

DIGITAL FINANCIAL SERVICES USAGE AND ITS EFFECT ON FINANCIAL LITERACY: INDONESIAN EVIDENCE

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Abstract. Purpose – The present study helps to explore the determinants of Digital Financial Literacy (DFL) in Indonesia by considering the interaction of knowledge, attitudes, financial ability, and digital financial services in determining the level of literacy.

Research methodology – The data was gathered on 200 demographically varied people and were analyzed with the help of Partial Least Squares Structural Equation Modeling (PLS-SEM) to measure correlations between the variables and their reliability, validity, and predictive abilities.

Findings – Digital financial knowledge emerged as the strongest predictor of literacy ($\beta = 0.296$, $p < 0.001$), followed by financial capability ($\beta = 0.237$, $p = 0.007$) and user attitudes ($\beta = 0.214$, $p = 0.004$), while digital financial service usage showed only a weak and marginally significant effect ($\beta = 0.105$, $p = 0.051$). Education level significantly moderated the impact of knowledge on literacy ($\beta = 0.175$, $p < 0.01$), and gender influenced the link between capability and literacy ($\beta = 0.192$, $p < 0.05$). These results highlight that digital inclusion in Indonesia depends not only on access but also on enhancing financial knowledge, capability, and equitable digital literacy across regions and demographic groups.

Research limitations – The study focused exclusively on the Indonesian context, potentially limiting generalizability to other markets with different digital infrastructure and financial ecosystems.

Practical implications – Findings suggest policymakers and industry professionals should develop comprehensive approaches that integrate educational initiatives, skill development, and user-friendly service design rather than simply expanding service availability.

Originality/Value – This research uniquely identifies the gap between digital financial service availability and actual literacy levels, challenging the assumption that increased access automatically enhances financial literacy.

Keywords: attitudes and behavior, digital financial service, digital financial literacy, knowledge and understanding, digital financial capability.

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1. Introduction

Digital delivery of financial services has been drastically transformed by the global digital revolution, and digital financial services are now a crucial economic inclusion/development driver globally, especially in the emerging economies where digital financial services have the potential to be offered owing to the limitations posed on traditional banking infrastructures. Being one of the most quickly digitalizing economies, the development of digital financial services in Indonesia has been supported by the continued rise of mobile technology

penetration, as well as the growth of the need to use an easy-to-access financial solution (Setiawan et al., 2022; Trinugroho et al., 2022). Such services have proven to be vital in furthering financial inclusion, financial stability, and business development, particularly when it comes to such institutions as Small and Medium-sized Enterprises (SAMES), since the COVID-19 pandemic has prompted an accelerated implementation rate and a heightened awareness of the need to be digitally financially literate, to achieve the maximisation of service usage and high utilisation rates (Kurniasari et al., 2023; Ariansyah et al., 2021; Kusumawardhani et al., 2023). Digital financial literacy enables a person and a business to successfully use the digital financial platform, address risks, and make good financial choices (Nurkholik, 2023; Kurniasari et al., 2023).

Nevertheless, the process of the digital financial service penetration in Indonesia has been compromised with numerous obstacles, such as technological barriers, inadequate infrastructure, and the absence of education (Akbar & Rahmawati, 2023; Setiawan et al., 2022). These problems are further complicated by the digital gap between urban and rural communities, which restricts access to vulnerable groups, and financial literacy and the capacity to comprehend and utilize financial data is an important factor in empowering people to embrace and completely use digital financial services (Trinugroho et al., 2022; Nugraha et al., 2022; Nurkholik, 2023). The situation is also complicated by inequality in financial literacy and access to digital financial services in the regions, and the direct impact of government support on financial literacy is yet to be adequately investigated (Setiawan et al., 2022; Nugraha et al., 2022; Shehadeh et al., 2025).

The existing literature has largely considered either technological adoption or financial literacy separately and has not yet considered the interaction of the two factors to the extent of impacting digital financial literacy (Kurniasari et al., 2023; Ibrahim et al., 2021; Nurkholik, 2023; Kusumawardhani et al., 2023). Although the research on the adoption of digital financial services, on the one hand, and financial literacy, on the other, continues to increase, there are still critical knowledge gaps concerning the interaction between the two constructs to change the development of digital financial literacy, and very little empirical research on the relative significance of technological access and financial knowledge, the mediating role of attitudes and financial capability, and the moderating role of demographics in the contexts of the developing economies. Also, research tends to be cross-sectional without longitudinal views of the digital financial literacy development after adoption, whereas behavioral factors including attitudes, social factors, and technostress are underrepresented (Muat et al., 2025).

The given gaps are addressed in the present research through studying three major research questions, including: (RQ1) What is the relationship between the adoption of digital financial services, knowledge and understanding, attitudes and behaviors and financial capability as independent and dependent variables and digital financial literacy of Indonesian adults? (RQ2) Which predictors have the strongest impact on the understanding of the variance in digital financial literacy and (RQ3) What are the ways in which demographic factors are mediating these relationships? The objectives of the research are to investigate the joint effect of the technological adoption and financial literacy variables on developing digital financial literacy, the most significant predictors, and the effect of demographic moderation. Through these interactions, the study can provide policy-relevant findings to policymakers to

strengthen technology infrastructure and deliver more targeted financial literacy programs, allow financial institutions and fintech firms to design more inclusion-focused digital products to a wider range of people, and add to the academic knowledge of digital financial inclusion through technology-literacy intersectional analysis in developing economy settings (Akbar & Rahmawati, 2023; Kurniasari et al., 2023; Setiawan et al., 2022; Ibrahim et al., 2021).

