without integrating a usability design approach into user authentication security for mobile banking apps, several adverse effects can arise. Users may encounter difficulties navigating the app or managing authentication processes, leading to frustration and potential abandonment of the service. Inadequate usability can also result in users employing less secure practices, such as choosing weak passwords or repeatedly failing to authenticate, which increases vulnerability to fraud and unauthorized access. Additionally, the lack of focus on usability can contribute to lower adoption rates of mobile banking services. If users find the security measures cumbersome or confusing, they might avoid using the app altogether, which hinders financial inclusion and economic participation. Over time, this can limit the app's effectiveness in reaching underserved populations and reduce its overall impact on financial empowerment and economic growth within the community. Usability has greatly been considered as one of the significant quality attributes to determine the success of mobile applications. Mobile banking application is increasingly recognized as an emergent m-commerce application, which is dignified to become the giant killer mobile application arena (Hussain, Abubakar & Hashim, 2014).

The need for enhancing usability while preserving user authentication of mobile banking applications is therefore very important (Porfírio et al., 2024; Malik, Muhammad & Sajid, 2021). It is worth noting that usability is an important factor in the production of high-quality and usability products particularly in mobile applications (Weichbroth, 2020; Hoehle & Venkatesh, 2015). The main purpose of interface design is the usability of a good system (Santoso et al., 2024). With these deliberations, the study contributes to the ongoing research in the field by enhancing the understanding of usability issues and vulnerabilities as well as challenges in mobile banking applications. It aims at balancing robust security measures with usability, addressing issues like low adoption rates due to a low understanding of complex authentication processes. The study identifies usability challenges and security vulnerabilities in mobile banking applications, emphasizing the importance of accessible and secure mobile banking services. The significance lies in enhancing user experience, boosting security awareness, and informing the development of better mobile banking solutions, ultimately promoting financial inclusion and economic growth in Tanzania.

By making mobile banking applications more user-friendly and secure, financial services become more accessible to a wider range of people, including those who are less tech-savvy. This increased understanding of usability issues, vulnerabilities, and challenges in mobile banking applications, can foster greater financial inclusion and trust in digital banking, reducing risks of fraud and enabling safer transactions, envisioning innovations in response to the findings. Enhanced understanding of the usability of mobile banking applications can also contribute to better financial literacy and management, empowering individuals and communities economically. In rural and underserved areas, user-friendly banking solutions can bridge gaps left by traditional financial infrastructure, fostering

greater economic opportunities and reducing financial inequality. The study was guided by the following main study objective (SO):

> *To assess user authentication security in mobile banking applications using a usability design approach in Dodoma, Tanzania.*

To achieve this study's objective, the study survey considered two themes; that is to say, i) current usability issues and security vulnerabilities in mobile banking apps used by customers and ii) usability challenges faced. The paper is organized as follows; the next section (two) describes the relevant literature and concepts to the subject under investigation, and section three provides the methods and materials used to achieve the study objectives. Section four gives results and discussion of the study and finally, section five outlines the conclusion and recommendations of the study.

2. Literature Review

Assessment of security and user authentication: As the study involves assessment of the user authentication security in mobile banking applications, it was worth expounding on the meaning of the phrase "assessment" as applied in this study. Assessment is the process of evaluating or measuring the effectiveness, quality, or performance of something, often through analysis or investigation (Szalay & Deese, 2024). While security is concerned with Measures and protocols designed to protect systems, data, and users from unauthorized access, attacks, or breaches (Kruzikova et al.,2024), in the context of mobile banking, it refers to safeguarding financial transactions and personal information, user authentication is related to the process by which a system verifies the identity of a user, typically through credentials such as passwords, biometric data, or other security measures to ensure that only authorized individuals can access certain resources (Kumar et al., 2024; KA & Subramanian, 2024).

