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Determinants of Digital Financial Inclusion in Enhancing Financial Well-being Among Poor Households: Evidence from Malaysia

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ABSTRACT

This study examines the factors influencing financial well-being and investigates the mediating role of digital financial inclusion among households with incomes below the national poverty line in Malaysia. The study used Partial Least Squares Structural Equation Modelling (PLS-SEM) and Importance-Performance Map Analysis (IPMA) to estimate the results. This study collected 1,171 responses and found that digital literacy, digital financial service infrastructure, and financial service providers were determining factors of digital financial inclusion. Financial service providers and digital financial inclusion showed a significant relationship with financial well-being. Mediation analysis showed that digital literacy, digital financial service infrastructure, and financial service providers indirectly affected financial well-being through digital financial inclusion. The results of the IPMA showed that financial service providers and digital financial inclusion were the most important factors in achieving financial well-being. Furthermore, financial service providers were the key factor of digital financial inclusion in high-poverty states, while digital literacy was a key factor in moderate- and low-poverty states. The study offers insights for policymakers working towards an inclusive society and provides financial service providers with information to design services that meet the needs of poor households. This study also offers important implications for other developing countries in Southeast Asia that share similar socio-economic and digital challenges.

Keywords: digital financial inclusion, poor households, financial well-being, Malaysia, SDG1: no poverty
JEL Classification: G210, G51, G53

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INTRODUCTION

Poverty remains a concerning issue in Malaysia. According to Department of Statistics Malaysia (DOSM), households are classified as poor if their incomes are below the national poverty line income (PLI) (DOSM, 2021). Recent data shows that, between 2019 and 2021, the poverty rate increased from 5.6% to 8.2% (DOSM, 2023c), then slightly decreased to 6.2% in 2022 (DOSM, 2023a). Despite this reduction, the growing disparity impedes economic progress, heightens social conflict, and leads to social instability. Hence, addressing poverty issues requires sustained efforts to foster a more inclusive society.

Improving financial well-being through financial inclusion is essential for addressing poverty (SDG 1: No poverty) (Bashir & Qureshi, 2023). An inclusive financial system creates the foundation for building robust and resilient households. Financial well-being is defined as the capacity to fulfil day-to-day financial commitments, remain resilient in coping with income disruptions, achieve future goals, and make informed financial decisions (BNM, 2022). However, a survey found that only 50% of Malaysian working adults were financially resilient, with 28% of them lacking sufficient money to purchase necessities (AKPK, 2018). These issues are also reflected in a survey by OECD, which found that 59.2% of Malaysian respondents were worried about meeting living expenses (OECD, 2020). Despite various efforts undertaken by the government, such as the National Databank of Poverty (Program eKasih), Rahmah Cash Aid (Sumbangan Tunai Rahmah-STR), social protection programmes (Perlindungan Tenang), and Agent Banking initiatives over the years, the financial well-being of many Malaysians remains relatively low. The Financial Capability and Inclusion Demand Side (FCI) 2024 survey, conducted by the Central Bank of Malaysia (Bank Negara Malaysia-BNM), continues to highlight the persistent financial vulnerability among Malaysians. More than half of Malaysians (63%) reported that they could not cover their living costs for three months if their incomes were disrupted, while 61% indicated difficulty in securing a RM1,000 emergency fund (BNM, 2024). The survey also revealed low digital literacy and a lack of awareness of website security among Malaysians, especially among the poor, who are more likely to earn irregular income and have insufficient savings. This evidence highlights the urgent need to enhance financial well-being to achieve a more inclusive and sustainable society.

Digital financial inclusion (DIC) has proven to be more effective than traditional methods in enhancing poor households' financial well-being (Ozili, 2018). Technologies like artificial intelligence, big data, cloud computing, 5G, blockchains, and the Internet of Things ensure financial service providers have more accurate risk control and facilitate tailored, affordable services for poor households. The World Bank (2014) explains that digital financial inclusion is the provision of formal financial services through digital channels to underserved and excluded population at an affordable cost and in a sustainable manner for providers. It is vital for poverty reduction, as the poor are often excluded from the financial system due to low-income restrictions, as well as a lack of collateral and documentation (Zhou & Wang, 2021). In Malaysia, poor households have a higher likelihood of being an underserved and unserved population that requires immediate action from the Malaysian government. They face limited geographical accessibility, difficulties in conducting digital transactions, inadequate documentation, and low financial literacy (BNM, 2023). These challenges prevent them from completely utilising the financial services.

While relevant literature on digital financial inclusion has focused on countries

like India (Gupte et al., 2012; Sehrawat et al., 2021; Sharma, 2016), Indonesia (Alwahidin et al., 2023; Faturohman et al., 2024), and various African nations (Bongomin et al., 2018; Kass-Hanna et al., 2022; Ketu, 2023; Kouladoum et al., 2022; Lyons et al., 2020; Lyons & Kass-Hanna, 2021; Matita & Chauma, 2020; Nsiah et al., 2021), Malaysia presents a distinct case. According to the Department of Statistics Malaysia (DOSM, 2025), the ICT Access by Households 2024 survey reported that mobile phone ownership in Malaysia was 99.5% with 97.9% owning smartphone. Internet access reached 98.8% in urban areas and 90.3% in rural areas. Supporting this, the Malaysian Communications and Multimedia Commission (MCMC) (MCMC, 2021) reported that the mobile phone penetration rate exceeds 90% among those who earn below RM1,000 and between RM1,000–RM3,000. This suggests strong potential for digital financial services (e.g., internet banking, mobile banking, digital payments, digital banking) to enhance the financial well-being of poor households in Malaysia. In contrast, many African nations rely on basic mobile phones with limited internet functionality to access financial services such as M-PESA in Kenya (Jack & Suri, 2011). Although India also recorded high smartphone ownership, they continue to face significant disparities and digital divide between urban and rural areas in achieving digital financial inclusion, highlighting the need to enhance financial education and promote greater social inclusion (Malladi et al., 2021). Meanwhile, Indonesia faces different challenges. Indonesia has accelerated the utilisation of digital technologies; however, the adoption of digital financial services remains limited, with 48% of the population financially excluded and, among the 52% with access to accounts, only 9% actively use digital financial services. This may be due to weaker internet quality and affordability compared to neighbouring countries (The World Bank, 2021). These contrasts position Malaysia as a unique context of investigation. Despite high ICT penetration, engagement in banking activities remains the lowest among other internet activities. This highlights the unique challenges Malaysia faces, particularly the gap between access to technology and the usage of financial services among poor households. Therefore, a holistic approach to promoting digital financial inclusion is needed to effectively improve the financial well-being of poor households in Malaysia.

Financial well-being is influenced by various determinants, as shown in past studies. Notably, the individual-level factors such as financial literacy, financial knowledge, financial behaviour (Mahdzan et al., 2019; Rahman et al., 2021; Sehrawat et al., 2021; Selvia et al., 2021), financial stress (Mahdzan et al., 2019; Rahman et al., 2021), locus of control (Mahdzan et al., 2019), and financial inclusion (Selvia et al., 2021) have been examined in most studies. However, the findings remain mixed and contradictory. There is also a lack of studies focusing on community-level factors from the supply-side, such as the role of financial institutions (Bashir & Qureshi, 2023).

Moreover, research linking financial inclusion with poverty alleviation has concentrated on traditional financial services. The identified variables included access (Aziz & Naima, 2021), availability (Aziz & Naima, 2021; Sharma, 2016), usage (Ahamed & Mallick, 2019; Gupte et al., 2012), penetration (Sharma, 2016), outreach (Ahamed & Mallick, 2019; Gupte et al., 2012), ease of transactions (Gupte et al., 2012), financial literacy (Aziz & Naima, 2021; Selvia et al., 2021; Vaid et al., 2020), and affordability (Aziz & Naima, 2021). In the digital financial ecosystem, digital financial services are more inclusive and effective in achieving financial inclusion (OECD, 2016). Digital financial inclusion has been found to act as a mediator in promoting economic growth (Liu et al., 2021).

This study builds on existing literature by exploring how digital financial inclusion mediates the relationship between the demand-side factors (financial literacy and digital literacy) and supply-side factors (digital financial service infrastructure and financial service providers) in affecting financial well-being of poor households in Malaysia. Both demand- and supply-side factors are crucial in shaping poor households' behaviour, influencing their decisions, and creating pathway to reduce poverty.

Our research offers several key contributions. First, by integrating both demand- and supply-side perspectives into a framework, this study provides a more comprehensive understanding of digital financial inclusion that supports financial well-being. Second, the use of importance-performance map analysis (IPMA) allows us to assess the importance and performance of these factors. This analysis assists policymakers in designing targeted interventions and developing strategies aimed at improving digital financial inclusion and enhancing the financial well-being of poor households in Malaysia.

Third, while Mahdzan et al. (2019) and Rahman et al. (2021) have examined financial well-being across high-income (Top 20%), middle-income (Middle 40%), and low-income (Bottom 40%) groups in Malaysia, and Sabri et al. (2025) investigated the low-income young adults, our study takes a closer look at a specific subset of the B40 group-households living below the national poverty line. Unlike the general B40, these households encounter unique challenges related to financial stability. They are also the primary target of Malaysia's national development agenda such as the Twelfth Malaysia Plan (RMK-12) and the Malaysian Financial Sector Blueprint 2022-2026, which aims to foster a prosperous, inclusive, and sustainable society through improved financial well-being and the digital transformation of the financial sector.

This agenda aligns closely with the United Nation Sustainable Development Goal 1 (No poverty). Thus, this investigation is important because these households are the primary target of Malaysia's economic development plan aimed at building an inclusive society. Being included in the financial system provides them with tools, resources and opportunities to pursue financial security and a more promising future. This study contributes new insights into how digital financial inclusion can be better designed and support this vulnerable group and offers valuable insights for poverty eradication strategies.

Findings of the present study offer valuable insight for policymakers in achieving the national agenda of building an inclusive society and a digitally inclusive society through targeted interventions for states with varying poverty rates. Our findings also provide financial service providers with valuable information for designing services that satisfy the financial needs of poor households. This study also offers important implications for other developing countries in Southeast Asia that share similar socio-economic and digital challenges.

The paper is organised as follows: Section 2 reviews the literature, Section 3 details the research methodology, Section 4 and 5 presents the results and discusses the findings. Sections 6 concludes the paper. Sections 7 and 8 cover implications, limitations and future research recommendations.

LITERATURE REVIEW

This section reviews the existing literature with the aim of establishing a conceptual foundation for understanding the relationships among the variables examined in this study.

It begins with an overview of the theoretical review of the Digital Divide Theory and the Family Resource Management Theory, followed by an empirical review of financial well-being (FW), digital financial inclusion (DIC), financial literacy (FIL), digital literacy (DIL), digital financial services infrastructure (INF), and financial service providers (FSP).

Theoretical Review

Poor households remain among the most unserved and underserved segments of the population in Malaysia. According to the Financial Inclusion Framework 2023-2026, the Central Bank of Malaysia (BNM, 2023) highlighted that they face unique challenges, such as limited geographical accessibility (i.e., residing in areas distant from financial institutions), digital financial exclusion (e.g., digital divide, residing in areas with poor digital connectivity), and difficulties in obtaining financial services given their risk profile (i.e., lack of documentation, irregular income). These barriers make it difficult for them to be included in the financial system and to achieve financial stability.

These challenges indicate that poor households in Malaysia are not only facing limited access to formal financial institutions but also structural and digital inequalities. This situation can be understood through the lens of the Digital Divide Theory, which explains the gap between people who have access to digital technologies and those who do not (Van Dijk, 2017). The digital divide refers to not only the physical lack of access to digital tools, such as devices for accessing digital financial services and internet connectivity, but also to a continuing process of obtaining access to updated devices, stable Internet connections, as well as skills and competencies to effectively use these technologies. Poor households, particularly those residing in rural areas, often face economic constraints, limited INF, a lack of financial access points, and have insufficient knowledge to use digital financial tools. Learning to operate and understand digital technologies are steps towards the actual use of digital financial services, thereby enhancing DIC. However, digital divide creates inequalities in society that lead to an unequal distribution of resources, resulting in unequal access to digital technologies and unequal participation in society.

In Malaysia, the urban-rural digital divide remains a significant challenge to achieving DIC (Gong & Mohd Ghazali, 2023). Although Malaysia has reported high levels of household ICT access (DOSM, 2025), the statistics do not account for the affordability or the quality of internet connections (Gong & Mohd Ghazali, 2023). Additionally, individuals with lower financial literacy, particularly those from rural and low-income households, remain unserved or underserved by the banking system (Gong & Hollins-Kirk, 2022). Addressing the digital divide by improving network speed, service quality, and reliable internet connectivity, especially in rural and remote areas, is essential for expanding digital connectivity access to digital financial services. Digital Divide Theory provides a lens to understand how disparities in demand-side (DIL and FIL) and supply-side (INF and FSP) affect poor households' ability to participate in digital financial systems and achieve FW.

According to Sen's Capability Approach (Sen, 1999), poverty is not only a lack of income but also represents a deprivation of capabilities, namely the real freedoms and opportunities to make choices and achieve meaningful well-being. Hence, development involves the expansion of these capabilities to allow them to escape from their current conditions. In the context of this study, capabilities refer to the ability of poor households to participate meaningfully in the financial system and to manage their limited resources

more effectively through digital finance in order to improve their financial well-being.

This study utilises the Family Resource Management Theory as a foundational framework to understand how poor households achieve financial well-being in a digital financial environment. The theory posits that a family's financial decisions can be explained through a system-oriented approach (Deacon & Firebaugh, 1988). This theory identifies three main components in how a family manages their resources and achieves goals, namely inputs, throughputs, and outputs.