2. Literature review

2.1. Digital financial literacy

Digital financial literacy has been described as the knowledge, skills, and practices needed to operate digital financial services, such as the capacity to utilize digital platforms when engaging in financial transactions, comprehend digital financial products, and manage the risks involved with using or utilizing digital financial services such as cybersecurity threats, fraud, among others (Setiawan et al., 2022; Kurniasari et al., 2023). Digital financial literacy is becoming an essential tool as the process of transitioning to digital platforms in the sphere of financial services gains momentum: people are able to make more balanced financial choices and effectively utilize digital tools, particularly in developing economies such as Indonesia which has seen a quick increase in digital finance uptake (Nurkholik, 2023; Sinaga et al., 2023). The importance of digital financial services in financial inclusion and economic resiliency was even amplified during the post-pandemic period, making them even more important. Studies indicate that the more digitally financially literate are people, the more favorable financial outcomes they can achieve and manage their finances using digital resources (Kusumawardhani et al., 2023; Nugraha et al., 2022). Nationwide in Indonesia, with mobile phones and internet penetration being abundant, digital financial literacy has boosted economic inclusion, especially with SMEs (Kurniasari et al., 2023; Ibrahim et al., 2021).

The electronic financial literacy comprises three components, which are interdependent. Traditional and digital financial products knowledge and understanding are the first ones, which imply understanding of both products. Lack of financial knowledge, and digital knowledge, in particular, affect the underutilization of digital services, and an increase in knowledge results in improved financial decisions and outcomes (Kurniasari et al., 2023; Sinaga et al., 2023). The second element, attitudes and behaviors, is the perception of digital financial services as safe, helpful, and trustworthy that is connected to the increased financial ability and improved results. These people possess better positive attitudes and will be more inclined to use and get competent with these services. There are also behavioral styles like trust in technology and risk-taking, which have an impact on adoption (Trinugroho et al., 2022; Kurniasari et al., 2023; Ibrahim et al., 2021; Setiawan et al., 2022). Financial capability is the third component and is not just limited to the basic financial management but also covers sound decision making and risk management with the use of digital tools. The increased financial capacity leads to better utilization of online services to plan, save, and invest, which helps to be more resilient in times of economic uncertainty (Nurkholik, 2023; Setiawan et al., 2022; Kusumawardhani et al., 2023).

2.2. Digital financial services

Digital financial services are various financial products and services that are provided through digital infrastructure, including mobile banking, mobile money, digital payments, and digital lending (Trinugroho et al., 2022; Ariansyah et al., 2021). Financial services in Indonesia include a financial inclusion revolution with digital financial services, in particular, mass use of mobile technology, as an access facilitator to financially underserved groups (Setiawan et al., 2022). The digital financial services also became more popular with the COVID-19 pandemic increasing its power and potential to be applied even in case of crisis situations and growing the number of financial instruments (Kusumawardhani et al., 2023; Sinaga et al., 2023). However, there are other characteristics that influence the adoption of digital financial services such as access to technology, trust in digital platforms, and the preconceived usability. In Indonesia, the problem of access to technology, in particular, is still observed in rural places where the rate of internet penetration and smartphone usage is lower (Akbar & Rahmawati, 2023; Setiawan et al., 2022). Another determinant of the adoption is trust in digital financial services platforms, particularly their data security and reliability of the platform (Ibrahim et al., 2021). Also, the usability is essential to promote the use of digital financial services because intricate designs can push the potential consumers away, or the user may lack the required technical competence (Nurkholik, 2023).

2.3. Theoretical framework

The theoretical base of the research is a combination of three complementary frameworks that would explain the process of adoption of digital financial services and the process of development of literacy. Technology Acceptance Model (TAM) has it that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are the primary influencing factors that determine the intentions of users to adopt technology (Davis, 1989). In the case of applying to digital financial services, the Unified Theory of Acceptance and Use of Technology (UTAUT) considers the performance expectancy, effort expectancy, social influence as well as enabling conditions as the factors that influence the choice to adopt the technology, and mobile banking and digital payments are adopted by users when they perceive it convenient and conducive to their financial activities (Venkatesh et al., 2003). Social influence by family and peers is especially significant in the collectivist society of Indonesia, and enabling factors such as government initiatives like QRIS are the key contributors to the use of fintech (Kang et al., 2011; Sukaris et al., 2021). Although TAM and UTAUT are concerned with the first-time adoption, Financial Behavior Theory explores further how users become competent in using online financial services in the long run. According to this theory, people that are more financially literate have greater chances of using these services because they can evaluate risks and make informed decisions (Reyes-Mercado, 2021; Sadik & Rahman, 2024). Perceived risk and trust are vital in financial decision-making, particularly in new economies where the issue of digital fraud might discourage the adoption (Dhanda & Arora, 2023). The combination of these three theoretical perspectives gives a holistic concept of understanding how the technology adoption should be strengthened by the use of behavioral change and continuous learning to offer conceptual framework of addressing the digital financial services adoption, knowledge and understanding, attitudes and behaviors, and financial capability as predictors of digital financial literacy development.

