An Empirical Examination of the Factors Affecting the Adoption of Digital Payments: The Case of Egypt

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Abstract. Financial inclusion is a crucial element of sustainability, especially in emerging economies with policies that entail providing equitable access to financial services for individuals and businesses to expand the opportunities for vulnerable individuals, small investment projects and diversify financial risk. Respectively, financial inclusion would be a path for achieving sustainable development goals through fostering inclusive economic growth, enhancing financial security, and mitigating the adverse impacts of financial exclusion. Technology advancements have led to the introduction of new payment services such as digital wallets, electronic payment platforms and mobile money. Such digital payments play a vital role in achieving financial inclusion particularly post the COVID-19 pandemic, which led to nations taking prompt action to provide individuals with a means of conducting their daily transactions smoothly, so the shift to digital payments. Issues such as limited internet connectivity, lack of a proper digital infrastructure and low financial literacy arise in developing nations. Thus, the researcher decided to examine digital payment users' intention, giving implications for business owners and policy makers. The paper would document how the pandemic changed consumer behavior. This study will employ Technology Acceptance Model [TAM] to identify the determinants of digital payments use intention among individuals in the Egyptian economy adopting a quantitative exploratory one, employing the PLS-SEM. A survey was used to collect the data using snowball sampling and the findings supported the hypotheses proposed regarding how the TAM variables affected perceived usefulness and perceived ease of use, so influencing the intention to adopt digital payments in Egypt.

Keywords: Financial inclusion, digital payments systems, TAM, Egyptian economy.

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1.Introduction

Financial inclusion is an essential component of overall economic growth and individual well-being, serving as a fundamental component of economic development and sustainability. It ensures that individuals and businesses can access essential financial services affordably, a concept supported by key literature. [Demirguc-Kunt et. al, 2018; World Bank, 2018]. Pivotal to emerging economies, financial inclusion has a pronounced significance in enhancing gross domestic product [GDP], mitigating income inequality, fostering sustainable development as well as empowering marginalized groups, such as individuals in rural areas and women, to participate more rigorously in the economy [Sahay et al., 2015; Bruhn & Love, 2014; Allen et al., 2016]. [World Bank, 2018].

Since financial inclusion gained worldwide importance on nations' development agendas, stakeholders sought effective tracking measures [World Bank, 2014]. A primary method has been the adoption of digital payments [d-payments], which represent a shift from traditional to electronic financial platforms, thereby promoting broader financial participation as conveyed by Demirguc-Kunt et al. [2018; Surin & Jack [2016] This transition relies heavily on mobile technology; which overcomes traditional barriers and facilitates secure electronic transactions [Ozili, 2023; Au & Kauffman, 2008; Mallat, 2007]. That is, the use of bank issued cards, e-commerce, mobile payments and financial technology [Fintech] applications to conduct any form of payment or money transfer rather than the actual use of cash [Zandi et al., 2013]. As this domain flourishes in its ubiquity and user base, d-payments emerge as a fundamental facilitator of efficient and secure electronic payments between any parties involved [Ondrus & Pigneur, 2006].

The Technology Acceptance Model [TAM] explains how perceptions and behaviors towards new technology influences their adoption of new technologies like digital payments [Davis, 1989; Venkatesh & Davis, 2000]. If a technology is perceived as useful and easy to use, it is more likely to be adopted, so suggesting a framework for policymakers to enhance financial inclusion through digital payments [Venkatesh & Bala, 2008]. Perceived usefulness, explained as the extent to which individuals believe that using a particular technology will improve their lives, while perceived ease of use, is degree to which a user expects the technology to be effortless to comprehend and operate [Davis, 1989]. Based on these explanations of the two TAM determinants, the framework suggests that if perceived usefulness and perceived ease of use exist according to individuals' perceptions, then, they are more likely to adopt d-

payment platforms [Slade et al., 2015; Oliverira et al., 2016]. Therefore, understanding TAM's influence on the adoption of d-payments is important for policymakers to determine how to build on it as a means for enhancing financial inclusion.

One major issue in the research on financial inclusion is how the COVID-19 pandemic has influenced individuals' likelihood of adopting d-payments. Although primarily a health crisis, the pandemic triggered economic disruption that accelerated the adoption of d-payments due to the need for social distancing. [Nicola et al., 2020; Baker et al., 2020]. The pandemic prompted a shift in societal norms, particularly in emerging economies, as it emphasized the critical role of digital financial services in maintaining economic stability [Gupta and Verma, 2022; Ozili, 2021; Demirguc-Kunt et al., 2022; Iman, 2021].

However, despite the benefits, several barriers limit the widespread adoption of d-payments especially in emerging economies. According to the World Bank's [2017] report, the following challenges are listed: financial literacy within the nation, limited internet connectivity, lack of proper digital infrastructure and concerns over data security [Ozili, 2018; Iman, 2019; Awad & Dessouki, 2017]. Yet the use of cashless and digital payments became a key indicator of financial inclusion in emerging economies, such as Egypt [World Bank, 2020].

In Egypt, economic challenges caused by the pandemic, highlighted the importance of financial inclusion [Huterska et al., 2021]. The government along with the Central Bank [CBE] have been pivotal in promoting digital financial services to over 105 million Egyptians [Hassan and Abdalla, 2023; World Bank, 2023]. The rise in d-payment platforms, such as mobile wallets reaching 13 million users by the end of 2020 and Fintech applications, such as Fawry which experienced a 40% rise in user base in 2019 [Fawry, 2019 ; World Bank , 2020]. Other Fintech applications that have gained further momentum are Instapay and Sahl, which have become integral to people's daily lives. The surge in the adoption of d-payments within Egypt, however, is not an indicator of financial literacy, which according to Lausardi and Mitchell [2014], reflects an individual's ability to understand and effectively use various financial skills, such as personal budgeting, financial management and investment, a factor strongly correlated to an individual's economic well-being.

This research aims to empirically assess the determinants of the intention to use d-payment, based on TAM explanation of adoption behavior. Moreover, authors will shed the light on influence of the pandemic and financial literacy for d-payment development and thus financial inclusion. The study

would assist managers in setting better business models and shaping future directions in development of d-payment. The findings could aid policymakers in formulating effective strategies to bolster digital financial services, aligning with the financial inclusion goals set by the CBE in 2022 [CBE, 2022].. Thus, the research seeks to consider:

"Which factors in the Technology Acceptance Model [TAM] affect the intention to use digital payments among individuals in the Egyptian economy, and what was the effect of the COVID-19 pandemic on such adoption?"

The paper is divided into the following sections first, a review of previous literature, followed by the research methodology section, then, the results of the research and finally, the discussion and policy implications section.

2.Literature Review

In this section of the paper, the theoretical background of the research is established with a review of the previous literature.

2.1 Financial Inclusion and Digital Payment Technologies

Financial inclusion, defined as the access to and adoption of formal financial services, is a vital component of poverty alleviation and socioeconomic development [Demirguc-Kunt et al., 2018]. Financial inclusion plays a pivotal role in enhancing economic growth through the broadening of access to financial services. This inclusivity is not just through opening bank accounts, but also savings, insurance, loans as well as digital services at a cost affordable to the various socio-economic classes within the society [Demirguc-Kunt et al., 2018]. Research has shown that countries with higher financial inclusion have lower poverty and income inequality levels, since the access to financial services [Sahay et al., 2015]. Furthermore, financial inclusion fosters entrepreneurship through the provision of financial resources to small and medium enterprises [SMEs] which are usually underserved by the traditional banking system [Bruhn & Love, 2014]. This is a rather important role since SMEs contribute to a nation's GDP growth as well as job creation, therefore, allowing more robust economic growth [Demirguc-Kunt et al., 2018]. Furthermore, the broader participation by individuals translates into higher aggregate demand and better resource allocation, so propelling further economic growth [Ozili, 2020]. It can be deduced that financial inclusion is a critical catalyst for economic growth, as it enhanced individual welfare, reduces poverty and income inequality and supports entrepreneurship, all of which allow for economic development of nations.

Among the various means of financial inclusion as per the World Bank's Findex Database, digital payments is identified as a key indicator of financial inclusion [World Bank, 2018]. This is due to the adoption of d-payment platforms, such as mobile money, Fintech applications, online banking as well as e-wallets; that is, any cashless means of payment, reflects the ability of an individual to access and use formal financial services, which corresponds with the definition of financial inclusion in previous literature. Aker and Mbiti [2010] discussed in their research how d-payments serve as a gateway to broader financial inclusion as they provide the underserved populations with an accessible and convenient means to formal financial services. D-payments have the potential to overcome the traditional barriers to financial inclusion, such as lack of proper infrastructure, high transaction costs and geographical remoteness [Jack & Suri, 2014]. This potential supports the rationale to use d-payments as an indicator of financial inclusion. Thus, d-payment solutions enable individuals, who were once excluded from a nation's formal financial sector to conduct affordable and secure financial transactions in a convenient manner.

Financial inclusion addresses the availability of opportunities to individuals and businesses of financial services in affordable, timely and appropriate means through various financial products [Levine, 2005]. Sarma & Pais [2011] researched the importance of intending to use digital payments by individuals and businesses overcoming socio-economic as well as geographical barriers as a means of increasing financial inclusion. Worldwide, digital payments have become a key player in promoting economic growth and enhancing financial inclusion as they facilitate business and individual transactions with minimal effort and costs [Hasan et. al, 2013]. According to the 2017 World Bank Global Findex Database, mobile money services, a form of digital payments, have aided the unbanked as well as the minimally banked individuals in developing nations, who make up millions of the population, in accessing financial services. This would translate into reducing the shadow economies in nations, so promoting economic growth in a sustainable manner as Schnider and Enste [2000] deduced from their research allowing governments to better regulate financial activities and enhancing tax compliance through financial transparency. Furthermore, the ongoing progression in digital technology coupled by the revolution within the Fintech industry worldwide is a phenomenon that cannot be ignored in transforming the financial scene and paving the way for further progression. Hence, as a cornerstone in today's financial landscape, it is inevitable to research digital payments and the intention of individuals to adopt them as they are at the forefront of the digital revolution.