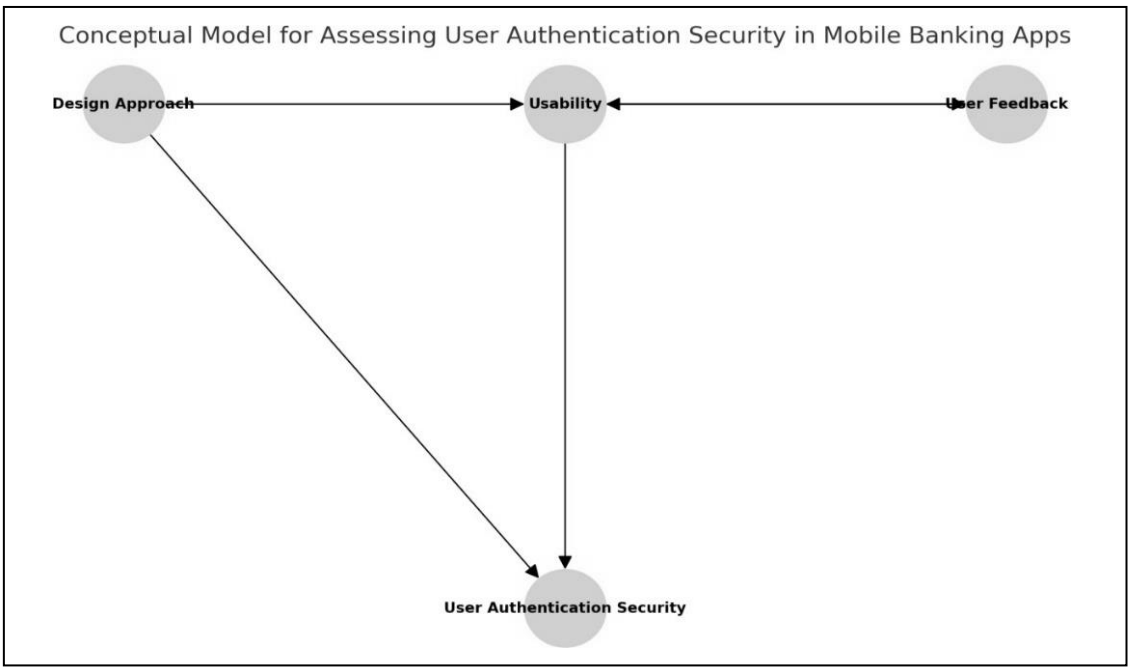
Usability design approach for mobile banking applications: A method of designing systems and interfaces with a focus on how easy and intuitive they are for users to interact with (Frans et al., 2024). It aims to enhance the user experience by making systems efficient, effective, and satisfying to use ISO 9241-11 states that the extent of usability is to be used by a specific user to attain the specific objectives in a specific context of application in terms of effectiveness, efficiency, and satisfaction (Bevan, Carter & Harker, 2015).

The physical restrictions on cell phones and wireless networks mean that the right research method must be carefully chosen and the possible contextual factors to be known should be reduced if they are not central to design and mobile usability studies (Alhejji et al., 2022). The assessment of product development and user experience is critical to how the process model, product development, and outcome have been established. The usability and experience of the user are distinct, as they also consider the usefulness. By analyzing usability, we can better visualize aspects of software architecture usability before implementation (Speicher, 2015). Then, it can help you identify the user interface's 3 major components (the required components, user-friendly components, and components to run them). Mobile banking application usability involves several mobility-related challenges such as mobile frames, networks, various resolutions, small screen sizes, capacity, and limited processing capabilities and processing inputs. Features of usability make the product or system usable. In all cases, the user must possess both subjective and objective experience if a system is to be used (Alhejji et al., 2022; Hussain, Abubakar & Hashim, 2014). Applications designed for mobile devices that allow users to conduct banking activities, such as checking balances, transferring money, and paying bills anywhere at any time referred to as mobile banking applications (Mohan, Mathur & Reddy, 2015).

Theoretical literature review: According to Sadiron et al. (2024), user satisfaction in mobile banking applications is very crucial and their study aimed at evaluating user satisfaction through a user interface (UI)/user experience (UX) design in mobile banking and finding out what kind of UI/UX appearance users want using the user-centered design method (Diallo et al., 2024). This research uses a qualitative approach. In addition to the qualitative approach, this research also incorporates a quantitative approach. Data collection in this research used usability testing, interviews, and questionnaires. We calculated the data obtained from the questionnaire statistically using Microsoft Excel. The results of questionnaire data analysis can be in the form of graphs or numbers. Researchers create a list of required elements or features to maintain, add, improve, or remove after collecting and analyzing data. Researchers will implement the requirements list by providing prototype design recommendations. The research results showed that 90% of participants completed the task scenarios given during the evaluation of ongoing mobile banking usability testing. Furthermore, during the evaluation of mobile banking prototype recommendations, 99% of participants completed the 10 task scenarios that had been given. The appearance that users want is a more attractive appearance by adding more icons and illustrations, as well as making the appearance more modern. Additional features that users want, namely adding an electronic wallet top-up feature, not limiting the account mutations that can be seen, adding a share feature after the transfer, adding fingerprint and face ID features in the login section, and adding a copy feature to be able to copy account numbers. This applies to my research proposal which also enhances user authentication security in mobile banking apps: "usability -design approach" in Dodoma".

Empirical literature review: Quintero (2024) in Sweden explained identifying the current usability issues and security vulnerabilities in mobile banking apps used by customers in Dodoma, Tanzania. Tsobdjou & Pierre developed A Framework for the Security Assessment of Android Mobile Banking Applications. Ali and Abazeed (2024) study focused on securing Mobile Banking. Computer shacking cyber security measures in mobile banking: examining the latest cyber security. Rashid (2024) developed a framework for security improvement on the usage of mobile money applications based on the iris biometric authentication method. This study was applied in investigating the usability challenges faced by users when interacting with current Authentication mechanisms in mobile banking apps in Dodoma, focusing on factors such as user experience, accessibility, and ease of use Sadiron (2024) evaluated the application of the user-centered design method to evaluate the relationship between user experiences, user interface and customer satisfaction on banking mobile application. Allayed (2024) looked at Arabian banks 'mobile applications accessible for blind or partially sighted users: customers' perspective and evaluation. Sebastian (2024) focused on what affects the promoting intention of mobile banking services and finally, Nanda (2024), examined usable security features and user perceptions of physical authentication devices.