2.4. Hypothesis development

According to the combined theoretical framework, the hypothesis below test associations between the adoption of digital financial services and other aspects of financial literacy in determining digital financial literacy in Indonesia. Using digital financial services also subjects individuals to different digital tools and platforms and thus increases their familiarity and competence with managing finances through digital means, which is consistent with the postulate of TAM that perceived ease of use and perceived usefulness are the determinants of adoption and promote the development of usefulness that leads to practical familiarity and contributes to better digital financial literacy (Kurniasari et al., 2023; Sinaga et al., 2023; Davis, 1989).

H1: *Digital financial services adoption has a positive effect on digital financial literacy.*

The high frequency of engagement with digital financial services platforms fosters confidence and provides the victim with the information that could help them carry out complex financial assignments, which is supported by UTAUT, where the performance expectancy and effort expectancy are significant factors that predict the probability of adopting financial technologies, which financial knowledge makes individuals make more informed choices and use digital financial tools more effectively (Venkatesh et al., 2003; Nurkholik, 2023; Kusumawardhani et al., 2023).

H2: *Knowledge and understanding have a positive effect on digital financial literacy.*

The attitudes towards digital financial services are also of important essence in promoting increased participation since confidence in security, reliability, and utility motivates a person to explore and use more services with confidence. The Financial Behavior Theory highlights that the core determinants of financial decisions include trust and perceived risk whereas the behavioral characteristics concerning openness to technology and risk tolerance determine interaction with a platform (Reyes-Mercado, 2021; Setiawan et al., 2022).

H3: *Attitudes and behaviors have a positive impact on digital financial literacy.*

It is proven that more financially capable people are better at using digital financial services as the Financial Behavior Theory states that people with a higher financial literacy are more confident in their financial decision-making and using financial technologies (Nurkholik, 2023; Sadik & Rahman, 2024).

H4: *Financial ability has a positive impact on digital financial literacy.*

These relationships might be mediated by such demographic variables as age, gender, education level, and income because the UTAUT indicates that these variables are the moderator of technology adoption in terms of performance and effort expectancy as younger users are easier to adopt the services and education and income determine the capabilities of decision making (Venkatesh et al., 2003; Budiharseno & Kim, 2023).

H5: *The connections between digital financial services adoption and knowledge as well as attitudes and financial capability mediate through demographic variables on digital financial literacy.*

Figure 1 presents the proposed research model that incorporates these theoretical frameworks to investigate the relationship between the digital financial services adoption and the other forms of digital financial literacy and the complexity of developing literacy by addressing the enabling and limiting factors. These hypotheses will be evaluated through structural

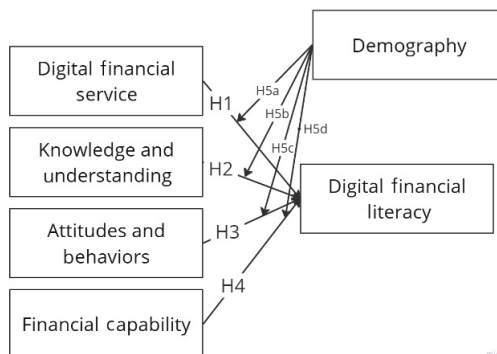


Figure 1. Research model

equation modeling that will analyze both the conceptual relationships of the constructs and the role of individual measurement indicators to their respective constructs to analyze thoroughly the empirical validity of the theoretical framework.

3. Methodology

3.1. Research approach

This paper uses a quantitative methodology to test the correlation between variables that contribute to the adoption of digital financial services and the creation of digital financial literacy in Indonesia. The research design is based on Structural Equation Modeling (SEM) that will be used to test the hypotheses proposed and evaluate the interactions of the key variables (Nugraha et al., 2022). The choice of this method is determined by the ability to investigate the direct implications of the adoption of digital financial services and the digital financial literacy (Kusumawardhani et al., 2023). In carrying out this study, it is expected that by using this method, they will get a wholesome understanding of how various variables will aid in the formation of digital financial literacy. The quantitative design, will also allow testing the theoretical models and hypotheses rigorously and considering the demographic factors contributing to the results that will guarantee the reliability and further relevance of the results (Trinugroho et al., 2022).

3.2. Data collection methods

The collection process was based on a holistic strategy which involved the use of a structured questionnaire to reach a large population using both online and offline methods to cover every demographic group including those who were not frequently online (Kurniasari et al., 2023). To make the survey more refined, a strict pre-testing was held to eliminate ambiguities, and to make sure that the questions were clear and culturally fitting. The reliability analysis checked the internal consistency with the Alpha of Cronbach and Composite Reliability values of all constructs of over 0.70 (Setiawan et al., 2022). To achieve the diversity of representation, the research was focused on the population of the Indonesian adults aged 18 years and

above with access to the digital financial services. A stratified random sample was used, which covered various age groups, education, gender, and the urban/rural areas (Ariansyah et al., 2021; Ibrahim et al., 2021). The G*Power analysis was applied, which has 95% confidence level and 7% margin of error, to calculate the required sample size of at least 196 respondents basing on the adult population of Indonesia of about 285 million individuals (Faul et al., 2007; Cochran, 1977). A one-hundred and twenty valid answers were gathered during March and May 2023. The survey was on the areas of Java, Sumatra, and Kalimantan comprising the largest percentage of the Indonesian people and activities. The stratified random sampling