2.2 Digital Payments Adoption Explained by TAM

An array of studies has explored various aspects of this phenomenon, focusing on user acceptance, technology adoption models, and individual behavior towards these systems. Driven from the Theory of Reasoned Action [TRA] which discussed an individual's behavior is determined by their intention to act in a certain way, the Technology Acceptance Model [TAM] was introduced by Davis [1989] in a seminal paper. Building the theoretical model, Davis [1989], primarily focused on two factors: perceived usefulness [PU] and perceived ease of use [PEOU], which are believed to influence a user's intention to adopt a particular technology. Davis further developed the theory for the foundation to understanding the model's application within various technological contexts, including digital payments.

Other studies explored TAM while adding other dimensions, such as Vankatesh & Davis [2000], who expanded on the original model by introducing factors such as social that would affect the acceptance of digital payments. In contrast, Zhou [2012] addressed a rather different aspect affecting the adoption of digital payments, by focusing on how user satisfaction affects the intention to use mobile payments. The study highlighted the role of security and trust in enhancing PU and PEOU, suggesting that these factors significantly contribute to the technology's acceptance. Other researchers, such as Kim et al. [2010] examined the impact of social factors and personal innovativeness on PU and PEOU focusing on mainly mobile payment services. Their findings indicated that social influences and individual innovation traits can significantly affect users' perceptions, so affecting their adoption of technology. Chen [2013] emphasized the findings indicating that PEOU and PU are strong predictors of the intention to use mobile payments. Furthermore, research such as Shin [2009] explored how usability and enjoyment influence PU and PEOU, offering a more nuanced understanding of user acceptance in the d-payments world.

Collectively these studies highlight the significance of the various versions of TAM in analyzing digital payment systems, stressing the complexity of factors influencing technology acceptance. While Davis [1989] and Venkatesh & Davis [2000] placed the theoretical groundwork, subsequent research by Zhou [2012], Chen [2013], Kim et al. [2010], and Shin [2009] expanded the model by integrating additional variables such as trust, social influence, quality perceptions, and user experience. This research though, adopts the TAM to determine the variables affecting d-payments' adoption since the constructs of TAM, namely, the system characteristics and individual differences, each with a subset of variables, affect PU and PEOU, which eventually affect the individual's intention to adopt d-payments.

The TAM framework is divided into two parts, the first testing the digital system characteristics; which are mobility, reachability, convenience and compatibility, while the second is the individual's characteristics, namely, knowledge and personal innovativeness; which would affect user acceptance of technology. Mobility, the first variable of digital system characteristics, is the ability to access services through mobile devices, such as smartphones, over wireless networks anytime and anywhere [Kim et. al, 2010]. Dahlberg et. al, explained mobility as the ability to conduct transactions anytime and anywhere which significantly enhances PU of digital payments. According to Dahlberg et. al [2008], mobility is a key variable in driving the adoption of mobile payment services, as it describes the capability and flexibility of payment methods that can be used seamlessly in any physical or digital environment, which aligns with the modern consumer's lifestyle, offering unprecedented ease in managing financial transactions. This view is supported by Zhou [2013], who found that the mobility offered by d-payments increases the perceived convenience, which in turn positively influences the intention to use these services. Au & Kauffman [2008] explained mobility as the concept of "anytime, anywhere" transactions; that is, an individual's ability to make payments without the constraints of time or location while Slade et. al [2005] discussed how mobility is the practical usage of payment technologies in any situation, whether while travelling or at home.

Donner & Tellezz [2008] explained reachability, as the capacity of payment technologies to be applicable and accessible to various consumers regardless of their socio-economic status, their geographical location or the technological aptitude. Reachability was constructed in Kim et. al's [2010] research as the possibility of people being contacted anytime and anywhere, which is an expansion of Mallat's [2007] research where it was considered as access to payment platforms by people in rural or underdeveloped areas. Sripalawat et .al [2011] argue that reachability, or the widespread availability of d-payment options, increases their PU. That is, sers are more likely to adopt a payment method that is accepted across a wide range of merchants and services. This is echoed by Kim et al. [2010] and Koenig-Lewis et al. [2015], who suggest that enhanced reachability, through extensive merchant adoption, significantly contributes to the perceived ease of use, encouraging users to adopt digital payments.

The third variable within the system characteristics is compatibility, or the degree to which digital payment systems align with users' existing values, experiences, and needs, is another crucial factor in determining individuals' use digital payments. Kim et. al [2010] concluded that compatibility has a strong correlation to PU and PEOU, so affecting user's intention to adopt d-payments due to its positive impact

on user needs and lifestyle. Pablou and Fygenson [2006] emphasized that compatibility considers the degree to which d-payment technologies support and align with the regulatory, cultural and economic contexts off users conforming to domestic and international financial regulations, so positively aligning with the intention to adopt these payment methods. As for Klein and Sorra [1996], they considered the relationship between compatibility and adoption of payment methods, focusing on the former as the degree of ease with which users can integrate payment technologies into their daily routines, which yielded a positive correlation.

The last of the system characteristics variables, convenience, is perhaps the most directly influential factor on the PU and PEOU of d-payments. It encompasses ease of transaction, time savings, and the elimination of physical barriers as explained by Kim et. al [2010] through the analyses of user satisfaction surveys. Liébana-Cabanillas et al. [2014] highlight that convenience and PEOU show a strong positive correlation, which directly affects the intention to adopt d-payments. This sentiment is reinforced by Yang et al. [2012], who found that the convenience of not needing to carry cash or physical cards greatly enhanced the PU of d-payment systems. Zhou [2011] highlighted that the flexibility and accessibility of payment technologies; that is, convenience, is directly correlated to the PU and PEOU of d-payments.

Therefore, it can be deduced that while mobility and reachability are crucial according to previous research, yet mobility emphasized the personal freedom to transact anywhere, whereas reachability focused on the systemic availability of the service across vendors. Both were positively correlated with PU. As for compatibility and convenience, compatibility deals with how well d-payments fit into existing lifestyles and technological ecosystems, affecting both PU and PEOU, by ensuring the user does not need to significantly alter their habits. Convenience, on the other hand, directly impacts PEOU by simplifying the transaction process, making it faster and more efficient, so directly influencing users' adoption intentions.

Loke [2017] researched mobile payments adoption in Malaysia, but contrary to the afore-mentioned studies, he determined that mobility and convenience did not have a significant impact on the behavioral intention of individuals to adopt mobile payments. The reasons behind this were deduced by Loke [2017] to be due to the high prevalence of alternative payment methods that were well-integrated into people's everyday lives. Zhou [2008] discovered in his study on mobile banking in China that compatibility did not play a significant role in mobile payments adoption, especially among older

users; that is the correlation between compatibility and mobile payments varied depending on demographics. In addition, Slade et al. [2013] concluded from investigating d-payments in rural areas, that the relationship between reachability and the adoption of d-payments was not significant due to the poor infrastructure in such areas coupled with low rates of technological literacy.

TAM's second construct considered is individual differences, whose variables personal innovativeness and knowledge of d-payments are researched to determine their impact on PU and PEOU. As research in various social science fields repeatedly indicated that human behavior has a rather strong influence on people's perceptions and ultimately actions, the adoption of digital payment technologies fits perfectly under this category. Individuals with high personal innovativeness are more inclined to experiment with new technologies, as indicated by Chang, Cheung and Lai [2005] when researching the dynamics of an individual's decision to resort to online shopping. Agrawal and Prasad [1998] adopted personal innovativeness, the willingness of an individual to try new technologies, as the main construct in determining the acceptance of new technologies. They found that personal innovativeness directly influenced PEOU, as innovative individuals are more capable and willing to learn and use new technologies. Slade et. al [2015] discovered that innovativeness significantly impacted non-users' intentions in adopting remote payments, while Rogers [2003], in his book, posits that innovators and early adopters have a higher tolerance for risk and a more favorable attitude towards new technologies, enhancing their perception of the technology's usefulness and ease of use. Demographic factors, such as age, education and income, influence personal innovativeness; that is, it is more likely to find a correlation between younger individuals with higher educational backgrounds likely to adopt digital technologies than their counterparts. Moreover, an individual's income level affects their willingness to adopt d-payments as concluded by Arvidsson [2014] and Martins et al. [2014].

Knowledge about d-payment systems as another variable under personal differences showed in previous research a significant impact on PU and PEOU, since lack of familiarity and understanding act as barriers to adopt d-payments. Laukkanen [2016], determined that consumers' knowledge of d-payments directly influenced their perceptions of its usefulness. Kim and Lee [2009] support this, indicated that awareness and experience with d-payments can reduce perceived complexity and increase PEOU, so positively affected adoption intentions. Sharma and Govindaluri [2014] concluded that awareness and knowledge of the technology is a primary determinant among other factors of the intention to adopt it.

However, a study by Vankatesh et al. [2003] determined that factors, such as, social influence and performance expectancy affect the adoption of d-payments more than individual differences. This was corroborated by Dahlberg et al. [2015], who found that factors, such as perceived risk, perceived ease of use and trust play a more significant role in influencing the adoption of d-payments than personal innovativeness and knowledge of d-payments. Table 1 below explains the TAM variables.