Prior studies have utilised the Family Resource Management Theory to explain financial-related issues. Inputs are the demand and resources, such as social status, self-control, locus of control, financial literacy (Sehrawat et al., 2021), money attitude, financial knowledge (Wijekoon et al., 2022), income, saving, education (Gutter & Copur, 2011), financial standing, parents' education, ethnicity, and immigration background (Mimura et al., 2019). These variables have been defined in past studies. Throughputs refer to the process of planning and action taken to achieve goals by transforming the inputs into measurable outputs. They have been defined through various variables, such as financial knowledge (Mimura et al., 2019) and financial behaviour (Gutter & Copur, 2011; Sehrawat et al., 2021; Wijekoon et al., 2022). Lastly, outputs refer to the outcomes of planning and action taken that are produced through the managerial system, such as financial well-being (Gutter & Copur, 2011; Sehrawat et al., 2021), financial practices (Mimura et al., 2019), and economic well-being (Wijekoon et al., 2022).

In this study, the inputs consist of demand-side factors (FIL and DIL) and supply-side factors (INF and FSP), which are the resources and capabilities that enable poor households to enter the digital financial system. The throughput is represented by DIC, which reflects the process through which poor households apply the resources to access and use digital financial services, such as mobile banking, online banking, and e-wallets. This stage involves decision-making, learning, and adopting digital tools in their financial transactions and management based on the resources, knowledge, and skills they possess. The output of this study is FW, which is the desired outcome of utilising the demand- and supply-factors through DIC. When households possess the required financial and digital skills and have access to necessary resources and support, they can effectively engage in digital financial service to better manage their finances and make informed financial decisions, which ultimately enhances their FW. Figure 1 illustrates the proposed research framework.

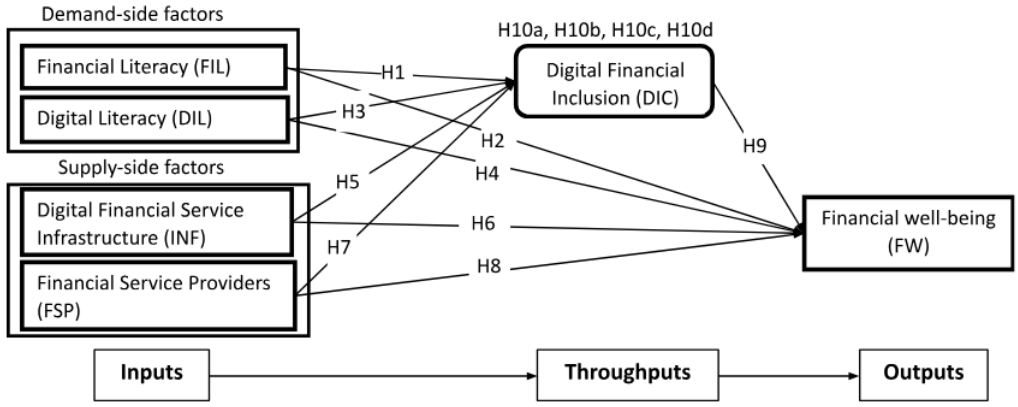

Figure 1. Research framework

Financial Well-being (FW)

FW is essential for poor households to escape from poverty. FW signifies the ability to achieve financial security, fulfill present and ongoing financial obligations, and improve a person's quality of life through sound financial decisions (BNM, 2022; CFPB, 2017). FW can be gauged from two perspectives: objective and subjective (Mahdzan et al., 2023b). Objective FW considers a person's financial assets and liabilities such as income level, savings, debt level, and investment, whereas subjective FW gauges a person's perception of their financial situation.

This study examines subjective FW as it provides a dynamic view that encompasses satisfaction, perceptions, and personal understanding of financial aspects, which is important for understanding individuals' reactions about their financial condition (Sajid et al., 2024). FW is conceptualised as output, drawing on the Family Resource Management Theory.

Financial Literacy (FIL)

In today's complex financial landscape, FIL is fundamental to financial inclusion (Khan et al., 2022). According to OECD (2016), FIL is a set of knowledge, skills, attitudes, and behaviours essential for making wise financial decisions to achieve FW. The Financial Literacy Framework highlights that financially literate individuals can access and use financial services effectively, meet immediate financial requirements, and plan financial goals (Atkinson & Messy, 2012). However, it shows that individuals with lower income levels are more likely to have lower FIL, which limits their ability to manage finances prudently and live within their means.

Existing literature indicates that FIL facilitates financial decision-making process, supports the effectiveness of the financial system, and enhances financial inclusion Grohmann & Hamdan, 2024). Empirical evidence shows that a higher FIL level strengthens the impact of financial depth and significantly influences financial inclusion (Grohmann & Hamdan, 2024; Lusardi & Mitchell, 2014; Jamison, 2014; Khan et al., 2022). FIL increases individuals' willingness to engage in the financial system (Ozili, 2020) and supports poverty reduction initiative (Peng & Mao, 2023). These findings suggest that FIL equips poor households with the awareness and ability to access and use digital financial services and thereby promotes DIC.

Moreover, past studies have shown a positive correlation between FIL and FW (Bongomin et al., 2018; Heriyati et al., 2024; Rahman et al., 2021; Sajid et al., 2024). People with higher FIL can better manage their finances. They have awareness of how to avoid excessive processing costs and interest rates on loans, and to borrow within their means, which enhances their savings (Lusardi & Tufano, 2015). However, low-income and low-education groups often exhibit lower FIL levels (Dvorak & Hanley, 2010), hindering their ability to benefit from financial services (Lyons et al., 2019). Although Bongomin et al. (2016) found that FIL does not influence financial inclusion among poor households in Uganda, they argued that social capital is crucial for poor households in utilising FIL to achieve financial inclusion. This is because strong social networks can build trust and shared knowledge. Putnam (2000) defines social capital as networks, norms, and trust that facilitate cooperation for mutual benefit. He suggests that social capital can positively influence educational outcomes and contribute to economic development by strengthening community ties and trust. Strong social connections and networks create an environment

for economic cooperation and information sharing. This is corroborated by the study by Woolcock (2001), which shows how microenterprise programmes leverage social relationships as collateral, allowing poor group to participate in the financial system. This highlights that social capital acts as a bridge in helping poor households engage in the financial system. Similarly, some studies have showed no association between FIL and FW (Shim et al., 2009), while others have showed negative correlations (Mahdzan et al., 2023a). These inconclusive results may suggest that the relationship between FIL and FW needs further investigation, particularly in the context of poor households in Malaysia.

To fill the gap in the mixed evidence, this study measures FIL among poor households by assessing their knowledge-based numeracy, understanding, and knowledge of financial concepts. By focusing on the poor households in Malaysia, this study enriches the literature on how FIL influences DIC and FW. Drawing on the Family Resource Management Theory, FIL is conceptualised as an input that enables poor households to make informed financial decisions and facilitates access to digital financial services. Accordingly, we hypothesise that

H1: FIL positively influences DIC.
H2: FIL positively influences FW.

Digital Literacy (DIL)

Digital financial services are increasingly important in the digital economy for deepening financial inclusion and expanding outreach to the financial system (Alliance for Financial Inclusion, 2021). According to the Technology Acceptance Model (TAM), individuals who believes that using a particular system is beneficial and easy to use are more likely to accept and use the technology (Davis, 1989). However, poor households with lower level of digital literacy and limited awareness of online security (BNM, 2024) may lack confidence and perceive digital financial transactions as difficult to perform. To effectively use digital financial services, individuals need to possess digital knowledge and skills for conducting transactions and operating devices.

Kass-Hanna et al. (2022) define DIL as the ability to access and use a mobile phone and the internet to operate digital financial services. They measured DIL with mobile technology access, mobile phone proficiency, and mobile money proficiency in building financial resilience for the vulnerable population of South Asia and Sub-Saharan Africa. Meanwhile, Alkhwaldi (2024) explains that people with a good level of DIL are well-informed and can effectively use fintech for better financial management. It is also mentioned that countries promoting DIC, such as Kenya, show higher DIL levels. They tend to be banked and have more financial transactions and savings (Jack & Suri, 2011; Mujeri & Azam, 2018). Bongomin et al. (2024) further explained that DIL equips the poor with the skills to use financial technologies such as biometrics and mobile money, enabling them to fully take advantage of the opportunities and minimise the risks brought by fintech. They found that DIL has an interaction effect between these technologies and DIC. When the unbanked poor women, youth, and person with disabilities in rural Uganda are digitally literate, they are more confident in effectively utilising financial services and mobile money using biometric technology.

Furthermore, DIL is crucial in digital environments, as it enables people to make better financial decisions when using digital financial services. This has been proven in

past studies that show proliferation of digital technology promotes household savings behaviour. Ouma et al. (2017) found that the ability to use mobile phones for financial transactions increases the likelihood of saving due to the frequency and convenience in using digital financial services. Brüggen et al. (2017) explained that maintaining a healthy balance in spending and saving is crucial for financial well-being. While digital financial literacy is frequently discussed in the literature, we argue that examining DIL as a separate construct provide a deeper understanding of how this skill independently contributes to financial outcomes. This is crucial, as low DIL among marginalised populations remains a barrier to utilising digital financial services (Aziz & Naima, 2021), even though it is a driver for developing inclusiveness and financial resilience (Lyons et al., 2020).

Malaysia is transitioning into a digital economy, yet digital literacy has received relatively limited attention in finance research (Lyons et al., 2020). To address the limited exploration of DIL in the context of poor households in Malaysia, we extend the investigation by exploring the effects of DIL on both DIC and FW. In this study, DIL refers to the digital awareness, knowledge, and skills needed for carrying out digital financial transactions. Given the important role of DIL in the digital financial ecosystem, DIL is conceptualised as an input, drawing on the Family Resource Management Theory. DIL enables individuals to participate and manage their finances effectively. We hypothesise that

H3: DIL positively influences DIC.
H4: DIL positively influences FW.

Digital Financial Service Infrastructure (INF)

INF, both general and digital financial, is essential for establishing a secure and reliable financial system (Demirguc-Kunt et al., 2017; Ediagbonya & Tioluwani, 2023; Ozili, 2018). The effectiveness and efficiency of digital financial service, such as digital payment, online banking, and mobile banking, rely on robust information communication technology (ICT) and identification (ID) system. General INF, including reliable internet connectivity and network, is necessary for real-time financial transactions and secure data transmission, while digital financial INF, such as interoperable and digital ID systems, is crucial for user authentication, information verification, and fraud prevention.

However, the absence of adequate INF can hinder poor households' ability to benefit from expanding financial services (Demir et al., 2022; Peng & Mao, 2023). For instance, Suhrab et al. (2024) found that well-established INF is correlated with higher DIC and reduced income inequality. INF enhances better access to digital financial services, especially in rural areas (Lyons et al., 2019). Al-Afeef & Alsmadi (2025) found that enhancing DIL is important for promoting financial inclusion, which supports people in making better financial choices and improving their FW.

Extensive studies have found that infrastructure development boosts well-being and contributes to quality of life (Gardoni & Murphy, 2020; Ketu, 2023). Despite these findings, limited attention has been given to the role of INF in supporting FW, which overlooks how digital financial service INF affects poor households in accessing and benefiting from digital financial services.

In this study, INF encompasses the general infrastructure of digital devices and internet connectivity, as well as the digital financial INF of the ID system and access points. The theoretical arguments above emphasise that well-established INF enhances accessibil-

ity to digital financial services, thereby contributing to better FW. Drawing on the Family Resource Management Theory, INF is conceptualised as an input that supports households' ability to engage with digital financial services. Hence, we hypothesise that

H5: INF positively influences DIC.
H6: INF positively influences FW.

Financial Service Providers (FSP)

FSP, which includes banks, financial institutions, and fintech companies, are driving the prominence of digital financial services, creating a dynamic and inclusive financial ecosystem. Services such as online banking, mobile banking, e-wallets, digital payments, and robo-advisors have transformed how people manage their finances, promoting DIC (Thathsarani et al., 2021).

FSP is pivotal in providing formal financial services to vulnerable groups (Ozili, 2020). They carry the responsibility of understanding these groups' unique needs and continuously enhance digital financial services in order to bring them into the financial system. A working paper from IMF found that quality of financial institutions is one of the key drivers of DIC (Khera et al., 2021). Furthermore, FSP plays a crucial role in enhancing FW. Ozili (2022b) identifies three key functions of FSP in fostering FW, which are a digital transactional platform, an agency network, and the customer's access device. Additionally, Losada-Otalora et al. (2020) showed that the role of banks in providing information transparency uplifts the FW of customers, as the high-quality information from bank helps customers make better financial decisions.

Existing studies that examine the role of financial institutions mainly focus on quantitative metrics such as the number of bank branches, ATMs, and bank accounts per capita (Khera et al., 2021; Nsiah et al., 2021). In this digital financial ecosystem, these measures overlook the functional role of FSP in supporting digital engagement. In this study, drawing on the Family Resource Management Theory, FSP is conceptualised as an input. It refers to banks and non-bank financial institutions that offer digital financial services to the poor through channels like online/mobile banking and e-wallets. Considering the theoretical foundation for the role of FSP in enhancing DIC and FW, this study addresses the gap and hypothesises that

H7: FSP positively influences DIC.
H8: FSP positively influences FW.