Table 1. Operational definition of variables

Variable	Type	Definition	Code	Indicators
Digital financial Literacy	Dependent	The ability to understand and effectively use digital financial services	DFL1	Ability to use various digital financial services (e.g., digital banking, e-wallets)
			DFL2	Sufficient knowledge about digital financial products (e.g., online investments, digital loans)
			DFL3	Confidence in making financial decisions using digital platforms
			DFL4	Ability to identify and avoid digital financial fraud
Digital financial services	Independent	Access and usage of digital financial platforms	DFS1	Access to digital financial services
			DFS2	Usage of digital financial services for daily needs
			DFS3	Trust in security and efficiency
			DFS4	Perceived ease of use
Knowledge and understanding	Independent	Comprehension of digital financial concepts and products	DFK1	Understanding of digital payment products
			DFK2	Understanding of digital asset management
			DFK3	Understanding of digital alternatives
			DFK4	Understanding of digital insurance products
			DFK5	Understanding of customer rights
Attitudes and behaviors	Independent	Individual's attitudes and behavioral patterns toward digital financial services	DFA1	Experience with digital payment services
			DFA2	Experience with fintech services
			DFA3	Experience with asset management platforms
			DFA4	Frequency of digital financial service usage
			DFA5	Willingness to recommend services
Financial capability	Independent	Ability to effectively manage financial resources through digital means	DFC1	Ability to manage financial activities digitally
			DFC2	Control over financial activities
			DFC3	Understanding of digital features

was used to have the proportional representation of the urban and rural respondents in these regions. Quality control measures were used to consider both the geographical and technological accessibility variables with minimal possibilities of biases concerning the region or digital divide (Trinugroho et al., 2022; Ariansyah et al., 2021).

The study variables have been operationalized using the pre-existing scales commonly used to measure digital financial literacy along with the survey instrument being developed based on validated scales modified by Davis (1989) to measure technology acceptance constructs, Venkatesh et al. (2003) to measure UTAUT measures, and Lusardi and Mitchell (2014) to measure financial literacy components. These scales were also modified to suit the culture of Indonesia (Setiawan et al., 2022; Kurniasari et al., 2023; Nugraha et al., 2022). Digital Financial Literacy (DFL) is the dependent variable that will be measured on multiple scales, such as the skill to use digital financial services, knowledge of digital financial products, confidence in choosing digital financial products, and the skill to detect fraudulent activities (Nugraha et al., 2022). Digital Financial Services (DFS), Knowledge and Understanding (DFK), Attitudes and Behaviors (DFA), and Financial Capability (DFC) are independent variables and have indicators such as accessibility, trust, understanding, experience, and proficiency (Ibrahim et al., 2021; Akbar & Rahmawati, 2023). Answers will be recorded on a five-point Likert scale (1 strongly disagree, 5 strongly agree), which is good to guarantee the validity of the instruments, as well as to reduce bias, as the items will be balanced. Standardized categorical variables gather control variables, i.e., age, education, income, and frequency of usage (Trinugroho et al., 2022; Kusumawardhani et al., 2023). Table 1 contains a description of the operationalization of the variables in detail and the theoretical basis.

3.3. Data analysis techniques

The research analytical framework is a comprehensive one in terms of data validation and hypothesis testing, as it begins with a massive initial data screening and pre-processing stage (Trinugroho et al., 2022). The study uses a number of techniques to guarantee the validity of the measurement tools. The concept of content validity is evaluated by an expert, Confirmatory Factor Analysis (CFA) is used to test the construct validity, and the criterion validity is tested by comparing the results of the new scale with other, well-established scales in the context of a correlation (Kurniasari et al., 2023). There is reliability testing using Cronbachs Alpha (CA), Composite Reliability (CR), and item total correlation testing, which verify internal consistency in all constructs (Setiawan et al., 2022). Each construct is also tested on the validity of each construct using factor loadings and Average Variance Extracted (AVE), with all of the items having to be within the recommended thresholds.

The results are then analyzed with the help of SEM which is a two-step systematic procedure. The first is measurement model validation where it is ascertained whether the constructs are reliable and valid. This comprises the assessment of the loading of factors, Average Variance Extracted (AVE), and the index of discriminant validity (Kusumawardhani et al., 2023). Second, testing the structural model that addresses the relationships between variables formulated as hypotheses. R-square is used to evaluate the model fit (Setiawan et al., 2022; Kurniasari et al., 2023) as well as adjusted R-square (Nugraha, 2022). With the help of this comprehensive approach, the data can be studied in a subtle way, and the confidence in the outcomes of the research can be enhanced.

4. Results

4.1. Demographic of the respondents

Table 2 shows the demographic description of the 200 respondents, which will provide a crucial understanding of the structure of the research sample. The highest number of respondents were aged 18–34 years and therefore comprised 43.5% of the total respondents. This is in turn followed by 34–44 age bracket with 31.5% and above 45 years with 25%. These results correspond to the results of previous research, which indicate that younger generations tend to embrace digital financial services more (Kurniasari et al., 2023; Setiawan et al., 2022). Gender of the sample indicates that most of the respondents are women since most of them are 63% whereas the male gender is 37%. Such gender imbalance offers a decent background to the investigation of gender-specific attitudes and preferences in online financial literacy and usage (Trinugroho et al., 2022). On the monthly income, half of the respondents earn less than Rp 5,000,000, 25.5% were earned within Rp 5,000,001 to Rp 10,000,000, and 24.5 earn above Rp 10,000,000. Such a wide spectrum of incomes highlights the socioeconomic diversity of the respondents, which is critical to variations in financial inclusion and access (Nugraha et al., 2022; Kusumawardhani et al., 2023).