Conceptual model of the study: Creating a conceptual model from the study on "Assessing User Authentication Security in Mobile Banking Applications: A Usability-Design Approaching Dodoma" involves identifying and defining the key concepts and their relationships. The conceptual model adopted in this is depicted in Figure 1. User Authentication Security (UAS) Measures and protocols implemented to verify the identity of users accessing mobile banking apps. Passwords, biometrics (fingerprint, facial recognition), and two-factor authentication (2FA) are the most common authentication methods according to Bonneau et al. (2012). Design Approach directly influences Usability by ensuring that the app is user-friendly and meets users' needs. Usability has a feedback loop with user feedback indicating that user input continuously informs and improves usability aspects. Usability also directly impacts user authentication security, as a more usable app makes it easier for users to comply with security protocols. The design approach indirectly influences user authentication security through its impact on usability.



Source: Synthesized by the Authors (2024)

Figure 1: Conceptual model for assessing user authentication security in mobile banking applications

Underscores the interconnectedness of design, usability, and security in the context of mobile banking applications, highlighting the importance of a holistic approach to enhancing user experience while ensuring robust security (Hunter, 2019). The literature reviewed reveals that the usability of a user interface is not one "single dimension" property. Many usability attributes need to be considered and measured. Shackel proposed four-dimensional characteristics that impact product acceptance: efficacy, ability to learn, adaptability, and attitude (Shackel, 2009). Elliyana & Sari (2014) carried out a study on the Internet banking website of Mandiri Bank of Indonesia with Nielsen's usability heuristics.

The method of research used was a descriptive analysis, with a hundred participants participating through questionnaires. According to this study, Mandiri Internet banking does not fully implement all heuristics. Heuristics that were judged not well, were; error prevention, flexibility and efficiency of use, and aesthetic and minimalist design (Malik, Muhammad & Sajid, 2021).

Kebkab Kassaye (2013) used the qualitative method (heuristic evaluation) to measure the usability of banking websites. He found different usability issues mentioned by experts. He also suggested ways to improve the usability of banking websites by using a user-centered approach (Kebkab Kassaye, 2013). A method that examines the usability of mobile apps and recognizes the possibility of usability problems has been developed by Biel Grill and Gruhn. The SATURN method consists of five activities. These activities include the context of analysis, determination of scenarios, evaluation of scenarios, interpretation, review, and tools. Biel Grill and Gruhn (2010) have used the mobile SATURN model and observed major usability problems. Lalji & Good (2008) studied the design of a mobile device for illiterate users. While the study adopted an incremental and user-centered design approach, they have tried to explain how the results from their study can be beneficial to non-traditional users in the field of design (Lalji & Good, 2008). Adamaet al. (2017) developed a prototype for m-banking for novice users based on recommendations and guidelines found in the literature.

They involved novice users and tested their prototypes. The results showed that the satisfaction level of users increased with the new prototype (Adama et al., 2017). Bernhaupt, Mihalic& Obrist (2008) provided a set of 'classical' approaches and added several theoretical innovations in the field of mobile devices and applications to test usability. He recommends incorporating both forms of field assessment and standard laboratory testing to accommodate many stages of the user-centered design and development procedure (Bernhaupt et al., 2008). Amin Babazadeh Sangar presented the smart banking model to enhance the usability of mobile software. In this respect, four new "visibility," "design," "navigation" and "compatibility" factors were achieved. The proposed model was presented by the factors in the earlier studies and obtained factors from his research. They created an application for a bank based on this model, following the proposed usability pattern by increasing the level of satisfaction (Sangar & Rastari, 2015). Azham Hussain has shown a range of usability measures to assess m-banking's usability. Measurement and dimension have been produced through a systematic literature review in the relevant previous studies (Hussain, Abubakar & Hashim, 2014). Fatih proposed a model that helps solve complex problems in the evaluation process of M-banking services and improves the performance of M-banking operations (Ecer, 2018).

3. Methodology

The research adopted a mixed-methods design, combining both qualitative and quantitative approaches to allow an in-depth understanding of user experiences and the effectiveness of different authentication methods in a holistic context. The approach was complemented with the case study, focusing on specific mobile banking applications to assess and enhance their authentication security through usability and design improvements taking the Dodoma region in central Tanzania. The study was conducted within the context of mobile banking applications, with participants interacting with the app in a controlled environment. This setting is chosen because it reflects the real-world context in which users engage with mobile banking apps, ensuring the relevance of the findings. Data collection will involve conducting surveys, interviews, and usability testing sessions within this specific setting. These methods allowed for gathering first-hand insights into how users interact with current authentication mechanisms. Analysis of collected data focused on identifying recurring themes and specific usability issues encountered during authentication processes. This study included some places in Dodoma urban region specifically Kikuyu, Sabasaba, and Nyerere square as summarized in Table 1.

