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Digital Banking and Disability: Examining Financial Inclusion for People with Visual Impairments in Tanzania

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Abstract

This study examined how digital banking services influence financial inclusion for people with visual impairments (PWVIs) in Tanzania. Guided by the Vulnerable Group Theory of Financial Inclusion, the study used a quantitative cross-sectional design and analysed 108 structured questionnaires using descriptive statistics, Pearson's correlation and multiple regression. Mobile banking was positively associated with financial inclusion ($r = .307$, $p = .001$) and remained a significant positive predictor in the regression model ($\beta = .290$, $p = .002$). Internet banking also had a positive correlation with financial inclusion ($r = .252$, $p = .009$) and a significant positive regression coefficient ($\beta = .216$, $p = .019$). ATM services had a weak negative correlation ($r = -.139$, $p = .152$) and a negative but statistically non-significant regression coefficient ($\beta = -.171$, $p = .060$). The model explained 16.8% of the variance in financial inclusion. The findings show that digital banking can advance inclusion, but its benefits differ across platforms. Financial institutions and regulators should apply inclusive-design standards, improve assistive technologies, make digital devices more affordable, strengthen accessibility regulation and provide targeted financial-literacy programmes for PWVIs.

Keywords: Digital banking, financial inclusion, people with visual impairments, mobile banking, internet banking, ATM services

Introduction

Persons with disabilities are more likely to experience poorer health outcomes, lower educational attainment and fewer employment opportunities (World Bank, 2023). These disadvantages can restrict participation in income-generating activities. People with visual impairments (PWVIs) also encounter significant barriers in banking and other service sectors (Hassan et al., 2020). The World Health Organization (WHO, 2023) estimates that at least 2.2 billion people globally have near or distance vision impairment. The International Agency for the Prevention of Blindness (IAPB, 2020) projects that the number of people with vision loss will increase by 55% to 1.8 billion by 2050. These trends have increased international attention to disability-inclusive finance. Visual impairment can significantly affect quality of life (Hakobyan et al., 2013) and can reinforce inequalities through reduced employment and educational opportunities (Abdulhussein & Abdul Hussein, 2023).

The United Nations Convention on the Rights of Persons with Disabilities requires States Parties to ensure that persons with disabilities can own property, manage their financial affairs and access bank loans and other forms of financial credit on an equal basis (United Nations, 2006). The United Nations (2024) nevertheless reports that persons with disabilities remain marginalised in development processes and that progress towards many Sustainable Development Goal targets remains insufficient. At the same time, the global economy is becoming increasingly digital (World Economic Forum, 2024). Digital transformation is reshaping financial transactions and the ways in which customers interact with banks (Tran et al., 2023), while many personal financial activities are moving from cash-based to digital channels (Cnaan et al., 2023).

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Digital banking has the potential to narrow financial-exclusion gaps by allowing customers to access accounts, transfer funds and complete transactions without visiting a bank branch (Tran et al., 2023). Banks are increasingly using digital technologies to automate processes, improve products and enhance customer experience (Juniper Research, 2024). Digital banking now includes automated teller machines (ATMs), internet banking, mobile applications, digital wallets and other remote channels. This study focuses on mobile banking, internet banking and ATM services because they are among the most visible digital channels available to retail bank customers. When these channels are accessible, affordable and convenient, they can help integrate underserved populations into the formal financial system (Nnaomah et al., 2024).

Despite these potential benefits, accessibility and usability limitations can make digital banking difficult for PWVIs (Benita et al., 2025). Technologies such as biometric authentication, digital signatures and alternative verification methods can improve accessibility and security when they are implemented inclusively (Thakkar & Saha, 2024). Marginalised groups must therefore be deliberately included in digital-banking transformation so that technology reduces rather than reproduces financial exclusion (Nnaomah et al., 2024). Africa has emerged as a major centre of mobile and digital financial-service adoption, enabling many people to access finance where conventional branch networks have limited reach (Willige, 2023). However, rapid digitalisation does not by itself guarantee equal access for persons with disabilities.