Table 2. Demographic of the respondents

Category	Sub category	Count	%	Code
Age	18–34 years old	87	43.5	Age_18–34
	34–44 years old	63	31.5	Age_34–44
	> 45 years old	50	25	Age_45
Gender	Male	74	37	Gender_Male
	Female	126	63	Gender_Female
Revenue/month	< Rp 5,000,000	100	50	Rev_5mil
	Rp 5,000,001 - Rp 10,000.000	51	25.5	Rev_5-10mil
	> Rp 10,000,000	49	24.5	Rev_10mil

4.2. Refined model testing

4.2.1. Descriptive statistic

Table 3 provides a summary of descriptive statistics of the study variables. The Digital Financial Literacy (DFL) mean scores are between 2.420 and 3.880 ($SD = 1.031 - 1.207$) indicating the difference in literacy levels of the participants. The scores of Digital Financial Services (DFS) are better; it goes between 3.845 and 4.155 ($SD = 0.963 - 1.082$) which means that they are well acquainted with such services. Knowledge and Understanding (DFK) scores ($3.395 - 3.900 / SD = 1.176 - 1.382$) indicate moderate and high financial knowledge. The score of Attitudes and Behaviors (DFA) ranges between 3.740 and 3.775 ($SD = 1.060 - 1.139$) and has a general positive attitude towards digital financial services. Lastly, Financial Capability (DFC) scores lie between 3.540 and 3.695 ($SD = 1.137 - 1.260$), which are moderate financial capability scores. Although the individual measures are used as part of the constructs, hypothesis testing is done at the construct level in order to test the relationships theoretically in a parsimonious

way. The analysis of measurement model proves that all indicators play great roles in terms of their constructs. f^2 analysis of Cohen indicates that DFK has medium to large effects of ($f^2 = 0.21$) whereas DFA and DFC have medium effects ($f^2 = 0.16$ and $f^2 = 0.18$). On the other hand, there is a poor effect size ($f^2 = 0.08$) of DFS, which strengthens the peripheral role in digital financial literacy (Kurniasari et al., 2023). The results demonstrate optimistic interactions with the digital financial services, though also indicate significant differences in the level of knowledge (Setiawan et al., 2022). The low scores of DFL can be interpreted as the fact that not all users are well-enough literate to make information-based financial choices due to the regular use (Nugraha et al., 2022). DFS has few variations, which suggests its widespread implementation but little direct effect on the improvement of literacy (Kurniasari et al., 2023).

Table 3. Descriptive statistic

Variable	Code	Mean	Standard deviation
Digital financial literacy	DFL1	3.880	1.151
	DFL2	2.595	1.096
	DFL3	3.805	1.207
	DFL4	2.420	1.031
Digital financial services	DFS1	3.845	1.073
	DFS2	4.155	1.082
	DFS3	4.135	0.963
	DFS4	4.155	1.015
Knowledge and understanding	DFK1	3.395	1.288
	DFK2	3.740	1.176
	DFK3	3.665	1.274
	DFK4	3.830	1.382
	DFK5	3.780	1.297
	DFK6	3.900	1.225
	DFK7	3.795	1.270
Attitudes and behavior	DFA1	3.750	1.112
	DFA2	3.740	1.119
	DFA3	3.775	1.060
	DFA4	3.775	1.093
	DFA5	3.770	1.139
Financial capability	DFC1	3.540	1.208
	DFC2	3.645	1.200
	DFC3	3.690	1.137
	DFC4	3.680	1.260
	DFC5	3.695	1.197

4.2.2. Mediation analysis

A mediation analysis was taken to determine the indirect effects using bootstrapping (5,000 resamples). The findings have shown that financial knowledge (DFK) is the mediating variable between Digital Financial Services (DFS) and Digital Financial Literacy (DFL) ($\beta = 0.115$,

$p < 0.01$). This implies that people who have better financial literacy can more easily transfer their use of digital financial services to better literacy outcomes. Also, there is a mediating effect of financial capability (DFC) between DFS and DFL ($\beta = 0.098$, $p < 0.05$), which means that those users, who acquire a better financial management skill due to digital finance, become more literate. Such results are consistent with the Financial Behavior Theory, which states that knowledge and financial skills are paramount in determining the financial decision-making (Reyes-Mercado, 2021).

4.2.3. Construct reliability and validity

The construct reliability and validity evaluation is a significant measure towards the quality and consistency of the research tool in structural equation modeling study. The measures of reliability employed in the study are CA and CR, and a score above 0.7 is considered to be highly consistent (Setiawan et al., 2022; Kurniasari et al., 2023). The AVE is used to assess convergent validity with a value above 0.5 pointing to the constructs characteristics explaining a considerable part of the variance in their indicators (Nugraha et al., 2022). All these indicators confirm the research instrument is dependable in measuring the construction of interest and that the items in each construction are connected enough to measure the same latent construct (Trinugroho et al., 2022).

