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The adoption of QR codes and mobile wallets technologies by South African consumers

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Abstract

The premise of this study is to contribute to the literature on the adoption of mobile payments within a South Africa context. The study focuses on QR codes and mobile wallets payment channels. These payment channels are part of the technology disruption which aims to improve efficiency, effectiveness, safety and reduce transaction costs. The research problem investigated is the low adoption rates of QR codes and mobile wallets which according to literature provides benefits to financial customers. The study sample population focuses on adults aged between 18 and 60 years old and living in different provinces of South Africa. Quantitative analysis is used to analyze a questionnaire that was completed by 178 participants. SPSS version 28.0 was used to for analyzing descriptive and inferential statistics. Parametric and non-parametric models were used in the investigation. The TAM model was used in informing the conceptual framework of this research. The results of from this study revealed that the adoption of QR codes and mobile wallets is influenced by transaction security, subjective norms, ease of use and behavior. The behavior element was tested using nudging and the study indicated that attributes of nudging such as incentives, education, knowledge, regulation have an influence of the adoption rates. The highest correlation has been the adoption of mobile payments and incentives which is a nudging attribute. It is also noted that the QR code and mobile wallets do not have the same effects on the adoption rates. This study

will contribute to the South African payments sector in policy enhancements, effectiveness of marketing methods and the increase in uptake.
Keywords: QR codes, mobile wallet, mobile payments

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CHAPTER 1

1.1. Statement of purpose

Disruptive technologies in the payment system have resulted in a move from the usage of cash to using mobile phones to make retail payments. The ability to use contactless payments such as Quick Response (QR) codes and mobile wallets has become important as a result the requirement for social distancing and the Covid-19 pandemic. The Covid-19 pandemic has accelerated the adoption of technology disruptions as it redefined how business provide goods and services to customers (Cyient, 2022). The financial sector has moved towards a more sustainable way of conducting business and this include using digital products and services. There has been innovation in the payment system space which has resulted in new access methods, platforms, and interfaces. QR codes and mobile wallets refer to instant payments that are real time transactions and funds are cleared and settled immediately. These mobile payments are available 24 hours a day and 365 days a year (Arango-Arango, 2021; Bruggink, 2021). While instant payments enhance the efficiency and effectiveness of the payment system it can also increase the risk of fraud (Diadiushkin, 2019). This study examines the needs and behaviour of the banked, unbanked, and financially excluded population and how mobile payments specifically QR codes and mobile wallets can be tailored towards the behaviour of the population, to increase the adoption rate. The technology acceptance model (TAM) is used to assess the aspects that have an influence on people adopting mobile payments. This research increases current literature by extending the discussion and themes on how technology can be used to include people in the South African financial sector.

1.2. Background

The South African banking and payments sector is regulated, monitored, and supervised by the South Africa Reserve Bank (SARB). The SARB received its powers to establish, regulate, monitor, and supervise the payment, clearing and settlement system from the South African Reserve Bank Act 90 of 1989. The National Payment System department of the SARB is mandated by the National Payment System Act No 78 of 1998 to ensure that the payment system is efficient, safe and payments providers/participants are sound and able to meet their payment, clearing and settlement obligations. One of the priorities of the National Payment System Framework and Strategy Vision 2025 of the SARB is financial inclusion and providing

access to electronic payments for the underserved communities and accommodating their payment habits (South African Reserve Bank, 2018). The use of mobile payments can be an important driver for the SARB Vision 2025 Strategy. While there is a move towards using QR codes and mobile wallets however most South Africans still have a preference of using cash and physical bank cards to make payments. Half of South Africans rely on cash to make transactions. Largely, South Africans are banked however there is a portion of the population which is unbanked. The country has over 80 percent of people that are banked while the remaining 20 percent is unbanked. (Banking Association of South Africa, 2021). For the unbanked people, cash remains their only option for making payments due to lack of access to QR codes and mobile wallets. There are instances when they are financially excluded because they do not use mobile payments. QR codes and mobile wallet payments provide efficient, safe, and more affordable ways of making payments and therefore all citizens should enjoy the benefits of these mobile payments (Venter de Villiers et al., 2020). The use of cash has implications such as high price of using cash, lack of safety from carrying cash and the inefficient way of making payments. The benefits of mobile payments can include economic growth and low transaction costs to both the payment participants as well as financial customers (Karsen et al., 2019). South Africa experienced a moderate increase of 16 percent in the number of people with bank and mobile money accounts between 2017 and 2021. Most of the increase relates to the bank accounts while a small percentage is related to mobile money accounts (Demirgüç-Kunt et al., 2021). Adoption in mobile payments is lacking as these payments methods are not growing at a faster rate than their introduction (Karsen et al., 2019). Lack of accessibility to mobile devices (smart phones), data, stable network and the internet restricts the amount of adoption of QR codes and mobile wallets. Another factor affecting adoption is the cost of QR codes and mobile wallets technology (Rootman & Kruger, 2020). Lack of trust, unaffordability, infrastructure, and education especially in rural areas and townships may be contributing factors to lack of adoption of mobile payments (Demirgüç-Kunt et al., 2021). Adoption of mobile payments is lacking in South Africa while countries like China aggressively uses QR codes and have made it easier, safer, and cheaper for their population (Zhong & Moon, 2022). This study assesses the status of the mobile payments domestically and internationally and provides recommendations based on the findings and analysis of the questionnaire.

1.3. Research problem

South Africa has low rates of QR codes and mobile wallet adoption in relation to the speed in which these mobile payments are introduced into the payments industry. Technology-led disruption in the financial sector, specifically in the payments space, has improved the way customers make payments. QR codes and mobile wallets provide efficient, safe, and cheaper ways of making and receiving payments. While the banked may have access to these mobile payment products through their banks however the uptake remains low as people may use bank account for receiving their salaries and withdrawing all their money to make cash payments and meaning there is lack of optimum use of bank accounts. This behavior prevents the population from enjoying the benefits of mobile payments. There is inadequate consideration for the behavior and needs of the population when non-bank and banks create payment products. This can be seen in inadequate products that do not consider people's differences. The unique lifestyles of people should be considered when designing, producing, and distributing mobile payments. This can be done by assessing how the population have made payments in the past and their current behaviour of making payments (Finken & Heiduk, 2020). Some people are remaining excluded due to the type of payment products and services that do not meet their needs.

The provision of mobile payments is inadequate on its own if there is lack of awareness, accessibility, and education. There must be appropriate measures to provide knowledge on how to access these products and how to use mobile payments (Koul et al., 2021). Zhong and Moon (2022) cited that China has increased access to QR codes by investment and upgrade in the applicable technologies. This has made the shopping experience easier with Alipay and WeChat Pay dominating the mobile payment space. Majority of the Chinese population have adopted QR codes as their preferred means of mobile payment. The increase in access meant that Chinese businesses could meet customer needs promptly. Financial inclusion is one of the priorities of the financial sector in South Africa and this study will provide insights into how mobile payments adoption can be increased and ensuring awareness, accessibility, and education. This study focuses on these research problems because they are assumed to be the main problems that are hampering the adoption of mobile payments and by finding solutions to these problems.

1.4. Research Questions

- What are the aspects or factors that influence QR code and mobile wallets adoption?
- Is nudging influence the adoption of QR codes and mobile wallets?
- What attributes of nudging have the most and least influence on the adoption of QR codes and mobile wallets?

1.5. Research Objectives

The overarching goal of this study is identifying approaches that can be used to increase the adoption of QR codes and mobile wallets by South African consumers and the specific objectives is:

- To assess the aspects that increase adoption of mobile wallets and QR codes, the study considers how those factors can be used to increase customer adoption rate of QR codes and mobile wallets.
- To determine the influence that nudging can have in altering behavior towards the use of QR code and mobile wallets.
- To determine which attributes of nudging can have the most results in increasing the adoption rate for both QR codes and mobile wallets.

1.6. Rationale of the Study

Technology is meant to improve the lives of all people and be an enabler for financial inclusion. Technology should not exclude people because of their backgrounds or statuses. The adoption of QR codes and mobile wallets remains low than what was anticipated when they were introduced. The study assesses the influence of QR codes and mobile wallets on the lives of South Africans. The literature considers the uptake and adoption of mobile payments of all people without considering the individual differences. However, technology does not influence people the same and therefore there is a need to zoom into those people that are financially excluded from the payments system. Research is lacking in the emerging economies on the adoption of new technology from a customer's perspective and this research provides reasons for lack of mobile payments adoption (Rootman & Kruger, 2020). The study will improve knowledge on the influence of QR codes and mobile wallets and therefore contribute to the understanding of how banks and non-banks can develop products and services according to the

customers perspective. The study will also add an understanding on how TAM can increase the adoption of QR codes and mobile wallets by adding nudging as another variable of the factors that impact the adoption of information technology as there is insufficient literature on nudging as a mediating factor in the adoption of technology.

1.7. Contribution of the study

The literature indicates that for an individual to choose QR codes and mobile wallets over other payments instruments they consider the costs, benefits, and usefulness. There is limited research on mobile payments that focuses on individual value to assess whether the mobile payments instruments provided to customers are what is important to them and is what they deserve (Rootman & Kruger, 2020). This study has identified a research gap that assess value creation for customers' by investigating customer needs and behaviour regarding mobile payments. This study aims to increase the current literature by assessing the customer needs in relation to QR codes and mobile wallets and additionally assess whether QR codes and mobile wallets can create value for customers. There is consensus in literature that perceived ease of use and usefulness are aspects that influence the adoption of technologies (Chueng et al., 2016; Finken & Heiduk, 2020; Slazuz, B.J, & Bick, 2022). Researchers have furthermore mentioned the following variables influence the adoption of technology: perceived security, attitude, and subjective norms. It is also important to study the behaviour of customers to ensure that payment instruments and channels created respond to individual behaviour. Researchers have included behaviour as a variable influencing adoption and assessed the relationship between mobile payments adoption and behaviour. However, there is limited studies on using nudging as a means of altering the behaviour and actions of consumers towards adopting mobile payments. This study will use nudging as a mediating variable to assess the relationship between nudging and QR codes and mobile wallets adoption. Lasty, there is limited research on the adoption of QR codes and mobile wallets from a South African perspective.

1.8. Delimitations of the study

This research covers the South African population with the focus on the banked and unbanked population. In terms of the banked population the scope in assessing the factors affecting the adoption of QR codes and mobile wallets will be limited to those that are financial excluded as

per the definition. In 2022, South Africa had approximately 6, 3 million people that have never been banked and 7,7 million people that are unbanked and due to the majority (34,7 million) of the population being banked it may limit the sample of the unbanked population (FinMark Trust, 2023). The study will use the TAM which considers the behavioral intention of people in relation to information technology (Davis, 1989). Numerous researchers have used the TAM to predict people's acceptance, usefulness, and the ease of using technology. Previous researchers have also included other factors such as trust, to determine the acceptance of information technology (Chueng et al, 2016). This study adds nudging as an additional variable to assess the adoption of QR codes and mobile wallet.

1.9. Operational Definitions

Technology Acceptance Model (TAM) is a model that centers around the two determinants of behavioral intention to use information technology. The two determiners include apparent usefulness and apparent ease of use of information technology. Perceived usefulness relates to the belief that using information technology will improve job performance. Perceive ease of use relates to the minimal effort of using information technology (Tsai et al., 2022).

Mobile payment is integrated between the mobile phone and the payment system and customers can instruct, approve, and conclude a financial transaction using wireless technology. Mobile payments in this study include QR codes and mobile wallets. QR code refers to a matrix generated barcode that is used to make payments. Mobile wallets store information on a card or coupon and are used for making payments. Mobile wallets users approve a transaction via a biometric verification as part of its safety feature (Finken & Heiduk, 2020).

Disruptive Technologies include the innovative products and services in the payment system that disrupt how people make and receive payments and how banks and non-banks operate. QR codes and mobile wallets are disruptors as they have allowed business to enhance their business models and provide customers with more options of making and receiving payments (Li-Ya et al., 2021)

Financial Inclusion means the ownership of a bank account, payment facility and having access to credit and being able to receive and send remittances (Koomson et al., 2020). This also relates to access to a financial product or service that is efficient, safe, and cheaper to use. People that are financially included can efficiently transact, save money in a safe place, and build a credit history (Demirgüç-Kunt et al., 2021).

The unbanked population refers to people who do not have a bank account or any account with a financial institution. People can be unbanked because of lack of documentation, economic and social status (Bustamante & Amaya, 2020). The unbanked population face discrimination from the banking sector as they cannot own a bank account due to the bank requirements. These requirements are not tailored for the circumstance of different people especially the poor.

Nudging is an intercession that can direct decision making or the behavior of people towards a certain direction (Ren & Liu, 2022). Nudging can be achieved by altering the content which is communicated about mobile payments or altering how mobile payments is seen by consumers (Schneider et al., 2018). Factors such as knowledge, education and experience can contribute to rational decision making and behavior and people can choose to use technology because they understand the cost and benefits.

1.10. Structure of the Dissertation

This dissertation is as follows: Chapter two of the study is the literature review and explores the relevant literature by evaluating the previous and current themes and debates. The relevant literature review classifies the research gaps that will need further investigation and therefore form a justification for the study. Furthermore, the chapter discusses the theoretical framework and the rationale for the chosen framework. The research hypothesis is explored using the TAM as the analytical framework and consider the variables that have been used in the original and updated models. An additional variable named “nudging” will be introduced when assessing the factors that influence QR codes and mobile wallets adoption. An explaining on the choice of the model (TAM) and the motivation for using the framework is provided. Furthermore, a research methodology to outline how the research will be conducted is explained and this

includes the sample, data collection, analysis, and interpretation. Lastly, the possible limitations and recommendations for future research is explained.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Introduction

This study provides insights to the payments system specifically QR codes and mobile wallets and how they can include the banked, unbanked, and financially excluded population into the payment system. The study will contribute to the current literature of the adoption of mobile payments by adding insights for banks and non-banks on how to consider the behavior of the population in the design and implementation of QR codes and mobile wallets. (Koul et al, 2021 ; Ghunaim, 2020) asserts that payment system is a gateway to including the unbanked population into the financial system. QR codes and mobile wallets have disrupted the mobile payment systems by making it easier, efficient, and safer to make payment transactions. There has been slower uptake of mobile payments such as QR codes and mobile wallets especially in developing countries. Similarly, Latin America has low mobile payments adoption rates resulting from high cash usage (Ainsworth et al., 2022). South Africa has a small percentage of people with mobile wallets and therefore is important to understand how the use of mobile wallets can be increased and if this platform serves the needs of South Africans. The literature review discusses the adoption of mobile payments and factors that should be considered to increase adoption by examining the debates and themes of the literature. The literature review furthermore identifies the research gaps of the uptake and adoption of mobile payments. Lastly, there is a deliberation on the theoretical model used in conducting the research.