Table 1: Distribution of respondents in different places of Dodoma

S/N	Areas covered in Dodoma	Participants in percentage
01	Kikuyu	60%
02	Nyerere Square	25%
03	Saba saba	15%

Source: Field Data (2024)

The study population included regular users of mobile banking applications, with a focus on individuals who frequently use such applications for financial transactions. The Recruitment was done through online advertisements and partnerships with financial institutions. The sample size of 50 participants was selected to provide a diverse range of user experiences and ensure the robustness of the findings. A mathematical formula for determining the sample size for a given confidence level and margin of error is generally derived from the principles of statistics applied to determine this sample. Yamane’s formula was adopted as it is often used to determine the sample size for a finite population with a desired level of precision.

$$n = \frac{N}{1+N(e2)}$$

Where by

N=population size n = sample size, e = margin of error N = 57

e = 0.5

n = 57 / (1+57(0.5)2)

Therefore: n =50

$$n = \frac{N}{1+N(e2)}$$

Where by

N=population size n = sample size, Z = score e = margin of error n = 57 / (1+57(0.5)2) therefore: n =50

Triangulation was used to enhance validity by combining multiple sources and pilot testing was conducted to refine interview questions and usability tasks. Consistent data collection procedures were implemented across all participants and Inter- rate reliability was ensured by training multiple observers to use the same criteria during usability tests. The data was examined using descriptive statistics for summarizing and describing datasets Statistical Package for the Social Sciences 30.0.0 (SPSS 30.0.0) was used to handle a wide range of statistical procedures and techniques, making it particularly suitable. Also, the study involved some aspects of the ethics such as ensuring the confidentiality and privacy of participant's data, especially when collecting sensitive information related to their experiences with mobile banking applications and authentication mechanisms. The issue of confidentiality and more ethical aspects were addressed through enacting informed consent, anonymizing participant data, all procedures comply with ethical guidelines to protect the rights and well-being of participants, and finally, efforts were made to include a diverse participant pool, ensuring representation of different genders and minority groups (gender & minority inclusion)

4. Results and Discussion

Demographic profile of respondents: To contextualize the findings of the study on user authentication security in mobile banking applications within Dodoma, an analysis of the demographic profile of respondents was conducted. This demographic data provides insights into the characteristics of the participants, which are crucial for understanding the broader implications of the research findings. The demographic characteristics of the participants involved age, gender, and occupational status. Figures 2 and 3 show findings about the participant's age and gender

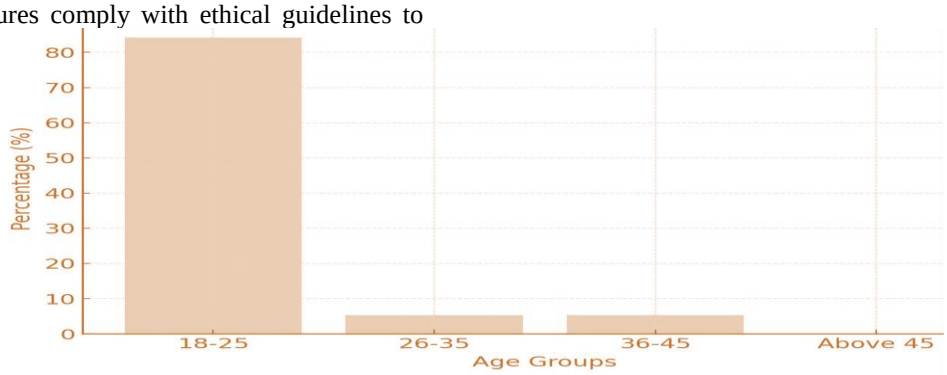


Figure 2: The findings about the age of the study participants

Source: Field Data (2024)

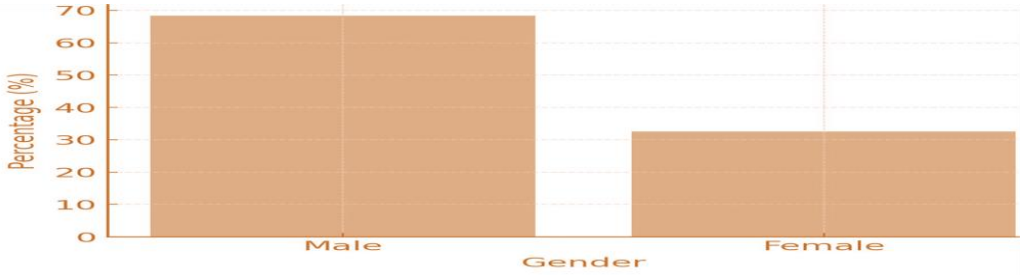


Figure 3: The findings about the gender of the study participants

Source: Field Data (2024)