Table 4. Construct reliability and validity

	CA	CR	AVE
DFL	0.826	0.884	0.656
DFS	0.819	0.880	0.647
DFK	0.930	0.943	0.703
DFA	0.869	0.904	0.654
DFC	0.905	0.929	0.724

Table 4 confirms robust construct reliability and validity for all measured constructs. DFK achieved the highest reliability with CA = 0.930 and CR = 0.943, indicating strong consistency in knowledge-related indicators (Setiawan et al., 2022). However, DFS and DFL, while still reliable, display slightly lower CA values (0.819 and 0.826, respectively), which may suggest that financial literacy levels among respondents are not as stable as digital service adoption (Kurniasari et al., 2023). It may mean that although a significant number of users actively use digital financial services, their level of knowledge is uneven, and it is necessary to introduce financial education programs (Nugraha et al., 2022). DFA and DFC, on the other hand, were also very reliable with DFA (CA = 0.869, CR = 0.904) and DFC (CA = 0.905, CR = 0.929), respectively. Convergent validity was satisfactory with all constructs having an AVE exceeding the 0.5 value with 0.647 (DFS) and 0.724 (DFC) being the highest and lowest values, respectively. The results of these findings exemplify the strength of the measurement model since all measures are reliable and valid with sound basis of further structural model analysis and hypothesis testing.

4.2.4. Discriminant validity

Assessment of discriminant validity is an imperative procedure in guaranteeing that the constructs in the research model are indeed different and that they measure different theoretical concepts. The Fornell-Larcker criterion is one of the most commonly used criteria in PLS-SEM analysis which states that the square root of the AVE of the individual constructs must be larger than their correlations with other constructs (Setiawan et al., 2022; Kurniasari et al., 2023). Achieving discriminant validity would be to be sure that relationships among constructs are not confounded by overlap in measurement and that it can be tested properly and validly to interpret the structural model (Nugraha et al., 2022). It also ensures that the respondents see each construct as a distinct theoretical concept (Trinugroho et al., 2022).

Table 5. Discriminant validity

	DFA	DFC	DFK	DFL	DFS
DFA					
DFC	0.636				
DFK	0.774	0.651			
DFL	0.756	0.684	0.779		
DFS	0.773	0.682	0.819	0.815	

The findings of the discriminant validity presented in Table 5 indicate that constructs are still different, but there are significant relationships between some variables (Setiawan et al., 2022). The correlation between DFK and DFS (0.819) is relatively large, which indicates that the more financially informed the person is, the more likely he or she is to use digital financial services (Nugraha et al., 2022). Nonetheless, the medium relationship between DFL and DFA (0.756) shows that positive attitudes are not enough to ensure increased digital financial literacy (Kurniasari et al., 2023). This result highlights the significance of well-designed financial literacy initiatives which are capable of fostering positive attitudes and also provide individuals with effective knowledge on how to manage digital financial instruments (Trinugroho et al., 2022).

4.2.5. Demographic influences

Additional subgroup analysis was looking at demographic factors that affect digital financial literacy. The results indicate that the impact of DFK on DFL is also moderated by the education level ($\beta = 0.175$, $p < 0.01$) and therefore individuals with a higher education level have an increased advantage of using financial knowledge in making them more literate. Besides, there was a gender difference, with the male respondents having a higher correlation between financial capability and digital financial literacy ($\beta = 0.192$, $p < 0.05$), which is consistent with other literature indicating gender differences in financial confidence (Shehadeh et al., 2025). Interestingly, the age factor was not identified as a mediating factor in this study and it can be concluded that digital financial participation is becoming cross-generational in Indonesia. Such results demonstrate the necessity of making the financial education programs targeted to the particular population groups in order to be as effective as possible.

4.2.6. Comparative analysis with similar studies

This study has validated its findings as has been found in the same research on digital financial literacy in emerging economies. For instance, Muat et al. (2025) also identified financial knowledge as the most influential factor in shaping digital financial literacy, particularly among lower-income users. Similarly, Arifin et al. (2023) emphasized that digital financial attitudes play a crucial role in adoption, a finding that aligns with the significance of DFA in this study. However, unlike prior research that found digital financial services to be a strong predictor of literacy (Sukaris et al., 2021), this study suggests only a weak direct effect, reinforcing the need for intermediary variables such as knowledge and financial capability. These comparisons underscore the importance of contextualizing financial literacy models within specific economic and technological environments.

4.2.7. R-square analysis

R-square analysis is one of the important measures of PLS-SEM that determines the predictive power of a structural model by showing the percentage of variance of the endogenous constructs explained by independent variables. The R-square values are between 0 and 1, 0.75, 0.50, and 0.25 represent the substantial, moderate, and weak predictive accuracy, respectively (Setiawan et al., 2022; Kurniasari et al., 2023). Adjusted R-Sq considers the predictors and sample size, giving a more pessimistic estimate, which can be especially beneficial in the comparison of models with different levels of complexity (Nugraha et al., 2022). The evaluation of these values is crucial in identifying the practical and theoretical applicability of a research model in describing the variability of dependent variables of the research model (Trinugroho et al., 2022).