Table 1: TAM Characteristics

Category	**Variable**	**Description**
Digital System Characteristics	Mobility	Ability to access and use digital services anywhere using mobile devices over wireless networks.
	Reachability	The extent to which digital services can engage users across different contexts and environments.
	Convenience	The effortlessness and ease with which users can operate the technology.
	Compatibility	The degree to which the technology fits with the user's values and practices.
Individual Characteristics	Digital payments knowledge	Understanding the mechanisms and benefits of digital payment systems.
	Individual innovativeness	The predisposition of an individual towards adopting new technologies.

2.3 Financial Inclusion & Digital Payments: The Role of the COVID-19 Pandemic and Financial Literacy

2.3.1 The COVID-19 Pandemic

In late 2019, the COVID-19 pandemic took the world by surprise. Caused by the SARS-CoV-2 virus, the pandemic led to a global halt with profound effects economically, socially and technologically. Due to the urgency of quarantine, physical interaction was kept to a minimal and social distancing was deemed mandatory worldwide, the integration of technology into everyday life for work purposes, shopping and financial services was seen as the only means for survival [WHO, 2020].

The usage of various online applications for work purposes was at a peak during the pandemic and this incited the idea that technology integration in everyday lives was no longer a luxury, but rather a necessity. There was a notable increase of 30% in online banking users in Egypt during the pandemic [Egyptian Financial Supervisory Authority, 2020]. The pandemic created an environment conducive for entrepreneurs, particularly in Fintech to take the lead to create applications that facilitate everyday lives. For instance, the Egyptian Fintech startup Paymob raised $3.5 million to expand its services within the country during the pandemic aiming "to contribute to the financial inclusion movement while targeting economic growth by empowering merchants through payment facilitation" [Santosdilaz, 2020]. Banks, such as Banque Misr and the National Bank of Egypt, took the opportunity to enhance their online banking services and encourage users to embrace them by launching new digital platforms to facilitate remote banking and ensure business continuity during the pandemic [National Bank of Egypt, 2021]. Policymakers had to set proper frameworks in place to regulate the integration of technology into financial services among other aspects. The pandemic-induced social distancing measures and the need to minimize physical contact have propelled consumers and businesses towards digital payment solutions, marking a pivotal shift in payment behaviors. According to its annual report in 2020, Fawry, a leading Egyptian electronic payment provider, reported an increase in the usage of its services during the COVID pandemic, so met that surge with an expansion in its services to include more online payment options. Fawry, also, partnered with several businesses to facilitate contactless payments during and after the pandemic [Fawry Annual Report, 2021].

With that in mind, individuals' adoption of d-payments was divided into two categories as per the research of Kim et al. [2010], who determined that there are early and late adopters, with the former being the ones who were using d-payments prior to the pandemic, while the latter are the ones that were part of the masses that joined during the pandemic and sustained their status. The pandemic significantly accelerated the adoption of d-payments, as although a significant number of users in Egypt were using d-payments, yet it led to a rather mass exude adopting d-payments during and post the

pandemic [World Bank, 2020]. Early adopters of d-payments, were already familiar with the technology, increased their usage, exploring new platforms and services that emerged during the pandemic. This group's willingness to adopt digital innovations contributed to a broader acceptance and normalization of digital payments in daily transactions [Ozili, 2020]. On the other hand, late adopters, who had previously shown reluctance or limited engagement with digital payments, found themselves compelled to adapt to these technologies as traditional payment methods became less viable due to lockdowns and the closure of physical banking services according to Sharma et al. [2020]. This shift not only expanded the user base of digital payment platforms but also highlighted the importance of digital literacy and accessibility, essential components of financial inclusion.

The pandemic underscored digital payments as a significant infrastructure, enabling individuals and businesses to conduct transactions safely and efficiently under the constraint of social distancing. This transition had profound impact on financial inclusion, particularly in emerging economies where access to traditional banking services is limited. Digital payments have become a gateway for unbanked and underbanked populations to access financial services, contributing to economic participation and empowerment [Arunachalam & Kumar, 2020]. Moreover, according to the Mobile Economy Report published by the GSMA in 2020, the pandemic propelled the supply side entities, such as governments and financial institutions to facilitate the use digital payments, further demonstrating the role of digital financial services in enhancing financial inclusion. However, the rapid adoption of digital payments highlighted challenges such as privacy concerns, the availability of a digital infrastructure, financial illiteracy digital divides as well as the need for robust cybersecurity measures. Ensuring equitable access to digital payment technologies requires concerted efforts to address these issues, fostering an inclusive digital financial ecosystem [World Bank, 2020].

The COVID-19 pandemic has significantly influenced the adoption of d-payments, bridging the gap between early and late adopters and highlighting the importance of digital financial services in achieving financial inclusion. One of the issues, financial literacy, whether for early or late adopters, is of concern in this research as a descriptive variable whose impact on the intention to adopt d-payments is addressed.

2.3.2 Financial Literacy in relation to digital payment

Financial literacy is a critical aspect in the financial technology domain, as Lausardi and Mitchell [2014] stressed on its importance in enhancing individuals' understanding and use of financial products. They

determined that financial literacy equips consumers with the skills needed to assess the benefits and risks associated with digital financial services, which would affect their adoption intentions in a positive manner. Thus, a positive direct relationship exists between financial literacy and the adoption of d-payments. Klapper et. al [2016] determined in their study that higher levels of financial literacy are correlated with the continuous use of d-payment systems. Furthermore, research indicated that financial literacy enhances trust in and usage of digital financial services by providing individuals with the skills they need to better navigate complex financial environments [Gumilar et al., 2024].

Ozili [2020], in policy-focused research paper, accentuates the critical role that financial literacy plays in the adoption of d-payments, especially during the COVID-19 pandemic. Donner and Tellez [2008] concluded from their research on mobile banking in developing nations that financial literacy is crucial for comprehending and leveraging mobile financial services to increase financial inclusion. Their work focused on the challenges faced by low-literacy nations in adopting d-payments, so they recommended that financial education is a solution to bridge the gap. Within the context of financial literacy, demographics, namely, age, gender, income, educational level and occupational status, play an important role particularly in emerging economies, such as Egypt. In their research on the demand side determinants of financial inclusion, Fahmy and Ghoneim [2022] concluded that not all demographic variables have the same impact on financial literacy. The study found a strong link between income levels and financial literacy; that is, individuals with higher income have a better understanding of financial services. Education was, also, found to be strongly correlated with financial literacy, while age however, is not. Gender differences in financial literacy were highlighted in the study, showing that males have higher financial literacy levels than females in Egypt. The insights provided by Fahmy and Ghoneim [2022] are essential for tailoring financial education and inclusion strategies, especially with regards to digital services which are becoming more prominent worldwide.

The relationship between financial literacy and d-payments adoption is not a straightforward one, since variables, such as perceived ease of use, trust in the digital systems and self-efficacy play a rather significant role in whether an individual will adopt d-payments [Laukkanen & Pasanen, 2008; Slade et al., 2015]. Factors, such as a nation's regulatory framework and the availability of digital infrastructure influence the adoption of d-payment services as well [Aker & Mbiti, 2010]. Therefore, it is vital that we understand the interplay between financial literacy, d-payments adoption and financial

inclusion to allow policy makers and the providers of financial services to better develop strategies to promote inclusive and sustainable financial systems.

3. Research Gap, Research Questions and Hypotheses

3.1 Research Gap

Despite the significant strides in digital payments within Egypt, there remains a substantial research gap concerning the application of the Technology Acceptance Model to understand its effects on the adoption of digital financial services, considering the COVID-19 pandemic as a major economic shock. The available literature focuses on broader metrics of financial inclusion and the rise in digital payment platforms during the pandemic without an in-depth analysis of the specific elements of TAM. Furthermore, while a strong correlation has been proved between the pandemic and digital transformation, however, there is limited empirical research contextualizing how the pandemic altered the traditional predictors of technology adoption within Egypt. This gap underscores the need for targeted research evaluating the determinants of adoption of d-payments to consider financial inclusion expansion, whilst considering the pandemic induced impact to formulate sustainable strategies promoting digital financial services post-pandemic.

3.2 Research Questions

In light of the above research gap, this research aims to answer the following questions:

R1: How do the elements of the technology acceptance model [TAM] affect the adoption of digital payments within the Egyptian economy?

R2: How did the COVID-19 pandemic influence the adoption rates of digital payments in Egypt?

R3: What role do demographic factors [such as age, education and income levels] and financial literacy play in the adoption of digital payments in Egypt under the TAM framework?

3.3 Research Hypotheses

To answer the questions and as per the literature considered, the following hypotheses are under examination.

H: The TAM variables and digital payments adoption.

H1a: Mobility will have a positive effect on the perceived usefulness of digital payment.

H1b: Mobility will have a positive effect on the perceived ease of use of digital payment.
H2a: Reachability will have a positive effect on the perceived usefulness of digital payment.
H2b: Reachability will have a positive effect on the perceived ease of use of digital payment.
H3a: Compatibility will have a positive effect on the perceived usefulness of digital payment.
H3b: Compatibility will have a positive effect on the perceived ease of use of digital payment.
H4a: Convenience will have a positive effect on the perceived usefulness of digital payment.
H4b: Convenience will have a positive effect on the perceived ease of use of digital payment.
H5: Personal innovativeness will have a positive effect on the perceived ease of use of digital payment.
H6: Digital payment knowledge will have a positive effect on the perceived ease of use of digital payment.
H: Demographics, the COVID-19 pandemic, financial literacy and digital payments adoption
H7: The COVID-19 pandemic has influenced the intention of users to adopt digital payments.
H8a: Demographics have a positive effect on financial literacy.
H8b: Financial literacy affects the intention to use digital payments.
H9a: Perceived ease of use will have a positive effect on the perceived usefulness of digital payment.
H9b: Perceived ease of use will have a positive effect on the intention to use digital payment.
H10: Perceived usefulness will have a positive effect on the intention to use digital payment.