Digital Financial Inclusion (DIC)

The evolution of the financial service landscape contributes to the increase in DIC. DIC aims to bridge the gaps for underserved and unbanked populations, enabling their participation in the financial system through digital financial services. DIC is generally defined as efforts to extend formal financial services to the excluded and underserved populations through digital means. Ozili (2022a) highlights it as the sustainable provision of affordable digital financial services that bring the poor into the formal financial sector of the economy. The CGAP, a global partnership based at the World Bank (CGAP, 2015) defined it as digital access to and use of formal financial services by the excluded and underserved populations. Meanwhile The World Bank (2014) defined DIC as the deployment of digital

channels to deliver a wide range of formal financial services that meet the financial needs of financially excluded and underserved populations at a cost affordable to customers and sustainable for providers. Ediagbonya & Tioluwani (2023) explain that fintech provides platforms that allow people to engage in transactions such as buying and selling goods online through mobile phones from their homes and to carry out banking activities using mobile apps to manage their finance. These technologies have enabled a large number of Nigerians to access and benefit from digital financial services and contribute to a better quality of life. Digital financial services have the potential to improve FW by being more inclusive and effective in reaching the excluded population (Lee et al., 2023; OECD, 2016). Jiang et al. (2024) highlight the role of DIC in enhancing people's consumption levels, driving economic growth by improving their FW among the rural populations of China.

Access to banking services is strongly associated with poverty reduction, as it provides better financial management, increases resilience against financial shocks, and improves well-being (The World Bank, 2018). Demir et al. (2022) highlight that digital financial services are the key catalyst for inclusion, helping poor households become financially independent. Lyons et al. (2020) found that DIC significantly reduces poverty in developing countries. In regions such as South Asia and Sub-Saharan Africa, where large unbanked populations have embraced digital financial services, financial inclusion rates have increased (Kass-Hanna et al., 2022; Peng & Mao, 2023). The most successful mobile phone-based financial service, M-PESA, allows users to deposit money into an account stored on their mobile phones, send money to other users via SMS technology, and redeem deposits for regular money (Jack & Suri, 2011). This service has significantly increased financial accessibility and has positively impacted savings and investment behaviour in Kenya. DIC enhances participation in financial markets, promotes wealth accumulation, and helps prevent poverty (Peng & Mao, 2023). Furthermore, Liu et al. (2021) investigated the mediating role of DIC in fostering economic growth by supporting small and medium enterprises and encouraging consumer spending in China.

Past studies have employed different methods to measure DIC. Peng and Mao (2023) used the Digital Financial Inclusion Index developed by Peking University, which comprises dimensions of breath, depth of use, and digital support of financial services. In contrast, Kass-Hanna et al. (2022) used a survey questionnaire adapted from the Financial Services for the Poor program at the Bill & Melinda Gates Foundation, focusing on the adoption and usage of traditional and digital financial services in the developing countries among the poor, rural and unbanked populations. Meanwhile, the Global Findex database measures DIC based on the usage of mobile phone for financial activities such as payments, savings and borrowing (Global Findex Questionnaire, 2017).

Despite the growing significant role of DIC in the digital financial ecosystem, most past studies primarily examined the direct impacts of DIC on FW (Peng & Mao, 2023) and subjective well-being (Lei et al., 2023), with limited investigations into its mediating role in the FW framework, particularly among poor households. We argue that equipping poor households with financial and digital skills and knowledge, supported by well-established INF and the active role of FSP, will better include them in the financial system, allowing them to use and benefit from digital financial services, and realise higher levels of FW. This is important to gain a deeper understanding of how DIC creates a pathway for FIL, DIL, INF, and FSP in influencing FW.

While DIC has been examined by past studies in South Asian countries (i.e., Bangladesh, India and Pakistan) and Sub-Saharan African countries (i.e., Nigeria, Tanzania

and Uganda) (Kass-Hanna et al., 2022; Kouladoum et al., 2022), Kenya (Mulili, 2022), as well as in Indonesia (Alwahidin et al., 2023), the operationalisations of DIC in these countries were different from the context of Malaysia. For example, the greater achievements of DIC in Kenya, South Asia, and Sub-Saharan Africa were driven by mobile money services introduced by mobile network operators. In Indonesia, the success of DIC was achieved through the expansion of digital wallets and e-commerce platforms. In Malaysia, there is a high smartphone penetration rate among poor households. Addressing barriers related to FIL and DIL, improving INF, as well as strengthening the role of FSP could contribute to DIC and, in turn, enhance FW among poor households in Malaysia.

In this study, DIC is conceptualised as a throughput drawing on the Family Resource Management Theory. It refers to the ability of poor households to use digital financial services, including online/mobile banking and e-wallets, to meet their financial needs. To fill the gap, we investigate the mediating role of DIC in achieving FW, developing the following hypotheses:

H9: DIC positively influences FW.
H10a: DIC mediates the relationship between FIL and FW.
H10b: DIC mediates the relationship between DIL and FW.
H10c: DIC mediates the relationship between INF and FW.
H10d: DIC mediates the relationship between FSP and FW.

Furthermore, the issues of endogeneity have been widely acknowledged in studies examining FIL and DIC. Past studies, such as Bucher-Koenen and Lusardi (2011) and Behrman et al. (2012), have highlighted causality concerns related to FIL. Bucher-Koenen and Lusardi (2011) raised the possibility of a bidirectional relationship between FIL and financial retirement. By using financial knowledge as an instrumental variable, their study confirmed that FIL has a positive and significant effect on financial retirement. Meanwhile, Behrman et al. (2012) raised concerns about whether FIL or schooling is more influential in wealth accumulation and found that FIL plays a crucial role in enhancing wealth accumulation.

Similarly, studies on DIC have applied instrumental variable approaches to address endogeneity. Geng and He (2021) examined how DIC influences sustainable employment in China, using internet penetration as an instrumental variable. They confirmed the role of DIC in promoting sustainable employment. Similarly, Liu et al. (2024) investigated the relationship between DIC and household financial vulnerability. They used the average value of the digital financial inclusion index of neighbouring areas within the same city as an instrumental variable and found that DIC significantly reduces household financial vulnerability.

Despite the growing literature on DIC and FW, several research gaps remain. Although previous studies have examined these issues in Malaysia (Mahdzan et al., 2019; Rahman et al., 2021; Sabri et al., 2025), limited attention has been given to the population earning below national poverty line. This group remains underexplored in existing literature despite being the focus of the Malaysian government's national economic development policies. Furthermore, from the above discussion, it is also observed that past studies present inconclusive findings on how these factors affect DIC and FW. Additionally, the indicators used to measure variables such as DIC and the operationalisation of DIC in the Malaysian context are different from those used in other countries. Addressing these

research gaps is crucial for deepening the understanding of how DIC supports FW and for offering insights that aligns with Malaysia's aspiration to achieve a digital economy by 2030.

Overall, this study enriches the literature by extending the FW framework through an exploration of the mediating role of DIC in the relationships between demand-side factors (FIL and DIL) and supply-side factors (INF and FSP) in influencing the FW of poor households in Malaysia.

METHODS

Sample and Data

This quantitative research employed data from a cross-sectional survey targeting poor households in Malaysia. A poor household is defined as a household with a monthly income that falls below Malaysia's national poverty line income (PLI). Although the Department of Statistics Malaysia (DOSM) has defined different PLIs across states in Malaysia, this study used the average Malaysian PLI to define poor households (DOSM, 2021). At the time the research was conducted, the national PLI was RM2,208.

This study collected data across Malaysia using a non-probability purposive sampling technique. This technique is cost-effective and allows researchers to collect data from the most apropriate subjects, reducing sampling error (Obilor, 2023). The sample was collected through collaboration with a Malaysian government agency – KEMAS (Community Development Department under the Ministry of Rural and Regional Development). KEMAS actively supports the low-income households nationwide through various community and educational programs. The respondents of this study were participants of KEMAS programmes, specifically those from poor and low-income households. The minimum sample size required in this study was 384, following Krejcie and Morgan (1970) guidelines, based on a population over 1 million, with a 5% margin of error at a 95% confidence level. This study successfully collected 1,171 responses from December 2022 to October 2023.

We employed quota sampling based on the state-level poverty rate presented in Figure 2 to ensure representation across these regions. This total sample was segregated into three groups based on the poverty rate presented in Figure 2: high, moderate, and low. States classified as 'high' (over 20% poverty rate) include Sabah and Kelantan; 'moderate' (10%-20% poverty rate) include Sarawak, Kedah, Terengganu, and Perak; and 'low' (below 10% poverty rate) include Perlis, Pahang, Negeri Sembilan, Melaka, Johor, W.P. Labuan, Pulau Pinang, Selangor, W.P. Kuala Lumpur, and W.P. Putrajaya. The distinction highlights the disparities in wealth, income, education, and infrastructure, reflecting uneven development across the country, as pointed out by the Economic Affairs Minister (FMT, 2022).

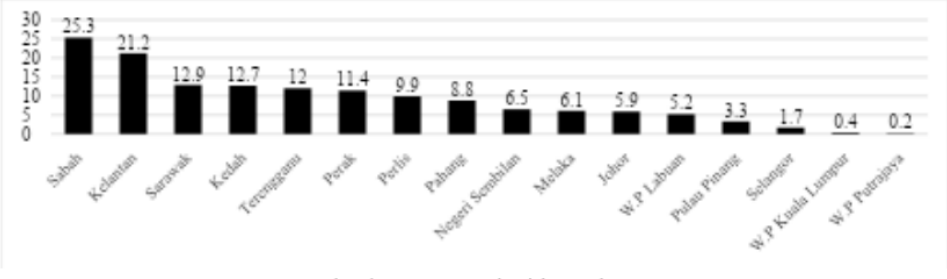

Figure 2. Absolute poverty incidence by state 2020
Source: DOSM, 2021

The self-administered questionnaires were distributed by enumerators. The questions were explained before the respondents answered. The respondents gave consent to participate in the survey and were informed of its purpose.

Measurement of Variables

The constructs of this study are extracted from the literature review, comprising six latent variables: FW, DIC, FIL, DIL, INF, and FSP. Academicians and industry practitioners in the field of financial management reviewed the questionnaire to establish face and content validity. The review ensures the items in the questionnaire were culturally appropriate and relevant to the Malaysian poor households' context. A pilot test with 33 respondents from the target population showed high internal consistency and reliability, with Cronbach's alpha ranging from 0.707 to 0.868, which is above the acceptable threshold of 0.7.

Items for the measured variables were adapted from previous studies and adjusted to fit the specifics of this investigation. Respondents were asked to rate their agreement levels with each item on a 5-point Likert scale, except for FIL, ranging from strongly disagree (1) to strongly agree (5). For FIL, respondents were given a score of one (1) point for a correct answer and zero (0) point for an incorrect answer or a blank. The percentage of items answered correctly determined respondents' financial literacy levels, which range from low FIL (1) to high FIL (5).

FW is the dependent variable of this study. A financial behaviour survey by the Credit Counselling and Debt Management Agency (AKPK) (AKPK, 2018) defines FW with three dimensions, namely the ability to meet financial commitments, satisfaction with the current financial situation, and financial resilience. In this study, respondents were required to rate their agreement levels on five statements adapted from the AKPK (2018) survey to assess FW, covering aspects such as respondents' financial position in covering living expenses, not relying on borrowing for essential needs, and satisfaction with their financial condition.

DIC is the mediating variable of this study. The interest of researchers in examining DIC is still growing. This study adapted the items from the Global Findex Questionnaire (2017), which measures financial inclusion and the Fintech revolution, including usage of mobile phones for payments, savings, and borrowing. Seven items were developed in this study to cover aspects of accessing and utilising digital financial services for payment, borrowing, insurance, and investment.

FIL is the first explanatory variable in this study. FIL can be divided into two categories, namely financial knowledge and financial application (Huston, 2010). According

to Rahman et al. (2021), poor households may have limited access to financial applications; therefore, measuring FIL based on financial knowledge is more appropriate for this population. Following Rahman et al. (2021), this study focused on financial knowledge to measured FIL. A total of five financial knowledge-based questions were adapted from the OECD (2022) that assessed general financial concepts, interest on loans, investments, and savings.

The second explanatory variable is DIL. Kass-Hanna et al. (2022) measured DIL with three dimensions, which are mobile technology access, mobile phone proficiency, and mobile money proficiency. This study developed seven items adapted from Kass-Hanna et al. (2022) to measure the DIL of the respondents. The aspects assessed include proficiency in using smartphones for financial transactions, proficiency in operating digital financial services, and security awareness.

The third explanatory variable is INF. Infrastructure, such as communication network, interoperable system, and financial service system, is a core component that determines the efficiency of digital financial service (Ediagbonya & Tioluwani, 2023; Ozili, 2018). This study developed ten items to measure INF by adapting the dimension of facilitating conditions of the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). Facilitating conditions are defined as the perception of an individual of the technical infrastructure that supports the use of the system. The items of facilitating conditions have been modified for the context of this study, covering aspects of devices, Internet connectivity, and financial services system of digital financial services.

The last explanatory variable is FSP. They are defined as agents that are expected to understand financial needs and work towards promoting inclusivity (Ozili, 2020). A study by Vaid et al. (2020) used the dimensions of outreach, penetration, availability, accessibility, and technology to measure the efforts taken by financial institutions in financial inclusion. Six items adapted from Vaid et al. (2020) assessed the role of FSP regarding accessibility, outreach, and affordability of digital financial services.