Table 6. R-square analysis

	R-square	R-square adjusted
DFL	0.691	0.627

Table 6 shows that the R-SQ of DFL = 0.691, which implies that 69.1% of digital financial literacy can be explained by its predictors (Setiawan et al., 2022). The value of adjusted R-squared of 0.627 indicates a high predictive potential, but it also indicates that the variables that are not measured can be influential (Kurniasari et al., 2023). This means that even though digital financial services, financial knowledge, attitudes, and capabilities are relevant in determining digital financial literacy, other situational variables like regulatory policies, access to financial education, and socio-economic conditions also contribute to digital financial competency in Indonesia (Nugraha et al., 2022) are also important.

4.2.8. Final pilot path analysis result

Path analysis PLS-SEM measures the relationship strength and significance of the hypothesized construct-construct relationships, which are significant evidence to hypothesis testing and validation of a theoretical model. The analysis review is of path coefficients (β), which show how strong and directional relationships are, t-statistics, and p-values, which show whether the relationships are statistically significant (Setiawan et al., 2022; Kurniasari et al.,

2023). The threshold of a path coefficient is usually regarded as significant when its t-statistic is greater than 1.96 (at $\alpha = 0.05$) and the p-value is lower than 0.05, which statistically indicates the presence of relationships to support the hypothesized relationships (Nugraha et al., 2022). Demographic factors, in their turn, were first suggested as moderators in this study but could not show any significant moderating effects, which indicates that the correlations between constructs can be considered to be the same across groups of people with different demographic factors (Trinugroho et al., 2022; Table 7).

Table 7. Final pilot path analysis result

	Path Coef	T statistics	P values	Decision
DFS -> DFL	0.105	1.635	0.051	Not supported
DFK -> DFL	0.296	3.183	0.001	Supported
DFA -> DFL	0.214	2.679	0.004	Supported
DFC -> DFL	0.237	2.440	0.007	Supported

The findings of the path analysis showed that three of the four model hypothesized paths (H2, H3 and H4) were significantly positive. DFK had the highest path coefficient of 0.296 ($t = 3.183$, $p < 0.001$) on DFL, then DFC, $\beta = 0.237$ ($t = 2.440$, $p < 0.01$), and followed by $\beta = 0.214$ ($t = 2.679$, $p < 0.01$) on DFL (Kusumawardhani et al., 2023). However, the relationship between DFS and DFL showed marginal significance with a relatively weak path coefficient of 0.105 ($t = 1.635$, $p = 0.051$), suggesting a less influential role than initially hypothesized (Ibrahim et al., 2021; Figure 2).

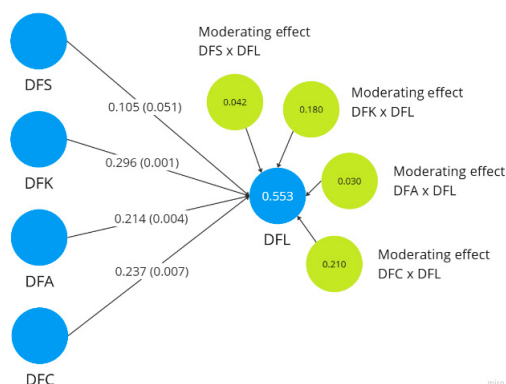


Figure 2. Hypothesis result

5. Discussion

The present study presents paradoxical results that do not support the current belief regarding the digital financial literacy development in emerging economies. Although knowledge is revealed as the most powerful predictor ($\beta = 0.296$, $p = 0.001$), the insignificant direct impact of the adoption of digital financial services ($\beta = 0.105$, $p = 0.051$) is the real contradiction

of the technology-deterministic perspective of the current body of research. In contrast to Sukaris et al. (2021), who established the existence of strong direct correlations between service access and literacy in different settings of emerging economies, the current Indonesian study indicates that simple exposures to the digital financial service do not necessarily lead to better literacy rates. The mediation analysis finds that knowledge is an important mediating variable ($\beta = 0.115$, $p < 0.01$) meaning that the lack of suitable financial knowledge would prevent users to effectively use digital financial services to improve their literacy. This goes against the presumption that access is the driving force of competency building.

The strong impact of financial capability ($\beta = 0.237$, $p = 0.007$) and attitudes ($\beta = 0.214$, $p = 0.004$) indicate the complexity of behaviors that would not be easily adopted in a linear way as suggested by TAM. The intercorrelations with constructs are high, especially that of DFK-DFS (0.819), which is the indication of selection bias that implies that those who have prior knowledge are more probable to adopt services, and it forms a reinforcing cycle that can lock out those who need literacy development the most. This pattern of selection bias critically challenges the prevailing assumption in existing literature that digital financial services universally enhance literacy across all user groups. The demographic moderation effects, particularly education's significant role ($\beta = 0.175$, $p < 0.01$), further reveal that digital financial services may inadvertently exacerbate existing inequalities rather than reducing them, contradicting optimistic projections commonly found in financial inclusion literature.

The weak service-literacy relationship exposes fundamental limitations in infrastructure-first approaches advocated in current policy discourse. Unlike developed economy contexts where infrastructure correlates strongly with literacy outcomes, Indonesia's digital financial landscape shows that trust deficits and usability concerns create barriers that infrastructure expansion cannot overcome. The evidence provided by studies by Budiharseno and Kim (2023) and Trinugroho et al. (2022) in regard to the security and privacy issues in the context of Indonesia, and this research proves by the weak direct relationship between services and literacy. The intermediate explanatory value ($R^2 = 0.691$) shows that, although the traditional predictors are significant, they do not account for much of the variance. This would indicate that contextual aspects that are unique to the socioeconomic and cultural setting of Indonesia have a role that could not be captured through the current theoretical frameworks that were developed in a Western setting. Such results essentially undermine the universal nature of digital financial literacy models and raise the question of the applicability of global best practices. It is possible that emerging economies might need context-based solutions instead of universal solutions that lie behind the present international financial inclusion systems.

