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RECALIBRATING FINANCIAL INCLUSION THROUGH FINTECH: THE ROLE OF DIGITAL LITERACY AS A MODERATOR

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ABSTRACT
This research aims to examine the role of digital literacy as a moderator in the relationship between financial technology (biometric identification and mobile money) and digital financial inclusion among people with disabilities in East Java. This research uses a cross-sectional design with an analytical and descriptive approach. Data was collected through semi-structured questionnaires from 360 SMEs owned by people with disabilities in East Java. Data analysis was carried out using Pearson correlation and SEM. The research results show that digital literacy has a significant and positive moderating effect on the relationship between financial technology and digital financial inclusion. Biometric identification and mobile money significantly promote digital financial inclusion. These findings emphasize the importance of digital literacy in increasing the adoption of digital financial services, which can expand financial inclusion for vulnerable groups. The implications of this research indicate the need for the East Java government to strengthen digital literacy programs and improve digital infrastructure to support people with disabilities. Financial service providers are advised to expand outreach to the disabled population. Limitations of this study include data only being collected from one area and its cross-sectional design. Further research is recommended to expand regional coverage and use a longitudinal design.

Keywords: Financial Inclusion; Fintech; Digital Literacy; Biometric; Mobile Money

INTRODUCTION

The rapid development of digital technology has changed the landscape of the financial industry significantly. The rise of fintech has become a major catalyst in promoting financial inclusion by offering innovative solutions that are more affordable, accessible and efficient to communities previously marginalized from the traditional financial system. In Indonesia, the government has prioritized the financial inclusion agenda as an effort to encourage inclusive economic growth and reduce social inequality. However, one group of people who often face obstacles in accessing financial services are people with disabilities. This problem becomes more complex when compared to the challenges faced by Small and Medium Enterprises (SMEs) run by people with disabilities. These SMEs often face obstacles in accessing the capital and financial services needed to develop their businesses.

Barriers in the traditional banking system, such as stringent requirements, high fees, and limited geographic reach, have led to many individuals and SMEs being marginalized from accessing and using financial services. Fintech exists as a potential solution to increase access to financial services by offering digital platforms that are more affordable, efficient and easy to access. However, the main challenge in achieving broad financial inclusion through fintech is the low level of digital literacy among society. Digital literacy refers to the ability to access, understand, evaluate and utilize digital information and technology effectively and critically. Low levels of digital literacy can be an obstacle to the adoption and use of digital financial services, thereby hindering financial inclusion efforts.

Fintech offers great potential in overcoming these barriers by providing digital platforms that are more affordable, efficient and easily accessible. With fintech, individuals and SMEs can access financial services more flexibly, without even having to visit a physical bank. However, to exploit the full potential of fintech, digital literacy is an important key. Digital literacy enables individuals to understand and use financial technology well and effectively. Unfortunately, the low level of digital literacy among society, especially in developing

countries like Indonesia, is a major obstacle in realizing financial inclusion through fintech. Apart from that, one of the main obstacles that has not been fully overcome is the use of biometric technology in banking which has not been fully implemented for people with disabilities. Biometric technology, which can provide more inclusive and secure identification solutions, is still not fully adopted in banking services for this group, adding to the complexity of the challenges faced in achieving truly inclusive financial inclusion.

Therefore, the solution needed to increase financial inclusion through fintech is to prioritize increasing digital literacy among society, especially for vulnerable groups such as SMEs with disabilities. In this context, it should also be noted that increasing digital literacy is not only needed by SMEs with disabilities, but also by the general public so that financial inclusion can be achieved as a whole. Thus, this research aims to recalibrate the scope of digital literacy in the context of digital financial inclusion in Indonesia, with a special focus on SMEs run by people with disabilities. By analyzing the role of digital literacy as a moderator in the relationship between financial technology and financial inclusion, this research seeks to provide new insights into how digital literacy can facilitate or hinder the adoption and use of digital financial services among SMEs with disabilities in Indonesia.

So the latest research is that research on financial inclusion through fintech with a focus on digital literacy among SMEs with disabilities in Indonesia is still relatively rare. Although financial inclusion and digital literacy have become topics that receive increasing attention, there is an unmet need to bridge the understanding between digital literacy, financial technology, and financial inclusion in this specific context. Previous research may have discussed financial inclusion or digital literacy separately, but this research aims to combine the two concepts and explore how digital literacy can be a determining factor in facilitating financial inclusion through fintech, especially for SMEs run by people with disabilities. Thus, this research brings new contributions to our understanding of how digital literacy influences access and use of financial services among SMEs with disabilities, as well as how fintech can be a means of increasing financial inclusion for this vulnerable group. Through a holistic approach and focus on vulnerable groups, it is hoped that this research will provide new insights that can be used to design more effective policies and programs in promoting financial inclusion in Indonesia. Thus, it is hoped that this research will not only provide a deeper understanding of digital literacy and financial inclusion, but also provide a strong empirical basis for developing more effective strategies and interventions in increasing access and participation in the financial system in Indonesia, especially for SMEs. run by people with disabilities.