2.2 Empirical Review

2.2.1 Aspects that influence mobile payments adoption use

2.2.1.1 Technology usefulness, benefits, and costs

Rootman and Kruger (2020) assessed the aspects that have an influence on the adoption of Zapper specifically in South Africa. The foundation of the study is constructed on the TAM. The aim of the study was to include a unique variable that can improve the literature of user adoption of mobile payments. Zapper is one of the mobile payment technologies in South Africa and is widely used by the population that have adopted mobile payments. Majority of South Africans use mobile phones and that provides them with a tool to enable access to mobile payments. However, not everyone will opt for using mobile payments and the study identified the aspects that influence mobile payments adoption technology as usefulness, benefits, and costs. The use of mobile payment technology should add value to people's lives for the technology to be considered useful. Usefulness is said to be the dominant variable that influence adoption of mobile payments technologies. Usefulness is defined from the context that one believes that using Zapper will enhance how a payment is concluded. The cost and benefits are considered by users as they decide whether they will adopt mobile payment technologies. Rootman and Kruger (2020) advocates that when new technology is designed and rolled out, customer perspective should form part of the process of new technology. This research aligns to the research gap in the sense that it will consider the needs and behaviors of users by adding a variable that will contribute to mobile payments adoption. The author also identified that there is limited research on mobile payment on emerging economies and this research will address.

2.2.1.2 Government Regulation

Verma et al (2020) studies how government regulation can affect user intentions in continuing to use mobile payments services. The research uses the theory of planned behavior by incorporating norms, the ability for the merchant to be pro-active and demonetisation. The

study contributes to the impact of mandatory regulation to increase adoption of mobile payments. In 2016, the government of India implemented demonetisation whereby a currency is stripped of its legal tender status. This was to increase cashless payments while overcoming the cash crisis India had. Demonetisation compels people to use mobile payments and for merchants to facilitate mobile payments. Demonetisation compelled merchants to be proactive in identifying the needs of customers and using the customer need to create mobile payments offering what can meet the needs to customers. Mandatory regulations can alter the behavior of customers as they would want to conform to social accountability and moral norms. Demonetisation may not be successful in other countries where there may be resistance for this mandatory regulation, no cash crisis, lack of infrastructure and where regulation may infringe human rights of other population groups that lack access to mobile payment technologies. The study did not investigate the negative effects that demonetisation has had on financial inclusion and if it was successful in reaching the number of people it intended to move into mobile payments. This study considers government regulation as an attribute of nudging that can be used to alter the behavior of people towards mobile payments adoption.

2.2.2 Barriers to mobile payments adoption

2.2.2.1 Insecurity risk

In assessing the barriers to mobile payments adoption (Humbani, 2021) added another element of psychology to the variables that are considered the main barriers to mobile payments adoption. A study conducted by (Humbani, 2021) shows that insecurity risk factor had a significant influence on mobile payment adoption. Insecurity risk consists of factors namely, psychology, security, privacy, performance, time, product, financial and social. These factors relate to technological reliability and the security of mobile payment system. The study argues that if there is less perceived risk then there is a higher chance that a user can adopt mobile payments. Eliminating users fears and insecurities can drive customers towards mobile payments adoption. According to the author, there are high crime rates related to mugging people and taking their cash, bank cards fraud and automated teller machines (ATMs) crime. However, the move to mobile payments has been slow. Crimes related to bank cards and ATM's may be a possibility that people still feel insecure about the risks of banking and

payments. The elimination of the mentioned crimes could alleviate the insecurities that users may have about mobile payments securities. The research offers insights on the formulation of strategies that service providers can use to eliminate the risks entrenched in the use of mobile payments. The research does not assess the influence of the different types of risk and how they influence mobile payments adoption from a developing economy perspective. Furthermore, the study did not provide insights on how safe platforms can be designed and implemented to ensure that the insecurities that users are eliminated. In assessing the barriers that may make users reluctant to use mobile payments the insecurity as a factor will be considered in this research.

From the perspective of China which is at an advanced stage in terms of mobile payments adoption and mobile payments also account for a large portion of transactions. Tsai et al. (2022) argues that transaction security will affect those who use mobile payments tools as well as those who do not use mobile payment tools. This is because both physical and digital payment tools carry some form of transaction risk. The authors employ the security of transactions as a mediating effect on the attitude and intentions of usage and the study results indicate that transaction security influences the intention and attitude of usage. The study revealed mobile payments adoption differs in Asia depending on the region, while China has significant adoption regions such as Taiwan remained low in terms of adoption of mobile payments. The study confirms that mobile payments adoption differs according to regions. The author suggests that further research should consider the reasons why the development of mobile payments is not equal in different countries. This study will focus on the South African perspective and different provinces in South Africa will be considered.

2.2.2.2 Religion

Natakusumah (2022) conducted research in Indonesia using the TAM which include the following variables: perceived security, perceived ease of use and usefulness, and religiosity to assess user acceptance of fintech and mobile money. In the study the author refers to information technology in a context of small business management. The author uses TAM to evaluate the apparent usefulness and apparent ease and how they influence small and medium business in the traditional market with an Islamic community. Little research considers the use of mobile payment by small business in facilitating payment. The study revealed that merchants

refuse of use FinTech due to religious reasons. When merchants do not provide mobile payment technologies then people in small towns will not be unable to access mobile payment services. Natakusumah (2022) cited that religion and technology are seen as competing factors and technology is seen as a potential threat in the Muslim community hence the resistance to adopt mobile payments. For people that are religiously rooted they will resist technology. From a small business perspective limited space, limited time, flexibility, convenience, and financial resources to implement the technology for mobile payments influence mobile payments adoption. Small businesses need to trust that technology is secured from personal data leaks and technology breaches before they can adopt mobile payment. While the study found that there are benefits for adoption of technology by small and medium businesses. The author argued that sharia FinTech should develop in the future to ensure that there is acceptance and adoption of mobile payments through sharia. Sharia FinTech is innovations that are developed using the sharia principles, meaning the financing agreement will follow the Islamic rules (Winarto, 2020). Sharia FinTech will mean that religion is also considered when developing mobile payment technologies. The study could investigate whether sharia FinTech products can change the perception of people towards mobile payment technology and whether sharia FinTech is the answer to increasing adoption by the Muslim community. Another research gap is that the study did not investigate how can Sharia FinTech be increased and developed to ensure that the Muslim community is not excluded from mobile payments due to their religious belief.

2.2.2.3 Financial Exclusion

Demirgüç-Kunt et al. (2021) cites that financial inclusion should result in digital payments, credit and savings benefits for the population. Financial inclusion should also provide greater privacy and security. Formal identification is a requirement for opening a bank account in countries and for people without a formal identification they are unable to own a bank account. Formal identification is also required for owning a mobile phone as part of the mobile phone registration process. The authors argue that improved identification systems that will ensure that the population is able to obtain a formal identity will enable greater access to financial services and foster financial inclusion. Mobile phones can be an enabler for financial inclusion by reducing the remoteness of areas and increasing access to financial services. It is positive to note that many people that are unbanked in Sub-Saharan Africa have mobile phones. However,

the gender gap is impacting ownership of mobile phones as only 77 percent of woman own a mobile phone compared to the 86 percent of males. Most of the unbacked population feels insecure about using an account from a financial institution and therefore will require help to use an account. Ainsworth et al. (2022) suggest that there should be more focus on educating customers about those institutions that provide mobile payments to foster trust on these institutions.

The role of the financial provider is empowering and educating people when they open bank accounts to eliminate the insecurity that come with opening and owning an account from a bank. According to the Global Findex 2021 survey, the use of digital payments grew more than the ownership of a bank account. Demirgüç-Kunt et al. (2021) advocates for payments of the unbanked population to be shifted into a bank account or mobile money account and promoting digital payments by enabling utility bills. The authors note that participants in the digital payment's environment have an important role in creating affordable, safe, and efficient products that are apparently useful as well as easier that the use than cash. The authors do not consider the impact that the gender gap, lack of education and lack of formal identity has on the consumer behavior of those who want to be included in the mobile payment platforms.

Ezzahid and Elouaourti (2021) constructs a financial inclusion index that assesses how reforms in Morocco have increased and the author also explores the aspects that determine financial inclusion. The study used two approaches in measuring the level of financial inclusion and this includes access or financial services usage, and the second method includes all the elements related to financial inclusion (usage, access, quality, and welfare). The study revealed that the contributing factors to informal finance and formal finance are different. While having high education and having to participate in the labour market increases the chances of being financially included. An increase in income fosters financial inclusion. Age, gender, and educational level can force people into the informal finance for example an older person, a woman, and a person with low education. In Morocco, women are excluded due to lack of money and the reliant of a parent having a bank account. Remoteness of some areas increases the high cost of owning a bank account and therefore creates barriers to financial inclusion. Mobile banking can remove barriers by promoting access, it allows people in the rural part of the country to be financially included by solving remoteness. Mobile banking fosters inclusion because the documentation requirements are minimal. Ezzahid and Elouaourti (2021) advocates that Islamic finance may be an option for people who are excluded because of religious reasons. The study does not verify if Morocco has reached an optimal level of

financial inclusion. This study will consider education as an element that can increase mobile payments adoption rates.

2.2.3 Continued use of mobile payments

Zhong and Moon (2022) investigated how consumer behavior varies between QR codes and facial recognition. The findings shows that QR codes have been high adopted in China and mobile payment technologies are available in shopping malls, restaurants, convenient store as well as supermarkets. Facial recognition is expected to exceed 700 million users in 2022 (Zhong & Moon, 2022). Perceived ease of use provided by facial recognition gives its user more value which may promote continuous use. The authors assert that habits are the main driver of continuous use, and therefore the forming of QR codes as a habit would improve the usage on a continuous level. The authors furthermore mentioned that the continuous use of QR codes could lead to positive view and people will in return spread positive word of mouth. The high adoption of QR codes may mean that people have already formed a habit of using QR codes and therefore will use facial recognition payment as a try run and if they are not satisfied then they will default back to QR codes. The study focuses mainly on QR codes and therefore there is scope to further study of facial recognition payments and how they have transformed the digital payments space.

Numerous studies in this report have focused on the initial adoption of mobile payments. However, its equally important to ensure that the use of mobile payments is sustained as people can default back to using cash. Humbani and Wiese (2019) introduced a model that is integrated, and this entails the factors that influence users' primary adoption of mobile payments as well as the intention for people to continue to use mobile payments technologies. Continued satisfaction and reliability of the mobile payment technologies is an important factor for continued use. Innovation means FinTech and financial institutions can remain competitive and adaptable to the changing needs of customers. From a South African perspective convenience and compatibility have a significant influence on mobile payments adoption while high cost and lack of safety in using mobile payment apps can contribute to barriers of mobile payments. According to the authors, future benefits of the mobile payment apps provide a motivation for continued use rather that the convenience of the mobile apps. When the cost of transacting increases to a point where it becomes, unaffordable people can resort to using cash or cards to lower their transaction costs. Safety bridges of technologies can result in lack of

trust in mobile payment apps which may result in people discontinuing to use mobile payments. The limitation of this study is that it only relates to South Africa and different result may be obtained from other countries. A research gap from the perspective of the continued use is assessing if there has been discontinued use of mobile payments and the reasons thereof. This study will analyse the adoption of QR codes and mobile wallets separately because their adoption rates may vary because of their differences.

2.2.4 Consumer behaviour towards mobile banking

2.2.4.1 Mindfulness

Flavian and Guinaliu (2020) introduced mindfulness to mobile payments adoption. Mindfulness is introduced as a tool to better understand the behaviour of consumers. Mindfulness implies the mental state at which a human being is actively aware and that makes them more receptive to the different choices and new information at their disposal. The authors explain the four dimensions of mindfulness and they include: a customer seeking information on the functionality of technology, comparing different technologies to seek their uniqueness, a person being cognizant of how technology fits their local context and the awareness of the advantages and disadvantages of technology. According to the study mindfulness has a positive influence on customer attitude, perceived ease of use and usefulness. A mindful person can positively be linked to the four dimensions of mindfulness. In the study the authors used a population sample from Spain and the United States (US) and revealed the influence of mindfulness was not significantly different in these two countries. Further research should consider adoption of mobile payments technologies using mindfulness as a variable and considering different cultures. In terms of the research gap identified is that the study is limited to Spain and the US which means the results can differ according to the population sample as well as the country in which the investigation is done. Therefore, there is a need for the concept of mindfulness to be used in South Africa as part of studying the consumer behavior. This study will use a sample of South Africans to test the behavioral component to mobile payments adoption. The research was undertaken during the Covid-19 pandemic which had some people changing their behavior to adjust to the pandemic. However, post Covid-19 further research on the implication on mindfulness on mobile payments adoption may be necessary. In addressing the identified research gap, this research will consider consumer behavior post covid-19 and

how it can influence mobile payments adoption. Post covid the mental state of people has changed and therefore the results may be different from (Flavian & Guinaliu, 2020).

2.2.4.2 Psychographics

In South Africa, (Slazuz et al., 2022) conducted a study into the consumer behavior and argued that psychographics plays an important role in how people behave. Psychographic refers to psychological attributes of people and in this context, it includes the interest in mobile payments, how consumer personality will shape their adoption of mobile payments, attitudes towards mobile payments and opinions about mobile payments technologies. Customers differ and the segmentation of people according to their psychological attributes means that more of their needs can be satisfied. When FinTech's and financial institutions develop mobile payments products they should consider psychological attributes to ensure that they can better serve the needs of customer. One research gap identified is studying the different generational groups and how their psychological attributes influence mobile payments adoption. Generations can be studies according to millennials, generation Y and baby boomers. Researching different generational groups could form part of market segmentation. Grouping customers can provide effectiveness and efficiency in how mobile payments technology is marketed and sold. Furthermore, future research could focus on comparing how financial institutions and FinTech's have influenced the consumers adoption by comparison of uptake and consumer confidence level. The population sample to this study considers different generations and four age groups from the age of 18 to 60 years have been included in this study.

2.2.4.3 Nudging

Ren and Liu (2022) used digital nudging as a mediating factor to assess the scope of the factors that affect the adoption of social marketing and the authors assets that nudging positively influence trust, social benefits, and ubiquitous connectivity. In the research modified TAM is used as a conceptual framework investigation. The study investigation focuses on social media in the marketing context from a consumer perspective. Another study by (Schneider et al., 2018) explores the concept of nudging from an network and computing interface design which considers the visual and content included in the design. While both these studies considers technology digital nudging these studies do not study the impact of digital nudging on mobile

payments. The literature is limited in terms of exploring digital nudging from a mobile payments perspective which is what this study will focus on. This study will contribute to an increased literature on digital nudging in the payment systems area and also consider different attributes of nudging.