4. Research Methodology

This research employed a quantitative exploratory approach to investigate the relationship between TAM variables and the intention to adopt and use d-payment systems. TAM is a well-established theoretical framework that studies how individual attitudes towards and perceptions of technology affect the adoption of it. In the context of this study, the researcher uses TAM variables to assess their impact on the intention to adopt and use d-payments. This approach allows for a systematic data-driven exploration of the factors that contribute to the uptake of d-payments technologies, which are an important indicator of financial inclusion. By quantifying the influence of these TAM variables, the study provides valuable insights that can aid in the development and promotion of d-payments to enhance financial access and inclusion.

4.1 Conceptual Framework

Figure 1 represents the conceptual framework adopted in this research signifying the concepts discussed in the literature review and summarizing the hypotheses that are examined.

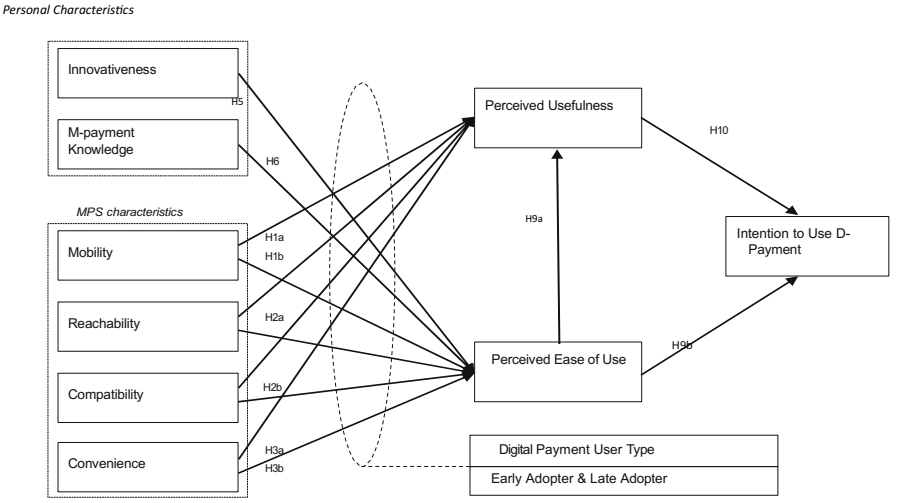


Figure 1. Conceptual Framework

[Source: Lee & Kim, 2010]

4.2 Variable Specification

In this study, the independent variable[s] are the innovativeness and d-payment knowledge under the construct personal characteristics and mobility, reachability, compatibility and convenience under the digital payment system characteristics. The mediator variables in the study are perceived usefulness, perceived ease of use which help in understanding the how or why of the relationship between the independent and the dependent variables. The intention to adopt d-payments is the dependent variable of the study which gives inferences into financial inclusion.

Below are tables explaining the variables and their measurements adopted throughout the study.

Table 2: How TAM Variables are measured

Variable	Measurement
Innovativeness	Independent ordinal variable measured using a 5-point Lickert scale by asking respondents to rate their openness to new experiences and technologies.
Digital Payment Knowledge	Independent ordinal variable measured using a 5-point Lickert scale by assessing respondents' self-reported knowledge and familiarity with digital/cashless payment systems.
Mobility	Independent ordinal variable measured using a 5-point Lickert scale by asking respondents to rate the ease of using digital payments on the go.
Reachability	Independent ordinal variable measured using a 5-point Lickert scale by evaluating how respondents perceive the accessibility of digital payments from across different platforms and locations.
Compatibility	Independent ordinal variable measured using a 5-point Lickert scale by evaluating how well the sample feel that the digital/cashless payment options available integrate with their existing devices and systems.
Convenience	Independent ordinal variable measured using a 5-point Lickert scale by the responses received regarding the perceived efficiency and ease of using digital payments in the sample's daily lives.
Perceived Usefulness	A belief ordinal mediator variable measured using a 5-point Lickert scale by the degree to which a respondent believes that using digital payments would enhance their payment experience.
Perceived ease of use	A belief ordinal mediator variable measured using a 5-point Lickert scale by assessing how easy respondents perceive the use of digital payments.
Intention to use digital payments	Dependent ordinal variable measured using a 5-point Lickert scale by the probability that respondents will use digital payments in the future.

Table 3: Demographic variables and the COVID-19 pandemic variables

Variable	Category	Measurement
Age	Control Variable	Continuous
Gender	Dummy Variable	Categorical 0- Male 1- Female
Education	Control Variable	Ordinal
Occupation Status	Control Variable	Categorical 0- Unemployed 1- Employed
Income	Control Variable	Continuous
Digital Payment Use [Frequency per month]	Descriptive Variable	Ordinal
Period of Digital Payment Use	Descriptive Variable	Ordinal
Primary Reason for Use	Descriptive Variable	Categorical
Adopted prior to COVID or after	Dummy Variable	Categorical 0 – Adoption before COVID 1- Adoption after COVID

4.3 Instruments and Sampling

4.3.1. Targeted population and sampling methods

Egypt, the study environment, is according to the Global Findex [2017] a nation with low financial inclusion, particularly, in rural areas [El-Baz, 2020]. According to the Global Findex and World Bank 2021 Reports, Egypt is among the few nations where more than half of the world's unbanked population reside compared to other countries in the region with approximately 67% of the adult population not having a bank account in comparison to other Middle Eastern countries. In Saudi Arabia, according to the 2021 Global Findex Database, 82% of the adult population have a bank account, which shows significant progress in financial inclusion, while in the United Arab Emirates, 93% of adults own a bank account and in Jordan, 52% do.

However, Egypt's progress in financial inclusion stands out within the MENA region due to the substantial initiatives and policy implementations by the CBE. These implementations reflected a rise in adults with a bank account from 33% in 2015 to 45% in 2021 as reported by the Central Bank of Egypt [2022]. Other countries in the region, such as Lebanon and Jordan, have shown slower progress due to less aggressive policies by their central banks [2021]. Moreover, Egypt's introduction of digital payments, aligning with the CBE's financial inclusion strategy, aims to integrate the informal economy has been a game changer. Since 2020, mobile phone usage in financial transactions has increased by around 12% from the previous year [Central Bank of Egypt, 2021]. This increase stands out in comparison to other countries, such as Saudi Arabie and the UAE, which although enjoy higher levels of financial inclusion are more focused on traditional banking services [World Bank, 2021].

In Egypt, there is a 12% difference in the use of d-payment services between men and women as mentioned in the Global Findex Report [2021], while approximately 70% of individuals with accounts have not adopted d-payments, such as mobile phones or the internet. This data piqued the researcher's interest to study how TAM affects the adoption of individuals within the Egyptian economy of digital payments.

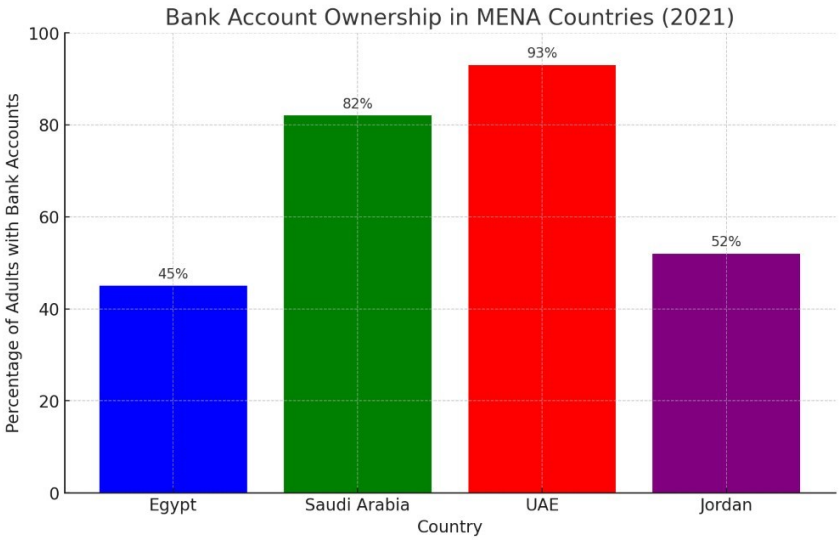


Figure 2: Bank account ownership in MENA countries [2021]

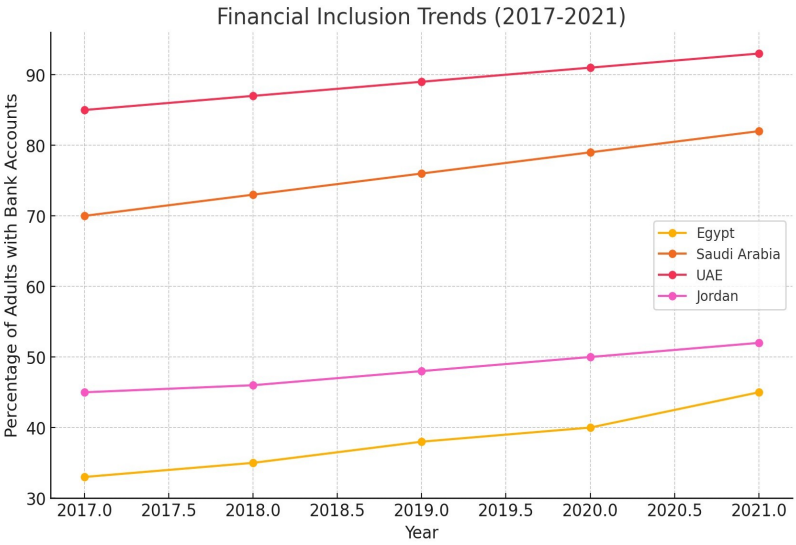


Figure 3: Financial inclusion trends in some MENA countries [2017-2021]

For this research, the targeted was adults over the age of 18 years, who have access to social media and technology. The researcher chose the minimum age of 18 as in Egypt this is the university admission age where individuals are likely to have access to various cashless means of payments whether Fintech mobile applications or cards, such as prepaid bank cards, supplementary credit cards or Telda.