LITERATURE REVIEW & HYPOTHESIS

Financial technology and digital financial inclusion

According to the World Bank(2020)and OECD(2018), access to financial services is considered key to sustainable poverty alleviation and inclusive development in developing countries. Financial services for people with disabilities can help increase income and living standards(Wann & Burke-Smalley, 2023). However, expanding access remains a challenge, especially in Sub-Saharan Africa. Demirguç-Kunt et al.,(2018)estimates that 1.7 billion adults worldwide do not yet have a basic account due to high costs, information asymmetry, and lack of documentation. This shows that the lack of services for people with disabilities continues to increase because they do not have access to safe financial services for saving, borrowing, investing, etc., which has a negative impact on their livelihoods.(Mogaji et al., 2021). GSMA(2020)shows that FinTech can offer better solutions to transform financial services for poor, underserved communities in developing countries like Indonesia. Wang and He(2020)believes FinTech such as biometrics and mobile money can help people with disabilities access digital financial services at more affordable costs. Ozili(2018)noted FinTech can provide affordable, responsive and safe banking services for people with disabilities without bank accounts, such as mobile money for payments and transfers. Digital technology can overcome barriers to financial inclusion such as affordability for people with disabilities(Akpuokwe et al., 2024; Santoso, 2023). Therefore, we derive the hypothesis that:

H1. Financial technology significantly and positively promotes digital financial inclusion among people with disabilities

Biometric identification and digital financial inclusion

The identification system plays an important role in individual financial inclusion for access to formal services including finance(Organization for Economic Co-operation and Development [OECD], 2018). Identity verification helps financial service providers comply with anti-money laundering regulations(Thommandru & Chakka, 2023). However, more than 1 billion people do not have official identification (World Bank, 2022). People with disabilities in developing countries have difficulty meeting identification requirements to open a bank account(Banks et al., 2021; Karki et al., 2023). World Bank(2020)suggests the use of biometric FinTech to improve financial access for people with disabilities by reducing identification requirements. Biometrics enable people with disabilities without formal identification to access financial services(Furnell et al., 2022). Addo and Senyo(2021)believes digital identification (ID) technology plays an important role in ensuring financial access to empower people with disabilities out of poverty. The biometric ID system performs fast registration(SS Ali et al., 2020; Cherrat et al., 2020), preventing duplication(Drozdowski et al., 2021), and verify identity without documents(Jain et al., 2021), addressing the challenge of lack of identification for safe financial access for people with disabilities without bank accounts while complying with anti-money laundering regulations (Marron, 2013). So, we put forward the hypothesis that:

H1a. Biometric identification significantly and positively promotes digital finance inclusion among people with disabilities

Mobile money and digital financial inclusion

According to Kara et al.,(2021), the majority of people with disabilities in developing countries do not have access to financial services due to cost and geographic barriers. Candiya Bongo et al. (2022) show that mobile money can overcome distance and cost barriers, increasing the financial inclusion of poor communities in rural developing countries such as Indonesia. Aboagye et al.,(2020)observing mobile money can increase access to financial services for people with disabilities at lower costs. Ahmad et al.,(2020)agree that mobile money is beneficial for financial inclusion by providing access to additional services such as savings, credit, insurance. Ali et al.,(2021)observing mobile money provides a cheap and safe money transfer tool for users. Wachira(2023)asserts mobile money enables payments, cheap money transfers, and secure electronic storage of value, reducing the risk of loss and financial crime. Kamande et al.(2021)proving that mobile money provides transaction records used by people with disabilities to apply for loans due to limited collateral and information asymmetry problems. Wang and He(2020)argue that because it is suitable for people with disabilities with small cash flows, mobile money accommodates small transactions at affordable costs. With high mobile network coverage in developing countries, mobile money offers a digital channel to extend affordable and secure financial services to the world's 1.7 billion unbanked adults(World Bank, 2020). Therefore, we state the hypothesis that:

H1b. Mobile money significantly and positively promotes digital financial inclusion among people with disabilities

Digital literacy and digital financial inclusion

Financial inclusion is defined as everyone's access to quality financial services at affordable prices and with dignity(Soetan & Umukoro, 2023). Anakpo et al.,(2023)refers to digital financial inclusion as access and use of formal financial services digitally by marginalized groups. Digital financial services must be tailored to customer needs at affordable costs. The success of M-PESA in Kenya in 2007 popularized digital financial inclusion(Wachira, 2023). However, Sanni et al.,(2023)observing the risk of crime in the mobile money ecosystem. OECD(2020)suggests digital literacy can help people with disabilities make the right decisions and minimize risks in consuming digital financial products(Yang et al., 2023). Digital literacy reduces the digital divide between educated and illiterate consumers(OECD, 2020), increasing access and use of digital financial services for people with disabilities without bank accounts. Literacy also provides understanding for people with disabilities before consuming digital financial products(Santoso, 2023). As a result, we refute the hypothesis that:

H2. Digital literacy significantly and positively encourages digital financial inclusion for people with disabilities

Digital literacy: a moderator between financial technology and digital financial inclusion

According to GSMA(2020), the development of digital technology has increased access to financial services for people who do not have banking services. Scholars like Alameda(2020), Milan (2019), Dolson and Jagtiani(2024)argues FinTech can provide previously unavailable access to financial services for marginalized communities at lower costs. However, the use of FinTech requires digital literacy competencies(OECD, 2020). Digital literacy helps people with disabilities compare financial products according to their needs(OECD, 2020), increasing consumption of digital financial products(Prete, 2022). Digital literacy enables people with disabilities to use technology, communicate and make digital transactions(Abdulquadri et al., 2021). Digital literacy helps FinTech digital credit analysis, avoiding over-lending(Saini, 2019). Digital literacy increases understanding of risks such as fraud and cyber security as well as data privacy rights in using digital financial services(Banco de Portugal, 2018). Kass-Hanna et al., study(2022)shows that increased financial and digital literacy is associated with increased savings, loans and risk management of people who use non-bank financial institutions or mobile money services. Therefore, we state the hypothesis that:

H3. Digital literacy significantly and positively moderates the relationship between financial technology and digital financial inclusion among people with disabilities

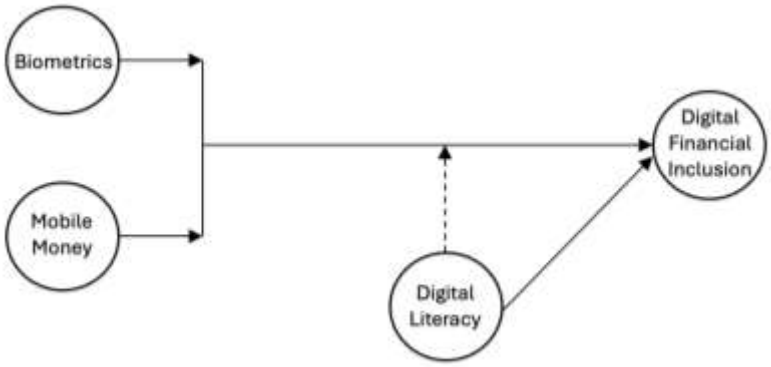

Figure 1. Conceptual Framework
Source: Processed Data (2024)

METHODS

Research design

This study adopted a cross-sectional research design combined with analytical and descriptive approaches to collect data and produce results. This particular design was used specifically because of its advantage in obtaining large amounts of data from samples located in a dispersed area. Additionally, this design does not suffer from sample unavailability in follow-up studies that is common in longitudinal designs. In addition, there are no repeated errors in the research instrument because it can obtain responses from selected respondents at a certain time. In addition, this design is also most suitable for research that uses heterogeneous measurement scales which is useful for eliminating consistency bias and increasing validity (Wulff et al., 2023).

Population and sample size

The population for this study was selected from 20,654,659 businesses located in four regions (cities & districts) in East Java using the MSME Census database in East Java by the Central Statistics Agency(Disco & BPS, 2022). The report shows that around 360 of these businesses are MSMEs owned by people with disabilities(Purmadani, 2023).

Therefore, the sample used was saturated until 360 MSMEs owned by people with disabilities were used in this research.

Data collection instruments and processes

This study used a semi-structured questionnaire with a 5-point Likert scale to collect data from selected respondents, due to its simplicity and flexibility(Webb et al., 2024).

Measurement of research variables

Variable measurements were adopted from previous research which was proven to be reliable and valid. Financial technology was measured using 25 items, including biometric identification (11 items) and mobile money (14 items), while digital literacy and digital financial inclusion were measured using 19 and 16 items, respectively. Reliability and validity tests show the Cronbach's Alpha coefficient above 0.7 in Table 1(Sürücü & Maslakçi, 2020; Tentama & Anindita, 2020).

Parametric test

Parametric tests were carried out to check the normal distribution of data using histograms and scatterplots, as well as multicollinearity tests using VIF and tolerance factors, with significant and positive results. This research aims to examine the impact of digital literacy interactions on the relationship between financial technology and digital financial inclusion among people with disabilities using structural equation modeling (SEM). SEM was chosen because of its ability to combine manifest constructs and latent variables, as well as overcome measurement error(Hair et al., 2022).

Moderation effect

For the moderation test, a SEM model was built using confirmatory factor analysis (CFA) in AMOS to determine convergent and discriminant validity. Structural equation models combine independent variables, moderator, dependent, and moderating interaction terms with bootstrap bias-corrected confidence intervals via CB-SEM. Goodness-of-Fit (GoF) indices such as CMIN/DF, TLI, CFI, IFI, and RMSEA are used to evaluate the model. The moderated model should have better fit indices than the unmoderated model without moderator interaction effects(Hair et al., 2021). The CFA results and structural models will be explained further.

Table 1.Variable Definition

Dimensions	Likert Scale Measurement Items for Variables
Biometric identification (BM)	BM1: Using biometrics saves time BM2: Using biometrics makes banking easier BM3: Biometrics are easily accessible for transactions BM4: Biometrics meets my transaction needs BM5: Using biometrics is safer BM6: Biometrics are now available for use in transactions BM7: Using biometrics is cheaper BM8: Biometrics are more authentic BM9: Biometrics are more convenient BM10: More reliable biometrics BM11: Biometrics keeps transactions confidential
Mobile money (MM)	MM1: I always use mobile money in my business MM2: I save time when I use my cell phone to do my business MM3: Mobile money is available when I need it MM4: Mobile money speeds up my business transactions MM5: I keep most of my money on my phone MM6: I use mobile money to pay my suppliers MM7: Some customers pay me using mobile money MM8: I use mobile money more often than banks MM9: Mobile money meets my expectations MM10: Mobile money meets my financial needs MM11: Mobile money is safer than carrying cash