2.2.5 Conclusion of the literature review

Mobile payments have provided an opportunity for the unbacked, banked population and government grant recipients a platform that lowers cost, cut remoteness to accessing financial services and provide an opportunity for a credit record (Demirgüç-Kunt et al., 2021). There are also barriers that hamper the process of adoption of mobile payments such as social status, demographics, psychographics, and religion. Various literature (Ezzahid & Elouaourti, 2021; Flavian & Guinaliu, 2020; Rootman & Kruger, 2020) have investigated the aspects that influence the mobile payments' adoption especially from the customer perspective and (Koul et al,. 2021; Natakusumah, 2022; Humbani & Wiese, 2019) provided their perspective from a merchants or small and medium business point of view. The authors provided insights on the factors of adoption and the barriers to mobile payments adoption and how they can be minimised and ultimately eliminated. The literature did not consider how customer behavior can be shifted towards the acceptance and adoption of mobile payments. There is a lack of insights on how we can use customer behavior to understand the needs of customer to provide them with mobile payments products that meet their needs and are flexible to evolve with the change in customer behavior.

2.3 Theoretical framework

2.3.1 Introduction

This part of the research explains the theoretical framework which is used in conducting the research. A theoretical foundation of the framework is discussed by reviewing the literature and providing the rationale for the selected framework and the rationale for the framework.

2.3.2 Technology Acceptance Model (TAM)

The TAM by (Davis, 1989) will be used in the conducting the research. TAM uses measurement scales to forecast the acceptance of IT by users. The two-variable used in this model include perceived usefulness and perceived ease of use. The TAM is used to analyse the relationship between perceived usefulness, perceived ease of use and the acceptance of new information technology. The model has been used by numerous researchers (Koenaite et al., 2019; Flavian & Guinaliu, 2020; Finken & Heiduk, 2020; Natakusumah, 2022) to study user acceptance in new IT including mobile payments and used in different fields of study including technology, finance, business, and marketing. The model considers the behavioral intention of users and therefore makes it essential for studying the adoption of mobile payments as a disruptive technology from a customer perspective and assessing the behavioral intentions of customers. Current researchers have modified the TAM by introducing other variables to assess user acceptance which were not included in the original TAM. Natakusumah (2022) added religiosity and investigated user acceptance from a religious perspective and considering user in the context of a small business in an Islamic community. Flavian & Guinaliu (2020) included mindfulness which is widely used term in psychology as a construct to assess perceived behavior. This research alters the variables of the original TAM by introducing nudging as a variable. The types of nudging include setting mobile payment as a default option, making mobile payment more attractive than using cash, making it easy to use mobile payment and prompting people to use mobile payment. In using nudging the research will contribute to the updated variable that can be used to assess the impact of mobile payments on the population.

2.4 Research framework

2.4.1 Introduction

Mobile payments provide the potential to improve the way people make payment transactions by improving efficiency and safety of making payments from a merchant and consumer point of view (Venter de Villiers, 2020). There is consensus from literature that the use of mobile payments provides advantages to the payment system. Transactions become cheaper as there

is less cash handling requirement for making payments which reduce the danger that comes with carrying cash. The safety of digital platforms of mobile payments is an important factor in ensuring that there is sustained use of mobile payments. Perceived usefulness of mobile payments significantly affects the use of mobile payments. Mobile payments should add value by improving the current performance of payments. When people do not derive value from mobile payments, they tend to default back to using cash, which is said to be inefficient, expensive, and unsafe as compared to mobile payments. Perceived ease is another factor that influence the acceptance of mobile payments. For increased acceptance to occur the mobile payments must be easy to use, not complex and the use of language should be easy to understand. The investment of education and knowledge in mobile payments will improve the ease of use. This section of the study discusses the theoretical underpinnings of the TAM and how it has evolved over the years from when it was founded in 1989. This section will make augments for the use of TAM and how it relates to this study. A conceptual framework will be drawn, and variable explained, and hypothesis will be generated to explain the relationship between the variables.

2.4.2 Theoretical underpinning TAM 3

Davis (1989) founded the TAM in which he introduced a step-by-step process of using scale items to measure the acceptance of users to information technology. Davis (1989) constructs include perceived usefulness, perceived ease of use and behavioural intention. The researcher revealed that there is a high correlation between acceptance of use and perceived usefulness as well as acceptance of use and perceived ease of use. The TAM assumes that social norms do not affect behaviour or attitude in system use, the study found that attitude does not significantly influence the acceptance of use which was a limitation provided by this theory. Davis (1989) examined user acceptance in an information technology space however the study generated interest in studying user acceptance from the perspectives of different and new technologies.

As the theory of TAM evolved researchers used perceived usefulness and ease of use as mediating factors. Taylor (1995) validated that TAM is a more solid model to predict the behaviour intention towards the use of systems. Taylor (1995) revealed that subjective norms and self-efficacy affects the behaviour towards the use of technology. (Venkatesh & Bala, 2008) updated the TAM to Technology Acceptance Model 3 (TAM3) in which there are

additional constructs that are used to determine consumer acceptance to technology and they include perceived usefulness, perceived ease of use, behavioral intention and subjective norms. Further researchers used perceived usefulness and perceived ease of use as mediating factors and studied the relationship of mobile banking and trust and found a partial mediating relationship (Kabakuş, 2022).

The TAM 3 will be used in this study as the most recent theory that is suitable for assessing customers' acceptance to technology. TAM is widely used in the literature and some researchers have use it as a basis to generate their models for assessing acceptance to information technology. This study focuses on acceptance of the use of mobile payments (QR codes and mobile wallets) which have been in existence for years, however, the acceptance and adoption have been low in South Africa. The TAM conceptual framework will support the investigation of QR codes and mobile wallets because these products are in the technological environment in which the TAM is highly recommended and several researchers in the finance and technology environment have generated their recommendations using the TAM (Chueng, et al., 2016; Humbani, 2021; Kabakuş, 2022). Therefore, the TAM 3 makes the framework reliable for research of technology acceptance and has been updated to TAM to add another important variable of subjective norms to cater for the societal influence on the behaviour of others. This study will assess the behavioural aspect of people towards the acceptance and adoption of mobile payment's platforms and one of the strengths of the TAM is that it studies the behavioural intention of users and therefore is able to assess the readiness of consumers to adopt technology which is able to predict how users will behave. This study will investigate how the understanding of human behaviour can shape the decision that are made by financial institutions and fintech companies in the creation of mobile payments products and marketing of these products.

2.5 Conceptual framework research questions/research objectives

The literature had indicated the below variables appropriate for investigating the relationship the factor that influence access and adoption by information technology (Chueng et al., 2016; Natakusumah, 2022). This research explores the adoption of technology by assessing the influence that perceived usefulness, perceived ease of use, perceived transaction security and subjective norms (independent variables) have to the adoption of QR codes and mobile wallets

(dependent variable). The selected dependent variables are selected based on the literature and their ability to provide responses to the factors that affect the adoption of QR codes and mobile wallets (Kabakuş, 2022; Chueng et al., 2016). The study introduces nudging as the mediating variable because aim of the study is to provide recommendation on how the increase in the adoption of QR code and mobile wallets can be achieved for customer to realise the benefits of using mobile payments. The TAM also considered the behavioural intention of customers of which the study assesses the influence of nudging as a mediating variable that as it can influence the decisions and behaviour of customers by altering their behaviour and perception about mobile payments.

2.6 Research hypothesis

2.6.1 Perceived usefulness (Adoption of QR codes and Mobile wallet)

The concept of perceived usefulness and perceived ease of use has been indicated a several studies (Kabakuş, 2022; Natakusumah, 2022) as the determinants that are used to assess the behaviour of people towards use of information technology. Perceived usefulness is a belief that technology will improve job performance and therefore provides benefits to those using the technology. The use of QR codes and mobile wallets have been proven by literature to reduce the cost of payment transactions for both the merchant as well as for customers. QR codes and mobile wallets provide additional safety features than cash and it reduces the time of making transactions therefore providing efficiency. Usefulness has been used as a dependent variable which is the adoption of QR codes and mobile wallets.

2.6.2 Perceived ease of use

Perceived ease of use is defined as the trust that using a certain information technology would be effortless (Davis, 1989). Literature shows that customers would choose a technology that is easy to use, and this include a process that is simple and easy to understand (Finken & Heiduk, 2020; Tsai et al., 2022). (Demirgüç-Kunt et al., 2021) assets that customers may be excluded from participating in the payment system because of the fear that they will not be able

to use the digital payments platforms that are available and resort to not adopting those platforms. The proposed hypothesis is as follows:

H1 Perceived ease of use influence the adoption of QR codes and mobile wallets.

2.6.3 Perceived transaction security

Perceived transaction security is the confidence that customers have that their transactions can be completed in a safe platform. Tsai et al., (2022) asserts that for mobile payments to be adopted by customers they need to trust the mobile payment platforms and therefore security becomes an important factor. Customers need to have trust that their personal information is protected from information leaks. Gupta and Jhamb (2020) indicate that fraud is considered the primary reason for resistance of people adopting payment platforms and their preference for using cash.

H2 Perceived transaction security influence the adoption of QR codes and mobile wallets.

2.6.4 Subjective norms

Subjective norms refer to social pressures that alter the behaviour of people because of the belief that most or some people will disapprove or approve certain behaviour. (Venkatesh & Davis, 2000) provides that people may choose to behave a certain way even when they do not favour that particular behaviour because of social influence. Davis (1989) stated that subjective norms have insignificant affect on behavioural intention he acknowledge that social influence should be investigated which may indirectly influence subjective norms. Schepers and Wetzels (2007) revealed that subjective norms significantly influence perceived usefulness and behavioural intention. People that are close to a customer can influence their behaviour (AL-Nawafleh et al., 2019). Waris et al., (2022) supports that subjective norms is an important construct on the usage of technology.

H3 Subjective norms influence the adoption of QR codes and mobile wallets.

2.6.5 Attitude

Attitudes reflect on the feelings that a person has about the use of mobile payments. Attitudes can be changed from being indifferent to a sustainable attitude as the impact of information

change as part of the adoption journey. Sustainable attitude can be developed by generic information however this does not guarantee that adoption will take place (Goodarzi et al., 2021). Attitude has been used as a factor that influence the adoption of technology in the TAM model.

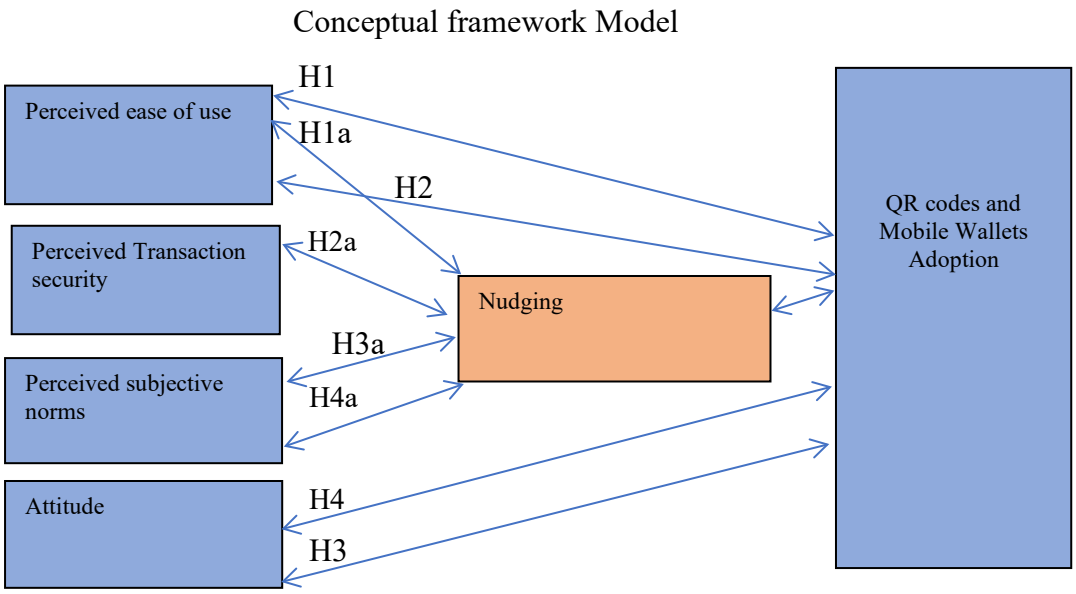
H4 Attitude influence the adoption of QR codes and mobile wallets.

2.6.6 Nudging

This study considers behavioural economics aspects which can be used to influence behaviour in a certain or specific direction and in this case how nudging can be used to increase the adoption of mobile payments. Ren and Liu (2022) assessed how digital nudging can influence the acceptance of social media platforms and asserts that consumers are not always rational in their behaviour. The element of nudging addresses decisions and behaviours that are not based on sound judgement and assisting consumers in making sound decisions can influence the acceptance and adoption of mobile payments. Using nudging can enable people to benefit from cheaper, safer, and more efficient transactions. This study contributes to the literature by assessing the influence of nudging on the acceptance and adoption of QR codes and mobile wallets. The study proposes the inclusion of nudging as an additional variable as it can influence the adoption of mobile payments.

H5 Nudging influence the adoption of QR codes and mobile wallets.

Figure 1: Conceptual framework model



2.7 Hypothesis testing plan

2.7.1 Methodology

The study used the qualitative research approach to investigate the relationship between the independent, mediating, and dependent variables. A hypothesis testing was conducted, and data collection was done through a structured questionnaire. Numerous researchers have used a questionnaire to gather data and investigate the relationship between the factors that affect the adoption of mobile payments. A questionnaire is selected because the amount of data to be collected is large and aim to received responses from a minimum of 200 participants as supported by literature (Rootman & Kruger, 2020; Slazuz and Bick, 2022). Participants in the survey are adults from 18 to 60 years that are born from different provinces in South Africa to minimise on the bias of respondents from the same province. Convenience sampling was used, and this was done via an online platform and WhatsApp to distribute the questionnaire. This form of sampling is preferred to reach people from different areas in South Africa.

2.7.2 Measurement/Data Analysis

The data was used to analyse the nature of the relationships between the independent variable and dependent variables. Descriptive statistics was used to describe the variables and the characteristics of respondents. A 2 and 3-point Likert scale was used to provide for a moderate number of options for respondents. The SPSS version 28.0 software was used to analyse data.

CHAPTER 3

3 RESEARCH METHODOLOGY

3.1 Research Approach

The study takes a quantitative research approach and use the research questions to formulate hypothesis. The selected research approach is due to its ability to follow a structured and systematic approach (Creswell, 2017). Quantitative research approach will enable this study to provide more objective results which will be communicated using numbers to back up the data produced. The advantage of quantitative analysis is that it is efficient and allows for a large sample size to be analysed. Quantitative research is more relevant than qualitative analysis because of its element of correlational research as the objective of the research is to test causal relationship between independent variable and dependent variables as well as the relationship between the mediating variable and dependent variable. This study adopts a paradigm of positivism technique because of its goal of generating causal relationships by isolating and controlling all factors while ensuring that only the proposed variables as listed in the conceptual framework are studied.