According to Comrey and Lee [1992], a sample size of 300 is the proper one for multivariate statistical research for the results to be reliable. Furthermore, Krejcie and Morgan [1970] determined that to study financial inclusion on a national level, a sample of over 300 is required to ensure adequate statistical analysis and to be able to generalize the findings. Accordingly, this study targeted more than 300 individuals to be able to rely on the findings to draw conclusions about the research.

4.3.2. Data collection and survey design

A quantitative approach collecting primary data using a structured survey, was adopted, leveraging a multiple-item method where responses to each item were measured using a five-point Likert scale [Kim and Lee, 2010]. This scale ranged from "strongly agree" to "strongly disagree," allowing for an in-depth understanding of participants' attitudes, perceptions, and behaviors regarding the research topic [McIver and Carmine, 1981].

The survey was constructed using the research conducted by Kim and Lee [2010] following rigorous and comprehensive review of existing literature to identify validated measures used by other researchers

that were relevant to the research constructs. The aim was to ensure the use of established instruments, contributing to the reliability and validity of the survey, thus, allowing for the tailored measurement of specific constructs within the context of the research.

Seeking to ensure the clarity and relevance of the survey questions, the researcher ensured that the questions were clear to avoid ambiguity, leading questions, and technical jargon, making them accessible to a broad audience. Furthermore, the survey was reviewed by a panel of experts in the field, who provided feedback on the content, structure, and wording of the questions which contributed to the content validity of the survey, ensuring that the items effectively captured the constructs of interest. Before the survey was deployed to a larger audience, it underwent a process of preliminary testing and refinement to enhance its reliability and validity. The initial version of the survey was tested on a sample of academics in the field of interest. This testing phase aimed to identify any issues with the survey's content, format, and overall ease of use. The feedback received from the academic sample initiated the refinement of several survey items, instructions, and layout. Adjustments were made to improve question clarity, adjust the length of the survey to an optimal duration, and ensure that the items were appropriately aligned with the study's research objectives.

Following the academic testing phase, the survey was subjected to a pilot test with a small group of 10 respondents who were representative of the study's target population. The purpose of the pilot test was to simulate the survey's administration process and gather preliminary data on its performance in a real-world setting. The pilot test provided insights into how respondents interpreted the questions, the time taken to complete the survey, and any technical issues encountered during the completion process.

Based on the findings from the pilot test, a few changes were made to the survey, such as revision of specific items that were found to be confusing or misinterpreted by respondents, adjustments to the survey layout to enhance navigability, and improvements to the instructions. These refinements were critical in enhancing the survey's face validity and ensuring a smooth administration process in the main study.

The survey is divided into four sections as below in table 4 with a demographics data as the first part, followed by the financial inclusion section, then, the COVID-19 pandemic impact on digital payments and finally a game testing financial literacy. A copy of the survey can be found in Appendix A. The survey was administered to the study's target population whilst ensuring confidentiality and anonymity of the respondents, thereby encouraging honest and accurate replies. The data collection strategy capitalized on snowball sampling using the accessibility and widespread of online platforms chosen for their broad user bases and the ability to target specific groups that align with the study's demographic criteria, along with direct email outreach, to facilitate participation from a diverse set of respondents relevant to the study's context. This extended the reach to professionals, academics and individuals interested in the research topic, while the use of direct email targeted individuals and professional groups whose expertise was relevant to the study.

The data collection phase spanned six weeks, a period determined to be sufficient for reaching a broad audience while maintaining the relevance and timeliness of the data collected. The six-week window allowed for the survey to be shared and circulated among potential respondents, thereby maximizing exposure and participation rates. Regular reminders were posted on the selected online

platforms and sent midway through the data collection period to encourage participation from those who might have missed or delayed completing the survey initially.

Table 4: Survey questions and the variables they measure

Questions	Variable Measured	Source
Q1, Q2	Demographic Data	Demirguc-Kunt et al [2017]
Q3, Q4, Q5	Socioeconomic status	Majid et al. [2022]
Q6	Usage frequency	Davis, F. D. [1989].
Q7	Experience	Venkatesh & Davis [2000].
Q8	Reason for adoption	Turner, Ralph. [2007].
M1, M2, M3	Mobility	Kim et al. [2010]
R1, R2, R3	Reachability	Kim et al. [2010]
CM1, CM2, CM3	Compatibility	Kim et al. [2010]
CV1, CV2, CV3, CV4	Convenience	Kim et al. [2010]
PI1, PI2, PI3	Personal Innovativeness	Kim et al. [2010]
PK1, PK2, PK3, PK4	Digital payments knowledge	Kim et al. [2010]
PEOU1 -PEOU 5	Perceived ease of use	Kim et al. [2010]
PU1-PU3	Perceived usefulness	Kim et al. [2010]
BI1- BI4	Behavior intention	Kim et al. [2010]

4.4 Data analysis methods

The initial stage of the data analysis was the examination of the demographic characteristics of the participant sample, utilizing descriptive statistics to provide an overview of the sample composition. This offered insights into the distribution of key demographic variables such as age, gender, educational background, current employment status and income level. Furthermore, questions about the duration of d-payments usage, the primary reason for d-payments usage as well as whether they were early adopters of d-payments; that is prior to the COVID-19 pandemic, or late adopters, post the pandemic were analyzed to reflect a clear picture of the respondents.

To statistically assess the reliability and consistency of the constructs measured in the survey, Cronbach's alpha was used . According to Gilem and Gilem [2003], this statistical measure is pivotal for evaluating the internal consistency of the items within each construct, ensuring that they are coherently capturing the underlying concept. Cronbach's alpha values range from 0 to 1, where the higher values indicate greater internal consistency, so reflecting a reliable measurement of the construct. Following the reliability and validity assessment, Partial Least Square [PLS-SEM-SEM] testing was conducted using the SPSS software to test the hypotheses outlined in the proposed research model in to depict relationships between the variables [Kim and Lee, 2010]. PLS-SEM-SEM was particularly advantageous for this study as it facilitated the examination of causal relationships between variables and assessed the overall fit of the empirical data with the theoretical research model.

This structured analysis ensured the integrity of the research findings, offering robust evidence to support the proposed model and contributing valuable insights into the study's field.

5. Results

5.1 Sample View

A total of 334 responses were gathered and underwent a thorough screening process to ensure the integrity and usability of the data. A check for completeness of responses, identification and exclusion of any responses with missing or invalid answers was conducted to rule out any invalid or fraudulent submissions. The screening resulted in the exclusion of 26 responses due to missing data or invalid responses, such as inconsistent answering patterns that suggested random or careless responses. Consequently, a final dataset comprising 308 valid responses was compiled for empirical analysis. The 308 valid responses represent a 92% valid response rate which according the Fincham's [2008] benchmark of 60% is acceptable.

The examination of the responses provided the following descriptive statistics giving insights into the demographics, behaviors, and preferences related to digital payments usage among the respondents.

Table 5: Demographic profile of respondents

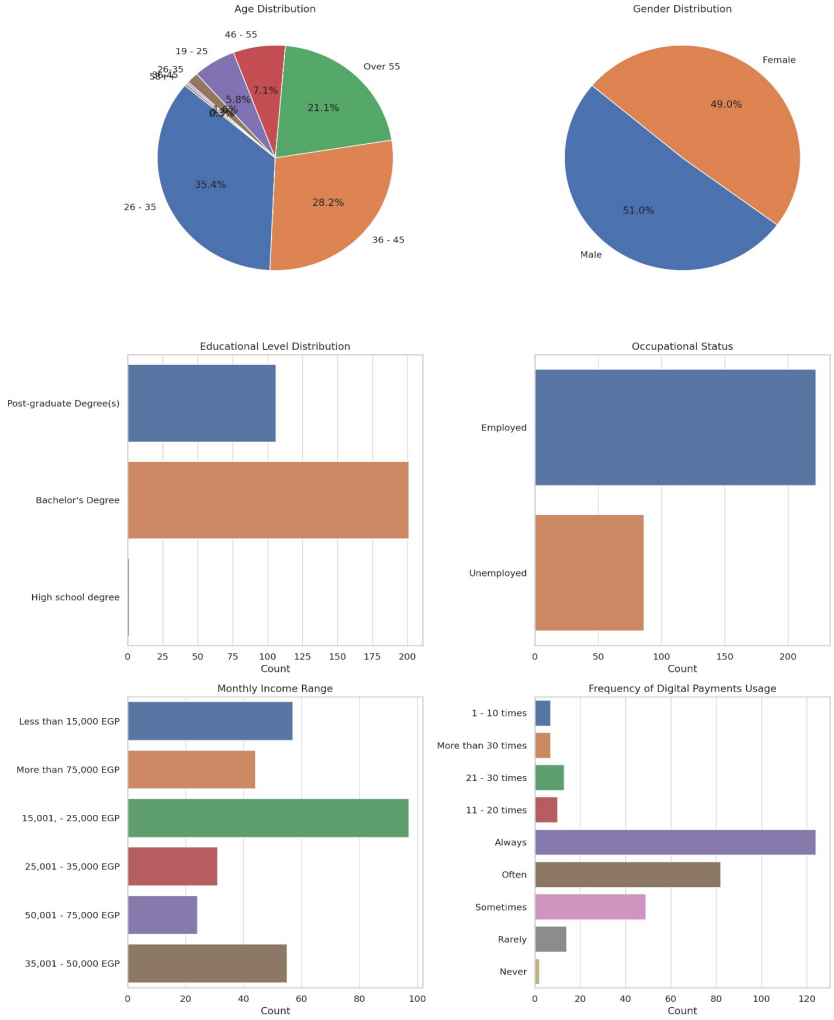
Description	Age Range	Gender	Educational Level	Occupational Status	Monthly Income Range
Count	308	308	308	308	308
Unique Categories	8	2	3	2	6
Most Frequent Category	26-35	Male	Bachelor's Degree	Employed	15,001-25,000 EGP
Frequency of Most Frequent Category	109	157	201	222	97

Table 5 above along with the graphical representation [figure 4] shows the distribution of respondents across various demographic attributes such as age range, gender, educational level, occupational status, and monthly income range. For instance, the most common age range among respondents is 26-35 years, and the most frequent gender is male. Most respondents are employed and have a bachelor's degree, with their monthly income most commonly falling within the range of 15,001 to 25,000 EGP

- Age Distribution: Most respondents, totaling 109 out of 308, are in the age range of 26-35 years, followed by 36-45 and over 55. This suggests a wide adoption of digital payments across various age groups, with a higher concentration among younger to middle-aged adults.
- Gender Distribution: The gender distribution is nearly balanced, with a slight majority of male respondents [157] compared to female [151].