	MM12: Mobile money is cheap MM13: Mobile money is always reliable MM14: Mobile money is easy to access
Digital literacy (DL)	DL1: I have skills in operating mobile money DL2: I have knowledge about mobile money DL3: I can easily switch between mobile money menus DL4: I can easily operate mobile money transactions DL5: I am able to make transactions using mobile money DL6: I have the ability to use mobile money DL7: I can clearly interpret the mobile money menu DL8: I have knowledge about mobile money applications DL9: I can use my mobile phone effectively to make mobile money transactions DL10: I am familiar with mobile money transactions DL11: I am aware of all services transacted using mobile money DL12: I know about mobile money products DL13: I can easily make payments using mobile money DL14: I can easily borrow money using mobile money DL15: I can easily save money in my mobile money account DL16: Mobile money platforms have helped me save money regularly DL17: I reduced my spending because of mobile money DL18: I can easily interpret mobile money messages DL19: I am familiar with mobile money PIN
Digital financial inclusion (DFI)	DFI1: I can easily access financial services because there are many digital providers near my place of business DFI2: I can easily access financial services due to the wide range of digital providers DFI3: I can easily access financial services from digital providers due to their availability DFI4: I can easily access financial services because digital providers offer them regularly DFI5: Financial services offered by affordable service providers DFI6: Financial services offered by digital providers are readily available DFI7: Digital financial services provider offering a variety of products DFI8: The financial services offered by digital providers suit my needs DFI9: Financial services offered by secure digital providers DFI10: The financial services offered by digital providers meet my needs DFI11: Financial services offered by digital providers are reliable DFI12: The financial services offered by digital providers are very convenient DFI13: Financial services offered by relevant digital providers DFI14: Financial services offered by digital providers are useful DFI15: Terms and conditions of use of financial services offered by digital providers are favorable DFI16: Financial services offered by digital providers have improved my business

RESULTS

Respondent Results

The findings of this research show that data was collected from 360 respondents out of 360 samples selected for this research. This accounts for a response rate of 100%. This response rate is good enough to provide results that support the hypotheses set out in this study.

Sample Demographic Characteristics

This study captures demographic information on MSME actors in East Java as shown in Table 2.

Table 2. Sample Demographic Data

No		Characteristics	Frequency	Amount
1	Gender	Woman	230	64%
		Man	130	36%
2	Age	18-25 years old	54	15%
		26-33 years old	130	36%
		34-41 years old	104	29%
		42-49 years old	25	7%
		> 50 years	47	13%
3	Education	No school	11	3%
		elementary school	7	2%
		JUNIOR HIGH SCHOOL	72	20%
		SENIOR HIGH SCHOOL	173	48%
		Diploma	61	17%
		Bachelor	36	10%
4	Business license	Yes	169	47%
		No	191	53%
5	Business Category	Micro Scale	133	37%
		Small Scale	166	46%
		Medium Scale	61	17%
6	Length of Business	< 5 years	158	44%
		6-10 years	130	36%
		11-15 years	50	14%
		>15 years	22	6%
7	Business Skills Training	Yes	187	52%
		No	173	48%
8	Products Sold	Trading	209	58%
		Garments & Apparel	58	16%
		Agriculture	43	12%
		Other Products	50	14%
9	Challenges in business	Lack of Capital	140	39%
		Limited access	50	14%
		Lack of Financial Skills	36	10%
		Absence of Collateral	18	5%
		Low Sales	115	32%
10	Business Financial Recording	Yes	259	72%
		No	101	28%
11	Capital Sources	Banking	173	48%
		Government	86	24%
		Independent	101	28%

Source: Processed Data (2024)

Descriptive statistics

Descriptive statistics were generated for each variable in this study. The findings show the following mean scores and standard deviations for the various variables: Biometric

identification (Mean 3.49355; SD 1.13033); mobile money (Mean 4.2231; SD 0.94232); digital literacy (Mean 4.499; SD 0.84791); digital financial inclusion (Mean 3.7254; SD 1.34113).

Analysis Pearson Correlation

The main objective of this research is to examine the impact of digital literacy interactions in the relationship between biometric financial technology and mobile money as well as digital financial inclusion for people with disabilities in East Java. Pearson correlation analysis was carried out to determine the relationship between the variables studied. The results are shown in Table 3.

Table 3.Pearson Correlation Analysis

Variable	N	Mean	Std. Dev	Biometrics	Mobile Money	Digital Literacy	Digital Financial Inclusion
Biometrics	360	3.4935	1.13033	1			
Mobile Money	360	4.2231	0.94232	0.514**	1		
Digital Literacy	360	4,499	0.84791	0.425*	0.658**	1	
Digital Financial Inclusion	360	3.7254	1.34113	0.642**	0.423*	0.341*	1

Note:
**. Correlation significant at the 0.01 level (two-tailed)
*. Correlation significant at 0.05 level (two-tailed)
Legends: Digital financial inclusion – digital financial inclusion

Source: Processed Data (2024)

Pearson correlation analysis revealed that biometric identification and digital financial inclusion were significantly and positively related ($r = 0.642$; $p < 0.01$). This means that increasing the use of biometric identification has an impact on increasing digital financial inclusion among people with disabilities, but through a moderate relationship. In addition, Pearson correlation analysis also shows that there is a significant and positive relationship between mobile money and digital financial inclusion ($r = 0.423$; $p < 0.05$). This implies that increased use of mobile money may increase digital financial inclusion among people with disabilities, but through a weak link. Pearson correlation analysis also shows that there is a significant and positive relationship between digital literacy and digital financial inclusion ($r = 0.341$; $p < 0.05$). This shows that increasing digital literacy has an impact on increasing digital financial inclusion among people with disabilities, but through a weak relationship.
Furthermore, Pearson correlation analysis also revealed that digital literacy and biometric identification were significantly and positively related ($r = 0.425$; $p < 0.05$). This means that increasing digital literacy leads to increased use of biometric identification among people with disabilities, but through a weak relationship. Finally, Pearson correlation analysis shows that there is a significant and positive relationship between digital literacy and mobile money ($r = 0.658$; $p < 0.01$). This shows that increasing digital literacy causes an increase in mobile money use among people with disabilities, but through a moderate relationship.