3.2 Research Design

The research design explains the strategy and logical way of how the research will be laid out in the document to ensure that the research problem is sufficiently addressed. The research design will include the data collection, analysis, and interpretation. In survey has been used in the collection of data. A questionnaire was prepared and distributed to the selected population sample for completion. In acknowledging that a survey provides some limitations of error

failures such as content error which reduces the accuracy of information and thereby reducing the ability to generalise the results. There is also consideration for sampling errors where respondents may not be forthcoming with the data and there may be lack of responses (Gurbuz, 2017). In analysing data, the study was cognisant that the survey outcome can be bias and in reducing this biasness the questionnaire should did not have ambiguity (Blair, 2019)

3.3 Data Collection methods

The study used a survey to collect data. A survey makes it easier to reach the population sample besides the remoteness between the different provinces in South Africa. A survey allows for the collection of data from many people. A questionnaire was generated, and data collected with the aim of addressing the research problems. The structure of the questionnaire comprised of questions on each variable of the research hypothesis model. A total of 26 questions were contained in the questionnaire. The questions enabled quantitative and qualitative results to be generated therefore balancing the numerical data that is communicated and the content thereof.

3.4 Population and sample

A sample was chosen from the population and stratified by province population group. The sample presents a diverse view as the experience of mobile payments will differ depending where in South Africa a person is based or was born. The proposed sample improves representation of the sample and reduce the possibility of results that are bias. The proposed sample size proposed is between 200 to 300 respondents as per previous similar studies that were conducted in South Africa. The sample includes adults as per the South African definition and the age range which is accessible is 18 to 60 years due to the limitation of access to people that are over the age of 60 years. The results are used to generalised to the wider population outside of the population sample used.

3.5 Research instrument

A questionnaire is used to gather data for the analysis. The complexity of the sample size will require an instrument that provides structured, standardised, and open-ended questions of which a questionnaire is able to achieve. The questionnaire includes both close-ended and

open-ended questions. The following assumptions by (Gurbuz, 2017) were considered in terms of accuracy and the usefulness of data: the responses received from respondents are correct, all the questions asked are correct, all variables have been conceptualised, the research purpose and research problem hypothesis is unknown to the respondents and the pollsters have no effect on the survey. This study is objective in terms of the data received by also identifying visible errors of completion of the questionnaire and making an objective decision on whether to exclude that data to avoid compromising the study confidence level.

3.6 Procedure for data collection

A method of collecting data included a survey. Two distribution methods were used, and they include email and WhatsApp. The distribution lists include a portion of University of Witwatersrand MBA Saturday class 2022/2023 students and random population from different provinces. The population covers people from different ages and provinces in South Africa. The sample population selected did not require an approval. The collected data was saved on Microsoft Excel file enable exporting to the data analysis software. The data was be stored on the Wits cloud to ensure flexible access to data as well as to safeguard the data.

3.7 Data Analysis strategies and interpretation

The data analysed was exported from a Microsoft excel file and loaded on the IBM SPSS 28.0 tool which was then used to formulate, analyse, and determine the composition of the respondents. In ensuring that the data collected is reliable and accurate, the reliability and validity tests were performed. In measuring the strength of a dataset, the Cronbach's alpha was used. Cronbach's alpha is widely used in statistics a tool to measure the reliability of a dataset (Jain & Angural, 2017). In terms of validity analysis convergent and discriminant validity methods will be used to determine the correlation coefficient of the variables. The discriminant validity measures whether the constructs are related or unrelated (Bertea & Zait, 2011). Upon receiving the results from excel then SPSS was used to support the results. Unbiased statistics was used to communicate the results. A regression model was used to investigate the relationship between the variables. The hypothesis test and rank correlation tests for parametric and non-parametric analyses were used enable the understanding of the relationship between

the dependent variables (perceived ease of use, perceived usefulness, perceived transaction security and subjective norms) to the independent variable (adoption of QR codes and mobile wallets).

3.8 Quality Assurance

Quality assurance is imperative in a survey in ensuring that results produced and communicated offers accuracy, validity as well as reliability. Quality assurance procedures should be established to minimise data collect errors to ensure that there is high quality data that is collected. Sampling strategies and biasedness can contribute to errors in the survey and therefore should be eliminated. The institutions selected for the survey will be able to provide the appropriate population sample as per the aim of the research. The researcher has the relevant knowledge, skills, and expertise to conduct this research. Additionally, a research supervisor who will be providing guidance to limit the research errors that may occur. In terms of sampling the targeted responses are between 200 and 300. However, the survey was distributed to 300 people to cater for errors and non-participation. This ensured that there is an adequate sample for estimation and generalisation to the wider population. The data reliability and validity were tested as part of the data analysis strategy.

3.9 Ethical considerations

This study is guided by the principles of ethical considerations of the Wits business School in how the research is designed, data is collected, and analyses is conducted (Bougie & Sekaran, 2019). Ethics were followed in this study to ensure that participants are informed of the aim of the study. There was consent received from all participants prior to the commencement of the study. Consideration was taken to ensure that participants are not harmed in any way by contributing to the study. Considerable care was taken to protect the individual identity of respondents and the responses received will be purely for this study. Data was collected, and safely stored in a device that requires a password and after the study is conducted and published the data will be deleted. Honesty and integrity principles were followed during the study.

CHAPTER 4

4 DATA ANALYSIS AND RESULTS DISCUSSION

4.1 Introduction

This chapter discusses the data received from respondents across different provinces in South Africa as well as different age groups. This chapter discusses the following: descriptive statistics, reliability of the data, normal distribution, and inferential statistics with the aim of achieving data results that will respond to the research questions, achieve the objective of this study, and prove the hypothesis. This chapter uses SPSS software version 28.0 to analyse the data collected from the questionnaire and the findings are evaluated and the results interpreted.

4.2 Response rate

The questionnaire was distributed to 300 adult population across different provinces in South Africa and 185 participants completed the questionnaire. A 62-percentage response rate was achieved for this study. From the 185 participants that responded to the questionnaire, only 178 participants formed part of this analyses. Incomplete data was received from 7 participants' which made their data unreliable.

4.3 Descriptive statistics

Descriptive statistics considered in the study include the province in which the respondents reside in and the age group applicable to them. This section provides the statistics of the respondents per province and evaluate the data per age group. According to Silva & Borges (2023) descriptive statistics should include the arrangement, simplifying and describing the quantitative data.

4.3.1 Demographics

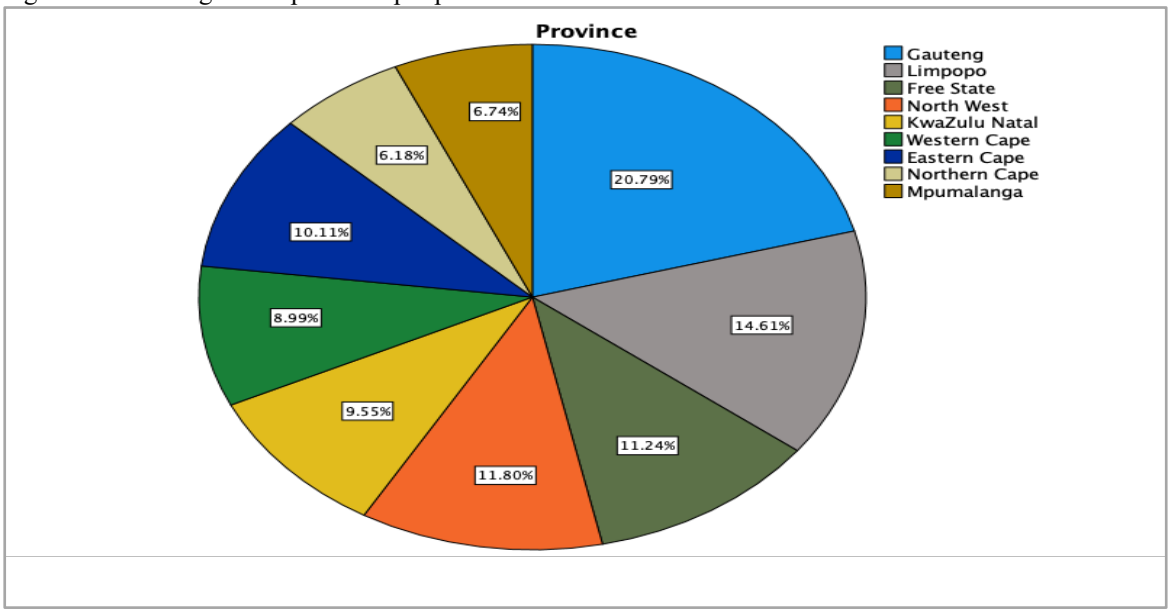
4.3.1.1 Province

Most respondents reside in Gauteng and account for 20.8%. According to According to Stats SA (2022) census, Gauteng has the largest population in South Africa with 15,1 million people and therefore most respondents are aligned to the population. The least respondents reside in Northern Cape and account 6.2% of the responses. Northern Cape remains the province with the least population at 1,3 million. Other provinces are split between 6.7% and 14.6% as shown in Table 1 and figure 2 below.

Table 1: Respondents per province

Province				
		Frequency	Percent	Cumulative Percent
Valid	Gauteng	37	20.8	20.8
	Limpopo	26	14.6	35.4
	Free State	20	11.2	46.6
	North West	21	11.8	58.4
	KwaZulu Natal	17	9.6	68.0
	Western Cape	16	9.0	77.0
	Eastern Cape	18	10.1	87.1
	Northern Cape	11	6.2	93.3
	Mpumalanga	12	6.7	100.0
	Total	178	100.0	

Figure 2: Percentage of respondents per province



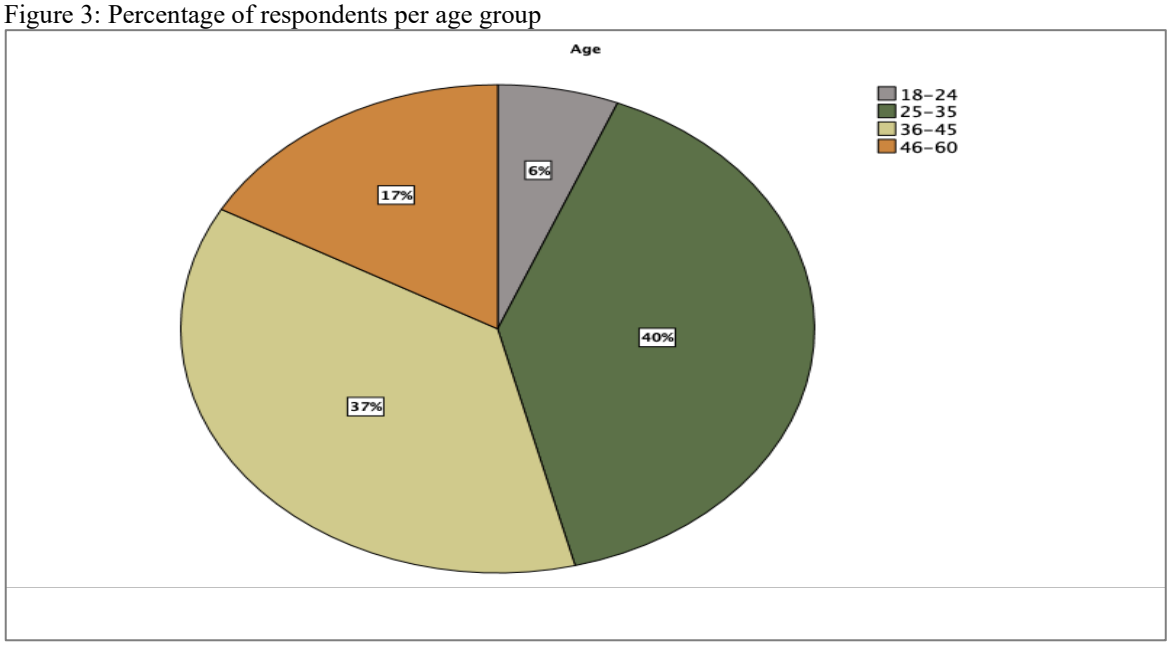
4.3.1.2 Respondents age group

In a total of 178 respondents, 40% is 25-35 age group, 37% is 36-45 age group, 17% is 46-60 age group while the least of respondents are 18-24 years old and accounting 6%. Majority of respondents are in 25-35 age group and 36-45 age groups as shown in table 2 and figure 3 below.

Table 2: Respondents age groups

		Frequency	Percent	Cumulative Percent
Valid	18-24	11	6.2	6.2
	25-35	71	39.9	46.1
	36-45	66	37.1	83.1
	46-60	30	16.9	100.0
	Total	178	100.0	

Figure 3: Percentage of respondents per age group



4.3.1.3 Age and Province crosstabulation

A crosstabulation is used to analyse and present the interaction between the two variables and this include respondents per province and as well as the age groups. Table 3 shows that the

majority of the respondents in age group 18-24 are from North West and account for 36% of the responses, followed by Gauteng with 27% of responses. Three provinces (Kwa-Zulu Natal, Western Cape and Eastern Cape) had 0% respondents for age group 18-24. The highest responses are from Limpopo by the age group (25-35) and account for 24%. The age group 36-45 accounts for 37% of all responses and 17% from the Eastern Cape. In Mpumalanga, had 0% responses for age group 46-60 and most respondents were from the Free State province accounting 35%.

Table 3: Age and Province crosstabulation

			Province									
			Gauteng	Limpopo	Free State	North West	KwaZulu Natal	Western Cape	Eastern Cape	Northern Cape	Mpumalanga	Total
Age	18-24	Count	3	1	1	4	0	0	0	1	1	11
		% within Age	27.3%	9.1%	9.1%	36.4%	0.0%	0.0%	0.0%	9.1%	9.1%	100.0%
		% within Province	8.1%	3.8%	5.0%	19.0%	0.0%	0.0%	0.0%	9.1%	8.3%	6.2%
	25-35	Count	14	17	5	10	6	3	7	3	6	71
		% within Age	19.7%	23.9%	7.0%	14.1%	8.5%	4.2%	9.9%	4.2%	8.5%	100.0%
		% within Province	37.8%	65.4%	25.0%	47.6%	35.3%	18.8%	38.9%	27.3%	50.0%	39.9%
	36-45	Count	14	7	7	3	6	11	9	4	5	66
		% within Age	21.2%	10.6%	10.6%	4.5%	9.1%	16.7%	13.6%	6.1%	7.6%	100.0%
		% within Province	37.8%	26.9%	35.0%	14.3%	35.3%	68.8%	50.0%	36.4%	41.7%	37.1%
	46-60	Count	6	1	7	4	5	2	2	3	0	30
		% within Age	20.0%	3.3%	23.3%	13.3%	16.7%	6.7%	6.7%	10.0%	0.0%	100.0%
		% within Province	16.2%	3.8%	35.0%	19.0%	29.4%	12.5%	11.1%	27.3%	0.0%	16.9%
Total		Count	37	26	20	21	17	16	18	11	12	178
		% within Age	20.8%	14.6%	11.2%	11.8%	9.6%	9.0%	10.1%	6.2%	6.7%	100.0%
		% within Province	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

4.3.2 Reliability

4.3.2.1 Cronbach's Alpha

In measuring the accuracy and reliability with regards to the collected data, this study makes use of the Cronbach's Alpha test to assess the reliability. Validity tests are also used to determine the reliability and accuracy of the data. In measuring the strength of a dataset, Cronbach's alpha is widely used in statistics a tool to measure the reliability of a dataset (Bonnet and Wright, 2015; Jain and Angural, 2017). According to Kent (2007) the Cronbach's Alpha of $\alpha > 0.900$ is excellent, $0.800 < \alpha < 0.900$ is good, $0.700 < \alpha < 0.800$ is acceptable $0.600 < \alpha < 0.700$ is questionable, $0.500 < \alpha < 0.600$ is poor and $\alpha < 0.500$ is unacceptable.