- Educational Level: Many respondents have attained higher education levels, with many holding Bachelor's and Post-graduate degrees. This suggests that the survey participants are highly educated.
- Occupational Status: The percentage of employed respondents is 72.07%, while 27.92% are currently unemployed.
- Monthly Income Range: Monthly Income Range: Income ranges vary among participants, with a notable number of responses from both lower and higher income brackets. The most common income range is "15,001 - 25,000 EGP", with 97 respondents.
- Frequency of Digital Payment Use: "Always" is the most reported frequency, with 124 respondents indicating this as their usage rate, so reflecting a rather high engagement in the usage of d-payments. Other significant responses for the use of digital payments were rarely and sometimes, suggesting varied levels of reliance on digital payments among the participants.
- Duration of Digital Payment Use: "More than 4 years" is the most common duration, with 120 respondents or 38.96% of the responses, suggesting a long-term adoption of digital payment methods among the survey participants. However, the rest of the responses indicate that the surge in users could be driven by external factors, such as the onset of the COVID-19 pandemic.
- Primary Reason for Using Digital Payments: The predominant reason for using digital payments among respondents is "Easier access than cash," with 115 responses, highlighting convenience as a key factor. Other reasons include the ease of transaction and security, indicating that practicality and safety are significant considerations for users.
- Change in Digital Payments Usage Due to COVID-19: A large number of respondents were already using digital payments frequently before the COVID-19 pandemic, suggesting that the pandemic did not initiate but possibly accelerated the adoption for some users. However, a substantial portion began or increased their usage of digital payments during the pandemic, reflecting a shift towards digital platforms as a response to health and safety concerns.

- Figure 4: Demographic composition of study sample



5.2 Reliability and validity analysis

To test the validity and reliability of the constructs used in the model, Cronbach's Alpha test was used to yield the below results. Results higher than 0.6 indicate various level of reliability, yet any values lower indicate an unacceptable level of reliability.

Table 6: Reliability and validity test results

Scale/Dimension	Number of Questions	Cronbach's Alpha	Interpretation
Mobility	3	0.808	High internal consistency
Reachability	3	0.809	High internal consistency
Compatibility	3	0.863	Excellent internal consistency
Convenience	4	0.898	Excellent internal consistency
Personal Innovativeness	3	0.807	High internal consistency
Payment Knowledge	4	0.876	Excellent internal consistency
Perceived Ease of Use	5	0.972	Exceptional internal consistency
Perceived Usefulness	3	0.948	Very high internal consistency
Behavioral Intention	4	0.940	Very high internal consistency

These results convey that should the measurement be repeated with the same conditions, the constructs would measure the same attributes without much error. Furthermore, the results reflect that the constructs are well-captured through the survey questions.

To assess whether multicollinearity exists and to what extent it affects the stability and interpretation of the regression model, a variance inflation factor [VIF] analysis was conducted [James et al., 2013]. Multicollinearity is when the independent variables in a study are highly correlated, which leads to misleading standard errors and unreliable results, so undermining the statistical validity of the model [O'Brien,2007]. Table 3 below provides the VIF results for the research model.

Table 7: VIF Analysis

Variable	VIF
Mobility	2.441247
Reachability	3.341724
Compatibility	4.125916
Convenience	4.514192
Personal Innovativeness	1.535525
Personal Knowledge	3.876100
Perceived Ease of Use	7.676771
Perceived Usefulness	9.645509
Behavioral Intention	6.018725

As per the above table, the VIF values for PU and PEOU indicate that there is a multicollinearity between the mediator variables, which may influence the regression model. While the TAM other independent variables indicate low levels of multicollinearity and so more stable contributions to the research model.

4.3 Data analysis: Regression results

The sample size along with the multiple constructs of the research model led to using PLS-SEM using SPSS as the algorithm computes partial regression relationships and structural models while using "separate ordinary least square regressions" **[Hair et al., 2018]**. Thus, for the purpose of this study, it was the most appropriate regression method to use. The table below shows the results presented indicating the correlation between the independent and dependent variables of the study.

Table 8: PLS-SEM test results

Variable	Coefficients [PU]	Coefficients [PEU]	Coefficients [BI]
Mobility	0.097	0.149	
Reachability	0.217	0.136	
Compatibility	0.239	0.39	
Convenience	0.447	0.319	
Personal Innovativeness		0.159	
Personal Knowledge		0.713	
Perceived Usefulness			0.609
Perceived Ease of Use			0.306
Behavioral Intention			

Thus, the analysis indicated a strong and growing adoption of digital payments, driven by convenience and facilitated by technological advancements and possibly accelerated by recent global shocks such as the COVID-19 pandemic. The data suggests that digital payment systems are an integral part of financial transactions for many individuals, with usage patterns that are likely to continue evolving.

Table 9: Hypotheses testing results

Hypothesi	Independent	Depende	Coefficien	Std.	t-Value	p-	R-	Result

s	Variable	nt Variable	t	Erro r		Value	square d	
H1a	Mobility	Perceived Usefulnes s	0.097	0.04	2.425	0.016	0.673	Accepted
H1b	Mobility	Perceived Ease of Use	0.149	0.05	2.98	0.003	0.673	Accepted
H2a	Reachability	Perceived Usefulnes s	0.217	0.04 6	4.717	<0.00 1	0.673	Accepted
H2b	Reachability	Perceived Ease of Use	0.136	0.05 2	2.615	0.009	0.673	Accepted
H3a	Compatibility	Perceived Usefulnes s	0.239	0.05 6	4.267	<0.00 1	0.673	Accepted
H3b	Compatibility	Perceived Ease of Use	0.39	0.05 9	6.61	<0.00 1	0.673	Accepted
H4a	Convenience	Perceived Usefulnes s	0.447	0.05 3	8.435	<0.00 1	0.673	Accepted
H4b	Convenience	Perceived Ease of Use	0.319	0.05 4	5.907	<0.00 1	0.673	Accepted
H5	Personal Innovativene ss	Perceived Ease of Use	0.159	0.03 1	5.129	<0.00 1	0.78	Accepted
H6	Digital Payment Knowledge	Perceived Ease of Use	0.713	0.04 4	16.205	<0.00 1	0.78	Accepted
H9a	Perceived Ease of Use	Perceived Usefulnes s	0.609	0.06 9	8.823	<0.00 1	0.834	Accepted
H9b	Perceived Ease of Use	Intention to Use	0.306	0.06 6	4.636	<0.00 1	0.834	Accepted
H10	Perceived Usefulness	Intention to Use	0.609	0.06 9	8.823	<0.00 1	0.834	Accepted

The above table indicates that all hypotheses based on the statistical testing were accepted as all p-values generated were below 0.001 indicating the significant influence of the independent variables on the dependent variables. As for the t-value and R-squared values, they indicated that the model fits the data well; that is the research model adopted is appropriate.

Table 10: User type and adoption pattern

User	Pre-	Use Change	Primary Reason	Future Use

Type	Pandemic Use	Due to Pandemic		Intent
Early Adopter	High	Increased/ Stable	Varied [e.g., convenience, security]	High
Late Adopter	Low/None	Increased	Primarily convenience	High

Table 10 shows the usage before and during the COVID-19 pandemic, the primary reasons for using digital payments and their future use intentions. Based on this data, the following can be deduced:

- Early Adopters: Their usage was maintained or increased during the pandemic indicating that the pandemic influenced their future intent to use digital payments.
- Late Adopters: These individuals who prior to the pandemic were not frequent users of digital payments, increased their use which is likely to be due to reduced physical contact during the pandemic.

Both types of users indicate a high intent to use digital payments in the future, implying that the pandemic likely solidified the role of digital payments as a necessary financial tool. The results indicate that the H9a hypothesis that the intention to adopt digital payments was accelerated by the COVID-19 pandemic is true. For late adopters, a significant increase in the rate of adoption was noted, hence, indicating a strong correlation between the pandemic and adoption of d-payments.

The sample tested indicated financial literacy levels characterized as predominantly medium to high reflecting moderate understanding of financial concepts and practices in Egypt. Based on the OECD 2017 guide to financial literacy, the responses to the game used to test for financial literacy showed high financial literacy in their responses to the game [Appendix B] with 126 responses. Medium levels of financial literacy accounted to 142 responses which is the highest level, while a small proportion projected low levels of financial literacy with 40 instances.