On the part of the participant's occupation status findings, the occupational status of respondents varied, with the majority being students, who made up 63.16% of the sample. This aligns with the age distribution and suggests that a significant portion of the study's participants are likely to be tech-savvy individuals in the early stages of their careers. Interestingly, there were no respondents from the employed or retired categories, indicating a potential gap in the study regarding the perspectives of working professionals and older individuals. Self-employed respondents constituted 10.53% of the sample, while 21.05% identified as unemployed. The absence of employed individuals may limit the study's ability to generalize findings to those in regular employment, who might have different experiences and expectations from mobile banking applications (Owusu et al., 2021). The demographic profile of the respondents reveals a study population that is predominantly young, male, and student-oriented. These characteristics are likely to influence the findings related to user authentication security and usability in mobile banking applications especially among youth (Shree, Gurusamy & Balaji, 2019). For example, younger users may prioritize convenience and speed in authentication processes, while older or employed individuals might have different security concerns or usability requirements

Mobile banking usage: The study also considered the findings related to the usage patterns of mobile banking applications among the respondents, understanding how frequently users interact with these applications and their experience with mobile banking provides essential context for assessing the usability and security of authentication methods. The field data revealed diverse patterns in the frequency of mobile banking application usage among respondents. Figure 4 summarizes the findings from the participants about mobile banking usage. The aspects considered under this theme included the frequency of using mobile banking (days) and experience of using mobile banking applications in (years)

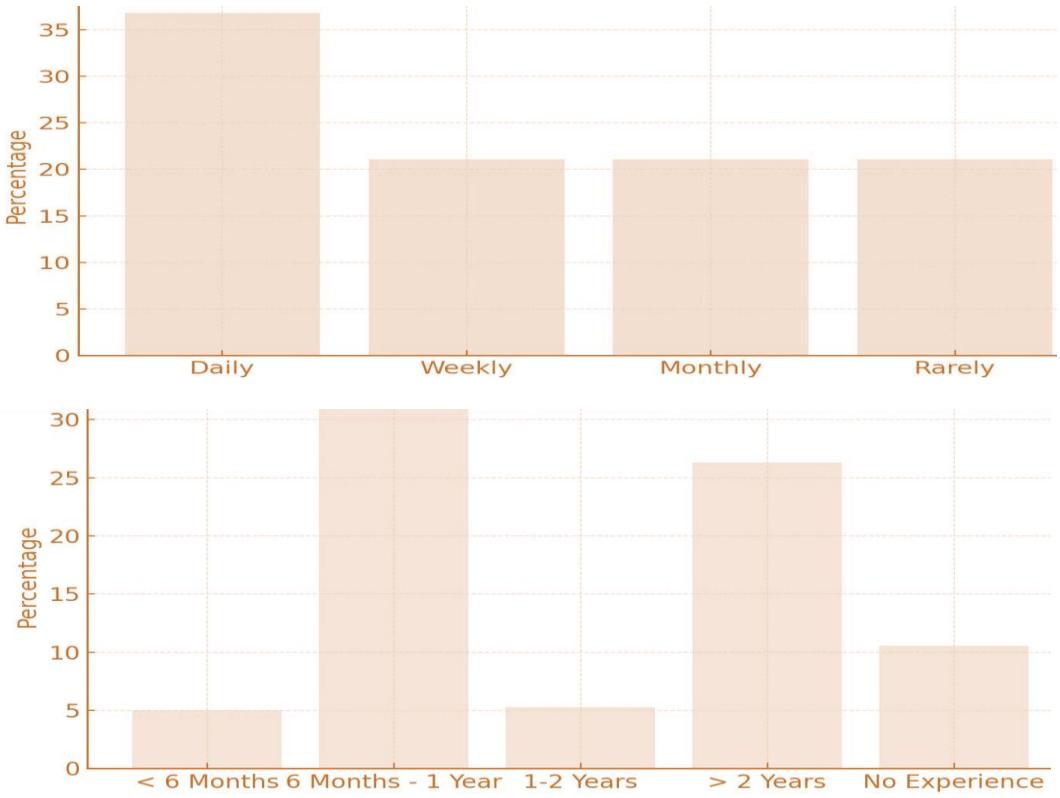


Figure 4: The findings about the experience of mobile banking applications
Source: Field Data (2024)

The findings on mobile banking usage revealed a broad spectrum of user engagement, from daily to rare usage, and from novice to experienced users. A significant proportion of daily users suggest that for many, mobile banking has become an integral part of their financial management routine. However, the presence of respondents with little to no experience also underscores the need for mobile banking applications to be accessible

and intuitive to attract and retain new users. These usage patterns have direct implications for the design of user authentication systems. For daily users, authentication methods must be quick and seamless to avoid frustration, while still maintaining high levels of security (Shaikh & Karjaluoto, 2016). For those with less frequent usage, ease of use and clear instructions may be more critical to ensure that users do not encounter barriers or confusion when they do engage with the applications according to Owusu Kwateng, Osei Atiemo, and Appiah (2019). Understanding the varied levels of experience with mobile banking can also help in tailoring security features to meet the needs of both seasoned users and those who are just beginning to explore the benefits of digital banking. This diversity in usage and experience highlights the importance of flexible, user-centered design in enhancing both the usability and security of mobile banking applications.