In Tanzania, banks such as CRDB Bank, NMB Bank and Equity Bank have introduced mobile banking, internet banking and USSD-based services (Tanzania Digest, 2023). The expansion of digital channels has supported broader financial access (Bank of Tanzania, 2025a), while banks continue to invest in digital infrastructure and transformation (Ally, 2024). Tanzania's payment system has also evolved through mobile wallets, contactless payments and mobile applications (Bank of Tanzania, 2022). The Alliance for Financial Inclusion (AFI, 2019) identifies access, usage and quality as core dimensions for monitoring digital financial inclusion. Because the quality dimension is difficult to measure consistently, the present study focuses on access to and usage of digital banking services among PWVIs (National Council for Financial Inclusion, 2023).

The National Financial Inclusion Framework 2023-2028 directs financial-service providers to improve access to appropriate products for excluded and underserved groups (Bank of Tanzania, 2023a). The annual financial-inclusion reporting framework combines supply-side regulatory data with demand-side evidence from users (Bank of Tanzania, 2023b). On the supply side, the Bank of Tanzania has continued to develop national digital infrastructure, including the Tanzania Instant Payments System, to improve the accessibility, usability and affordability of digital financial services (Bank of Tanzania, 2025b). The Financial Services Registry has also recorded growth in financial access points and use of digital channels. These developments make it important to assess whether available products are adequate and usable for specific target groups, including PWVIs (National Council for Financial Inclusion, 2023).

FinScope Tanzania (2023) reports continued improvement in national financial inclusion, reflected in an increase in the Tanzania Financial Inclusion Index from .68 in 2022 to .72 in 2023. Monitoring this progress requires both supply-side evidence and feedback from users on the adequacy, accessibility and usability of available services (National Council for Financial Inclusion, 2023). This study therefore examines the demand side of inclusion by focusing on PWVIs' access to and use of digital banking. Despite progress in digital transformation, accessibility remains a major challenge for PWVIs (Hassan et al., 2020), who often have less equal access to technology-mediated financial transactions than sighted users (Fayyad & Al-

Sinnawi, 2024). These barriers are inconsistent with the broader disability-inclusion commitments reflected in the United Nations development agenda (United Nations, 2024).

Tanzania's growing digital infrastructure has increased the importance of ensuring that digital financial services are inclusive (Bank of Tanzania, 2023b). Although use of digital banking has expanded, exclusion remains substantial for some groups (FinScope Tanzania, 2023). Existing Tanzanian research has largely examined digital financial services and financial inclusion in general, while the experiences of PWVIs have received limited empirical attention. The main objective of this study was therefore to examine the inclusion of PWVIs in digital banking services in Tanzania. Specifically, the study assessed the extent to which access to (1) mobile banking, (2) internet banking and (3) ATM services influences the financial inclusion of PWVIs.

Theoretical Literature Review

The study is anchored in the Vulnerable Group Theory of Financial Inclusion developed by Ozili (2020). The theory argues that people who are socially or economically vulnerable face a heightened risk of exclusion from formal financial services and therefore require targeted inclusion strategies. In the context of digital banking, the theory implies that financial institutions should adapt technologies, policies and service processes so that vulnerable users can access and use formal financial services independently. Digitalisation can reduce physical and geographic barriers, but only when systems are designed around the needs and capabilities of excluded groups.

Ozili (2024) further explains that a vulnerability-focused approach can identify groups that are financially excluded because of income, gender, age, disability or other characteristics. However, the approach may overlook non-vulnerable people who also lack access to formal finance if policies are targeted too narrowly. Profit-oriented banking models may also discourage institutions from investing in customers who require additional support, including PWVIs (Fayyad & Al-Sinnawi, 2024). The theory is relevant to this study because the dependent variable captures the financial inclusion of PWVIs, while mobile banking, internet banking and ATM services represent the digital channels through which accessibility and usage are assessed. It therefore provides a basis for identifying barriers, evaluating inclusive products and considering policy and regulatory responses.