Table 11: Correlation tests

Statistic	Value	Description
Sample Size [N]	308	Total number of participants in the study.
Mean [BI]	1.96	Average score of Behavioral Intention.
Standard Deviation [BI]	1.022	Measures the dispersion of BI scores.
Mean [FL]	5.29	Average score of Financial Literacy.

Standard Deviation [FL]	1.413	Measures the dispersion of FL scores.
Pearson Correlation [BI & FL]	-0.098	Indicates a weak negative correlation.
Significance [Correlation]	0.043	Significance level of the correlation.
R Square	0.01	Proportion of variance in BI explained by FL.
Adjusted R Square	0.006	Adjusted R square considering degrees of freedom.
Standard Error of Estimate	1.018	Standard error of the regression estimate.
ANOVA F-value	2.973	Tests the overall significance of the regression model.
ANOVA p-value	0.086	Significance of the regression model.

6. Findings Analysis

In this section of the paper, the researcher elaborates on the relationships between the variables as per the empirical analysis.

6.1 Discussion

The analysis of the 308 valid responses to the survey provided an in-depth understanding of the demographics, behaviors and preferences of d-payment users in Egypt, highlighting a significant trend towards such adoption across various demographic segments. The consideration of the demographics of the study is important as they are pivotal indicators signaling the potential for sustained growth in d-payments. For instance, the age range of 26-35 years reflected the highest adoption, which suggests a strong inclination towards d-payments among those who are economically active. This demographic characteristic coincides with how among this age, the personal characteristics of TAM are high as per the survey responses. Hence, in comparison to previous literature, that indicated a strong correlation between demographics and d-payments adoption, it is likely that not all demographic characteristics have the same impact as deduced by Fahmy and Ghoneim [2022]. Another important observation from the research is the high frequency of d-payments usage among the sample, which indicates a strong integration of d-payments into daily financial activities from the early adopters. Moreover, the long-term use of d-payments, as indicated by a majority who have been using such services for over four years, reflects a sustained trust and reliance on d-payment services, which allows for the deduction that it is not merely a temporary shift in behavior but rather a long-standing change.

The Egyptian government has been promoting d-payment services over the past decade in collaboration with the CBE to support economic efficiency, reduce transaction costs and most importantly enhance the formalization of the economy. The transition from a cash to a cashless economy

is a crucial one within the Egyptian economy where the informal or shadow economy accounts for a significant portion of activity. The improvements in infrastructure and widespread of telecom services along with the ever-increasing numbers of mobile users has facilitated the increase in adoption of d-payments.

The TAM variables have shown a strong correlation with the adoption of d-payments among Egyptian users as per the empirical results. Mobility was found to be positively correlated with both perceived usefulness and perceived ease of use, which supports previous findings by Zhou [2013] and Au & Kauffman [2008]. Nevertheless, this finding contradicts Loke's [2017] deduction that mobility did not significantly influence adoption of d-payments. Furthermore, today's Fintech platforms are simpler to engage with and use, coupled with the convenience of cashless payment methods available in most outlets and online has further increased the adoption of digital payments. Reachability and compatibility, also, showed positive correlations with PU and PEU, and hence, the adoption of d-payments. This finding supports previous research by Kim et al. [2010] among others, yet compatibility was found to have a stronger correlation effect than reachability in this research. Convenience showed the highest positive impact on PU and PEU underscoring the ease and efficiency of using d-payments. This is consistent with previous studies that highlight convenience as a crucial factor in the acceptance and sustained use of technological solutions as indicated by Yang et al. [2012].

The variables of personal differences in TAM, digital payments knowledge and personal innovativeness tested in this research have, also, shown strong positive correlation to the adoption of d-payments. With the former, the research reflected that individuals with greater awareness and understanding of digital payment methods are more likely to appreciate their benefits, so adopt them, which aligns with Majid et al. [2022] who concluded that higher levels of digital financial literacy correlate positively with technology adoption. Roger's [2003] Diffusion of Innovations theory asserts that innovators and early adopters- pre-pandemic adopters in this research- play an important role in the spread of technology.

The restrictions imposed by the pandemic led to d-payments becoming a crucial tool for conducting safe transactions and the social distancing led to banks stepping up to improve their cashless financial services so attracting more users. This shift is reflected in the study with the increase in the number of users who began and expanded their use of d-payments during the pandemic, showing how an external shock can catalyze technological adoption. The findings emphasize how the pandemic acted as a stimulus shifting the public's openness to new technologies with innovative individuals taking the lead worldwide. Sharma et al. [2020] reached the same conclusion in their study, indicating that the pandemic was an impactful economic shock on people's behaviors.

Previous literature stressed the criticality of financial literacy to enhance d-payments adoption and increase financial inclusion. However, the majority of the sample showed medium levels of financial literacy which implies that a fair size of the sample has an adequate understanding of financial concepts. Those with high financial literacy make more informed financial decisions, such as investment decisions while those with low levels struggle with basic financial tasks as budgeting. The pandemic could have been a reason why within the Egyptian economy, low rates of financial literacy did not stop people from adopting d-payment services which was proposed by the World Bank, 2020. Another aspect would be that due to the overtaking of technology during the pandemic, this led to a surge in technological

literacy, an area that should be studied to determine its impact on d-payments and thus, financial inclusion. Furthermore, the personal characteristics of TAM showed a high correlation with the adoption of d-payments, which indicates that personal innovativeness and knowledge are stronger in factors in influencing people's behavior. However, the low levels of financial literacy from the sample are around 13%, which when generalized to the Egyptian population accounts for a lot. This may require more effort from financial institutions along with banks to inform people of the various financial concepts and their benefits.

Therefore, the analysis s substantiates the research question that the TAM characteristics do have an influential impact on the adoption of digital payment systems in Egypt and this adoption was further propelled by the COVID-19 pandemic. The empirical data highlighted the shift towards d-payments, particularly during and post the pandemic, which shows an alignment between the theoretical model and the empirical evidence collected from the sample population. It is worth noting that the pandemic played a catalyst role in the adoption and use of digital payments as captured by the empirical data. The pandemic led to a paradigm shift in financial services adoption, as individuals moved from the traditional payment methods that were previously used to digital platforms.

D-payments adoption is an indicator of financial inclusion since such behavior allows for individuals to become part of the formal financial sector within the economy. Such an outcome has been a focal point for the Egyptian government not merely as a means of achieving economic goals, such as growth with the inclusion of those unbanked as well as the increase in services used by those who were more reliant on cash, but also as a key element to achieve the nation's Sustainable development goals for 2030 [Vision, 2020]. Hence, the integration of d-payments has enhanced financial inclusivity within the country, which supports Demirguc-Kunt's et al. [2018] research. The World Bank [2020] has, also, determined that d-payments enable the efficient delivery of government services to individuals through the usage of technology. In Egypt, where economic reforms aim to stabilize and develop the economy, d-payments foster sustainable economic development by reducing transaction costs, enhancing financial transactions and transparency which aligns with several of the SDGs. Therefore, d-payment services are not only a mechanism for financial inclusion, but also a foundational strategy for achieving sustainable economic development in Egypt. Because of this, the government has been focusing on enhancing and improving the various means of d-payment services along with campaigns from banks and Fintech applications to further engage more people.

6.2 Contribution and Policy implications

This paper contributes to supporting how the TAM explains digital payment behavior, particularly within the Egyptian economy. The research findings validate TAM's core principles and show that individuals are likely to adopt digital payment solutions whenever they are useful and can be easily operated. Therefore, it can be deduced that TAM is an integral framework for policymakers in promoting digital financial services and enhancing financial inclusion within the economy.

Furthermore, this research focuses on the role of digital financial services in promoting financial inclusion as d-payments provide efficient and accessible means to reach those underserved by the regular financial system. This allows for the integration of a rather significant portion of the population

into the economy's formal financial system. This allows for empowerment of individuals and businesses, so enhancing economic participation and supporting the nation's sustainable development goals.

Given the research insights, several policy implications emerge for the Egyptian economy. First and foremost, the government needs to continue improving the nation's technology infrastructure to support the provision of digital financial technology and its adoption. The research sample did not include individuals in rural areas, since snowball sampling via social media was adopted and due to poor internet infrastructure in such areas, it was difficult to survey individuals there. Over the past years, the government has focused and worked in collaboration with Telecommunication companies in Egypt to improve internet connectivity as well as engage more mobile users in mobile wallets through the provision of various benefits. Hence, inclusive financial policies that ensure accessibility to all a population's segments could further embed individuals into the national economic fabric.

Another aspect the requires immediate attention from the government, CBE, Fintech application providers and other financial institutions, is to facilitate for users to be able to electronically register, that is, bank Know Your Customer [KYC]. Allowing such a step would facilitate for more users to be able to use digital financial services since the digitization of identity verification would enable the users to register and use the Fintech applications. Such a step would require the CBE to set a proper framework for the e-KYC as well as be able to monitor the users. This step should be coupled with facilitating for individuals to be able to buy mobile phones, which are the main means for accessing digital services. Such facilitations could be in the form of payment instalments, discounted mobile phones as well as access to Fintech applications, such as Fawry and Instapay upon phone purchase.

An important aspect that needs to be addressed as more people adoption digital services is how to secure them through various cybersecurity implementations which would promote a higher level of trust among users, particularly older generations would tend to be skeptical of technology. In addition to this, strong cybersecurity controls should be set in place in accordance with the CBE frameworks to avoid digital payment services coming to a halt as the recent incident that took place in July 2024 which led to several payment services stopping. Thus, enhancing customer protection frameworks to safeguard against fraud and misuse would aid in promoting d-payments adoption.