Measurement Model

Confirmatory factor analysis was conducted using AMOS to evaluate the convergent and discriminant validity between manifest variables and latent constructs, specifically in the context of this study. The results show that all variables meet the better model fit index based on the Goodness of Fit (GoF) recommendations used in this study. Figures 2–5 display the results of the Confirmatory Factor Analysis (CFA). The standard parameter estimates from the initial measurement model were all significant ($p < 0.001$) for biometric identification, with a Chi-square (X2) of 26.565 and degrees of freedom of 8. Other indices such as the Incremental Fit Index (IFI) of 1.294, Tucker Lewis Index (TLI) of 1.287, and the Comparative Fit Index (CFI) of 1.294, all exceeding the minimum recommended value. The

Root Mean Square Error of Approximation (RMSEA) was 0.073, below the recommended cut point of ≤ 0.08. CFA results showed that three items (BM1, BM5, and BM8) loaded on factor 1, while the other three items (BM7, BM3, and BM4) loaded on factor 2 of biometric identification. During the CFA process, five items were removed and six items were retained, as shown in Figure 2.

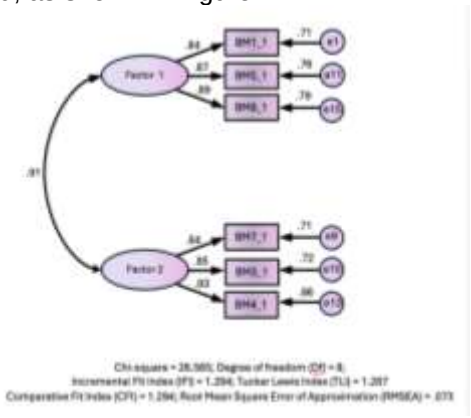

Figure 2. CFA model measurements for biometrics

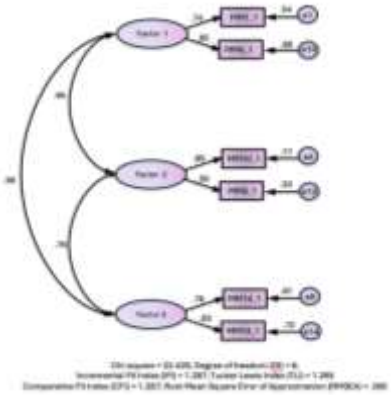

Figure 3. CFA measurement model for mobile money

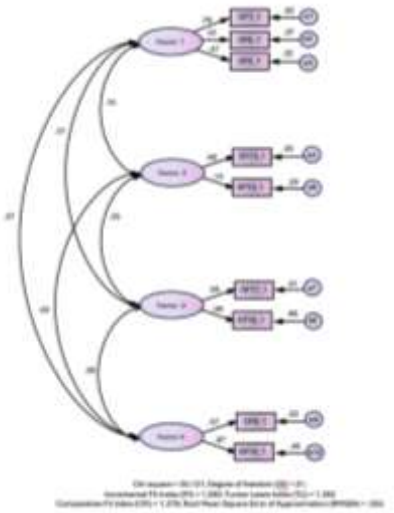

Figure 4. CFA measurement model for digital literacy
Source: Processed Data (2024)

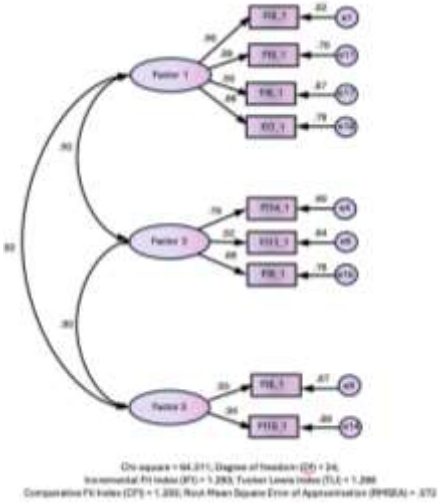

Figure 5. CFA measurement model for digital financial inclusion

In addition, the results show that the standard parameter estimates from the initial measurement model are all significant ($p < 0.001$) for mobile money with a Chi-square (X2) of 22.425 and degrees of freedom of 6, and an Incremental Fit Index (IFI) of 1.287 above the recommendation 0.95, and the Tucker Lewis Index (TLI) was 1.265 above the recommendation of 0.95. The Comparative Fit Index (CFI) was 1.287 above the recommended 0.90, and the Root Mean Square Error of Approximation (RMSEA) was 0.065 below the recommended cut point of ≤ 0.08. CFA results show that two items MM1 and MM4 loaded on factor 1, two other items from MM10 and MM8 loaded on factor 2, and two other items from MM14 and MM13 loaded on factor 3 of mobile money. Overall, eight items were removed and six items were retained during the CFA process as shown in Figure 3. This is based on Item Response Theory (IRT) which states that the fewer items, the better the measure of a variable, which is superior to Classical Test Theory (CTT) that relies on many items(Polat, 2022).