User experience (UX): The study further considered the data related to UX with mobile banking applications, focusing on ease of use, login issues, and security concerns. Understanding user satisfaction and challenges is essential for evaluating the overall effectiveness and usability of mobile banking applications. Figures 5, 6, and 7 summarize the findings from the participants regarding UX with mobile banking applications. The aspects considered under this theme included ease of use, login issues, and security issues.

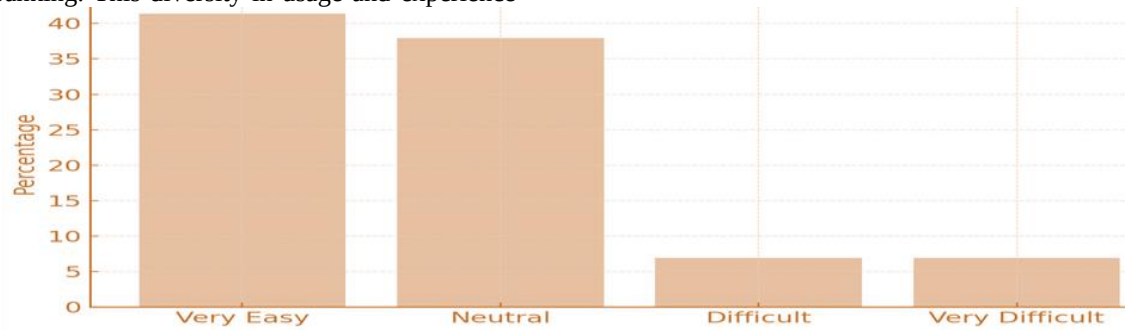


Figure 5: The findings about ease of use of mobile banking applications
Source: Field Data (2024)

Figure 6: Login issues in mobile banking applications
Source: Field Data (2024)

Figure 7: Security issues in mobile banking applications
Source: Field Data (2024)

The UX findings indicate that while a significant portion of users find mobile banking apps easy to use, there are still notable challenges, particularly with login issues and security concerns as also reckoned by Bakar, Aziz,

Muhammud & Muda (2017). The fact that over half of the users have faced login issues, suggests that improvements are needed in the authentication process to enhance both usability and security as asserted by Hayikader, Hadi, and Ibrahim (2016). Additionally, the substantial percentage of users who have experienced security issues underscores the importance of reinforcing security measures without compromising the user experience. Overall, these findings highlight the need for a balanced approach in mobile banking app design, ensuring that security features are both robust and user-friendly.

User design considerations: The study also explored respondents' views on the design of the authentication interface in mobile banking apps, highlighting the importance of design elements and preferred features. These insights are crucial for understanding user preferences and for guiding the development of user-centered authentication systems (Al Faisal et al., 2024). Figures 8 and 9 summarize the findings about design considerations obtained from the field data. The aspects considered under this theme included the importance of authentication interface design and preferred features in the authentication process.