Enhancing financial literacy through financial education programs and raising awareness by financial services providers along with banks would aid in lowering financial literacy rates that may hinder the adoption of d-payments as well as reduce the optimal usage of such services.

Last, but not least, is the importance of the government providing support through knowledge sharing and funding to entrepreneurial Fintech companies to encourage them to engage in technological innovations in d-payment systems that would meet the evolving needs of individuals. This support would create an environment conducive to entrepreneurship and innovation that would promote the development of applications to further financial inclusion.

Thus, the above policy implications would aid policymakers and businesses in promoting d-payment services, so further nationally enhance financial inclusion.

6.3 Limitations and Future Research

Along the development and progress of this research, several limitations were encountered. The reliance on self-reported data by individuals may be biased since people may encounter memory recall issues when asked questions relating to time aspects. They may, also, provide answers that may not reflect the truth in fear of not following the general trend or seeking social desirability.

The study sample focuses on urban populations within Egypt with access to digital services, so overlooking individuals in rural areas, whose answers may display different attitudes and behaviors towards digital payments. This would affect the generalization of the findings since a large proportion of the Egyptian population reside in rural areas, so future research could seek to include those less digitally integrated in order to provide a better picture of the case.

Another aspect that limits the ability to establish strong causal relationships between the variables is the utilization of cross-sectional data analysis since the data was considered at a point in time. The ability to track changes over time opens up future research prospects that may provide deeper insights into how the Egyptian policymakers are implementing financial inclusion frameworks and their impact.

7. Conclusion

This study contributes in bridging the identified research gap through the successful application of the Technology Acceptance Model [TAM] to analyze the adoption of digital payments in Egypt, while showing how the pandemic has expedited the integration and acceptance of the technology. The research analyzes the TAM variables, mobility, reachability, convenience and compatibility under the digital system characteristics construct as well as d-payments knowledge and personal innovativeness variables under the personal characteristics construct. The variables under the digital system characteristics show strong positive impact on perceived usefulness and perceived ease of use, which are critical in the adoption of d-payments. Considering the impact of the personal characteristics variables further enriches the study as it highlights how individuals with greater knowledge and an innate inclination towards technology are more likely to adopt them.

Considering the pandemic in the research was critical as it was a force that greatly altered consumer behavior worldwide and had a significant impact on digital transformation. The study's findings indicate that the pandemic was not merely a disrupter but rather a key aspect in a sustained shift in the financial behavior of individuals propelling them to adopt digital financial services.

This research considered the impact of financial literacy on d-payments adoption through the financial literacy game section provided in the survey [Appendix B] in order to get a clear understanding of the profiles of d-payment users. This was key to emphasize the need for comprehensive policies by the government and the Central Bank of Egypt.

The ongoing challenges within the Egyptian economy, such as poor technological infrastructure and low rates of financial literacy need to be addressed to ensure that the benefits of digital financial services are enjoyed by the population.

In conclusion, this research enriches the academic platform on digital financial services by showing how within an emerging economy as Egypt the dynamics of TAM interplay in the adoption of digital payments. It provides further insight into how consumer behavior is affected by external shocks,

the COVID-19 pandemic, which shaped individuals' behaviors and attitudes towards technology. The study provides the various stakeholders with insights to digital financial services to facilitate setting sustainable strategies that align with Egypt's financial inclusion framework capitalizing on the accelerated shift towards digitalization warranting a more inclusive financial ecosystem in the country and similar contexts worldwide.

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Appendix A: Research Survey

Research Survey

This survey is designed to gather data on the impact of digital payments on financial inclusion in the Egyptian economy. Digital payments encompass various channels, such as online transactions, mobile payments, the use of bank-issued cards, Fintech applications like Instapay, and online banking services. It is important to note that all information collected will be strictly used for academic research purposes, and respondents' identities will be kept confidential to ensure anonymity.

Demographic Data

This section aims to collect the demographic data of the respondents. Be reassured that all responses will remain anonymous.

1. Q1: Please choose your age range. *

- ◯ Under 18
- ◯ 19 - 25
- ◯ 26 - 35
- ◯ 36 - 45
- ◯ 46 - 55
- ◯ Over 55

2. Please specify your gender. *

◯ Male ◯ Female

3. Please specify your earned educational level. *

◯ High school degree ◯ Bachelor's Degree
◯ Post-graduate Degree[s]

4. What is your current occupational status? *

◯ Employed ◯ Unemployed

5. Choose your current monthly income range. *

◯ Less than 15,000 EGP ◯ 15,001, - 25,000 EGP
◯ 25,001 - 35,000 EGP
◯ 35,001 - 50,000 EGP
◯ 50,001 - 75,000 EGP
◯ More than 75,000 EGP

6. How frequently do you use digital payments per month? *

Mark only one oval.

◯ Never ◯ Rarely

◯ Sometimes ◯ Often

◯ Always

7. How long have you been using digital payments? *

◯ Less than 1 year

◯ 1 - 2 years

◯ 2 - 4 years

◯ More than 4 years

8. What is your primary reason for using digital payments? *

◯ Always carrying cards and mobile phone ◯ Easier access than cash

◯ Ease of transaction

◯ Quick access to accounts

9. Were you using digital payments frequently prior to the COVID-19 pandemic *

Yes No

B. Financial Inclusion

This section seeks to collect data about the relationship between digital payments usage and financial inclusion. The questions aim to determine the impact of mobility, reachability, compatibility, convenience, personal innovativeness, knowledge of digital payment, perceived ease of use and perceived usefulness on the use of digital payments.

The scale used represents the following answers:

1 - Strongly Agree 2 - Agree 3 - Neutral 4 - Disagree 5 - Strongly Disagree

10. M1: I believe that digital payment is independent of time. *

11. M2: I believe digital payment is independent of place. *

12. M3: I can use digital payments anytime while travelling. *

13. R1: In general, I would always be reachable by others through mobile phones or other digital means. *

14. R2: Digital payment can be conducted regardless of the location. *
15. R3: It is always possible for my bank to contact me when needed. *
16. CM1: I believe digital payment is compatible with existing technology. *
17. CM2: I believe digital payment is compatible with other digital services. *

18. CM3: I believe digital payment is compatible with my daily routine. *

19. CV1: Digital payments are convenient because I have a mobile phone. *

20. CV2: Digital payments are convenient because I can use them anytime. *
21. CV3: Digital payments are convenient because I can use them in any situation. *
22. CV4: Digital payments are convenient because digital services are not complex. *
23. PI1: I know more about any type of new products before other people do. *
24. PI2: I am usually among the first to try any new products. *
25. PI3: New products of any kind excite me. *
26. PK1: I enjoy purchasing products online. *
27. PK2: I use online banking, credit cards or mobile payments to make purchases. *
28. PK3: I mostly use digital payment options when purchasing products online. *
29. PK4: I would be confident to use digital payments for financial transactions. *
30. EU1: Learning to use digital payments is easy for me. *
31. EU2: My interaction with digital payment procedures would be clear and understandable. *

32. EU3: It would be easy for me to become skillful at using digital payments. *
33. EU4: I would find digital payments easy to use. *
34. EU5: I would find digital payment procedures flexible to interact with. *
35. PU1: Using digital payments would enable me to pay more quickly. *
36. PU2: Using digital payments makes it easier for me to conduct transactions. *
37. PU3: I would find digital payments a useful possibility for paying. *
38. BI1: Now I pay for most purchases digitally. *
39. BI2: Assuming I have access to digital payment methods, I intend to use them. *
40. BI3: During the next 6 months, I intend to pay for purchases digitally. *
41. BI4: 5 years from now, I intend to pay for purchases digitally. *

C. COVID-19 Pandemic Impact on the use of digital payments.

This section seeks to collect data about the impact of the COVID-19 pandemic on digital payments usage.

42. Rate the frequency of your digital payment transactions **before** COVID-19. *

Mark only one oval.

◯ Never ◯ Rarely
◯ Sometimes ◯ Often
◯ Always

43. Rate the frequency of your digital payment transactions **after** COVID-19. *

Mark only one oval.

Never Rarely
Sometimes Often
Always

44. I will frequently use digital transactions in the future. *

Never Rarely
Sometimes Often
Always

45. The COVID-19 pandemic increased my usage of banking transactions [ATMs, card usage, loans, deposits] *

Never Rarely
Sometimes Often
Always

46. The COVID-19 pandemic increased my usage of financial applications. *

Never Rarely
Sometimes Often
Always

Appendix B: Financial Literacy Game

Game

This section of the survey is a finance game.

1. Five brothers are going to be given a gift of 1,000 LE in total to share between

* them. Now imagine that the brothers have to wait for one year to get their share of the 1,000 LE and inflation stays at 7.3 percent. In one year's time they will be able to buy:

Mark only one oval.

- More with their share of the money than they could today.
- The same amount.
- Less than they could buy today.
- It depends on the type of things they want to buy.

2. You lend 25 LE to a friend one evening and he gives you 25 LE back the next day. How much interest/return has he paid on this loan? *

3. Imagine that someone puts 100 LE into a savings account with a guaranteed

* interest rate of 2% per year. They don't make any further payments into this account and they don't withdraw any money. How much would be in the account
at the end of the first year, once the interest payment is made?
[Minimum value in answer is zero.]

1. 4. And how much would be in the account at the end of 5 years if the interest was *
also saved in the account at the end of each year [remembering there are no fees or tax deductions]? Would it be:

Mark only one oval.

- More than 110 LE
- Exactly 110 LE
- Less than 110 LE
- Impossible to tell from the information given

5. Please specify whether you think the following statements are true or false. *

Statement	True	False
An investment with a high return is likely to be high risk.		
High inflation means that the cost of living is increasing rapidly.		
It is usually possible to reduce the risk of investing in the stock market by buying a wide range of stocks and shares.		

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