A total of 178 cases formed part of the questionnaire and 1 case was excluded from the statistics due to missing values. In testing the Cronbach's Alpha, 177 cases were included as shown in table 4. In testing the reliability of the data, the 18 Statements were used to achieve a Cronbach's Alpha of 0.731 which is above the minimum requirement of 0.700 acceptable range. See table 5.

Table 4: Number of cases for the Cronbach's Alpha test

		N	%
Cases	Valid	177	99.4
	Excluded[a]	1	.6
	Total	178	100.0

Table 5: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.731	.704	18

The questionnaire comprised of 26 statements. The first two statements comprised of the demographical questions, in which Statement 1 enquired about the province in which the respondent resides, and Statement 2 enquired about the age group of the respondent.

Table 7 shows that 18 Statement evaluated in this study. The questionnaire used different point scale due to the nature of each question. 2-point Likert scale is conducted on Statement 1 and 2. A 3-point Likert scale is conducted on Statement 3 to 18, inclusive of the neutral response option.

Table 6 Questionnaire statements - (questions)

Variables	Statement numbers	Statements
Perceived usefulness	1	Do you use QR codes
	2	Do you use mobile wallet
Ease of use	3	Does QR codes improve your payments
	4	Does mobile wallet improve your payments
Social norms	5	Are family, friends and colleagues using QR codes and mobile wallet
	6	Can social pressure make you use QR codes and mobile wallets
Transaction security	7	Are QR codes financially risky
	8	Are mobile wallets financially risky
	9	Can QR codes result in loss of your confidential information
	10	Can mobile wallet result in loss of your confidential information
Attitude	11	Can QR codes make you lose transaction control
	12	Can mobile wallet make you lose transaction control
Nudging	13	Can rewards make you use mobile payments
	14	Will you use mobile payments if regulations compels you
	15	Will knowing the advantages make you use mobile payments
	16	Will knowing the disadvantages make you not use mobile payments
	17	Would education on QR code make you use it
	18	Would education on mobile wallet make you use it

Table 7 indicate that individual items are between 0.700 and 0.756 and acceptable. However, transaction security-8 is at 0.699 and therefore questionable internal consistency.

Table 7: Cronbach's Alpha total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Perceived usefulness-1	34.64	28.117	-.255	.432	.756
Perceived usefulness-2	34.53	27.898	-.221	.297	.753
Ease of use-3	33.93	25.086	.281	.471	.722
Ease of use-4	34.03	25.255	.279	.327	.723
Social norms-5	34.20	24.629	.300	.239	.721
Social norms-6	33.91	23.878	.425	.283	.710
Transaction security-7	34.20	22.777	.400	.492	.710
Transaction security-8	34.21	22.144	.488	.533	.699
Transaction security-9	34.02	23.199	.380	.549	.713
Transaction security-10	34.11	22.283	.474	.658	.701
Attitude-11	34.53	22.387	.488	.679	.700
Attitude-12	34.57	22.565	.474	.667	.702
Nudging-13	34.08	25.669	.171	.145	.731
Nudging-14	34.10	25.546	.223	.187	.727
Nudging-15	34.05	24.719	.480	.466	.712
Nudging-16	34.02	23.880	.347	.242	.716
Nudging-17	33.96	25.697	.196	.541	.728
Nudging-18	33.97	24.828	.378	.591	.716

4.4 Normality Tests

4.4.1 Kolmogorov-Smirnov Test

The Kolmogorov-Smirnov Test (K-S test) is used for testing data normality. The K-S test is used for a data set that is above 100 in conjunction with a degrees of freedom parameter. In using the K-S test, when p value is more than 0.05, then the data is normally distributed and if the significance value is less than 0.05 then the data is not normally distributed (Drezner et al., 2008). Table 8 below shows that significance value is less than 0.001 and therefore it makes the data non-normal.

Table 8:Kolmogorov-Smirnov Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Perceived usefulness-1	.360	177	<.001	.634	177	<.001
Perceived usefulness-2	.418	177	<.001	.603	177	<.001
Ease of use-3	.352	177	<.001	.735	177	<.001
Ease of use-4	.388	177	<.001	.701	177	<.001
Social norms-5	.288	177	<.001	.793	177	<.001
Social norms-6	.277	177	<.001	.777	177	<.001
Transaction security-7	.274	177	<.001	.745	177	<.001
Transaction security-8	.270	177	<.001	.752	177	<.001
Transaction security-9	.290	177	<.001	.762	177	<.001
Transaction security-10	.278	177	<.001	.753	177	<.001
Attitude-11	.372	177	<.001	.688	177	<.001
Attitude-12	.384	177	<.001	.675	177	<.001
Nudging-13	.345	177	<.001	.749	177	<.001
Nudging-14	.379	177	<.001	.703	177	<.001
Nudging-15	.447	177	<.001	.594	177	<.001
Nudging-16	.245	177	<.001	.798	177	<.001
Nudging-17	.392	177	<.001	.695	177	<.001
Nudging-18	.403	177	<.001	.679	177	<.001

4.4.2 Skewness and Kurtosis

Skewness measures the asymmetry of a distribution. Kurtosis measures the extent of which the data has outliers. In checking normality thew following sample sizes and n-value ranges are used: a small sample size (< 50: n-value -1.96 and +1,96); medium size sample (50< N <300: n-value -3,29 and =3,29) and large size (>300: n-value -2 and +2 and -7 and +7). Table 9 below shows the assessment of Skewness and Kurtosis for the 18 variables and the standard error and ratio of its kurtosis or standard error and its ratio of skewness is used to test for normality. When the ratio is between -2 and +2 then normality is rejected. The ration is indicated as n-value on table 9 and table 10.

Table 9: Skewness and kurtosis test

	N	Skewness		Kurtosis		Skewness	Kurtosis
	Statistic	Statistic	Std. Error	Statistic	Std. Error	N Values	N Values
Perceived usefulness-1	178	-.159	.182	-1.997	.362	-.874	-5.517
Perceived usefulness-2	178	-.616	.182	-1.639	.362	-3,385	-4.57
Ease of use-3	178	-.049	.182	-.417	.362	-.269	-1.151
Ease of use-4	178	.150	.182	.229	.362	.824	.632
Social norms-5	178	.030	.182	-.671	.362	1.648	-1.853
Social norms-6	178	-.350	.182	-.725	.362	-1.923	-2.002
Transaction security-7	178	.044	.182	-1.760	.362	2.418	-4861
Transaction security-8	178	.055	.182	-1.731	.362	3.022	-4.781
Transaction security-9	178	-.330	.182	-1.531	.362	-1.813	-4.229
Transaction security-10	178	-.144	.182	-1.710	.362	-.791	-.472
Attitude-11	178	.723	.182	-1.232	.362	3.972	.340
Attitude-12	178	.819	.182	-1.075	.362	4.5	-.483
Nudging-13	178	-.005	.182	-.050	.362	-.027	-.138
Nudging-14	177	.091	.183	.561	.363	.497	1.545
Nudging-15	178	.639	.182	1.482	.362	3.510	4.093
Nudging-16	178	-.271	.182	-1.210	.362	-1.489	-3.342
Nudging-17	178	.211	.182	-.087	.362	.115	-.240
Nudging-18	178	.298	.182	.010	.362	1.637	.027

A sample of 178 at a confidence level of 95% rejects a null hypothesis and n-value over 3,29 (Kim, 2015). Table 10 below shows the results for testing normality and a significance value larger than 0.05, which indicates normally distributed data. Table 10 indicates the N-values and distribution of all 18 variables with comments on the distribution. Variable 3,4,5,6,10,13,14,17 and 18 are normally distributed. Variables 2 and 15 are non-normally distributed. Variable 1,7,9,11 and 12 are inconclusive. Considering the results for skewness and kurtosis graphical tests (Q-Q plots and histograms) for normality are conducted further.

Table 10: Skewness and Kurtosis test for individual variables

	N	Skewness	Kurtosis
	Statistic	N Values	N Values
Perceived usefulness-1	178	-.874	-5.517
		Normal distribution	Non-normal distribution
Perceived usefulness-2	178	-3,385	-4.57
		Non-normal distribution	Non-normal distribution
Ease of use-3	178	-.269	-1.151
		Normal distribution	Non-normal distribution
Ease of use-4	178	.824	.632
		Normal distribution	Normal distribution
Social norms-5	178	1.648	-1.853
		Normal distribution	Normal distribution
Social norms-6	178	-1.923	-2.002
		Normal distribution	Normal distribution
Transaction security-7	178	2.418	-4.861
		Normal distribution	Non-normal distribution
Transaction security-8	178	3.022	-4.781
		Normal distribution	Non-normal distribution
Transaction security-9	178	-1.813	-4.229
		Normal distribution	Non-normal distribution
Transaction security-10	178	-.791	-.472
		Normal distribution	Normal distribution
Attitude-11	178	3.972	.340
		Non-normal distribution	Normal distribution
Attitude-12	178	4.5	-.483
		Non-normal distribution	Normal distribution
Nudging-13	178	-.027	-.138
		Normal distribution	Normal distribution
Nudging-14	177	.497	1.545
		Normal distribution	Normal distribution
Nudging-15	178	3.510	4.093
		Non-normal distribution	Non-normal distribution
Nudging-16	178	-1.489	-3.342
		Normal distribution	Non-normal distribution
Nudging-17	178	.115	-.240
		Normal distribution	Normal distribution
Nudging-18	178	1.637	.027
		Normal distribution	Normal distribution

Table 11 below assess grouped variables and shows that Nudging exhibits skewness of 1,126 and a Kurtosis of 3,632 and indicate that normal distribution and non-normal distribution. Security exhibits skewness of -0.445 and a Kurtosis of -2,687 and indicate normal distribution. Norms exhibits skewness of -1.258 and Kurtosis of 0.049 and indicate normal distribution. Attitude exhibits skewness of -3,989 and Kurtosis of -2,892 and indicate non-normal distribution and normal distribution and therefore inconclusive outcome. Ease exhibits skewness of 0.203 and kurtosis of 0.859 and indicate normal distribution. Usefulness exhibits skewness of -1,769 and kurtosis of -3,26 indicating a normal distribution.

Table 11: Skewness and Kurtosis test for grouped variables

		Nudging	Security	Norms	Attitude	Ease	Usefulness
N	Valid	178	178	178	178	178	178
	Missing	0	0	0	0	0	0
Skewness		.205	-.081	-.229	.726	.037	-.322
Std. Error of Skewness		.182	.182	.182	.182	.182	.182
N-value		1,126	-0.445	-1.258	3,989	.203	-1,769
Kurtosis		1.315	-.973	.018	-1.047	.311	-1.181
Std. Error of Kurtosis		.362	.362	.362	.362	.362	.362
N-value		3,632	-2,687	.049	-2,892	.859	-3,262

4.4.3 Q-Q Plot Test

Q-Q plot test is used in this study to present the graphical test that evaluates normality. Q-Q plot shows the data observed in relation to the normal distribution expected quantiles. Q-Q plots tests are conducted on grouped variables, namely: Nudging, Security, Norms, Attitude, Ease and Usefulness (Adoption).

Figure 4 shows that for Nudging the data has an approximate normal distribution as the data points are closer to the plot line. However, there are deviations appearing in the tails.

Figure 4:Q-Q Plot of Nudging

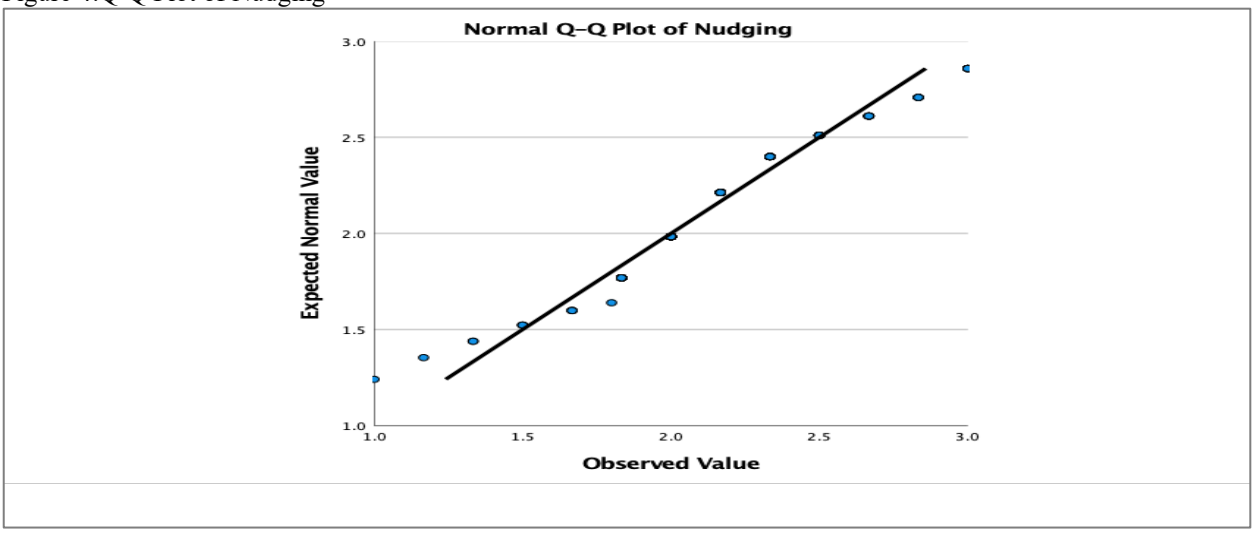


Figure 5 shows data on security as approximately normally distributed, this is indicated by the data points on the line and closer to the plot line. Similarly, there are deviation appearing at the tail.