Moreover, the results also show that the standard parameter estimates of the initial measurement model are all significant ($p < 0.001$) for digital literacy with a Chi-square (X2)

of 35.121 and degrees of freedom of 21, an Incremental Fit Index (IFI) of 1.280 above the recommendation of 0, 95, and the Tucker Lewis Index (TLI) was 1.263 above the recommendation of 0.95. The Comparative Fit Index (CFI) was 1.279 above the recommended 0.90, and the Root Mean Square Error of Approximation (RMSEA) was 0.053 below the recommended cut point of ≤0.08. The CFA results showed that three items DF7, DF6, and DF5 loaded on factor 1, two other items from DF13 and DF14 loaded on factor 2, and two other items from DF17 and DF16 loaded on factor 3, while the other two items from DF9 and DF10 loaded on factor 4. Overall, ten items were dropped and nine items were retained during the CFA process as shown in Figure 4. This is based on Item Response Theory (IRT) which states that the fewer items, the better the measure of a variable that is superior to with Classical Test Theory (CTT) which relies on many items.
Finally, further results reveal that the standard parameter estimates from the initial measurement model are all significant ($p < 0.001$) for digital financial inclusion with a Chi-square (X2) of 64.311 and degrees of freedom of 24, an Incremental Fit Index (IFI) of 1.293 above the recommendation of 0 .95, and the Tucker Lewis Index (TLI) was 1.288 above the recommended 0.95. The Comparative Fit Index (CFI) was 1.293 above the recommended 0.90, and the Root Mean Square Error of Approximation (RMSEA) was 0.072 below the recommended cut point of ≤0.08. The CFA results showed that four items FI3, FI5, FI6, and FI7 loaded on factor 1, three other items from FI14, FI11, and FI9 loaded on factor 2, and two other items from FI8 and FI10 loaded on factor 3 of finance. Overall, seven items were removed and nine items were retained during the CFA process as shown in Figure 5.

Analysis of moderation effects in AMOS

Moderation effect analysis using AMOS aims to examine the interaction impact of digital literacy in the relationship between financial technology (biometric identification and mobile money) and digital financial inclusion among people with disabilities in East Java. Two models are built: Model 1 evaluates the direct effect of biometric identification and mobile money on digital financial inclusion, while Model 2 adds the direct effect of biometric identification and mobile money as well as the indirect effect of digital literacy.
The analysis results show that Model 2 has a very good model fit index compared to Model 1, with a Chi-square (X2) of 0.931 and a degree of freedom of 1. Other indices such as the Incremental Fit Index (IFI), Tucker Lewis Index (TLI), and Comparative The Fit Index (CFI) showed excellent values, exceeding the minimum recommendations. This result is supported by a Normed Fit Index (NFI) value of 1.118 and a Root Mean Square Error of Approximation (RMSEA) of 0.000, which also meets the good criteria. Furthermore, structural equation modeling analysis shows that digital literacy has a significant and positive moderating effect in the relationship between biometric identification, mobile money, and digital financial inclusion among people with disabilities in East Java ($\beta = 0.492$; $t = 3.567$; $p < 0.001$). Digital literacy interactions increase the influence of financial technology on digital financial inclusion by 16%, confirming hypothesis H3 of this study. In total, financial technology and digital literacy combined explain 30% of the variation in digital financial inclusion among people with disabilities in East Java. In addition, the research results show that biometric identification ($\beta = 0.612$; $t = 5.456$; $p < 0.001$) and mobile money ($\beta = 0.441$; $t = 2.631$; $p < 0.01$) significantly encourage digital financial inclusion among these circles, in accordance with hypotheses H1a and H1b. Furthermore, digital literacy ($\beta = 0.475$; $t = 3.207$; $p < 0.001$) also has a significant impact supporting digital financial inclusion, in accordance with hypothesis H2.
The results of this analysis strengthen the understanding of how digital literacy moderates the effects of financial technology on digital financial inclusion among people with disabilities in East Java, providing an empirical basis for further policy and practice recommendations in increasing their access and participation in the digital economy.

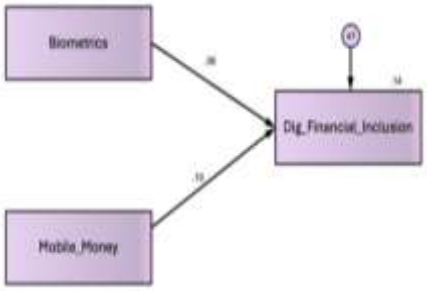

Figure 6. Unmoderated structural equation model in AMOS

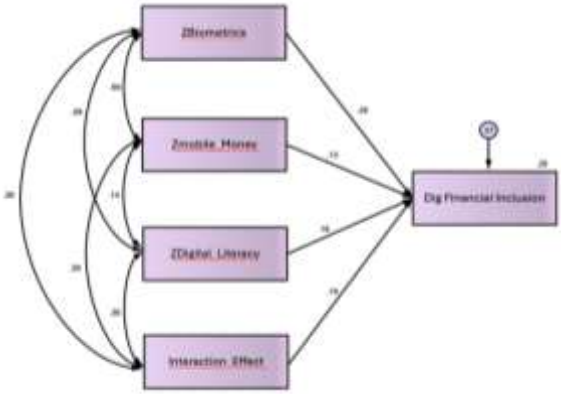

Figure 7. Moderated structural equation model for the interaction effect of digital literacy on AMOS

Source: Processed Data (2024)