6. Theoretical and practical implications

This paper adds to digital financial literacy theory because it disputes the belief that there is a linear relationship between access to technology and the development of literacy. The low direct impact of digital financial services adoption ($\beta = 0.105$, $p = 0.051$) is not related in accordance with Technology Acceptance Model principles and implies that Financial Behavior Theory can be a more appropriate perspective to consider the development of literacy

in emerging economies. The mediation effects via knowledge and capability suggest the evolution of digital financial literacy by having multifaceted behavioral pathways and not only by having direct exposure to technology. This demands a theoretical re-definition that includes such contextual variables peculiar to developing economies and the critique of the generality of models with their origin in the Western context as the main one. The mediocre strength of the model and the subtle correlation between constructs reveal the necessity of multi-faceted approaches that would address different stakeholders. Among financial service providers, this encompasses making digital platforms more accessible through user-friendly designs and simplified interfaces to low-literacy individuals, customer support and incentive-driven approaches, such as rewards to take financial literacy courses (Muat et al., 2025). Learning institutions need to consider digital financial literacy as a part of the curriculum and community outreach program and work with fintech companies and government entities to customize literacy programs to meet the needs of various demographic groups and implement practical training and make digital resources more accessible (Arifin et al., 2023; Akbar & Rahmawati, 2023). Policymakers should tighten the digital financial consumer protection systems to reduce fraud risks, expand state-supported digital literacy programs, particularly in the underserved areas, and invest in infrastructure, such as increasing internet access and lowering the smartphone prices so as to achieve equal access to digital financial services (Trinugroho et al., 2022; Shehadeh et al., 2025). Lastly, the advancements of service design and accessibility must consider the user capabilities and behavioral aspects and make platforms easy to use and user-friendly and the lack of trust is filled with the increased security and transparency, especially in the environment where digital fraud and misinformation are widespread.

7. Conclusions

This paper will offer empirical data about the determinants of Digital Financial Literacy (DFL) in Indonesia, and the results will demonstrate that digital financial knowledge ($\beta = 0.296$, $p = 0.001$) is the strongest predictor, then financial capability ($\beta = 0.237$, $p = 0.007$) and attitudes toward digital finance ($\beta = 0.214$, $p = 0.004$). Conversely, a digital use of financial services has a weak and insignificant impact ($\beta = 0.105$, $p = 0.051$, $f^2 = 0.08$), meaning that the access alone does not guarantee the improvement of literacy. Service use and literacy outcomes are explained by the model 69.1% ($R^2 = 0.691$) and the mediation analysis revealed that financial capability ($\beta = 0.098$, $p < 0.05$) and knowledge ($\beta = 0.115$, $p < 0.01$) are stronger in the indirect relationship between literacy outcomes and service use. Education is a major moderator of the relationship between knowledge and literacy ($\beta = 0.175$, $p < 0.01$) and gender disparities indicate that men have higher relationships between financial capability and literacy ($\beta = 0.192$, $p < 0.05$). Additionally, urban users tend to have a higher knowledge and competency level, and rural customers are more likely to be dependent on non-formal learning and peer pressure (meaning asymmetry in access to formal digital education). These results point to the fact that Indonesia doesn't merely include people digitally based on access to technology, but on education, gender, and geography as well.

Although these insights can be seen to enhance the knowledge of the digital financial environment of Indonesia, this paper is cognisant of a number of limitations that can inform future research. The cross-sectional study prevents causal explanation, hence longitudinal studies to monitor the change in literacy over an extended period. Also, the inclusion of geographically based focus on Java, Sumatra and Kalimantan, which represent most of the people, may not reflect the disparity in literacy in eastern Indonesia where the gap in infrastructure is still alive. Urban-rural and policy intervention variable, along with qualitative approach should be incorporated in the future studies to understand the behavioral and trust-based barriers better, particularly in low-income and rural populations. The localized literacy programs, increased digital infrastructure, and comprehensive service designs should be considered by policy makers and financial institutions that are sensitive to the diverse social-economic realities of Indonesia in order to ensure that the digital financial expansion is reflected into equitable literacy and participation in all parts of the country.

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Author contributions

Sylviana Maya Damayanti conceived the study and was responsible for the design and development of the data analysis framework. Sylviana Maya Damayanti and Arinda Mentari Putri were responsible for data collection and analysis. Aghnia Nadhira Aliya Putri and Fadrian Dwiki Maulanda conducted the literature review and contributed to the methodology development. All authors contributed to data interpretation. Sylviana Maya Damayanti wrote the first draft of the article, with Arinda Mentari Putri, Aghnia Nadhira Aliya Putri, and Fadrian Dwiki Maulanda providing critical revisions to the manuscript. All authors reviewed and approved the final version.

Disclosure statement

The authors declare no competing financial, professional, or personal interests from other parties that could have influenced the work presented in this article.

Data availability statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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