Figure 5:Q-Q Plot of Security

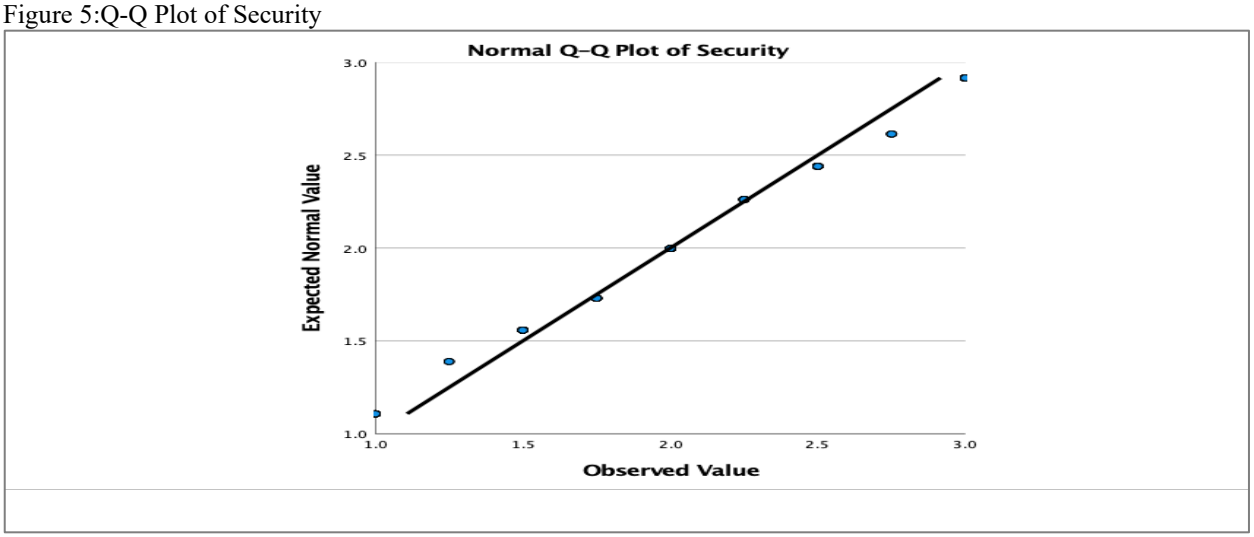


Figure 6 shows that data for Norms is approximately normally distributed, this is indicated by the points on the line and closer to the line.

Figure 6: Q-Q Plot of Norms

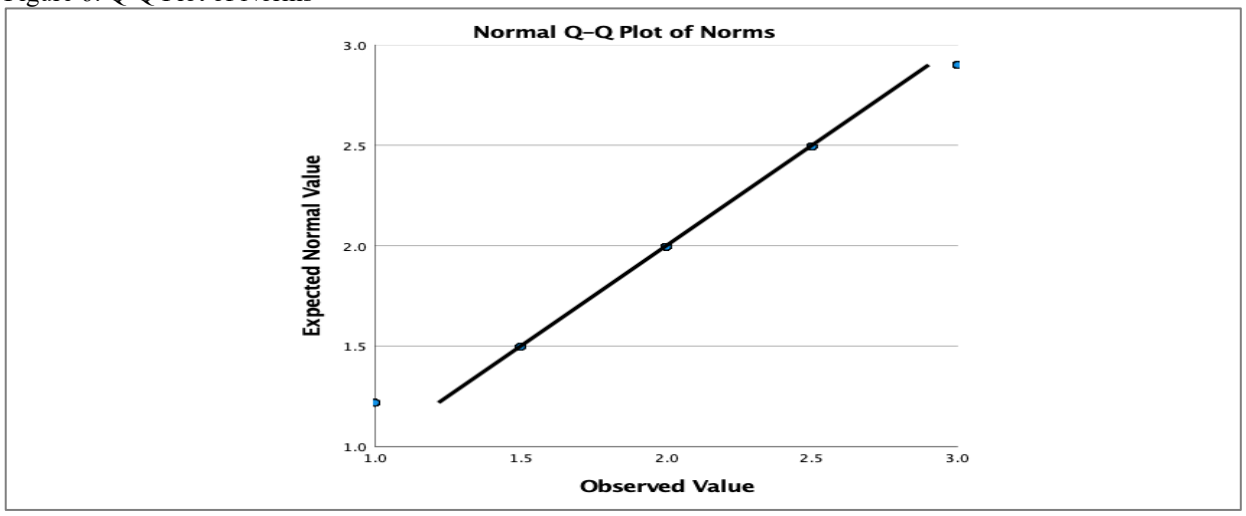


Figure 7 shows that the data on Attitude is deviating from normality this is indicated by the data points that are deviating from the plot.

Figure 7:Q-Q Plot of Attitude

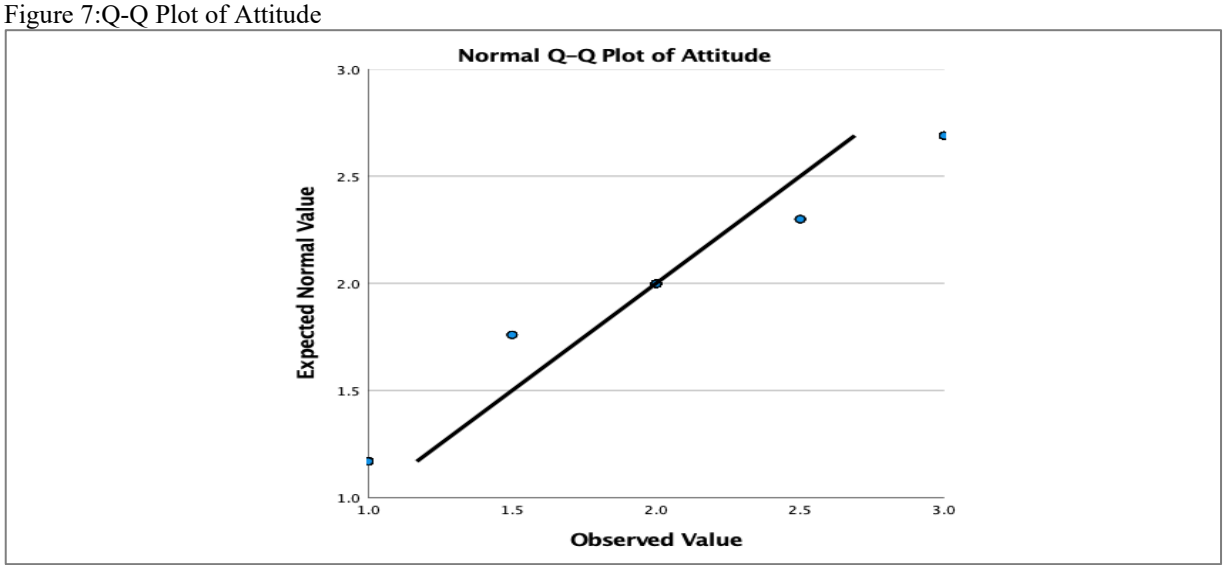


Figure 8 shows data on Ease as non-normally distributed; this is indicated by the data points that are not on the plot line or either close to the plot line.

Figure 8:Q-Q Plot for Ease

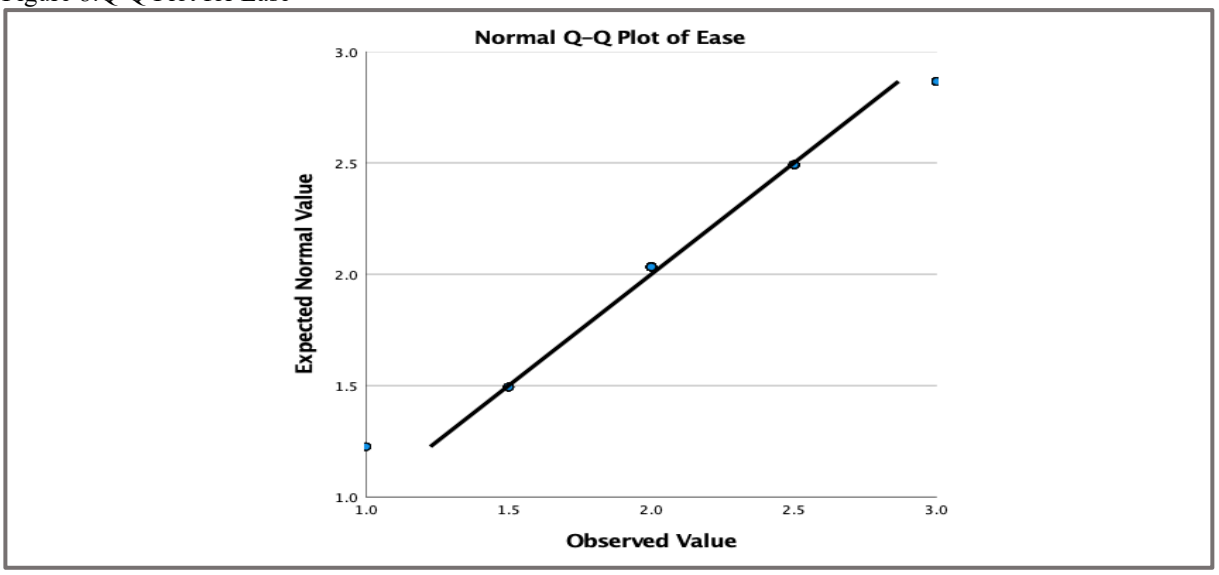
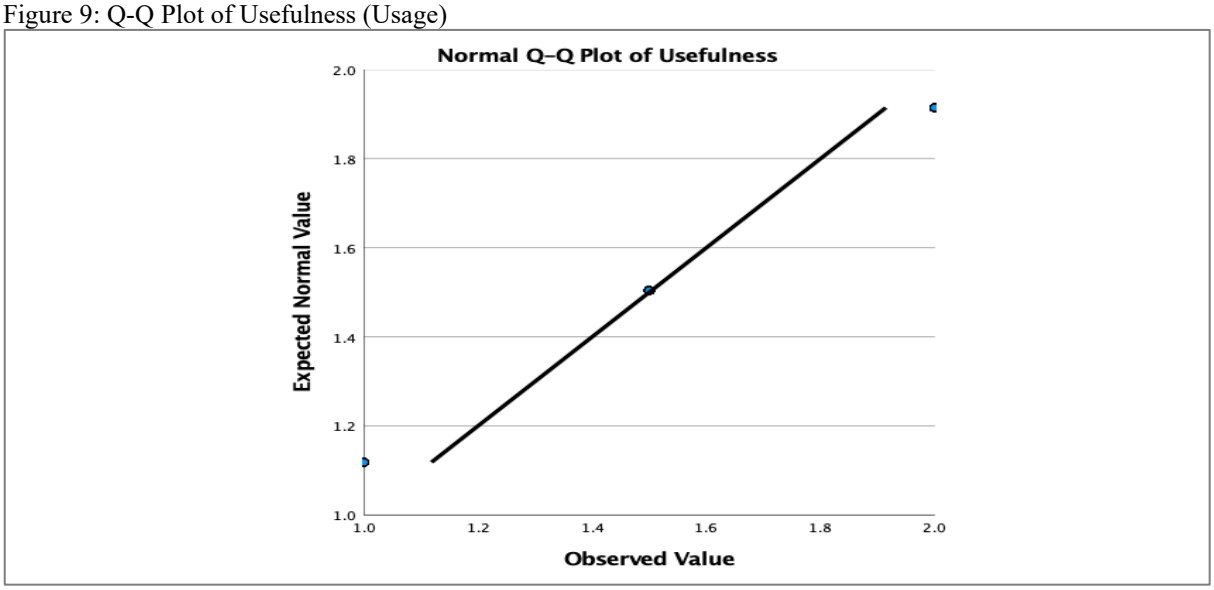


Figure 9 shows that the data on Usefulness is deviating from the normal distribution, this is indicated by the more data points deviating from the plot line.

Figure 9: Q-Q Plot of Usefulness (Usage)



4.4.4 Histogram

Histogram is another graphical tool used to evaluate the frequency distribution. For a perfectly normal distribution the bars height of the histogram will match up with the normal overlay. A symmetric histogram around the distribution indicates a normal distribution.

Figure 10 shows that Nudging is normally distributed, and the symmetry is around the distribution mean of 2.15.

Figure 10: Histogram for Nudging

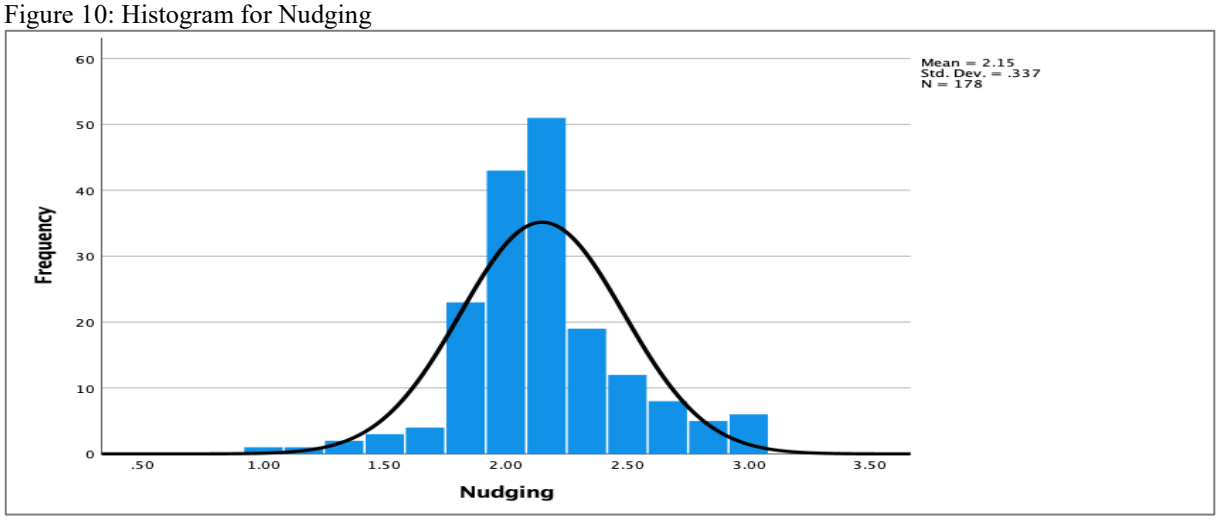


Figure 11 shows that Security has a normal distribution with a symmetric histogram around the distribution mean of 2.0.

Figure 11: Histogram for Security

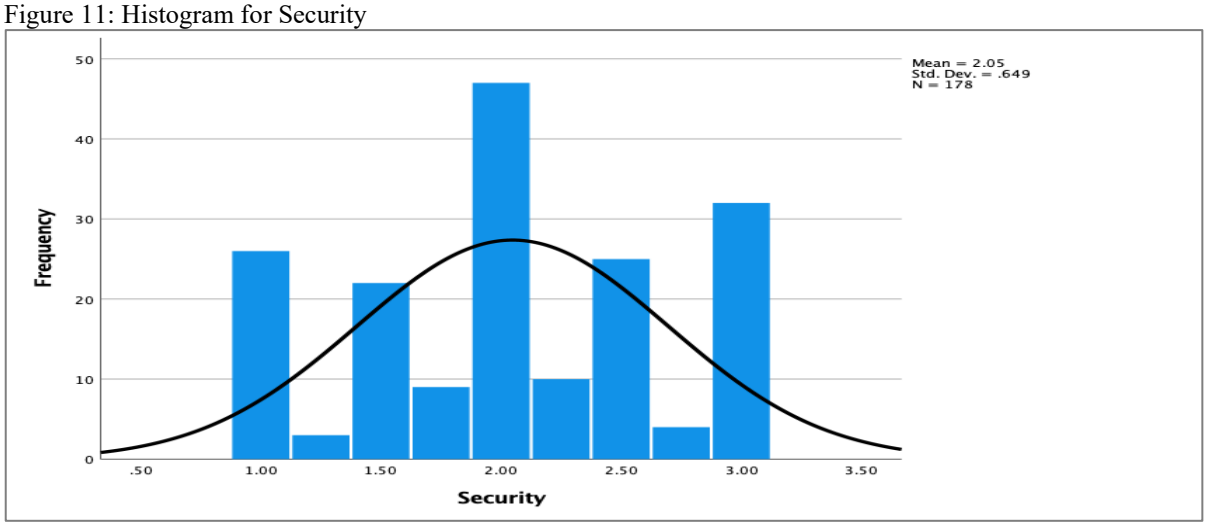


Figure 12 shows a normal distribution for Norms with a distribution mean of 2.12.