Empirical Literature Review

Mobile Banking Access for People with Visual Impairments (PWVIs)

Accessible mobile banking requires platforms that are perceivable, operable and understandable for users with different capabilities. Features such as screen-reader compatibility, voice commands, high-contrast displays, adjustable text and simplified navigation can improve independent use by PWVIs (Naeem et al., 2022; Sayal et al., 2020). Assistive technologies, including text-to-speech and voice recognition, can further support digital-banking access (Naik, 2024). Financial institutions should therefore engage vulnerable users in service design, customise interfaces and strengthen service standards. Without such adaptations, accessibility remains a major barrier to inclusive banking for visually impaired customers (Thakkar & Saha, 2024).

Customers commonly use mobile banking for transfers, payments and other routine transactions (Soyupak & Ipek, 2026). However, interface complexity, data overload and the risk of user error can reduce usability. Continued use depends on perceived usefulness, compatibility, security and the availability of knowledge and resources (Foroughi et al., 2019; Giovanis et al., 2019). Digital literacy, resistance to change, perceived risk and ease of use also shape adoption (Elhajjar & Ouaida, 2020). For PWVIs, limited information, inaccessible interfaces and the cost of suitable devices can restrict use (Hafiar et al., 2019; Mhizha, 2019). Nevertheless, mobile banking can

create an important pathway to formal finance where physical banking infrastructure is limited (Sukumaran, 2025). Based on this evidence, the study hypothesised that:

H1: Mobile banking access has a positive effect on the financial inclusion of PWVIs.

Internet Banking Access for PWVIs

Internet banking should provide equitable access for users with visual, hearing, mobility and cognitive disabilities (Lim, 2024; Puli et al., 2024). For PWVIs, accessible websites and account-management functions are important for financial independence. However, internet-banking platforms may remain inaccessible when interface standards are weak or bank employees lack the knowledge needed to support visually impaired customers (Hassan et al., 2021b). Financial technology has expanded the range of online financial services (Mbwambo et al., 2024), but adoption still depends on accessible design, security, perceived usefulness and trust (Kaur & Arora, 2020; Lin et al., 2020). Banks must therefore improve website accessibility and train customer-service personnel to support PWVIs. It was hypothesised that:

H2: Internet banking access has a positive effect on the financial inclusion of PWVIs.

ATM Access for PWVIs

ATM accessibility is shaped by both physical hardware and the user interface. Many machines provide limited adaptability for users with disabilities, even though inclusive ATMs can expand independent access across population groups (Willi et al., 2021). PWVIs may struggle to read screen information, enter personal identification numbers, follow visual instructions or use touchscreens without tactile keys (Hassan et al., 2021a; Subekti et al., 2021). Accessible security and authentication features can include audio guidance, tactile controls and biometric verification (Lavanya et al., 2022). Secure interactive ATMs should also incorporate text-to-speech and private audio functions so that PWVIs can complete transactions independently (Thakur et al., 2022).

ATM users may experience dissatisfaction because of design flaws, difficult navigation and frequent interface errors (Valenzuela et al., 2022). PWVIs additionally report challenges in locating machines, queuing, inserting cards, withdrawing cash, collecting receipts and recovering from transaction errors (Subekti et al., 2021). Audio prompts, text-to-speech, tactile keypads and mobile-phone integration can improve accessibility (Hassan et al., 2021a). Based on the literature, the study hypothesised that:

H3: Access to ATM services has a positive effect on the financial inclusion of PWVIs.