Table 4. Structural Equation Models for Moderation

Hypothesis	Path Coefficients	S.E	t-value	p-value
Biometrics→Dig Financial Inclusion	0.612	0.031	5,456	***
Mobile Money→Dig Financial Inclusion	0.441	0.031	2,631	0.032
Digital Literacy→Dig Financial Inclusion	0.475	0.017	3,207	***
Digital Literacy x Financial Technologies→Dig Financial Inclusion	0.492	0.003	3,567	***
	Non-moderated Model (1)		Moderated Models (2)	
Chi-square/CMIN	3,389		0.931	
Degrees of freedom (Df)	10		1	
Probability (P)	0.232		0.501	
Incremental fit index (IFI)	1,106		1,133	
Tucker–Lewis index (TLI)	1,096		1,139	
Comparative fit index (CFI)	1,119		1,130	
Normed fit index (NFI)	1,090		1,118	
Root mean square error of approximation (RMSEA)	0.045		0,000	

Note(s): n = 330; significance level: ***p < 0.001; **p < 0.01
Legends: Biometrics ID-biometrics identification; Dig financial inclusion – digital financial inclusion
Source: Processed Data (2024)

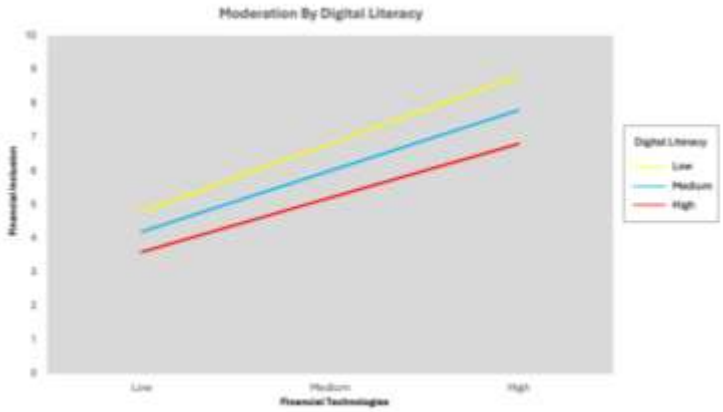

Figure 8. ModGraph for Interaction Effect of Digital Literacy
Source: Processed Data (2024)

Discussion of Results

The main objective of this research is to examine the impact of digital literacy interactions in the relationship between biometric financial technology and mobile money as well as digital financial inclusion among people with disabilities in East Java.

Digital Literacy: A Moderator Between Financial Technology And Digital Financial Inclusion

The results of this study indicate that digital literacy has a significant and positive moderating effect on the relationship between financial technology (biometric identification and mobile money) and digital financial inclusion among people with disabilities in East Java. The findings show that digitalization providers make financial services easier because the services offered can meet needs, are safe, reliable and useful. This finding is supported by Saini(2019), which argues that digital literacy can help people with disabilities in developing countries to analyze digital credit provided by FinTech, so they can make better choices to avoid the problems of over-borrowing, high interest rates and excess debt. Digital literacy helps them understand the terms and conditions of digital contracts before signing to avoid risks.

Prete(2022)also shows that digital literacy enables individuals such as people with disabilities to acquire the skills needed to become proficient in using digital technology, communication tools, and networks to obtain and evaluate information, communicate with others, and conduct digital transactions. Digital literacy helps vulnerable individuals compare various financial products on the market to ensure they meet their needs in terms of cost and reliability, thereby increasing financial inclusion.

Abdulquadri et al.(2021)suggests that digital literacy can help individuals such as people with disabilities to acquire effective communication skills through innovative channels such as chatbots to ask questions, perform verification, and provide personal information appropriately in digital financial matters.

Kass-Hanna et al.(2022)found that increased financial and digital literacy was associated with increased savings, loans and risk management among people with disabilities, especially those associated with Non-Bank Financial Institutions or mobile money service providers. Digital literacy related to the acquisition of skills and knowledge to increase digital proficiency can be acquired through social interactions, as explained by Bandura's Social Learning Theory(Rumjaun & Narod, 2020). People with disabilities can acquire digital skills and knowledge through observation, imitation, and modeling in social interactions. This Social Learning Theory, which links cognitive, affective, biological and socio-structural aspects in the learning process, can help them use financial technologies such as biometrics and mobile money efficiently.

In conclusion, digital literacy can help people with disabilities in developing countries like Indonesia to understand and evaluate the risks associated with using digital financial services, including fraud and cyber security such as phishing, pharming, spyware, and SIM card swapping(Banco de Portugal, 2018). These results support our hypothesis (H3) in this study.

Biometric identification and digital financial inclusion

The results of this research reveal that biometric identification significantly and positively encourages digital financial inclusion among people with disabilities in Indonesia. The findings show that the use of biometrics saves time, is safer, cheaper, more authentic and makes transactions easier to access. This finding is in line with Mutaz et al.,(2024), which found that the use of an iris recognition system connected to an automated teller machine helped more than a third of the 630,000 Syrian refugees access monthly cash transfers through Cairo Amman Bank.

According to the World Bank(2020), the use of FinTech tools such as biometrics for identification purposes can improve access and use of financial services among people with disabilities by reducing identification requirements. Chen et al.,(2023)also noted that digital identification technology plays an important role in ensuring access to financial services to empower vulnerable poor individuals. Biometrics have the potential to increase

adoption of digital financial services, especially by people with disabilities and formal identity documents. Biometrics makes it easier to open transaction accounts for people who do not have bank accounts, enables more cost-effective and remote customer acceptance, and facilitates the provision of additional financial services(Chigada, 2020).
World Bank Identification for Development Initiative(2020)also agreed that biometric identification systems record data quickly, prevent duplication, and verify the identity of individuals even if they do not have identification documents. This helps overcome the challenge of lack of identification when accessing and using financial services and avoid fraud. Biometric identification can improve security and make it a safer process to enable financial inclusion among people with disabilities in developing countries like Indonesia. These results support our hypothesis (H1a) in this study.