Analysis of Data

Structural Equation Modeling (SEM) has been widely used in past studies to examine financial outcomes (Chatterjee et al., 2019), with the partial least squares structural equation model (PLS-SEM) gaining traction in recent research on financial well-being (Faturohman et al., 2024; Kumar et al., 2023b; Lu et al., 2024) and financial behaviour (Dewi et al., 2025; Sabri et al., 2021). PLS-SEM is considered the most appropriate approach for this study, as it is suited to explanatory studies (Le, 2023) and has strengths in prediction and explanation (Hair et al., 2019; Kumar et al., 2023b). Furthermore, PLS-SEM imposes fewer distributional assumptions, which is often not realistic in social science research (Hair et al., 2019). Following past studies, the models of this study were analysed using PLS-SEM. The primary objective was to examine the factors influencing FW and to investigate the mediating role of DIC. A two-step approach was adopted to assess the measurement and structural models (Anderson et al., 1988). The measurement model evaluated the validity and reliability of the instruments, while the structural model assessed the study's hypotheses (Hair et al., 2019). Meanwhile, the mediation analysis in this study follows the statistical procedures recommended by Sarstedt et al. (2020). Compared to traditional mediation approaches such as the approach by Baron and Kenny and Hayes' PROCESS model, PLS-SEM estimates the entire structural model relationships simultaneously. It uses an iterative

process that considers the entire model structure, which provides a more comprehensive estimation of indirect effects. PLS-SEM is also more flexible in terms of data distribution assumptions (Nitzl, 2016) and offers higher statistical power and robustness (Hair et al., 2017; Hair et al., 2019).

To examine the variations among the high-, moderate-, and low-poverty groups, a multigroup analysis was conducted. Following the recommendation of Henseler et al. (2016), the measurement invariance of composites (MICOM) was assessed before performing the multigroup analysis. Additionally, an importance-performance map analysis (IPMA) was conducted to further identify key areas for action by evaluating the constructs based on their importance and performance (Ringle & Sarstedt, 2016). IPMA highlights strengths and weaknesses by focusing on constructs with high importance but low performance, which offers managerial implications.

The next section shows the results of this study.

RESULTS

This section presents the demographic profile of the respondents, the results of measurement and structural models using PLS-SEM, as well as the findings of the IPMA.

Demographic Profile

Table 1. Demographic Profile (n=1,171)

	Particulars	n	%		Particulars	n	%
Gender	Male	229	19.56	Age	18-24	150	12.81
	Female	942	80.44		25-34	326	27.84
					35-44	325	27.75
Race	Malay	977	83.43		45-54	219	18.70
	Chinese	52	4.44		55-60	108	9.22
	Indian	42	3.59		>60	43	3.67
	Iban	56	4.78				
	Melanau	9	0.77	Residential Area	Rural	805	68.74
	Bidayuh	8	0.68		Urban	366	31.26
	Bajau	6	0.51				
	Kadazan	5	0.43	Monthly Income Level (RM)	<500	122	10.42
	Others	16	1.37		500-1,000	156	13.32
					1,001-1,500	276	23.57
Marital Status	Single	293	25.02		1,501-2,208	617	52.69
	Married	785	67.04				
	Divorced	30	2.56	State	Sabah	182	15.54
	Widowed	63	5.38		Kelantan	108	9.22
					Sarawak	157	13.41
Education Level	No formal education	24	2.05		Kedah	147	12.55
	Primary	72	6.15		Terengganu	79	6.75
	Secondary	623	53.20		Perak	135	11.53

	Diploma	306	26.13	Perlis	97	8.28
	Bachelor's degree	138	11.78	Pahang	29	2.48
	Master's Degree/Ph.D	8	0.68	Negeri Sembilan	53	4.53
				Melaka	48	4.10
Number of Dependent	No dependent	1	0.09	Johor	47	4.01
	1-3	857	73.19	W.P. Labuan	65	5.55
	4-6	280	23.91	Pulau Pinang	18	1.54
	≥7	33	2.82	Selangor	4	0.34
				W.P. Kuala Lumpur	2	0.17

Table 1 displays the descriptive statistics for the demographic background of the respondents. This study was dominated by female respondents (80.44%). The majority of the respondents were Malay (83.43%), were married (67.04%), completed secondary education level (53.20%), had one to three dependents (73.19%), were between 25 and 34 years old (27.85%), lived in rural areas (68.74%), earned RM1,501-RM2,2208 in a month (52.69%), and were the majority from Sabah (15.54%).

Common Method Bias

Due to the data being collected from the same source, common method bias may distort the findings. To minimise common method bias, before collecting the data, the respondents were informed that their responses were anonymous, clear instruction were given, ambiguous items were avoided, and the questionnaire was kept concise. We further conducted Harman's single factor test, as recommended by Kock et al. (2021), to detect common method bias. The results show that the first factor explained only 38.40% of the total variance, which is well below the threshold value of 50% (Podsakoff et al., 2003), indicating that common method bias is unlikely to affect the results of this study. In addition, the full collinearity test was conducted. The variance inflation factor (VIF) for all constructs in this study was in the range of 1.026 to 2.474, which is below the threshold value of 3.3. (Kock & Lynn, 2012). Hence, the single data source is not considered a problem in this study.

Structural Equation Modelling

Step 1 Measurement model

Table 2 presents the convergent validity and reliability analysis by assessing the loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) of the construct for the samples (Hair et al., 2019). The loadings for the constructs were acceptable, except for a few items, which exceeded the 0.5 threshold (Hair et al., 2006). A total of five items (DIL1, INF2, INF4, INF5, and INF10) were removed because of low loadings. Although four out of ten items for INF were deleted, the remaining items still adequately captured the dimensions of INF, namely the aspects of devices, Internet connectivity, and financial services system of digital financial services. Retaining the removed items would have reduced the internal consistency, as indicated by Cronbach's alpha, CR, and AVE, to below the threshold values, raising concerns about the validity and reliability of the construct for the sample. The Cronbach's alpha, CR, and AVE for all the constructs satisfied the acceptable thresholds of greater than 0.7, 0.7, and 0.5, respectively.

Table 2. Measurement analysis

	Pooled	High	Moderate	Low
		Loadings		
Financial Well-being (FW)				
FW1:To accumulate wealth by accessing financial services.	0.702	0.722	0.727	0.637
FW2:To meet my family's financial commitments.	0.822	0.84	0.838	0.778
FW3:Improved living standards with financial services.	0.859	0.856	0.875	0.838
FW4:Income always cover living costs.	0.743	0.733	0.758	0.750
FW5:Do not need to borrow to buy necessities.	0.616	0.571	0.668	0.592
Cronbach's alpha	0.807	0.802	0.836	0.770
CR	0.829	0.824	0.860	0.794
AVE	0.568	0.564	0.604	0.525
Digital Financial Inclusion (DIC)				
DIC1:Access to digital financial services.	0.801	0.731	0.800	0.827
DIC2:Borrow through digital financial services at an affordable price.	0.608	0.570	0.710	0.531
DIC3:Make payment using digital financial services.	0.838	0.799	0.850	0.833
DIC4:Buy insurance plan through digital financial services.	0.764	0.794	0.850	0.641
DIC5:Make investment with digital financial services.	0.777	0.841	0.826	0.689
DIC6:Use digital financial services at least once a month.	0.774	0.737	0.786	0.778
DIC7:Digital financial services are user friendly.	0.817	0.792	0.835	0.804
Cronbach's alpha	0.886	0.873	0.912	0.855
CR	0.897	0.885	0.920	0.874
AVE	0.596	0.572	0.655	0.542

Financial Literacy (FIL) SIM

FIL1:If you and three friends win a prize worth RM800, how much will each person receive by sharing it equally?

A.RM100 B.RM200 C.RM300 D.RM400

FIL2:Which of the following is NOT a reason for recording savings and expenditures?

A.Able to avoid debt B.Save for future needs C.Can spend extravagant D.Needs come first

FIL3:Investments with high returns tend to be high-risk.

A.True B.False

FIL4:Fatimah lends RM10 to you, and you give her RM12 back next week. What is the total interest for this borrowing?

A.RM2 B.RM10 C.RM12 D.RM22

FIL5: Which of the following statements is NOT true for investment accounts?

A.Money can be withdrawn at any time.
B.There is a possibility of losing the principal.
C.An investment account has a higher return than a savings account.
D.A unit trust is an example of an investment account.

Digital Literacy (DIL)				
DIL2:Aware of website's security before making online transactions.	0.612	0.705	0.593	0.594
DIL3:Know how to open a digital financial services app and complete a transaction successfully.	0.875	0.851	0.865	0.879
DIL4:Know how to correct an error or reverses or cancels a transaction successfully when doing digital financial services transactions.	0.811	0.807	0.833	0.758
DIL5:Have experience transferring and receiving money using digital financial services.	0.890	0.878	0.892	0.872
DIL6:Have experience checking my account balance using digital financial services.	0.897	0.890	0.897	0.880
DIL7:Know the benefits of using digital financial services.	0.878	0.879	0.878	0.848
Cronbach's alpha	0.908	0.914	0.908	0.892
CR	0.918	0.921	0.917	0.904
AVE	0.694	0.701	0.694	0.659
Infrastructure (INF)				
INF1:Have a device (laptop, smartphones, tablet) to access to the digital financial account.	0.712	0.642	0.734	0.659
INF3:Afford to buy data and subscribe Internet line.	0.724	0.667	0.733	0.704
INF6:Transferring and receiving money through DuitNow or QR Pay is easy.	0.820	0.780	0.834	0.805
INF7:Making investment through digital financial services is easy.	0.742	0.725	0.835	0.61
INF8:Purchasing and renewing insurance plans through digital financial services is easy.	0.778	0.773	0.848	0.672
INF9:FaceID, TouchID, or digital authentication that linked to financial services accounts for transaction authentication is convenient.	0.786	0.769	0.764	0.813
Cronbach's alpha	0.854	0.822	0.881	0.805
CR	0.857	0.830	0.883	0.818
AVE	0.579	0.530	0.629	0.511
Financial Services Providers (FSP)				
FSP1:Bank, fintech, and financial institutions provide necessary information about products and services.	0.746	0.758	0.805	0.678
FSP2:Offer financial products and services digitally that meet my needs.	0.812	0.733	0.855	0.805
FSP3:Charge lower lending rate than informal financial services.	0.668	0.605	0.693	0.686
FSP4:Charges lower lending rate than other moneylenders.	0.675	0.600	0.683	0.717
FSP5:Easy to use digital financial services offered.	0.802	0.77	0.849	0.749
FSP6:Digital financial services offered save the effort of going to banks or physical stores.	0.782	0.759	0.796	0.763
Cronbach's alpha	0.844	0.803	0.873	0.829
CR	0.857	0.821	0.887	0.837
AVE	0.562	0.501	0.613	0.539

We assessed discriminant validity by analysing the heterotrait-monotrait (HTMT) ratio of correlations (Franke & Sarstedt, 2019). The HTMT values for all constructs (ranging from 0.132 to 0.779) fell below 0.85, indicating that respondents had a clear under-

standing of the latent variables. There were no overlapping items among the constructs from the respondent's perceptions. In addition, the Standardized Root Mean Square Residual (SRMR) was 0.061, indicating a good model fit, as it falls below the threshold of 0.08 (Hu & Bentler, 1999).

Step 2 Structural model

Table 3 shows the findings of the hypotheses testing for the groups of pooled, high, moderate and low. Panel A shows the results of direct relationship, and Panel B presents the mediating relationships.

Table 3. Hypotheses Testing

Hypotheses	Pooled			High			Moderate			Low		
A. Direct relationship	Std Beta	Std Error	f^2	Std Beta	Std Error	f^2	Std Beta	Std Error	f^2	Std Beta	Std Error	f^2
H1:FIL->DIC	-0.031	0.020	0.005	-0.093	0.045	0.028	0.002	0.032	0.000	-0.039	0.034	0.009
H2:FIL->FW	-0.070	0.025	0.009	-0.147	0.041	0.051	-0.030	0.039	0.002	-0.034	0.053	0.001
H3:DIL->DIC	0.385*	0.035	0.236	0.275*	0.068	0.098	0.378*	0.050	0.251	0.467*	0.063	0.350
H4:DIL->FW	-0.054	0.037	0.016	-0.032	0.060	0.008	0.007	0.055	0.001	-0.087	0.077	0.052
H5:INF->DIC	0.233*	0.033	0.051	0.301*	0.070	0.082	0.177*	0.048	0.024	0.272*	0.053	0.119
H6:INF -> FW	0.063	0.042	0.000	0.018	0.070	0.011	0.137	0.063	0.014	-0.047	0.080	0.034
H7:FSP -> DIC	0.254*	0.033	0.081	0.276*	0.061	0.074	0.312*	0.050	0.138	0.125*	0.056	0.002
H8:FSP -> FW	0.179*	0.045	0.028	0.215*	0.072	0.069	0.194*	0.073	0.030	0.146*	0.075	0.045
H9:DIC -> FW	0.469*	0.041	0.257	0.495*	0.074	0.384	0.361*	0.071	0.126	0.589*	0.064	0.565
B. Mediating relationship												
H10a:DIL->DIC->FW	0.251*	0.042		0.166*	0.075		0.172*	0.051		0.482*	0.129	
H10b:-FIL->DIC-> FW	-0.026	0.014		-0.066	0.037		-0.004	0.015		-0.050	0.038	
H10c:F-SP->DIC-> FW	0.172*	0.035		0.193*	0.088		0.150*	0.046		0.039	0.135	
H10d:INF->DIC-> FW	0.147*	0.038		0.226*	0.125		0.064*	0.032		0.355*	0.170	

Notes: **represents p<0.05, 10,000 bootstrapping procedure, FW=financial well-being, DIC=digital financial inclusion, FIL=financial literacy, DIL=digital literacy, INF=digital financial services infrastructure, FSP=financial service providers*

This study reveals a surprising finding regarding the role of FIL on DIC and FW across all groups. Therefore, H1 and H2 were not supported.

In contrast, DIL emerged as the most important determinant that positively influenced DIC across all groups (β_{pooled}=0.385, p<0.05; β_{High}=0.275, p<0.05; $\beta_{Moderate}$=0.378, p<0.05; β_{Low}=0.467, p<0.05), thereby supporting H3. However, no significant relationship was found between DIL and FW, hence H4 was not supported.