Conceptual Framework

Figure 1 presents the conceptual framework for the study. Mobile banking access, internet banking access and ATM services access are the independent variables, while the financial inclusion of PWVIs is the dependent variable. Financial inclusion is assessed through access to and usage of digital financial services, consistent with established access-and-usage measures (AFI, 2019; Demirgüç-Kunt & Klapper, 2012). The arrows represent the hypothesised positive influence of each digital-banking channel on financial inclusion.

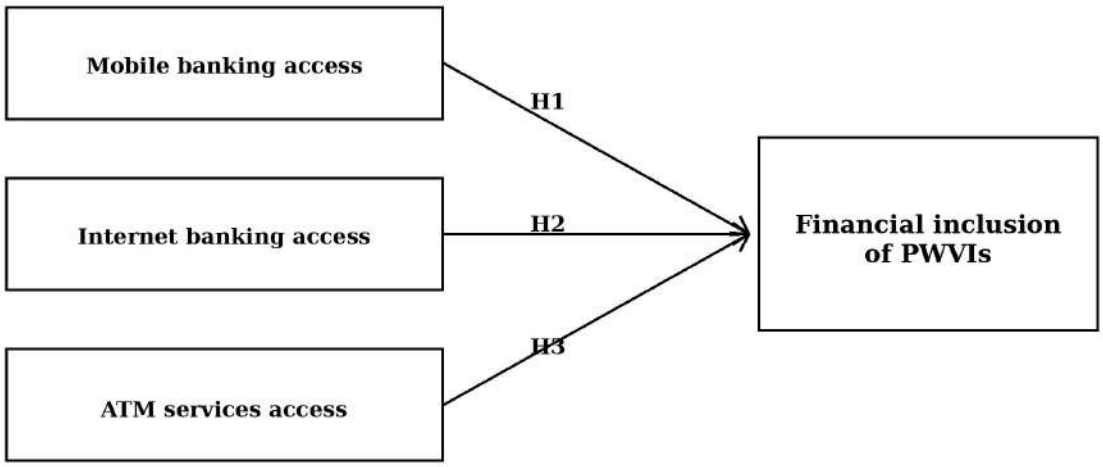


Figure 1: Conceptual framework for the study

Source: Authors' conceptualisation based on Ozili (2020, 2024).

Methods and Approaches

The study adopted a positivist philosophy and an explanatory cross-sectional design. It was conducted in Dar es Salaam among PWVIs registered with the Tanzania League of the Blind who held bank accounts. From a population of 200 account holders, a target sample of 133 was estimated using Yamane's (1967) formula at a 5% margin of error. Simple random sampling was used, and 108 completed questionnaires were analysed. Data were collected using a structured questionnaire, and all constructs were measured on five-point Likert scales. Mobile banking, internet banking and ATM services were the independent variables, while financial inclusion was measured through access and usage dimensions (AFI, 2019; Bank of Tanzania, 2023a). Descriptive statistics, Pearson's correlation and multiple regression were conducted using IBM SPSS Statistics, Version 29 (IBM Corp., 2022), with statistical significance assessed at $p < .05$. Cronbach's alpha was .776 for mobile banking, .602 for internet banking, .614 for ATM services and .557 for financial inclusion. The latter three coefficients indicate marginal or low internal consistency; consequently, the related findings should be interpreted with caution and the measurement scales should be refined in future research.

Findings

Profile of Respondents

The study surveyed 108 individuals with visual disabilities in Tanzania to assess their demographic attributes, banking engagement, and preferred access methods. The majority (88.9%) of the respondents were totally blind, with the remaining 11.1% classified as visually impaired (Table 1). In terms of gender, male respondents constituted two-thirds of the sample (67.6%), revealing a gender disparity that may mirror wider societal barriers for women with disabilities. The largest age group was 26–40 years (46.3%), indicating that the sample largely represented economically active adults. Education levels were relatively high with 63.9% of respondents having at least a diploma. NMB Bank was the most commonly used bank (60.2%) by the respondents. In terms of banking experience, half of the respondents (50%) had engaged with banking services for 1–5 years, with a significant 20.4% having over 16 years of experience—demonstrating a mix of new and seasoned users. Access methods varied with ATMs being the most used (74.1%).