Mobile money and digital financial inclusion

The results of this research show that mobile money significantly and positively encourages digital financial inclusion among people with disabilities in East Java. The findings show that the use of mobile money is faster in transactions than at banks, mobile money meets financial needs because of ease of access. The authenticity of these results relates to mobile money products such as the M-Shwari consumer loan offered by Commercial Bank of Africa to M-PESA customers in Kenya, which has played an important role in providing digital credit. OK, Candiya Bongomin et al.(2023)argues that mobile money can overcome cost and geographic barriers, resulting in increased financial inclusion for people with disabilities in developing countries such as Indonesia.
Additionally, Kamande et al.(2021)states that mobile money can provide useful transaction records for people with disabilities who do not have bank accounts when applying for loans, especially because they have limited collateral and cannot conclusively prove repayment capacity due to information asymmetry problems. Sheikh et al. (2023) and Wang and He(2020)also argued that mobile money allows people with disabilities to transact small amounts at affordable costs, despite facing unreliable connections and other risks. This is especially suitable for people with disabilities who have small and unpredictable cash flows. Jayachandra(2022)observed that mobile phones enable customers to make or receive payments, transfer money more cheaply, and store value electronically securely through permitted banks or non-banks. This reduces the risk of loss, theft and other financial crimes related to cash transactions. Mobile money has the potential to provide the most reliable digital channel for expanding affordable, effective and secure financial services thanks to increasing mobile phone network coverage, rapid growth in phone subscriptions and smartphone ownership in developing countries. These results support our hypothesis (H1b) in this study.

Digital literacy and digital financial inclusion

The results of this research show that digital literacy significantly and positively encourages digital financial inclusion among people with disabilities who do not have bank accounts in East Java. The findings show that the mobile money menu is very clear to interpret on mobile phones and it is easy to make payments, borrow money, and reduce the use of cash because of the existence of mobile money.
These results are supported by Klapper and Lusardi(2020)who found that low levels of numerical literacy, unavailability of options in local languages, lack of understanding of banking jargon, and application complexity mean mobile money users in India, Kenya, the Philippines, and South Africa rely on agents to fulfill their transactions. OECD(2020)observed that digital literacy can help marginalized and financially underserved people with disabilities who are vulnerable to risk and fraud to be ready to make informed decisions before consuming digital financial products.
Digital literacy enables people with disabilities to acquire skills they can use to fully exploit opportunities and minimize the risks posed by FinTech. Lev-On et al.,(2021)also emphasized that to understand simple instructions regarding the functioning of digital financial products and know where to get more information as well as how to resolve errors on FinTech platforms. This can ensure a safe digital financial environment, thereby increasing the uptake and use of digital financial services, as well as increasing digital financial inclusion.

Digital literacy can reduce the digital gap between educated and illiterate consumers of digital financial services. This could result in increased access and use of digital financial services by unbanked and underserved communities from all levels of society(OECD, 2020). Digital literacy gives people with disabilities the sophistication to process financial information before consuming digital financial products, which can result in the continued use of digital financial services in developing countries like Indonesia.

CONCLUSION

The results of this study reveal that digital literacy has a significant and positive moderating effect on the relationship between financial technology (such as biometric identification and mobile money) and digital financial inclusion among people with disabilities in East Java. FinTech can expand access to financial services to people who do not have bank accounts and are underserved by providing various financial services that are more affordable than traditional banks. This research also shows that biometric identification significantly and positively encourages digital financial inclusion among people with disabilities in East Java. Biometric identification can provide a reliable form of identification for individuals who do not have formal identification documents to access financial services from banks.
In addition, the research results show that mobile money significantly and positively encourages digital financial inclusion among people with disabilities in East Java. Mobile money can reduce the risk of loss, theft and other financial crimes associated with cash transactions, as well as lower the costs associated with those transactions. Finally, this research shows that digital literacy significantly and positively encourages digital financial inclusion among people with disabilities in Indonesia. Digital literacy can help unbanked and underserved communities to acquire the skills and abilities necessary to assess the potential risks and implications of consuming digital financial products offered by digital financial service providers

Implications

The results of this research have important implications for the East Java Government in supporting people with disabilities through digital literacy to utilize digital financial services, as well as designing digital infrastructure that reaches remote areas with offline solutions to overcome limited network connectivity. Mobile money service providers can expand their reach to vulnerable populations in rural areas, while governments can identify and address the digital literacy needs of vulnerable groups. Banks can adopt biometrics for identification, especially for vulnerable and illiterate individuals. The government also needs to integrate digital and financial literacy in the school curriculum to equip the younger generation with the necessary skills. This research incorporates Social Learning Theory to explain the acquisition of digital skills by people with disabilities and can be replicated in other developing countries to increase financial inclusion. Lastly, digital literacy is critical in the global financial technology ecosystem to help people with disabilities participate in digital financial markets by reducing the risk of fraud.

Research limitations and further research

This research has several limitations. The data collected mainly comes from people with disabilities in East Java, an area in a developing country. For further research, it is recommended that data be collected from other parts of the vulnerable population in Indonesia as well as other developing countries. This will make it possible to obtain more conclusive and general empirical evidence. In addition, this study used a cross-sectional design for data collection. In the future, it is recommended to adopt a longitudinal research design to investigate the impact of financial technology on digital financial inclusion in the presence of digital literacy over different time spans. This approach will provide deeper insight into changes and developments in digital financial inclusion over time.

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