For INF, the analysis confirmed the positive and significant association with DIC across all groups (β_{pooled}=0.233, p<0.05; β_{High}=0.301, p<0.05; $\beta_{Moderate}$=0.177, p<0.05; β_{Low}=0.272, p<0.05), thus H5 was supported. However, the results showed no significant relationship between INF and FW, indicating H6 was not supported.

The role of FSP demonstrated a consistent positive and significant effect on both DIC (β_{pooled}=0.254, p<0.05; β_{High}=0.276, p<0.05; $\beta_{Moderate}$=0.312, p<0.05; β_{Low}=0.125, p<0.05) and FW (β_{pooled}=0.179, p<0.05; β_{High}=0.215, p<0.05; $\beta_{Moderate}$=0.194, p<0.05; β_{Low}=0.146,

$p<0.05$) across all groups. Therefore, H7 and H8 were supported.

Furthermore, the results revealed that DIC has the strongest direct positive impact on FW across all groups ($\beta_{pooled}=0.469$, $p<0.05$; $\beta_{High}=0.495$, $p<0.05$; $\beta_{Moderate}=0.361$, $p<0.05$; $\beta_{Low}=0.589$, $p<0.05$). This result supports H9.

The mediation relationships were investigated in this study. The results further suggest that DIC acts as a significant mediator. DIC significantly mediated the relationship between DIL and FW in all sample sets ($\beta_{pooled}=0.251$, $p<0.05$; $\beta_{High}=0.166$, $p<0.05$; $\beta_{Moderate}=0.172$, $p<0.05$; $\beta_{Low}=0.482$, $p<0.05$), thereby supporting H10a. In contrast, DIC did not mediate the relationship between FIL and FW in any groups; thus, H10b was rejected. Furthermore, DIC was found to significantly mediate the relationship between FSP and FW for the pooled, high, and moderate groups ($\beta_{pooled}=0.172$, $p<0.05$; $\beta_{High}=0.193$, $p<0.05$; $\beta_{Moderate}=0.150$, $p<0.05$), supporting H10c partially. Lastly, DIC showed a significant mediating role between INF and FW across all groups ($\beta_{pooled}=0.147$, $p<0.05$; $\beta_{High}=0.226$, $p<0.05$; $\beta_{Moderate}=0.064$, $p<0.05$; $\beta_{Low}=0.355$, $p<0.05$), indicating support for H10d.

To support the results, adjusted R^2 and Q^2 were used to evaluate the predictive power of the models as presented in Table 4.

Table 4. Adjusted R^2 and Predictive relevance (Q^2)

	Pooled		High		Moderate		Low	
	Adjusted R^2	Q^2	Adjusted R^2	Q^2	Adjusted R^2	Q^2	Adjusted R^2	Q^2
DIC	0.652	0.550	0.629	0.497	0.614	0.526	0.713	0.567
FW	0.474	0.254	0.583	0.292	0.440	0.282	0.531	0.171

FW=financial well-being, DIC=digital financial inclusion

The adjusted R^2 for FW and DIC across all sample sets indicates moderate predictive power for the models, with the following range: $0.4<R^2<0.78$ (Hair et al., 2011). Additionally, the constructs in this study showed strong predictive accuracy for DIC and moderate predictive accuracy for FW, where the $Q^2>0.35$ and $0.15<Q^2<0.35$, respectively (Hair et al., 2013).

Multigroup Analysis

Multigroup analysis was conducted to determine the existence of significant differences across groups. This is the most efficient way to assess moderation across multiple relationships (Hair, 2018).

Prior to the significance test of the multigroup analysis, the measurement invariance assessment (MICOM) was conducted (Henseler et al., 2016). There are three steps in the MICOM procedure, namely configural invariance, compositional invariance, and the equality of a composite's mean value and variance across groups. Table 5 shows that the configural invariance and compositional tests were established, as all the constructs are identical and the c for all constructs are higher than 5% quantile of C_u. Meanwhile, the measurement invariance was partially supported, as not all the composites means and variance values were equal (Cheah et al., 2020).

Next, we proceed by examining group comparisons, as presented in Table 6. The results show observable differences in the path coefficients of DIL→DIC, INF→DIC, FSP→DIC, FSP→FW, and DIL→FW across the three poverty groups. This suggests that

enhancing DIL, INF, and FSP is essential for improving DIC, while FSP and DIC play an important role in enhancing FW, which is consistent with the results in Table 3.

Panel A (High vs Moderate) reveals that DIL and FSP show stronger effects on DIC and FW in the moderate-poverty group, while INF and FSP play a more important role in enhancing DIC and FW in the high-poverty group. Panel B (High vs Low) shows that DIL and DIC have greater influences on FW for the low-poverty group, while INF and FSP exhibit stronger effects on DIC and FW in the high-poverty group. Panel C (Moderate vs Low) finds that DIL and INF show stronger effects on DIC, and DIC shows a greater effect on FW in the low poverty group, while FSP appears to have stronger effects on DIC and FW in the moderate-poverty group.

Table 6. Multigroup analysis

Panel A	Path coefficient (High)	p-value (High)	Path coefficient (Moderate)	p-value (Moderate)
FIL->DIC	-0.093	0.020	0.002	0.480
FIL->FW	-0.147	0.000	-0.030	0.221
DIL->DIC	0.275	0.000	0.378	0.000
DIL->FW	-0.032	0.302	0.007	0.451
INF->DIC	0.301	0.000	0.177	0.000
INF->FW	0.018	0.398	0.137	0.016
FSP->DIC	0.276	0.000	0.312	0.000
FSP->FW	0.215	0.001	0.194	0.004
DIC->FW	0.495	0.000	0.361	0.000
Panel B	**Path coefficient (High)**	**p-value (High)**	**Path coefficient (Low)**	**p-value (Low)**
FIL->DIC	-0.093	0.020	-0.039	0.129
FIL->FW	-0.147	0.000	-0.034	0.259
DIL->DIC	0.275	0.000	0.467	0.000
DIL->FW	-0.032	0.299	-0.087	0.127
INF->DIC	0.301	0.000	0.272	0.000
INF->FW	0.018	0.400	-0.047	0.277
FSP->DIC	0.276	0.000	0.125	0.014
FSP->FW	0.215	0.002	0.146	0.026
DIC->FW	0.495	0.000	0.589	0.000
Panel C	**Path coefficient (Moderate)**	**p-value (Moderate)**	**Path coefficient (Low)**	**p-value (Low)**
FIL->DIC	0.002	0.480	-0.039	0.129
FIL->FW	-0.030	0.223	-0.034	0.259
DIL->DIC	0.378	0.000	0.467	0.000
DIL->FW	0.007	0.451	-0.087	0.127
INF->DIC	0.177	0.000	0.272	0.000
INF->FW	0.137	0.016	-0.047	0.277
FSP->DIC	0.312	0.000	0.125	0.014
FSP->FW	0.194	0.004	0.146	0.026
DIC->FW	0.361	0.000	0.589	0.000

Table 5. Assessment of Measurement Invariance

			Compositional Invariance				Equal Mean value			Equal Variances			
Group	Construct	Configural Invariance	*c*=1	5% quantile of *Cu*	Permutation p-value	Compositional Invariance	Differences	Confidence Interval	Permutation p-value	Differences	Confidence Interval	Permutation p-value	Measurement Invariance
High vs Moderate	DIC	Yes	1.000	0.999	0.329	Yes	0.377	[-0.144;0.145]	0.000	0.030	[-0.233;0.221]	0.809	Partial
	DIL	Yes	1.000	0.999	0.864	Yes	0.599	[-0.144;0.141]	0.000	-0.081	[-0.208;0.188]	0.398	Partial
	FIL	Yes	1.000	1.000	0.230	Yes	0.099	[-0.134;0.148]	0.163	-0.225	[-0.223;0.203]	0.041	Partial
	FSP	Yes	0.999	0.997	0.323	Yes	0.349	[-0.138;0.149]	0.000	-0.090	[-0.236;0.219]	0.446	Partial
	FW	Yes	0.998	0.995	0.393	Yes	0.106	[-0.152;0.146]	0.149	0.214	[-0.250;0.226]	0.078	Full
	INF	Yes	0.998	0.998	0.105	Yes	0.462	[-0.143;0.146]	0.000	-0.246	[-0.224;0.197]	0.026	Partial
High vs Low	DIC	Yes	0.999	0.998	0.065	Yes	0.002	[-0.147;0.147]	0.984	-0.078	[-0.235;0.244]	0.521	Full
	DIL	Yes	1.000	0.999	0.590	Yes	0.120	[-0.154;0.148]	0.126	-0.067	[-0.210;0.208]	0.545	Full
	FIL	Yes	1.000	1.000	0.423	Yes	-0.127	[-0.160;0.145]	0.120	-0.059	[-0.247;0.253]	0.664	Full
	FSP	Yes	0.997	0.995	0.192	Yes	0.031	[-0.163;0.152]	0.689	-0.021	[-0.269;0.262]	0.875	Full
	FW	Yes	0.999	0.995	0.635	Yes	0.041	[-0.147;0.154]	0.609	0.302	[-0.245;0.231]	0.013	Partial
	INF	Yes	0.997	0.995	0.129	Yes	-0.025	[-0.157;0.160]	0.757	0.064	[-0.219;0.224]	0.567	Full
Moderate vs Low	DIC	Yes	1.000	0.999	0.336	Yes	-0.373	[-0.138;0.129]	0.000	-0.108	[-0.210;0.210]	0.306	Partial
	DIL	Yes	1.000	0.999	0.532	Yes	-0.486	[-0.137;0.124]	0.000	0.024	[-0.161;0.175]	0.812	Partial
	FIL	Yes	1.000	1.000	0.226	Yes	-0.217	[-0.133;0.130]	0.001	0.167	[-0.201;0.229]	0.125	Partial
	FSP	Yes	1.000	0.998	0.848	Yes	-0.320	[-0.138;0.133]	0.000	0.073	[-0.232;0.210]	0.555	Partial
	FW	Yes	0.999	0.995	0.489	Yes	-0.074	[-0.140;0.148]	0.294	0.085	[-0.238;0.255]	0.498	Full
	INF	Yes	0.998	0.998	0.092	Yes	-0.495	[-0.138;0.134]	0.000	0.317	[-0.199;0.188]	0.000	Partial

FW=financial well-being, DIC=digital financial inclusion, FIL=financial literacy, DIL=digital literacy, INF=digital financial services infrastructure, FSP=financial service providers

Importance-Performance Map Analysis (IPMA)

We conducted a follow-up analysis using IPMA to further explore the findings by evaluating the importance and performance of the constructs. The IPMA identifies which constructs should be prioritised to improve the specific target construct.

The IPMA was conducted twice: first for FW as the target construct, and second for DIC as the target construct. The results for FW and DIC are presented in Table 7 and depicted in Figures 3 (FW) and 4 (DIC). The IPMA uses the average scores from Table 7 to indicate how important each factor is and how well it performs. Figures 3 and 4 will visually present these findings. The analysis concentrated on the right-hand area in Figures 3 and 4, highlighting items with high importance but low performance, which represent major managerial implications (Kumar et al., 2023a).

Figure 3 and Table 7 show that among the five constructs determining FW. DIC (I_{High}=0.495, P_{High}=65.770; $I_{Moderate}$=0.361, $P_{Moderate}$=58.707; and I_{Low}=0.589, P_{Low}=65.742) and FSP (I_{High}=0.351, P_{High}=67.156; $I_{Moderate}$=0.307, $P_{Moderate}$=60.508; and I_{Low}=0.220, P_{Low}=65.551) are the key areas, as they show high importance in explaining FW but low performance across all groups. Practitioners should prioritise these areas to improve FW among poor households in Malaysia, as they represent a significant potential. As the majority of the respondents reside in rural areas, this may be due to challenges related to the wide rural landscape and geographical spread in Malaysia. Financial institutions do not adequately reach poor households, especially those in rural areas (BNM, 2023). The Malaysian government has been making efforts to pursue balanced regional development, enhancing urban-rural linkage (Ministry of Economy Malaysia, 2020). Digital financial services support savings, insurance, investment, and convenience, while also eliminating physical barriers. These services help poor households better manage their finances, which is critical for enhancing FW. Similarly, FSP acts as intermediaries connecting poor households and the financial system. FSP enhances FW by providing quality information and innovating financial products and services that meet financial needs of poor households. FSP leverages digital platforms aimed at expanding accessibility and customise offerings to poor households. Digital innovation eliminates geographical barriers, facilitates the delivery of affordable financial services, and enhances DIC, thus FW. This is corroborated by the results in Table 3.

Figure 4 and Table 7 reveal that for the 'high' group (Sabah and Kelantan), the key constructs for DIC are FSP (I_{High}=0.276, P_{High}=67.156) and INF (I_{High}=0.301, P_{High}=68.067). Prioritising FSP and INF is essential, since they are more important than others but are currently underperforming, which is consistent with the findings in Table 3. INF is a crucial factor of DIC in this group that historically has uneven development (Lim, 2025). According to the Minister of Economy, states such as Sabah and Kelantan experience inequality and unbalanced development in terms of wealth, income, education and infrastructure (Salim & Chung, 2022). Additionally, the urban-rural divide contributes to limited geographical accessibility of the financial access points, poor digital connectivity, and inability to afford an internet subscription or smartphone (BNM, 2023). Although Agent Banking has been introduced in Malaysia as a government initiative to reach underserved segments, particularly in rural areas, it only provides basic financial services such as accepting deposits, facilitating withdrawals, transferring funds, bill payments, and financing payments (BNM, 2012). Enhancing these factors is important for economic development and poverty alleviation in these states.