Table 1: Respondent Characteristics, Banking Profile, and Access Methods

Variable	Category	Frequency (n=108)	Percentage (%)
Degree of Visual Disability	Totally Blind	96	88.9%
	Visually Impaired	12	11.1%
Gender	Male	73	67.6%
	Female	35	32.4%
Age Group	18–25 years	24	22.2%
	26–40 years	50	46.3%
	41–55 years	25	23.1%
	Above 56 years	9	8.3%
Education Level	Primary	13	12.0%
	Secondary	26	24.1%
	Diploma	42	38.9%
	Bachelor's Degree	27	25.0%
Bank Used	NMB	65	60.2%
	CRDB	15	13.9%
	NBC	6	5.6%
	KCB	11	10.2%
	DCB	11	10.2%
Duration of Banking Experience	1–5 years	54	50.0%
	6–10 years	25	23.1%
	11–15 years	7	6.5%
	16 years and above	22	20.4%
Access Method to Bank Account	ATM	80	74.1%
	Mobile Banking	50	46.3%
	Online Banking	17	15.7%
	Other (Branch, USSD)	17	15.7%

Descriptive Statistics

Respondents rated mobile banking positively overall. The highest rating was for trust in security (mean = 3.83), suggesting that PWVIs feel confident about the safety of their personal data on mobile platforms (Table 2). Respondents also agreed that mobile banking is convenient (3.50), user-friendly (3.43), and that they can use it independently (3.56). However, the affordability of assistive mobile devices scored low (mean = 2.19), highlighting a major economic barrier to access. Internet banking received mixed to low ratings. While "online banking saves time" had a moderate mean score (3.02), other items, such as independent use (1.89) and comfort in using the service (2.22), scored poorly. The perception of accessibility features on banking websites was also relatively low (2.57). These results indicate that internet-banking platforms are largely inaccessible or underutilized by visually impaired users. Responses regarding ATM services revealed critical accessibility challenges. The ability to use ATMs independently (1.57) and the presence of accessible features (1.82) were rated very low. Nonetheless, respondents found ATM usage time-saving (4.22) and expressed moderate comfort and confidence in using them with support (3.05 and 3.28, respectively). This suggests that while ATMs are widely used, they are not designed with accessibility in mind to accommodate the need for PWVIs.

Participants rated the ease of navigating mobile apps relatively high (3.52), confirming earlier findings about mobile platforms being more inclusive. However, banks were rated poorly in

providing information about ATMs (1.77) and supporting ATM usage (1.31). Likewise, usage of online banking for completing transactions was very limited (1.68), reinforcing the idea that these platforms do not meet the accessibility needs of PWVIs. The descriptive statistics highlight that mobile banking is the most positively perceived platform among PWVIs, with strong ratings in trust, convenience, and usability—though device affordability remains a challenge. Internet banking and ATMs, on the other hand, are generally viewed as inaccessible and difficult to use independently. These findings underscore the urgent need for banks to improve accessibility features, reduce technology costs, and provide targeted user support to enhance digital financial inclusion for PWVIs in Tanzania.

Table 2: Descriptive Statistics for Digital Banking Services and Inclusion

Category	Item	Mean	Std. Deviation
Mobile Banking	Assistive mobile devices are affordable	2.19	1.239
	I am able to use mobile banking independently	3.56	1.327
	Mobile banking is convenient	3.50	1.115
	Mobile banking app is user-friendly	3.43	1.170
	I trust the security of my personal information	3.83	1.156
Online/Internet Banking	Banking websites contain accessible features	2.57	0.811
	I am able to use internet banking independently	1.89	1.035
	I feel comfortable using internet banking devices	2.22	1.035
	Online banking saves me time	3.02	0.529
	I am confident my transactions are secure	2.87	0.844
ATM Services	ATMs contain accessible features	1.82	1.345
	I am able to use ATMs independently	1.57	1.025
	I feel comfortable using ATMs	3.05	1.417
	ATMs save me time	4.22	0.980
	I am confident my transactions are secure	3.28	1.452
Accessibility	I find it easy to navigate my bank's mobile app	3.52	1.188
	The bank’s website has assistive tools	2.71	0.684
	My bank provides information to locate ATMs	1.77	1.090
Usage	I regularly use mobile banking	3.00	1.440
	I complete online transactions via website	1.68	0.915
	My bank provides info to help use ATMs	1.31	0.755