Figure 12: Histogram for Norms

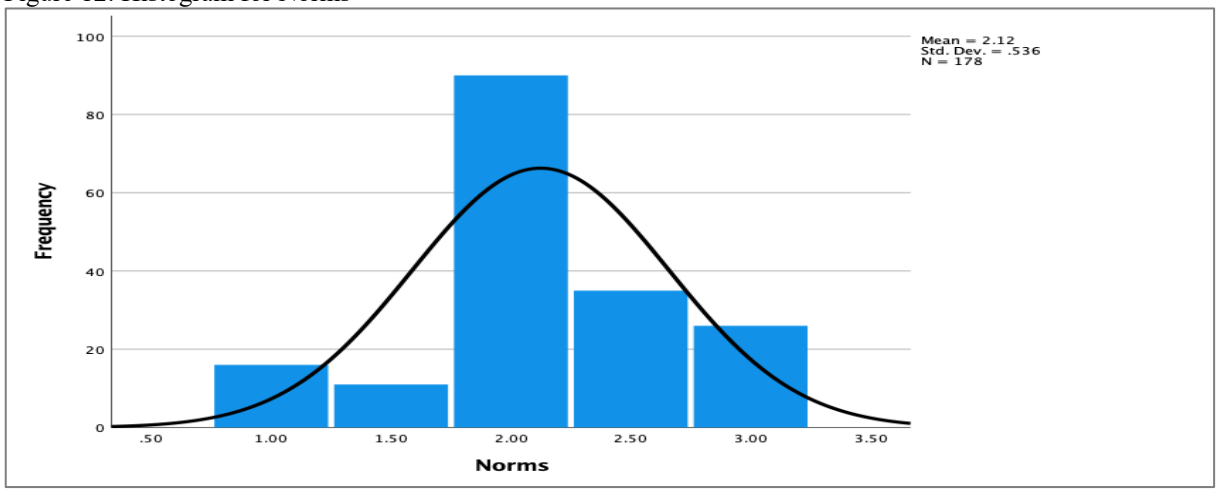


Figure 13 shows Attitude and indicates the variable data is deviating from the normal distribution. The distribution is negatively skewed which is presented by long left tail.

Figure 13:Histogram for Attitude

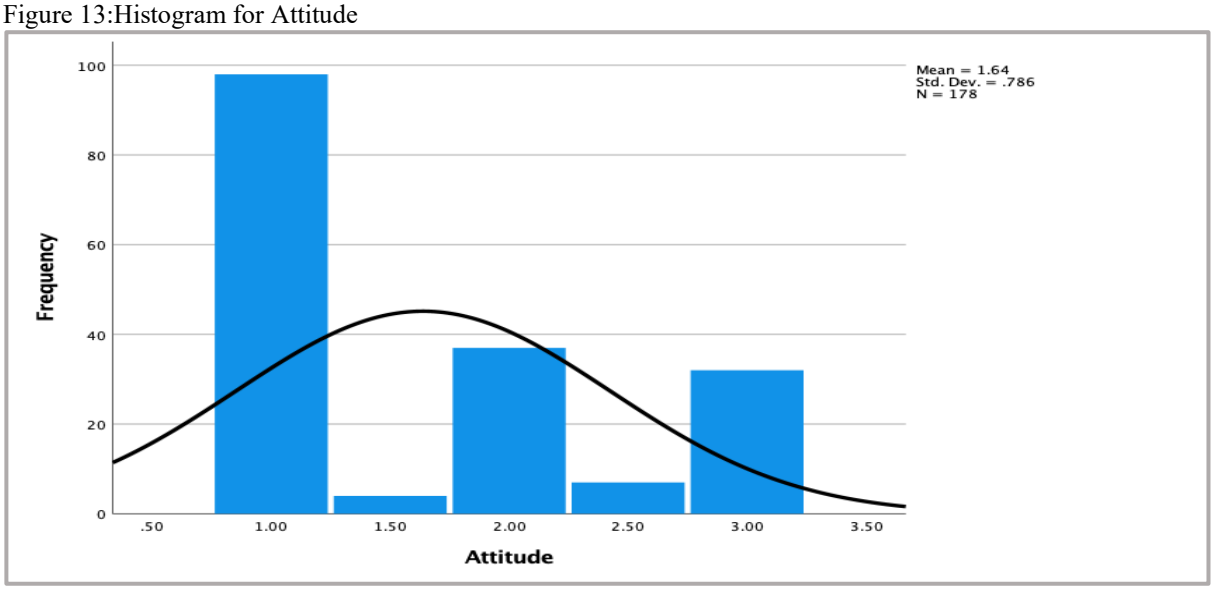


Figure 14 shows that Ease has a normal distribution with a symmetric histogram around the distribution mean of 2.21.

Figure 14: Histogram for ease

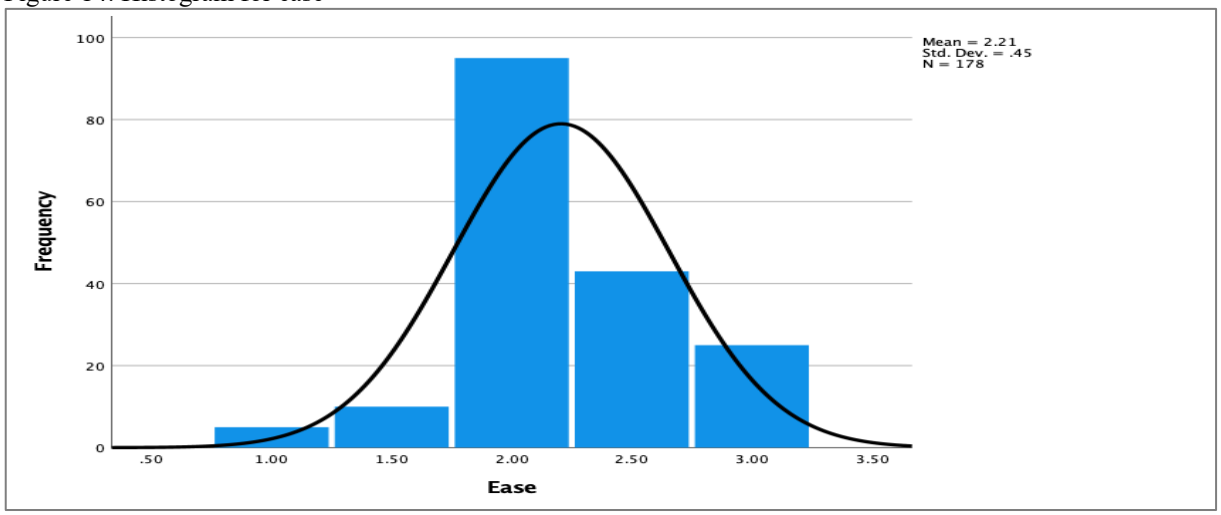
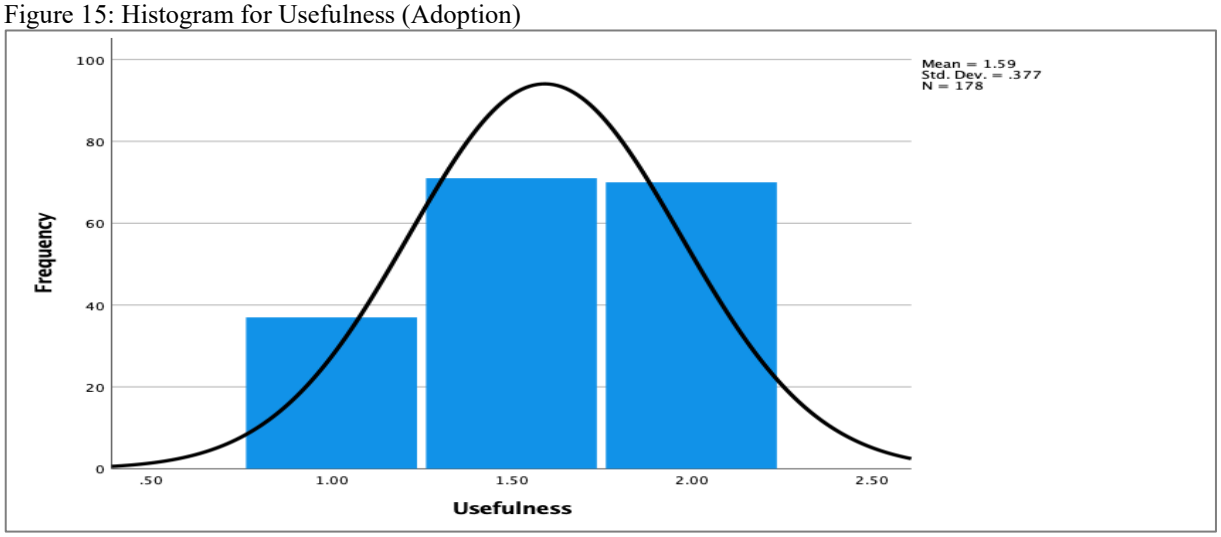


Figure 15 shows that Usefulness has a normal distribution with a symmetric histogram around the distribution mean of 1.59.

Figure 15: Histogram for Usefulness (Adoption)



4.4.5 Normality summary

4.4.5.1 Kolmogorov Smirnov Summary

In testing for normal distribution, the Kolmogorov Smirnov was used. The results obtained when conducting the K-S test indicated a significant value less than 0.001 would result in null hypothesis being rejected. According to the K-S test if the p value is greater than 0.05 the conclusion is that the data is normally distributed. However, the K-S test alone is not sufficient to conclude on data distribution (Kim, 2015).

4.4.5.2 Skewness and kurtosis Summary

In evaluating skewness and kurtosis a Z test was used to inform the results. The z-value indicated that two variables (Nudging and Attitude) have an inconclusive distribution while the other four variables (Security, Ease, Norms and Usefulness) exhibit a normal distribution. However, the Q-Q plot test and histogram were used further to validate the statistics as they are a good indicator for deviation from normal distribution. From the graphical tools nudging was verified as normally distributed. Attitude was confirmed by the graphical tools to have non-normal distribution.

4.4.5.3 Q-Q plot test and Histogram Summary

Q-Q plot data for five out of six grouped variables indicate a normal distribution with the data point o and near the distribution line. The Q-Q plot indicates that Attitude has data points that are mostly deviating to the right and left tail and therefore the is variable has deviated from the normal distribution. A histogram was also used as a second graphical tool in evaluating normal distributions. In evaluating the histogram for all grouped variables, the results indicate that five out of six variables are normally distributed even though the bars height to a small degree does not match with the normal overlay. The variable named Attitude indicates that it has a non-normal distribution. The histograms of the five grouped variables indicate that bars are slightly higher or lower than the normal overlay, however five variables' distributions have a symmetry around the distribution mean and do not indicate a significant deviation from normality.

4.4.5.4 Conclusion

The results of normality test presented some inconsistencies when considering the Kolmogorov Smirnov and Skewness and kurtosis. In validating these tests, a q-q plot and histogram was used and from the outcome it is evident that the data for five variable (Nudging, Security, Norms, Ease and Usefulness) exhibits a normal distribution and therefore parametric analysis is used in testing hypothesis. There was evidence from the graphical tools that data for one variable (Attitude) deviates from a normal distribution, with the histogram showing a skewed distribution and therefore nonparametric analyses will be used in testing hypothesis.

4.5 Inferential Statistics

4.5.1 Parametric tests for Hypothesis

4.5.1.1 Hypothesis testing

The p-value is used in deciding on whether to reject the null hypothesis. A critical level used is 0.05 and if the p-value is less than the critical level null hypothesis is rejected.
The adoption of QR codes and mobile wallets is measured using the variable named 'perceived usefulness' this variable was used for testing the population sample adoption of QR codes and/or mobile wallet. The t-test is used to test adoption of QR codes and the adoption of mobile wallets using separate tables below.

Table 12 below assess the possible relationship between the adoption of QR codes with other dependent variables namely: perceived ease of use (Ease), transaction security (Security) and social norms (Norms). The t-test revealed the following hypothesis outcomes:

- H1 Perceived ease of use influence QR codes adoption.

The p-value of Perceived ease of use (Ease) at 0.00 is lower than the critical value of 0.05, (Ho) the null hypothesis is rejected, and alternative hypothesis (H1) is accepted.

- H2 Perceived transaction security influence the adoption of QR codes.

The p-value of Security (0.03) is lower than the critical value of 0.05.

(Ho) the null hypothesis is rejected, and alternative hypothesis (H1) is accepted.

- H3 Subjective norms influence the adoption of QR codes.

The p-value of Norms (0.51) is higher than the critical value of 0.05.

(Ho) the null hypothesis is accepted, and alternative hypothesis (H1) is rejected.

Table 12:T-test for dependent variable and QR codes adoption

		Levene's Test for Equality of Variances		t-test for Equality of Means						
						Significance	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		F	Sig.	T	df	Two-Sided p			Lower	Upper
Security	Equal variances assumed	0.44	0.50	2.18	176	0.03	0.21	0.09	0.02	0.40
	Equal variances not assumed			2.20	174.89	0.02	0.21	0.09	0.02	0.40
Norms	Equal variances assumed	3.87	0.05	0.66	176	0.50	0.05	0.08	-0.10	0.21
	Equal variances not assumed			0.65	161.85	0.51	0.05	0.08	-0.10	0.21
Ease	Equal variances assumed	29.16	<0.00	4.66	176	<0.00	0.29	0.06	0.17	0.42
	Equal variances not assumed			4.51	133.51	<0.00	0.29	0.06	0.16	0.42

Table 13:T-test Group Statistic for dependent variables and QR codes adoption

Adoption of QR codes		N	Mean	Std. Deviation	Std. Error Mean
Security	No	82	2.16	0.61	0.06
	Yes	96	1.95	0.66	0.06
Norms	No	82	2.15	0.57	0.06
	Yes	96	2.09	0.50	0.05
Ease	No	82	2.36	0.51	0.05
	Yes	96	2.06	0.32	0.03

Table 14 assess the possible relationship between mobile wallets adoption with the other dependent variables namely: perceived ease of use (Ease), transaction security (Security) and social norms (Norms). The following results are provided.