In the 'moderate' group (Sarawak, Kedah, Terengganu, and Perak), both DIL ($I_{Moderate}$=0.378, $P_{Moderate}$=61.515) and FSP ($I_{Moderate}$=0.312, $P_{Moderate}$=60.508) require attention due to their importance for DIC but low performance. Socio-economic disparities in these states contribute to communication and access barriers. For example, in Sarawak, socio-economics disparities hinder the effective access to digital financial services, particularly for poor households in rural areas (John Lau, 2025). The Kedah state government has also initiated measures to bridge such gaps, as outlined in the Kedah Book 2035 (Mohd Yusoff et al., 2023). Moreover, low technological competencies among poor households in these states may create difficulties in conducting digital transactions (BNM, 2023). Improving these areas can help integrate poor households into the digital financial system.

The results showed that even in the 'low' group (Perlis, Pahang, Negeri Sembilan, Melaka, Johor, W.P. Labuan, Pulau Pinang, Selangor, and W.P. Kuala Lumpur), enhancing DIL (I_{Low}=0.467, P_{Low}=71.963) and INF (I_{Low}=0.272, P_{Low}=69.201) remains crucial for increasing DIC. Despite their higher economic development, these states still face digital disparities, particularly between urban and rural areas. A report by Khazanah showed that access to mobile and fixed broadband remains lower in rural areas compared to urban areas (Yang, 2024), which highlights inequitable INF development. Moreover, the Malaysia Digital Economy 2023 also reported the existence of urban-rural digital disparities in mobile phone usage and internet access in these states (DOSM, 2023b). The report further highlights that DIL is still a concern in these states, particularly among older adults, low-income groups, and the urban poor. However, FSP is found to have low importance and low performance, implying that poor households in these more developed states may have sufficient access to financial services, but lack the skills and confidence to use digital financial services.

Table 7. Importance-Performance Map Analysis

	Target Construct: Financial Well-being (FW)						Target Construct: Digital Financial Inclusion (DIC)					
	High		Moderate		Low		High		Moderate		Low	
	I	P	I	P	I	P	I	P	I	P	I	P
DIC	0.495	65.770	0.361	58.707	0.589	65.742						
DIL	0.104	74.340	0.143	61.515	0.188	71.963	0.275	74.340	0.378	61.515	0.467	71.963
FIL	-0.193	80.000	-0.029	78.031	-0.057	82.369	-0.093	80.000	0.002	78.031	-0.039	82.369
FSP	0.351	67.156	0.307	60.508	0.220	65.551	0.276	67.156	0.312	60.508	0.125	65.551
INF	0.166	68.067	0.200	58.816	0.113	69.201	0.301	68.067	0.177	58.816	0.272	69.201
Ave	0.185	71.067	0.196	63.515	0.211	70.965	0.190	72.391	0.217	64.718	0.206	72.271

Notes: *I = Importance; P=Performance, FIL=financial literacy, DIL=digital literacy, INF=digital financial services infrastructure, FSP=financial service providers, Ave=Average Scores*

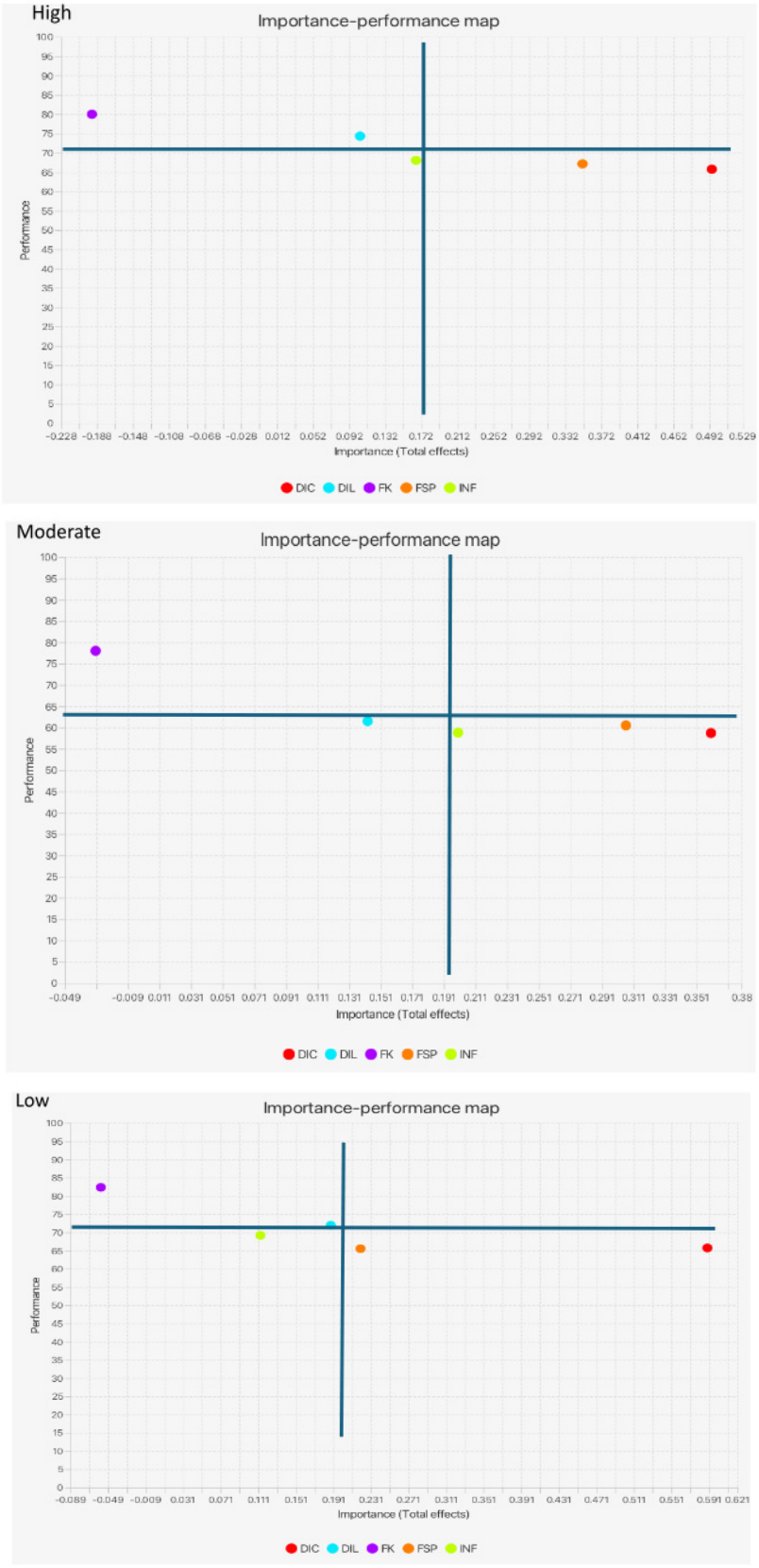

Figure 3. IPMA: Financial Well-being (FW)

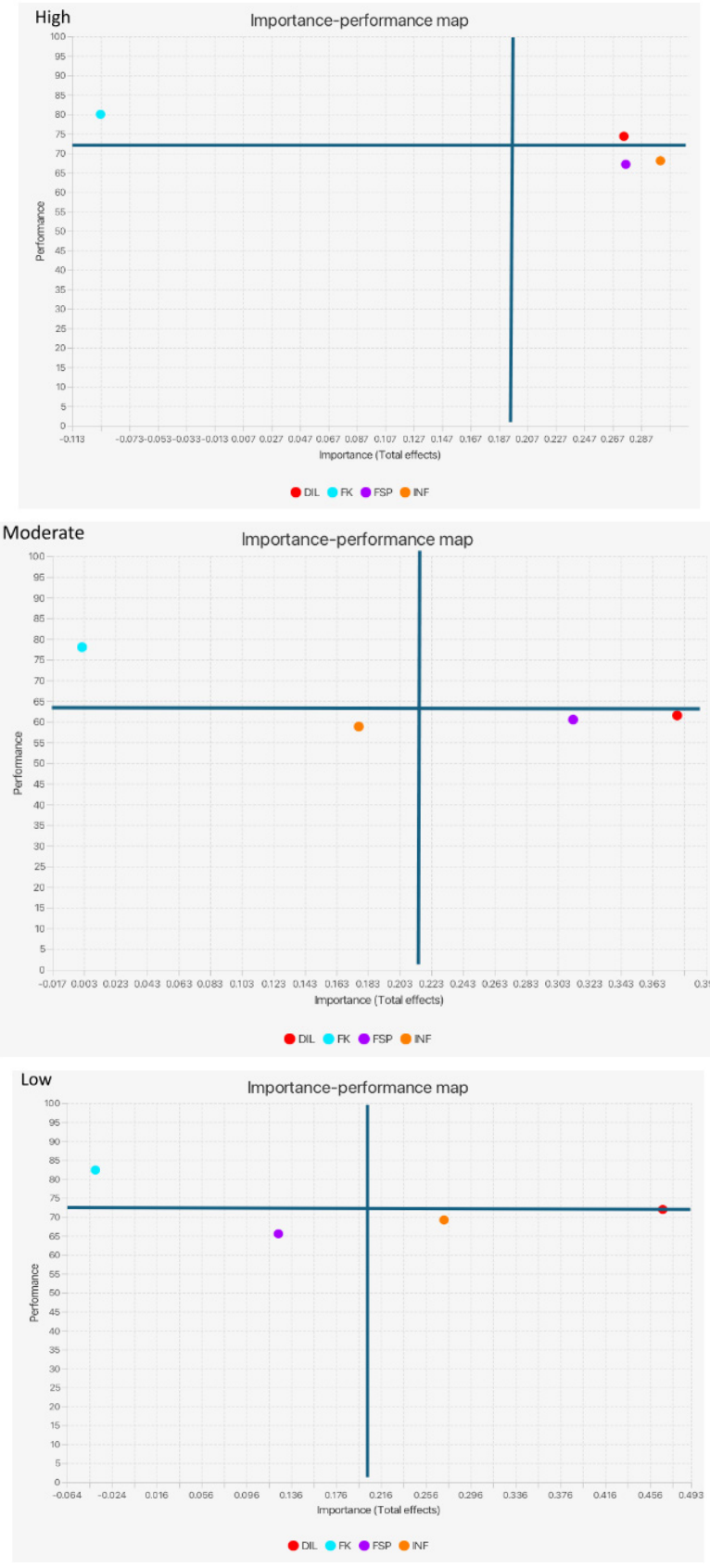

Figure 4. IPMA: Digital Financial Inclusion (DIC)

ROBUSTNESS CHECK

To further confirm the findings of this study and address potential concerns of bidirectional causality, we followed the recommendation of Hair et al. (2024) by adding interaction terms into the structural model. We then reanalysed the model using bootstrapping, testing the interactions between DIC and the four independent variables, namely FIL, DIL, INF, and FSP to examine the conditional effects of these variales on FW.

Table 8. Interaction terms

Interaction Terms	Std Beta	Std Error	BCI LL	BCI UL
Inter_FIL_DIC	-0.022	0.017	-0.055	0.012
Inter_DIL_DIC	0.055*	0.016	0.025	0.086
Inter_INF_DIC	0.033*	0.016	0.001	0.065
Inter_FSP_DIC	0.026	0.016	-0.006	0.057

Notes: **represents p<0.05, 10,000 bootstrapping procedure, Inter_FIL_DIC=interaction terms for financial literacy and digital financial inclusion, Inter_DIL_DIC=interaction terms for digital literacy and digital financial inclusion, Inter_INF_DIC=interaction terms for digital financial services infrastructure and digital financial inclusion, Inter_FSP_DIC=interaction terms for financial service providers and digital financial inclusion*

Table 8 presents the robustness checks with interaction terms. The results show that the DIC does not moderate the relationship between FIL and FW, which is consistent with the main findings, where FIL had a limited effect on FW.

Furthermore, the interaction terms between DIL and INF with DIC are positive and statistically significant. This indicates that a higher level of DIC strengthens the effect of DIL and INF on FW, which complements the findings in the main analysis, where these factors influenced FW indirectly through DIC.

Meanwhile, the results show that DIC does not moderate the relationship between FSP and FW. This confirms that FSP contributes to FW directly and indirectly through DIC, but the effect does not conditionally depend on DIC.

Additionally, the hypothesis testing results in Table 3 show that FIL has no significant relationship with either DIC or FW. This suggests that FIL alone may be insufficient to lead to DIC, and that poor households in Malaysia may only achieve DIC when certain enabling conditions are present. Drawing from the Sen's capability Approach (Sen, 1999), which emphasises that individuals need both resources and opportunities to act on them, this study further conducts an interaction analysis examining the moderating effect of DIL and household income on the relationship between FIL and DIC.

Table 9. Interaction effect of Income and DIL

Path	Std Beta	Std Error	P values
FIL->DIC	-0.034	0.020	0.087
FIL x DIL->DIC	-0.017	0.025	0.498
Income->DIC	-0.036	0.021	0.081
FIL x Income->DIC	-0.025	0.020	0.201

Notes: *10,000 bootstrapping procedure, FIL=financial literacy, DIC=digital financial inclusion, DIL=digital financial literacy, Income=monthly household income*

The results in Table 9 show that there is no moderating effect of DIL and Income on the relationship between FIL and DIC. This may suggest that poor households in Malaysia lack access to and the capability to use the financial knowledge and skills they possess, as they live below the poverty line and have limited resources. These constraints limit their ability to translate FIL into DIC.

DISCUSSION

This section provides a discussion based on the results obtained from the analysis.