Inferential Statistics

Correlation Analysis

Pearson's correlation analysis examined the relationships between mobile banking, internet banking, ATM services and the financial inclusion of PWVIs. As shown in Table 3, mobile banking had a positive and statistically significant relationship with financial inclusion ($r = .307$, $p = .001$). Internet banking also had a positive and statistically significant relationship with inclusion ($r = .252$, $p = .009$). ATM services had a weak negative relationship with financial inclusion, but the relationship was not statistically significant ($r = -.139$, $p = .152$). Correlations among the three digital-banking channels were weak and non-significant, indicating that the channels were relatively distinct in their association with inclusion outcomes.

Table 3: Pearson Correlation Matrix

		Mobile Banking	Internet Banking	ATMs Banking	Inclusion of PWVIs
Mobile Banking	Pearson Correlation	1	0.144	0.083	.307**
	Sig. (2-tailed)		0.136	0.394	0.001
	N	108	108	108	108
Internet Banking	Pearson Correlation	0.144	1	0.037	.252**
	Sig. (2-tailed)	0.136		.700	0.009
	N	108	108	108	108
ATMs Banking	Pearson Correlation	0.083	0.037	1	-0.139
	Sig. (2-tailed)	0.394	.700		0.152
	N	108	108	108	108
Inclusion of PWVIs	Pearson Correlation	.307**	.252**	-0.139	1
	Sig. (2-tailed)	0.001	0.009	0.152	
	N	108	108	108	108
Note: ** p < .01 (two-tailed).					

Regression Results

The multiple-regression model produced R = .409 and R^2 = .168, indicating that mobile banking, internet banking and ATM services jointly explained 16.8% of the variance in financial inclusion (Table 4). The adjusted R^2 was .144 and the standard error of the estimate was 3.830. The ANOVA results in Table 5 show that the model was statistically significant, $F(3, 104) = 6.978$, $p < .001$. The three digital-banking channels therefore predicted financial inclusion significantly better than an intercept-only model.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.409	**0.168**	**0.144**	**3.82986**
Note: Predictors were ATM services, internet banking and mobile banking.				

Table 5: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	307.064	3	102.355	6.978	< .001
	Residual	1525.455	104	14.668		
	Total	1832.519	107			
Note: Dependent variable: Financial inclusion of PWVIs.						
Predictors: ATM services, internet banking and mobile banking.						

Tables 6 and 7 present the regression coefficients and hypothesis-testing decisions. The intercept was B = 8.391 (p = .001). Mobile banking was a positive and statistically significant predictor of financial inclusion (B = .315, β = .290, t = 3.203, p = .002), supporting H1. Internet banking also had a positive and statistically significant effect (B = .350, β = .216, t = 2.393, p = .019),

supporting H2. ATM services had a negative but statistically non-significant coefficient (B = -.177, β = -.171, t = -1.904, p = .060); consequently, H3 was not supported. The results suggest that mobile and internet banking contribute positively to inclusion, whereas the current configuration of ATM services does not provide a reliable positive contribution for PWVIs.

Table 6: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.391	2.501		3.354	.001
	Mobile Banking	.315	0.098	.290	3.203	.002
	Internet Banking	.350	0.146	.216	2.393	.019
	ATMs Banking	-.177	0.093	-.171	-1.904	.060
Note: Dependent variable: Financial inclusion of PWVIs.						