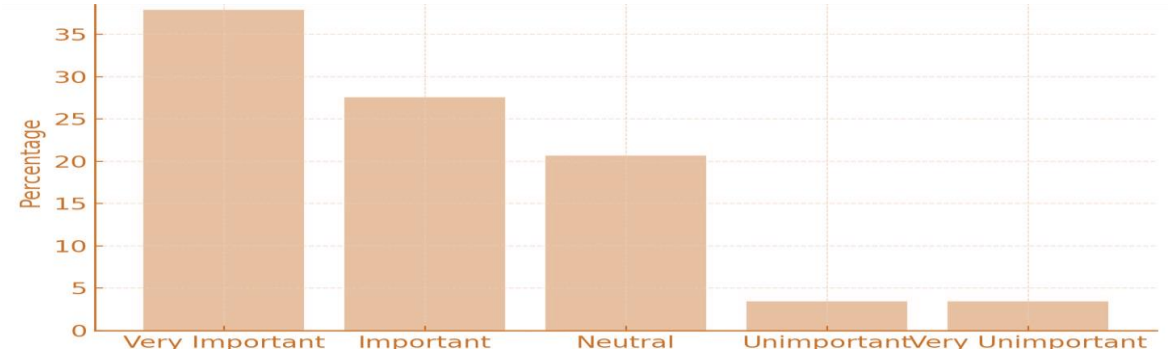


Figure 8: The findings about the importance of authentication interface design

Source: Field Data

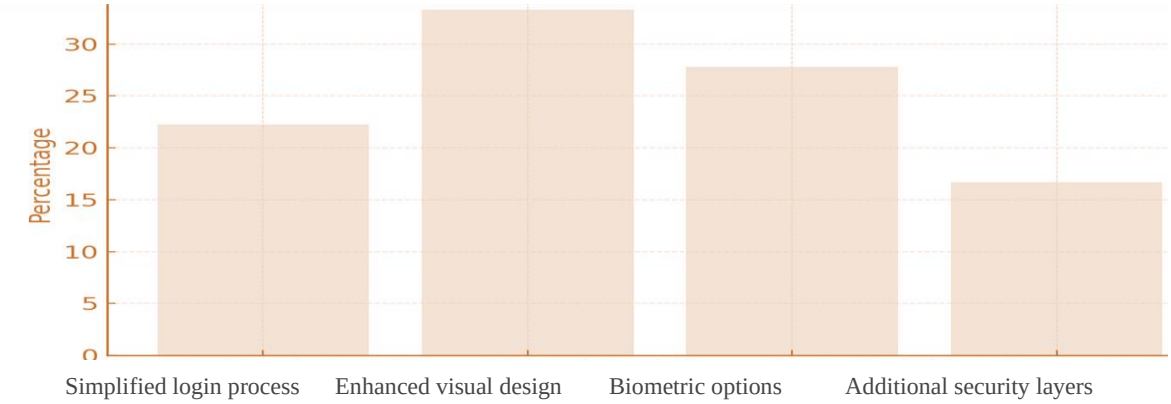


Figure 9: The findings about the preferred features in the authentication process

Source: Field Data

The design considerations findings underscore the critical role that interface design plays in the user experience of mobile banking apps. With 65.52% of respondents rating the design of the authentication interface as important or very important, it is clear that users value a well-crafted and visually appealing interface. This preference for enhanced visual design and biometric options reflects a desire for both security and ease of use. However, the varying preferences also highlight the need for flexibility in design, offering users options that cater to different priorities, whether it is a simplified login process or additional security layers. Balancing these elements is the key to developing an authentication system that meets the diverse needs of mobile banking users (Al Faisal et al., 2024; Gomez-Hernandez et al., 2023).

Authentication methods in use: The study finally considered providing insights into the types of authentication methods currently employed by respondents in their mobile banking applications. Understanding the distribution of these methods helps in assessing their popularity, effectiveness, and potential areas for improvement (Kruzikova et al., 2022). Figures 10 and 11 summarize the findings about authentication methods in the use theme.

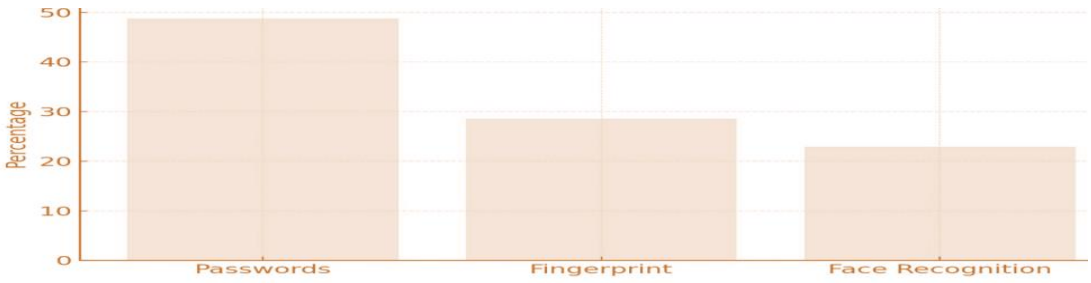


Figure 10: The findings about the authentication methods in mobile banking applications

Source: Field Data (2024)

The findings on authentication methods reveal that while passwords are still the most commonly used method, there is a notable shift towards biometric options such as fingerprint and face recognition. The substantial use of biometric methods suggests that users are increasingly valuing security features that combine convenience with enhanced protection (Kruzikova et al., 2022). Figure 11 summarizes the findings about the implications of authentication methods mentioned in Figure 10 in mobile money banking applications among study participants. These trends highlight the importance of continuing to innovate in the area of authentication, particularly in integrating and improving biometric options that can offer both security and ease of use (Sharma & Mathuria, 2018). As mobile banking continues to evolve, ensuring that these authentication methods are secure, user-friendly, and accessible will be crucial in meeting the needs of a diverse user base.

Table 11 below shows the experience of the participants about the usability heuristics of the mobile banking applications, their ratings on how mobile banking is secure, and what authentication method they prefer in a mobile banking app that will make the experience and usability easier.