Given the important effect of DIC in building an inclusive society, the findings of this study highlight crucial roles of DIL, FSP, and INF, all of which significantly influence DIC across all samples. This complements insights from the Global Findex 2025 (Klapper et al., 2025), which highlight that digital financial services promote access to and usage of financial services, thereby enhancing financial inclusion. This study showed that DIL was the most significant factor that positively influenced the DIC of poor households in Malaysia. The results align with those of previous investigations (Alkhwaldi, 2024; Jack & Suri, 2011; Lyons et al., 2020; Mujeri & Azam, 2018). A high level of DIL equips poor households with knowledge and skills to navigate digital devices effectively, enhancing their understanding of secure practices and increasing trust in digital financial services, thereby increasing the likelihood of their participation in the digital financial system (Aziz & Naima, 2021). This could improve their financial management, ability to save, and reduce financial vulnerability to economic shocks. Consistently, the results of IPMA further revealed that although DIL is highly important in increasing DIC, it has poor performance for low- and moderate-poverty rate groups. From a Digital Divide Theory perspective, this may reflect the urban-rural digital divide in these states, where a lack of digital competencies limits the ability to complete digital financial transactions (BNM, 2023; DOSM, 2023b).

Furthermore, this study demonstrated that the role of FSP significantly increases DIC across all groups. This suggests that FSP that provides quality information as well as understands and meets the financial needs of poor households promotes DIC (Ozili, 2020; Khera et al., 2021; Thathsarani et al., 2021). This finding aligns with the Capabilities Approach, which emphasises the importance of expanding poor households' capabilities by equipping them with the relevant financial information and services to expand their capabilities and improve their overall quality of life. Notably, the IPMA results indicated that FSP should be prioritised in the low- and moderate-poverty rate groups. This may be attributed to the socio-economic disparities within these states. FSP plays an important role in fostering economic development. However, the wide rural areas and geographical spread in these states lead to limited financial access point, particularly in the rural and remote areas (BNM, 2023), which hinder their ability to access and benefit from financial services. By leveraging digital platforms, FSP can expand accessibility by customising financial products and services to meet the specific needs of poor households. Digital innovation eliminates physical and geographical barriers, facilitating the delivery of affordable financial services and enhancing DIC. FSP connects poor households to economic opportunities through their engagement in a formal digital financial system (Mishra et al., 2024).

A well-established INF is vital for facilitating DIC. Lyons and Kass-Hanna (2021)

showed that countries with better INF development tend to participate in the financial system. INF is a fundamental to digitalisation and financial inclusion. Reliable Internet connectivity, an efficient ID system, and access points of digital financial services enable poor households to be inclusive of and benefit from the digital financial system (Ediagbonya & Tioluwani, 2023; Ozili, 2018; Peng & Mao, 2023; Suhrab et al., 2024). IPMA demonstrated that enhancing INF development should be prioritised in both high- and low-poverty rate states. The urban-rural divide within these states may contribute to the inequitable development of INF (Yang, 2024), which may further widen the gap in DIC. States with high poverty rate, such as Sabah and Kelantan, experience poorer digital INF that places them at a disadvantage in accessing digital financial services. Although low-poverty states have better INF, a lack of trust in digital platform could be a challenge for them in using digital financial services. Improving INF is a step to reduce digital divide and build a trusted and secure digital environment. Practical measures such as improving the internet connectivity by expanding broadband and mobile coverage, particularly in underserved rural areas, would allow them to gain reliable internet access when conducting digital financial transactions. Additionally, increasing the affordability and availability of digital devices through subsidies would lower the entry barriers for poor households to access financial services digitally. Activities related to cybersecurity, such as heightening awareness and developing guideline for users when using digital financial services, can increase trust and confidence in digital financial services. These improvements enhance the accessibility and reliability of digital financial services, thereby providing an alternative way for poor households to be included in the financial system.

In the context of FW, both DIC and FSP are found to significantly influence FW among poor households in Malaysia. The results revealed that DIC has the largest positive impact on FW across all groups. Li & Peng (2023) demonstrate that DIC promotes household welfare by increasing income and entrepreneurial opportunities, as they have greater access to loans. DIC potentially serves as a bridge to access the digital financial system, helping to break the poverty cycle (Demir et al., 2022; Peng & Mao, 2023). Digital financial services, such as mobile banking, online banking, and e-wallets, enhance access and reduce transaction costs, improving financial management and FW, which traditional financial infrastructure lacks (Thathsarani et al., 2021; The World Bank, 2018).

Similarly, FSP offers tailored services to meet the unique financial demands of low-income households, including microfinance, insurance products, and savings accounts with lower minimum balance requirements, improving FW. Hence, the role of FSP is crucial in helping poor households achieve greater FW (Selvia et al., 2021). This is in line with IPMA, which shows that DIC and FSP have high importance but low performance in enhancing FW across all samples. Enhancing urban-rural linkage among these states could efficiently enhance FW among poor households in Malaysia.

Contrary to the majority of previous studies (Grohmann & Hamdan, 2024; Jamison, 2014; Khan et al., 2022), this study found no correlation of FIL and DIC or FW among poor households in Malaysia. The Central Bank of Malaysia (BNM, 2023) reported that low FIL, particularly among low-income groups, hinders Malaysians from effectively utilising and benefiting from financial services. They often lack access to and the capability to use financial educational tools and resources, have low awareness of the need for and availability of suitable financial products and services, and possess insufficient knowledge and capability to use them, especially risk protection products. While Malaysia has introduced supportive initiatives, such as the National Strategy for Financial Literacy, to

address these challenges, the impact may not yet be reflected among low-income groups. Poor households face income constraints that limit their ability to apply FIL effectively.

These household-level findings reinforce global evidence from the Global Findex Report, which shows that poor group continue to face the greastest challenges in financial access (Klapper et al., 2025). The Global Findex Report 2025 reveals that they required assistance in using formal financial account. Matita and Chauma (2020) observed that income level is positively correlated with financial literacy, explaining that poor households have a higher marginal propensity to consume than higher-income households, as they spend most of their income on basic needs, while higher-income households are more likely to save or invest it. According to Lusardi et al. (2015), financial knowledge is a human capital investment that is needed for planning and managing income across the life cycle. This suggests that even if poor households are financially literate, their poor economic backgrounds restrict their opportunities to engage with financial products and services. Lyons et al. (2020) explained that low-income groups are more prone to financial exclusion, even though they possess financial knowledge and have access to technological infrastructures. This is because they tend to rely more on family or friends for financial supports than to engage in the financial system. However, Bongomin et al. (2016) and Sajid et al. (2024) demonstrate that FIL has indirect impacts on financial inclusion. Mahdzan et al. (2023) explain that the low-income groups face challenges in applying their financial knowledge effectively to actions that could improve their FW.

This study showed that DIL and INF are not related to FW. While DIL and INF development are crucial for building an inclusive digital financial system, they may not be the factors that directly impact FW of poor households. DIL equips poor households with the necessary skills to enhance their FW when participating in the digital financial system. Without these skills, they may lack confidence and face difficulties in operating digital devices or conducting digital financial transactions. Similarly, INF is a prerequisite for engaging in digital financial activities, as it provides reliable access to digital platforms and services. Without adequate INF, digital financial transactions may be disrupted, which can affect user's confidence in using digital financial services.

However, possessing the ability to effectively operate digital devices and conduct digital financial transactions, as well as having access to the necessary devices and digital financial services platform, does not directly translate into financial well-being. Past studies have shown that factors such as skills, attitudes, motivation (Castro-González et al., 2020; Limbu & Sato, 2019), and institutional capability (Losada-Otalora et al., 2020) affect FW through various mediators. This suggests the intricate interactions between several factors that determine FW, which can likely be explained by the mediating effect of DIC.

Our findings support the model developed in Figure 1, which is grounded in the Family Resource Management Theory, showing that poor households can better enhance their FW (output variable) by engaging in the digital financial system (throughputs-DIC) when provided with the necessary resources (input variables-DIL, FSP, INF). This study reveals that DIC has the most significant mediating effect on the relationship between DIL and FW. In other words, DIL can only play an impactful role and effectively improve the FW of poor households when it is included in the digital financial system (Alkhwaldi, 2024). Higher DIL levels allow poor households to use digital financial services more effectively, as they have a better understanding of the digital financial services available in the market. This builds trust and confidence when engaging with digital platforms, which facilitates better financial decisions as they recognise the benefits offered by digital finan-

cial services, thereby increasing financial transactions that improve poor households' FW (Jack & Suri, 2011).

Furthermore, DIC mediates the relationship between the supply-side factors (INF and FSP) and FW, suggesting that having INF and FSP alone may not sufficiently impact FW unless they facilitate engagement with digital financial services among poor households. This includes improved INF, such as wider network coverage, faster internet speed, reliable internet connectivity, and affordable data plans, which are essential for making digital financial services more accessible and usable for poor households. A well-established financial INF, together with a trusted and reliable FSP enhances physical access to digital financial services, making it more convenient, secure, and trustworthy for poor households to access full range of financial services. For example, poor households can receive government assistance through e-money, make affordable and fast fund transfers, and use features available on digital financial service platforms, such as savings and investment, which support better financial management.

This encourages poor households to more actively engage with digital financial services, promoting digital financial inclusion, and ultimately improving their financial well-being. This is corroborated by the studies of Lee et al. (2023), Peng and Mao (2023), and Suhrab et al. (2024), who found that good INF facilitates participation and usage of digital financial services and enhances FW. The studies by Demirguc-Kunt et al. (2017), Thathsarani et al. (2021), and Selvia et al. (2021) further demonstrate that FSP paves the way for DIC and improves FW. However, DIC does not mediate the relationship between FIL and FW, which is possibly due to the income constraints that limit their ability to apply the financial knowledge and skills effectively to engage in financial services.

IMPLICATIONS OF THE STUDY

This section discusses the implications for various stakeholders that derived from the findings of this study.

Theoretical Implications

As our unique contribution, this study focuses on a subset of the low-income population of Malaysia, namely households living below poverty line income, who have received limited attention in the past studies. This group faces unique challenges in financial stability, which affects their ability to achieve FW. This study is grounded in Family Resource Management Theory, which provides a systematic framework for understanding how poor households use the resources they possess (DIL, FIL, INF, and FSP) through the process of engaging in DIC to achieve FW. This study shows that both demand- (DIL) and supply-side (FSP and INF) factors jointly shape DIC among poor households in Malaysia. Access to digital financial services alone is insufficient; households must also possess the necessary knowledge, skills, and support to use these services effectively. The present study's findings highlight how DIC acts as an important process that bridges the gap between DIL and the broader roles of INF and FSP. DIC facilitates access, utilisation of, and benefits from digital financial systems, thereby enhancing their FW. Family Resource Management Theory offers insights into how poor households transform the resources they possess into their desired financial outcomes. Compared to the financial behaviour theory, which is widely used in studies of financial well-being and focuses more on individual psycholog-

ical factors influencing their financial decisions, this study offers a broader perspective by emphasising the process of engaging in the digital financial system to achieve FW.

This study demonstrated that FIL does not significantly affect DIC and FW, which contradicts findings from the majority of past studies, suggesting that poor households with low incomes have a limited capability to apply financial skills and knowledge effectively. Due to income constraint, they have fewer opportunities to engage in financial services and products. This implies that findings from past studies may not fully capture the realities of poor households, who faced resources constraints that influence their financial behaviour.

This study contributes to the literature by conducting a group differences analysis, in which the total sample is divided into three groups, namely states with high-, moderate-, and low-poverty rate, based on the poverty incidences across states in Malaysia. This analysis highlights how geographical disparities in poverty levels may influence DIC and FW, thereby providing a foundation for future studies in this field to explore targeted strategies for enhancing DIC and FW among poor households.

Managerial Implications

This study provides empirical evidence of the significant role of DIC and FSP in enhancing FW among poor households. However, these factors must be strategically prioritised across all samples. Digital financial services have the potential to close gaps in financial access and promote inclusion, particularly for marginalised groups. By leveraging technology and data-driven approaches, FSP can use alternative credit evaluation methods to better meet the financial needs of poor households, which often failed to meet standard requirements.

For example, Alipay in China has successfully demonstrated a transformative impact on increasing financial inclusion and enhancing poor households' lives, especially in rural areas. Alipay's Zhima credit (Sesame credit), which uses alternative data such as payment history and social behaviour to assess creditworthiness, allows the underserved population to access loans and financial products. Additionally, they offer a wide range of financial services, including payment, microloans (Huabei), investment (Yu'e Bao), and insurance, which enable poor households to engage in better financial management and enhance their FW.

Hence, policymakers should prioritise the development of a comprehensive digital financial ecosystem. Initiatives such as subsidies, incentives, and attractive digital financial services plan can foster digital financial inclusion and empower poor households to better manage their finances and break the poverty cycle. Additionally, FSP such as financial institutions and fintech companies may leverage digital technologies to provide convenient, affordable, and reliable digital access to innovative financial services. These services, such as savings, microloans, insurance, and investment, should be tailored to the financial needs of the underprivileged people in order to create a digitally inclusive society.

Our results showed that DIL is the key determinant of DIC among poor households in Malaysia. Enhancing skills and knowledge in navigating and utilising the digital devices is essential for increasing engagement in the digital financial system. Poor households can gain more confidence and improve security awareness for protecting their digital personal information and assets. To achieve this, policymakers can integrate DIL into national financial inclusion strategies and consumer protection framework. This would

help poor households build confidence, increase awareness, and use digital financial services safely.

In addition, the government can leverage national initiatives such as JENDELA (National Digital Network) by using community centres as hubs for digital literacy training. Furthermore, collaborative efforts between the government and the private sector, including banks and fintech companies, can provide resources and support for DIL initiatives. DIL programme should be customised to meet the needs of the targeted population, especially poor households residing in rural areas. For example, seminars and hands-on training workshops can be organised through rural development agencies. Additionally, awareness campaigns through widely accessible channels, such as social media, radio, and television, can effectively reach and educate poor households about enhancing their digital knowledge and skills.