Table 7: Hypothesis Testing Results

Hypothesis	β	p value	Decision
H1: Mobile banking access positively influences financial inclusion of PWVIs.	.290	.002	Supported
H2: Internet banking access positively influences financial inclusion of PWVIs.	.216	.019	Supported
H3: ATM services access positively influences financial inclusion of PWVIs.	-.171	.060	Not supported

Discussion of Findings

The findings demonstrate the important but uneven role of digital banking in the financial inclusion of PWVIs in Tanzania. Mobile banking was the most inclusive channel and showed both a positive correlation and a significant positive regression coefficient. Respondents reported comparatively favourable perceptions of convenience, security and independent use, which is consistent with research emphasising screen-reader compatibility, text-to-speech and simplified interfaces (Naeem et al., 2022; Sayal et al., 2020). The findings also align with evidence that mobile banking can expand financial access where conventional infrastructure is limited (Sukumaran, 2025; Soyupak & Ipek, 2026).

The affordability of assistive mobile devices nevertheless received a low rating. This finding indicates that technical accessibility does not guarantee effective inclusion when users cannot afford suitable devices. Similar barriers involving cost, information and digital literacy have been reported by Hafiar et al. (2019), Elhajjar and Ouaida (2020), and Mhizha (2019). The present findings differ from Mhizha's (2019) Zimbabwean study, which found more extensive exclusion from mobile banking, but both studies highlight affordability and capability constraints.

Internet banking had lower levels of usage and accessibility than mobile banking. Most respondents (92.6%) reported that they had never used internet banking, and only 4.6% used it independently. These findings are consistent with evidence that banking websites often lack accessible interfaces and that staff may be unable to support visually impaired users (Hassan et al., 2021b; Puli et al., 2024). They also support Kessy's (2021) conclusion that exposure to technology influences internet-banking adoption. Although usage was low, internet banking had a significant positive regression coefficient, indicating that accessible web platforms can enhance financial

autonomy. Banks should therefore improve website design and strengthen staff capacity to support PWVIs.

ATM services were widely used but remained difficult to access independently. Many respondents relied on assistance, compromising privacy and autonomy. This finding is consistent with studies documenting barriers such as the absence of audio guidance, limited tactile controls, difficult screen navigation and challenges in locating or operating machines (Hassan et al., 2021a; Subekti et al., 2021; Valenzuela et al., 2022). The regression coefficient for ATM services was negative but not statistically significant. Although this result does not establish that ATMs reduce inclusion, it shows that current ATM arrangements do not provide a reliable positive contribution. Voice-enabled functions, Braille or tactile keypads, private audio jacks and accessible authentication tools could improve usability (Madake et al., 2024; Thakkar & Saha, 2024). The result differs from Melubo and Musau (2020), who reported a significant contribution of ATM services to financial inclusion among women-owned enterprises in Kenya.

Inclusion Through Access and Usage

The findings support AFI's (2019) view that financial inclusion should be assessed through meaningful access and usage rather than the mere availability of services. Melubo and Musau (2020) similarly found that digital-banking channels can enhance financial inclusion when users have the knowledge and ability to use them. In the present study, mobile and internet banking had significant positive effects, whereas ATM services did not. This contrast shows that a platform can be available without being independently usable. Developers and financial institutions should therefore involve PWVIs in product design and improve navigation, screen-reading and identification features (Moon et al., 2022). The broader evidence reviewed by Puli et al. (2024) likewise indicates that disability-inclusive finance requires services that are accessible in practice, not only in principle.

Theoretical Alignment

The results are consistent with the Vulnerable Group Theory of Financial Inclusion (Ozili, 2020, 2024). Mobile and internet banking enhanced inclusion when they were accessible and usable, while the negative, non-significant ATM coefficient indicated that conventional infrastructure did not adequately accommodate PWVIs. The findings therefore reinforce the theory's argument that vulnerable groups require adaptive infrastructure, inclusive product design and targeted policy measures. They also show that digitalisation alone is insufficient: the benefits depend on affordability, accessibility and users' ability to engage independently with each platform.