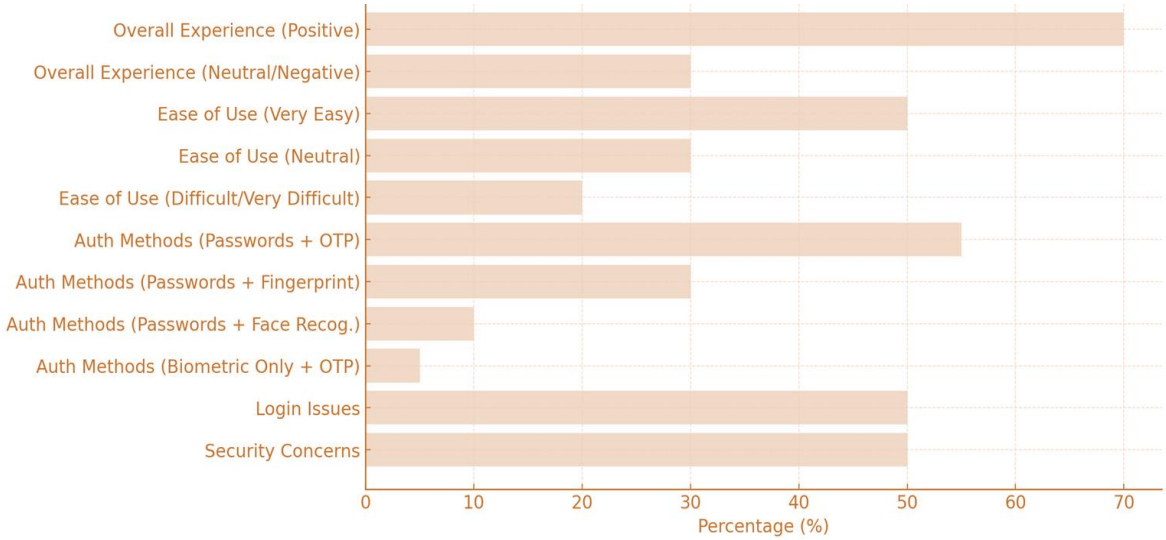


Figure 11: The findings about mobile banking applications usability and security experience

Source: Field Data (2024)

In summary, study findings revealed that most users are young students who frequently use mobile banking. While many find their apps easy to use, issues with login and security are prevalent. Preferences lean towards biometric authentication and enhanced design. The results emphasize the need for improved usability and security in mobile banking applications.

5. Conclusion and Recommendations

5.1 Conclusion

The study has provided valuable insights into the current state of authentication methods, user experience, and the impact of demographic factors on mobile banking practices. The study reveals a diverse range of user engagement, with a significant portion of respondents relying on the daily use of mobile banking apps and a

notable interest in biometric authentication methods. The findings highlight that while biometric options such as fingerprint and face recognition are increasingly favored for their convenience and security, traditional password-based authentication remains prevalent. Usability concerns persist, with a considerable percentage of users encountering difficulties during login and experiencing security issues, emphasizing the need for more robust and user-friendly solutions. Design plays a crucial role in user satisfaction, with a majority of respondents valuing an intuitive and aesthetically pleasing authentication interface. This underscores the importance of a user-centered design approach that balances ease of use with effective security measures. Additionally, addressing the needs of both frequent and infrequent users through tailored solutions and continuous improvements is essential for enhancing the overall user experience. In conclusion, by implementing the recommended improvements such as advancing biometric adoption, simplifying authentication processes, and enhancing security measures mobile banking applications can achieve a better balance between security and usability. These steps will foster greater user satisfaction and trust, ultimately contributing to the broader acceptance and success of mobile banking services. Mobile banking applications have become one of the largest new mobile commerce applications today, making it easy and convenient for users to execute transactions without any problems. This study investigates usability issues in developing countries, taking the Dodoma region in Tanzania as a case study, compares different features and experiences from a user and professional perspective, and opens gaps to improve the usability of mobile banking in transactions. The results of this study show that it is very important to consider user satisfaction and experience, user authentication with login, and security concerns for future development of mobile banking app interfaces.

5.2 Recommendations

Based on the findings, several key recommendations are proposed to enhance mobile banking security and usability.

1. First, promote the wider adoption of biometric authentication methods, such as fingerprint and face recognition, to improve both security and user experience.

2. Secondly, simplify the authentication process to address the 13.8% of users who find it difficult to use, ensuring the interface is intuitive and user-friendly.

3. Thirdly, address login and security issues by implementing additional security layers like two-factor authentication (2FA) and improving the stability of the authentication system.

4. Fourth, adopt a user-centered design approach, focusing on enhancing visual appeal and offering customizable options to cater to diverse user preferences,

5. Fifth, educating users on security best practices through in-app tutorials and notifications to reduce the likelihood of security issues. Tailor solutions to accommodate both frequent and infrequent users, ensuring accessibility for all demographic groups.

6. Finally, conduct ongoing usability and security assessments to stay ahead of potential issues and continuously improve the user experience. Implementing these recommendations will help balance security and usability, leading to greater user satisfaction and trust in mobile banking services. Finally, it is recommended that usability evaluation of mobile banking applications should be conducted sub-task-wise in every transaction to improve the satisfaction level of users.

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