The findings from IPMA showed that INF and FSP are priority areas for high-poverty states (i.e., Sabah and Kelantan) to enhance DIC. The historical uneven development in Sabah and Kelantan has contributed to imbalanced growth, limiting the economic opportunities and infrastructure development. Hence, increasing public sector investment in INF, such as expanding broadband and mobile internet access, is essential. The government can introduce subsidies for affordable mobile data plans and device-support schemes, while public-private partnership with telecommunication companies and technology providers can further enhance broadband coverage and ensure stable, high-speed connectivity to support digital financial transactions. Stable and reliable internet connectivity enables smooth digital financial transaction, which promotes greater financial inclusion.

Furthermore, FSP plays a vital role in expanding access to digital financial services by offering user-friendly platforms and removing access barriers to promote DIC. This includes simplifying digital identity verification processes, particularly for poor households. FSP can develop electronic Know Your Customer (e-KYC) systems that streamline the onboarding process by offering a fast and convenient online method to access financial services, such as linking accounts with national identity cards, using biometric verification, and designing user-friendly interfaces. These measures not only improved uptake rates but also ensure secure authentication when using digital financial services.

For moderate-poverty states (i.e., Sarawak, Kedah, Terengganu, and Perak), the present study highlights the need to improve DIL and enhance the role of FSP in promoting DIC. Policymakers, in collaboration with local community and agencies, can organise community trainings programmes, such as ICT workshops and digital learning courses, to share knowledge about financial technology and raise awareness about digital security, especially regarding financial fraud and scams. FSP can also innovate mobile-based financial services by integrating built-in guidance and educational content within their applications. For example, when users log in, a pop-up guide can appear to explain security tips and financial terms that required users to read and acknowledge the information before proceeding with financial transactions. These steps help improve DIL among poor households, increase their confidence, and support DIC.

For low-poverty states (i.e., Perlis, Pahang, Negeri Sembilan, Melaka, Johor, W.P. Labuan, Pulau Pinang, Selangor, and W.P. Kuala Lumpur), where the digital financial ecosystem is relatively mature, further enhancements on DIL and INF require more targeted interventions to reach poor households who may still be left behind, particularly those residing in rural areas. To enhance DIC, policymakers can leverage village community

centres and mosques as platforms for DIL workshops and training sessions. These initiatives help to raise awareness and knowledge about digital financial transactions and cybersecurity. This aligns with the strategies of government initiatives to migrate towards digital financial channels and build cash-lite communities among remote and underserved populations, as outlined in the Financial Inclusion Framework 2023-2026 (BNM, 2023).

Moreover, stable and affordable internet access remains a pre-requisite for accessing digital financial services. The Twelfth Malaysia Plan (RMK-12) highlights that, through the implementation of JENDELA, the government aims to develop a sustainable, inclusive, and high-quality digital INF with wider 5G coverage. It also introduces innovative funding schemes by commercial banks and government agencies to encourage greater investment in digital INF development. Therefore, continued development of digital INF is essential to bridge urban-rural gaps and build a more inclusive digital society.

This study showed no significant association between FIL and DIC or FW among poor households in Malaysia. As discussed, this may be due to the fact that income constraint limit their access and engagement with financial services and products; thus, they lack the capacity to apply financial knowledge and skills effectively. These findings suggest that improving FIL alone is not sufficient to uplift their financial conditions. Policymakers can design tailored financial planning awareness programmes that align with the real financial constraints faced by poor households. By practising effective financial planning, such as prioritising essential spending and adopting good financial habits, they can better manage their limited income and improve their financial conditions, which, in turn, enhances their FW.

Social Implications

This study highlights the significant role of DIC in enhancing FW among poor households, thereby contributing to the social development. DIC supports the inclusion of poor households who are often socially excluded and economically disadvantaged populations into the formal financial system. By providing access to financial tools in digital financial services, DIC offers poor households opportunities such as education and entrepreneurship. For example, poor households can sell products online and receive digital payments. This increases their income and also improve the quality of their life.

However, as digitalised information becomes more accessible, the associated risks such as fraud, scams, and identity theft also arises. To strengthen poor households' confidence and trust in using digital financial services, collaboration between the government and FSP is essential. The government should improve the legal and regulatory framework, as traditional laws may no longer be fully equipped to address the emerging risks landscape. Meanwhile, FSP are encouraged to partner with fintech companies to develop integrated risk-prevention system. These systems could include real-time detection of potential fraud and prompts users to take immediate actions, providing a safer and more inclusive digital financial ecosystem.

Some countries in Southeast Asia face socio-economic challenges in achieving digital financial inclusion. For example, Indonesia and the Philippines experience regional development disparities that cause a digital divide, making it difficult for certain groups to access technology and affecting their digital literacy capabilities, similar to the situation in Malaysia (Kanehira et al., 2024; Susilowati et al., 2024). To overcome these barriers, regulatory and public policies should play a significant role in creating a supportive envi-

ronment for inclusive digital finance.

This includes the implementation of Know-Your-Customer (KYC) procedures and the use of national identification numbers to facilitate fast and convenient customer onboarding and verification. The simplified KYC makes it easier for poor households to use financial services, even if they lack full formal documentation. Besides that, financial service providers can leverage alternative source of data, such as payment transactions and telecoms data, as well as analytics to access customer profiling, conduct credit risk assessments, and detect fraud to enhance their access to credit. To encourage saving and long-term financial resilience, digital financial services platforms can enhance the features by providing user-friendly product designs, such as mobile wallets linked to savings accounts and financial tools to help users set and track their financial goals.

Additionally, poor households also face cultural, social, and psychological barriers to DIC. For example, many poor households still prefer to use cash for transactions, rely on informal borrowing, and experience low levels of trust and confidence in using digital platforms. This could be attributed to lower levels of trust in financial institutions (Tay et al., 2022). Poor households tend to have greater trust and reliance on community support and social networks. These informal networks often act as substitutes for formal institutions such as banks and government services, particularly in areas with weak infrastructure and limited geographical accessibility.

For example, poor households residing in areas far from financial institutions and in areas with poor connectivity often rely on social networks such as families, neighbours, and religious groups to share information about financial services and provide encouragement to adopt digital tools. This helps build confidence in using digital financial services platforms. Hence, activities such as digital and financial literacy programmes can be delivered through local community centers to increase awareness, provide more information about the financial services, and equip them with skills to access and use digital financial services more effectively.

CONCLUSION

Poverty, which leads to social and economic disparities, can severely impact national well-being. Improving FW through DIC is a key strategy for resolving this issue. This study examines the role of FIL, DIL, INF, and FSP in influencing the FW of poor households in Malaysia and investigates the mediating role of DIC in these relationships.

By collecting responses from 1,171 poor households across Malaysia, we conclude that DIL, INF, and FSP are significant determinants of DIC, which supported H3, H5, and H7, and are corroborated by past studies. Poor households that possess higher levels of DIL have higher competencies in navigating digital devices and conducting digital financial transactions, thereby increasing the probability of DIC (Alkhwaldi, 2024; Jack & Suri, 2011; Lyons et al., 2020; Mujeri & Azam, 2018). The poor households in this study face structural barriers such as financial exclusion and vulnerable financial shocks, making DIL more important in enabling them to access formal financial services.

Moreover, FSP plays crucial role in fostering DIC by delivering quality information on financial products and services, as well as offering innovative financial solutions that expand accessibility and meet the financial needs of poor households (Khera et al., 2021; Ozili, 2020; Thathsarani et al., 2021). A well-established INF enhances accessibility

and reliability of digital financial services, thereby increasing DIC (Ediagbonya & Tioluwani, 2023; Ozili, 2018; Peng & Mao, 2023; Suhrab et al., 2024). Meanwhile, this study also demonstrated that both FSP and DIC are positively related to FW, which supported H8 and H9. The role of FSP in meeting the financial needs of poor households helps them make better financial decisions, which in turn improves FW (Khera et al., 2021; Losada-Otalora et al., 2020; Ozili, 2022b). DIC bridges poor households to the digital financial system, allowing them to use and benefit from digital financial services (Demir et al., 2022; Peng & Mao, 2023).

The mediating analysis demonstrates that DIL, FSP, and INF could indirectly impact FW through DIC, supporting H10a, H10c, and H10d. DIC enhances the accessibility and inclusiveness of financial services, allowing poor households to better manage their finances, which in turn improves their FW. While possessing DIL, having active FSP, and a well-established INF are essential, they are not enough to enhance FW. Poor households need to be effectively included in the digital financial system through DIC, which allows them to fully utilise and benefit from financial services. This is in line with the studies by Alkhwaldi (2024), Lee et al. (2023), Peng and Mao (2023), Suhrab et al. (2024), Demirguc-Kunt et al. (2017), Thathsarani et al. (2021), and Selvia et al. (2021).

This study found that FIL is not correlated with DIC and FW; thus, H1, H2, and H10b were not supported. This may be due to the income constraints encountered by poor households, which limit their opportunities to engage in financial services, thereby restricting their ability to effectively apply financial knowledge in practice (Mahdzan et al., 2023).

While our findings consistent with previous studies, we contribute by extending these relationships to households living in poverty, a sub-group that has received limited attention in prior studies. By integrating factors from both demand- and supply-side, the research framework provides a comprehensive understanding of how digital financial inclusion supports financial well-being.

This study extends the analysis by incorporating the importance-performance map analysis (IPMA) to determine priority factors that are useful for practitioners to enhance the FW and DIC among poor households in Malaysia. The present study's findings indicate that, among the examined constructs, DIC and FSP appear as the constructs that play the most important role in improving FW but are currently underperforming. On the other hand, the role of FSP is found to be the most important factor for achieving DIC in groups with high poverty rates, while DIL is the most important factor in achieving DIC in groups with moderate and low poverty rates. These findings highlight the digital divide and urban-rural gap that result from uneven development across states in Malaysia. Prioritising managerial interventions in these areas could effectively improve DIC and enhance FW among poor households in Malaysia.

The digital divide is not unique to Malaysia alone; several countries in the ASEAN region, including Indonesia, Vietnam, and the Philippines, face similar challenges (Ing & Markus, 2023). Issues such as limited internet speed, uneven digital infrastructure, and disparities in internet usage hinder the effective deployment of digital technologies in these regions. Addressing these barriers is crucial to ensuring that the benefits of the digital economy are equitably distributed. Our study highlights that improvements in DIL, INF, and FSP are important for achieving DIC and enhancing FW among poor households. However, for them to effectively apply FIL, they must first improve their financial conditions and practise effective financial planning. The research framework developed in

this study, which is grounded in the Family Resource Management Theory, offers valuable insights to other developing countries in Southeast Asia that share similar socio-economic and digital challenges.

LIMITATIONS AND RECOMMENDATIONS

Despite its contribution, this study has several limitations. This study only focuses on low-income households whose income falls below the poverty line. While the findings of this study provide valuable insights into the financial challenges faced by this low-income group, readers should be cautions in generalising the findings, as moderate- and high-income households may face different financial challenges. Improving FW is crucial at all income levels. Therefore, a comparative study across different income levels is recommended for future researchers to identify differences between the groups.

Furthermore, since this study only collected data from the poor households, the findings would be more comprehensive if future researchers gathered data from practitioners to better understand the challenges that they encounter in helping poor households enhance FW and DIC. Such an approach offers a more holistic understanding of this topic, as it examines it from both the demand-side and the supply-side perspectives.

Moreover, it should be noted that the non-probability sampling technique may cause bias in the data representative. In addition, the questionnaires were self-administered by the respondents. Although the questions were explained before the respondents answered, responses may still carry potential bias, which could affect the interpretations of the findings. Hence, a random sampling technique is recommended for better representatives in future studies. Furthermore, future studies could consider qualitative methods, such as interviews and focus groups, to better capture the impacts of factors such as personal emotions, social capital, and policy interventions.

Additionally, the cross-sectional dataset and PLS-SEM method may potentially overlook endogeneity issues and its limitation to draw causal inferences, particularly issues arising from bidirectional causal relationships among variables of financial literacy, digital financial inclusion, and financial well-being. As a result, it is difficult to mitigate the influence of potential omitted variables on the mediation paths. Future studies are therefore recommended to use longitudinal data or experimental design to better validate causal inferences and improve the reliability of the conclusions to better manage endogeneity issues.

Also, it is important to acknowledge that there may be confounding variables not included in the model of this study that could potentially influence the relationship between digital financial inclusion and financial well-being. Therefore, reader should exercise caution when generalizing the findings of this study.

In addition, the variables in this study were developed based on existing literature. To further enhance the novelty of future studies, it is recommended to explore emerging factors such as digital financial behaviour, digital technology acceptance, and mobile payment penetration rates. It is also recommended to consider cultural differences, government assistance, policy implementation barriers, regional disparities, and social capital, which could significantly interact with digital financial inclusion and financial well-being.

Lastly, to expand the Family Resource Management Theory, it is recommended to include moderating variable such as social network support and the role of women in

household financial decisions in the framework.

Despite these drawbacks, the strengths of the present study are numerous. First, limited studies have investigated the target population below the national PLI; the bulk of the pertinent previous research has focused on the bottom 40% (B40) populations in Malaysia. This is important, as poor households need more support for DIC. Next, there was insufficient research in Malaysia that categorised the impoverished people based on poverty frequency. Identifying specific segments of the poor population provides valuable data to practitioners in designing targeted interventions.

DATA AVAILABILITY STATEMENT

Data available on request from the authors

Ethical Approval

The ethical approval UUM/RMC/J-1/3/21288 was obtained from the Universiti Utara Malaysia (UUM) Research Ethics Committee.

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