Conclusion

The findings of this study confirm that digital banking services play a critical role in advancing financial inclusion for PWVIs in Tanzania, although unevenly across platforms. Among the three digital banking channels examined, mobile banking emerged as the most accessible and widely used, demonstrating its significant potential to bridge the financial inclusion gap for PWVIs. Its convenience, security, and proven compatibility with assistive technologies, as supported by strong positive correlations and significant regression coefficients, make it a particularly effective tool for promoting independent financial management. Although internet banking was less commonly used due to its own web accessibility challenges, it still showed a statistically significant positive impact on inclusion when accessible. This suggests that with improved design and robust support mechanisms, online banking platforms could serve as an important secondary channel for enhancing digital financial inclusion.

In contrast, ATM services are observed to be a barrier rather than an enabler of inclusion for PWVIs. The majority of users required assistance to operate ATMs, citing poor accessibility and lack of supportive infrastructure as key limitations. While a negative trend was observed between ATM usage and financial inclusion, it was not found to be statistically significant in the regression model. This highlights that, in their current design, ATM systems do not effectively support the inclusion of PWVIs and often compromise their privacy and autonomy. This underscores the urgent need for their redesign with comprehensive accessibility in mind. The study concludes that digital banking services, particularly mobile and internet platforms, can substantially enhance financial inclusion for PWVIs, provided that critical issues such as accessibility, affordability of assistive devices, and user training are diligently addressed. The results strongly support the theoretical premise that inclusive financial systems must deliberately accommodate the unique needs of vulnerable groups through thoughtful design and targeted policy interventions. Ensuring that digital financial services are truly usable by all will not only advance inclusion for PWVIs but also contribute significantly to broader national goals of financial equity and empowerment.

Recommendations

Financial institutions should develop and maintain mobile and internet-banking interfaces that comply with universal-design and web-accessibility standards. Platforms should support screen readers, voice commands, adjustable text and high-contrast modes. The Ministry of Finance and financial institutions should also explore tax and financing measures that make smartphones and other assistive devices more affordable for PWVIs. Banks should retrofit and procure accessible ATMs with voice-guided prompts, tactile or Braille keypads and private headphone connections, and should place machines in locations that are physically accessible and easy to navigate.

Targeted financial-education programmes should strengthen PWVIs' confidence and skills in using digital banking, protecting personal information and reporting service problems. Training can be delivered through accessible audio materials, community organisations and mobile applications. Commercial banks should involve PWVIs and disability-rights organisations in the co-creation, testing and evaluation of digital financial services. With appropriate safeguards and consent, financial institutions may also collect disability-related service requirements during account opening so that reasonable support and accessible communication can be provided.

The Bank of Tanzania and other relevant regulators should establish and enforce minimum accessibility standards for mobile applications, websites and ATM systems. Compliance should be incorporated into supervision, certification or licensing processes. A national coordination mechanism involving government agencies, financial institutions, disability organisations and technology developers could guide implementation and monitor progress. Financial-inclusion data should also be disaggregated by disability so that service gaps can be identified and interventions evaluated.

Limitations and Future Research

The study's cross-sectional design does not establish causality, and the sample was limited to 108 bank-account holders registered with the Tanzania League of the Blind in Dar es Salaam. The findings may therefore not represent all PWVIs in Tanzania, particularly those outside formal disability organisations or without bank accounts. The low internal consistency of the financial-inclusion scale ($\alpha = .557$) and the marginal reliability of the internet-banking and ATM measures also require cautious interpretation. Future research should refine and validate the measurement scales, use larger and more geographically diverse samples, combine surveys with interviews or usability observations, and compare accessibility across banks and digital platforms.

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