- H1 Perceived ease of use influence the adoption of mobile wallet.

The p-value of Perceived ease of use (Ease) at 0.00 is lower than the critical value of 0.05, (Ho) the null hypothesis is rejected, and alternative hypothesis (H1) is accepted.

- H2 Perceived transaction security influence the adoption of mobile wallet

The p-value of Security (0.08) is higher that the critical value of 0.05.
(Ho) the null hypothesis is accepted, and alternative hypothesis (H1) is rejected.

- H3 Subjective norms influence the adoption of mobile wallet

The p-value of Norms (0.27) is higher than the critical value of 0.05.
(Ho) the null hypothesis is accepted, and alternative hypothesis (H1) is rejected.

Table 14: T-test for dependent variables and mobile wallet adoption

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Significance Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Security	Equal variances assumed	0.27	0.60	1.76	176	0.08	0.17	0.10	-0.02	0.37
	Equal variances not assumed			1.74	124.52	0.08	0.17	0.10	-0.02	0.37
Norms	Equal variances assumed	4.35	0.03	1.08	176	0.27	0.09	0.08	-0.07	0.25
	Equal variances not assumed			1.03	111.35	0.30	0.09	0.08	-0.08	0.26
Ease	Equal variances assumed	36.69	<.001	3.06	176	0.00	0.21	0.06	0.07	0.34
	Equal variances not assumed			2.60	82.76	0.01	0.21	0.08	0.05	0.37

Table 15: T-test group statistics for dependent variables and mobile wallet adoption

	Mobile wallet Usage	N	Mean	Std. Deviation	Std. Error Mean
Security	No	63	2.16	0.65	0.08
	Yes	115	1.98	0.63	0.05
Norms	No	63	2.18	0.59	0.07
	Yes	115	2.09	0.50	0.04
Attitude	No	63	1.81	0.82	0.10
	Yes	115	1.53	0.74	0.06
Ease	No	63	2.34	0.59	0.07
	Yes	115	2.13	0.32	0.03

Table 16 assesses the potential relationship between attributes of nudging and adoption of QR codes. The p-value of education is less than 0.05 and therefore the null hypothesis is rejected. The p-value of incentives (0.57), (regulation (0.19), knowledge on advantages (0.41) and knowledge on disadvantages (0.31) is higher than the critical value of 0.05, therefore the null hypothesis is accepted.

- H5 Nudging influence the adoption of QR codes

Table 16: T-test for nudging attributes and QR codes adoption

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
						Significance	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Two-Sided p			Lower	Upper
QR code education	Equal variances assumed	46.77	<0.001	4.22	176	<0.00	0.31	0.07	0.16	0.46
	Equal variances not assumed			4.11	143.78	<0.00	0.31	0.07	0.16	0.47
Incentives	Equal variances assumed	8.68	0.00	0.56	176	0.57	0.04	0.08	-0.12	0.22
	Equal variances not assumed			0.55	151.42	0.58	0.04	0.08	-0.12	0.22

Regulation	Equal variances assumed	19.55	<0.00	1.29	175	0.19	0.10	0.07	-0.05	0.25
	Equal variances not assumed			1.25	139.39	0.21	0.10	0.08	-0.05	0.26
Advantages of mobile payments	Equal variances assumed	9.20	0.00	0.82	176	0.41	0.05	0.06	-0.07	0.18
	Equal variances not assumed			0.80	145.30	0.42	0.05	0.06	-0.079	0.18
Disadvantages of mobile payments	Equal variances assumed	0.51	0.47	1.01	176	0.31	0.11	0.11	-0.109	0.34
	Equal variances not assumed			1.02	175.15	0.30	0.11	0.11	-0.108	0.33

Table 17: T-test Group Statistic for nudging attributes and QR codes adoption

Group Statistics

QR code Adoption		N	Mean	Std. Deviation	Std. Error Mean
QR code education	No	82	2.39	.583	.064
	Yes	96	2.07	.417	.043
Incentives	No	82	2.12	.655	.072
	Yes	96	2.07	.508	.052
Regulation	No	82	2.13	.624	.069
	Yes	95	2.03	.424	.044
Advantages of mobile payments	No	82	2.16	.508	.056
	Yes	96	2.10	.369	.038
Disadvantages of mobile payments	No	82	2.22	.721	.080
	Yes	96	2.10	.788	.080

Table 18 below evaluates the relationship between attributes of nudging and the adoption of mobile wallet. The t-test reveals that the p-value of incentives (0.42), knowledge of advantages (0.16), knowledge of disadvantages (0.66) are greater than the critical value of 0.05 and therefore the null hypothesis is accepted. Therefore, the alternative hypothesis is rejected. P-value of regulation (0.01) and education (0.00) is less than the critical value of 0.05 and which confirms that the null hypothesis does not hold and therefore null hypothesis is rejected.

Table 18: T-test for nudging attributes and mobile wallet adoption

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Significance Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Incentives	Equal variances assumed	2.61	0.10	0.80	176	0.42	0.07	0.09	-0.10	0.25
	Equal variances not assumed			0.78	116.90	0.43	0.07	0.09	-0.11	0.25
Regulation	Equal variances assumed	7.71	0.00	2.45	175	0.01	0.20	0.08	0.03	0.36
	Equal variances not assumed			2.39	116.54	0.01	0.20	0.08	0.03	0.36
Advantages of mobile payments	Equal variances assumed	14.98	<0.00	1.38	176	0.16	0.09	0.06	-0.04	0.23
	Equal variances not assumed			1.25	95.96	0.21	0.09	0.07	-0.05	0.24
Disadvantages of mobile payments	Equal variances assumed	2.16	0.14	0.43	176	0.66	0.05	0.11	-0.18	0.28
	Equal variances not assumed			0.42	118.89	0.67	0.05	0.12	-0.19	0.29
Mobile wallet education	Equal variances assumed	35.09	<0.00	4.02	176	<0.00	0.30	0.07	0.15	0.45
	Equal variances not assumed			3.67	98.73	<0.00	0.30	0.08	0.14	0.47

Table 19:T-test Group statistics for nudging attributes and mobile wallet adoption

Mobile wallet Adoption		N	Mean	Std. Deviation	Std. Error Mean
Incentives	No	63	2.14	0.61	0.07
	Yes	115	2.07	0.55	0.05
Regulation	No	62	2.21	0.54	0.07
	Yes	115	2.01	0.50	0.04
Advantages of mobile payments	No	63	2.19	0.53	0.06
	Yes	115	2.10	0.37	0.03
Disadvantages of mobile payments	No	63	2.19	0.80	0.10
	Yes	115	2.14	0.73	0.06
Mobile wallet education	No	63	2.41	0.58	0.07
	Yes	115	2.10	0.42	0.04

4.5.2 Nonparametric test for Hypothesis

4.5.2.1 Mann-Whitney test

Mann Whitney test is used for distribution that is not normal. The test measures the distribution discounting the grouping variable and converting scores into ranks and comparing the mean for each rank. The null hypothesis is rejected when the mean ranks is significant. Table 20 indicate that the group that have adopted mobile payments and the one that has not adopted mobile payments are greater than 40 and 60 observations and therefore comply with the minimum requirement of more than 5 observations. (Sedgwick, 2015). Table 21 indicate that the p-value is 0.00 which is less than the significant value of 0.05 and therefore the null hypothesis is rejected. This confirms that the two groups have different attitude towards mobile payments tested.

Table 20: Mann-Whitney rank for attitude and mobile payments

	Usefulness	N	Mean Rank	Sum of Ranks
Attitude	1.00	37	63.57	2352.00
	2.00	70	48.94	3426.00
	Total	107		

Table 21: Mann Whitney test for attitude and mobile payments

	Attitude
Mann-Whitney U	941.000
Wilcoxon W	3426.000
Z	-2.620
Asymp. Sig. (2-tailed)	.009

a. Grouping Variable: Usefulness

4.5.2.2 Hypothesis summary

Parametric test

In testing the hypothesis, the t-test revealed that security and ease of use influence the population while ease of norms does not influence the population.

The majority is attributes of nudging revealed that nudging has an effect in the population. However, education has no effect on the population when testing the adoption of QR codes. Similarly, most attributes of nudging revealed that nudging influences the adopting of mobile wallets. Regulation and education showed no effect on the adoption of mobile wallets. The conclusion is that the attributes of nudging have more effect on QR codes than mobile wallets.

Nonparametric test

The variable attitude was tested using the Mann-Whitney test and the test revealed that the group that have adopted mobile payments and the other group that have not adopted mobile payments different attitude towards mobile payments.

4.5.3 Parametric Tests for correlation

4.5.3.1 Pearson rank correlation

Pearson rank correlation measures the direction and the strength of the linear connection of the tested variables. Pearson correlation coefficient is -1 to +1. A negative correlation is equals -1, while 0 indicate no correlation and a positive correlation equals to +1 (Shih & Fay, 2017).

Table 22 presents the results of correlations between the QR code adoption, security, norms, ease, and nudging variables. It is observed that there are positive correlations between all variables. The highest correlation is observed between nudging and norms as well as nudging and ease at (0.32) for both tests confirming a strong relationship. The lowest correlation is between ease and security at 0.19 confirming a weak relationship. Nudging as a mediating variable has the highest correlation with all other variables which confirm a stronger relationship. Pearson rank correlation reveals that there is relationship between all variables tested and the stronger relationship by nudging the mediating variable concludes that nudging can be used to improve the adoption of QR code and Mobile wallets. Table 23 measure the correlation between nudging attributes to identify which attribute can have the strongest and weakest influence. Similarly to the other dependent variables. The attributes of nudging have positive correlation. Education and Knowledge on the advantages of using QR codes and

Mobile wallet have the highest correlation at 0.45. And the weakest correlation is between incentives and the knowledge on the disadvantages QR codes and mobile wallet.

Table 22: Correlation of dependent variables

		Security	Norms	Ease	Nudging
Security	Pearson Correlation	1	.278**	.196**	.204**
	Sig. (2-tailed)		<.001	.009	.006
	N	178	178	178	178
Norms	Pearson Correlation	.278**	1	.275**	.321**
	Sig. (2-tailed)	<.001		<.001	<.001
	N	178	178	178	178
Ease	Pearson Correlation	.196**	.275**	1	.322**
	Sig. (2-tailed)	.009	<.001		<.001
	N	178	178	178	178
Nudging	Pearson Correlation	.204**	.321**	.322**	1
	Sig. (2-tailed)	.006	<.001	<.001	
	N	178	178	178	178
**. Correlation is significant at the 0.01 level (2-tailed).					

Table 23:Correlation of attributes of mediating variable (Nudging)

		Incentives	Regulation	Advantages of mobile payments	Disadvantages of mobile payments	Education
Incentives	Pearson Correlation	1	.161*	.263**	.069	.242**
	Sig. (2-tailed)		.033	<.001	.363	.001
	N	178	177	178	178	178
Regulation	Pearson Correlation	.161*	1	.299**	.224**	.128
	Sig. (2-tailed)	.033		<.001	.003	.088
	N	177	177	177	177	177
Advantages of mobile payments	Pearson Correlation	.263**	.299**	1	.398**	.452**
	Sig. (2-tailed)	<.001	<.001		<.001	<.001
	N	178	177	178	178	178
Disadvantages of mobile payments	Pearson Correlation	.069	.224**	.398**	1	.179*
	Sig. (2-tailed)	.363	.003	<.001		.017
	N	178	177	178	178	178
Education	Pearson Correlation	.242**	.128	.452**	.179*	1
	Sig. (2-tailed)	.001	.088	<.001	.017	
	N	178	177	178	178	178
*. Correlation is significant at the 0.05 level (2-tailed).						
**. Correlation is significant at the 0.01 level (2-tailed).						

4.5.3.2 Chi-Square Tests

Chi-square is used to test the association between the variables being tested. It can furthermore determine discrepancies between the expected and observed data because of a variation in the relationship between the variables tested. According to Ugoni & Walker (2014), when the p-value is more than 0.05 (chi-square critical value) then, the null hypothesis is rejected and if the p-value is less than the critical value then null hypothesis is accepted.

Table 24 tests the relationship between security, norms and ease in relation to QR codes adoption and show that null hypothesis is rejected for security and norms as their p-value (0.58) and (0.12) is bigger than the critical value of (0.05). Ease and QR code education have p-values (<0.00) which is less than the critical value 0.05 and therefore null hypothesis is accepted.

Table 24: Chi-square test for dependent variables and QR codes adoption

Pearson Chi-Square	Value	Df	Asymptotic Significance (2-sided)
Security	6.554[a]	8	.585
Norms	7.165[a]	4	.127
Ease	31.639[a]	4	<.001
QR code education	24.463[a]	2	<.001
N of Valid Cases	178		

Table 25 tests the relationship between the below variables and the adoption of mobile wallets. The test indicate that the p-value for security (0.35) and norms (0.30) are greater than the critical value of 0.05 and therefore the null hypothesis is rejected. Ease and mobile wallet education (<0.00) is less than the critical value 0.05 and therefore null hypothesis is accepted.

Table 25:Chi-square test for dependent variables and mobile wallets adoption

Pearson Chi-Square	Value	Df	Asymptotic Significance (2-sided)
Security	8.825[a]	8	.357
Norms	4.870[a]	4	.301
Ease	39.258[a]	4	<.001
Mobile wallet education	21.253[a]	2	<.001
N of Valid Cases	178		

Table 26 tested the relationship between attributes of nudging and the adoption of QR codes. The results show that the p-value of 0.04 for incentives and regulation, and <0.00 for QR code education which is less than the critical value (0.05) which indicate the null hypothesis is accepted. Knowledge of advantages and knowledge of disadvantages have a p-value of (0.75) and (0.34) respectively, and indicate that the p-value is greater than the critical value and null hypothesis is rejected.

Table 26: Chi-square test for nudging and QR code adoption

Pearson Chi-Square	Value	Df	Asymptotic Significance (2-sided)
Incentives	6.263[a]	2	.044
Regulation	11.116[a]	2	.004
Knowledge of advantages	5.168[a]	2	.075
Knowledge of disadvantages	2.149[a]	2	.341
QR code education	21.463[a]	2	<.001
N of Valid Cases	178		

Table 27 assess the relationship between the attributes of nudging and the adoption of mobile wallets and reveals that p-value of incentives (0.45) and Knowledge of disadvantages (0.35) are greater than the critical value (0.05) which indicates that null hypothesis is rejected. Regulation and knowledge of disadvantages have p-values (0.04) (0.02) that are less than the critical value and therefore their null hypothesis is accepted.

Table 27: Chi-square test for nudging and mobile wallet adoption

Pearson Chi-Square	Value	Df	Asymptotic Significance (2-sided)
Incentives	1.590[a]	2	.452
Regulation	6.322[a]	2	.042
Knowledge of advantages	7.149[a]	2	.028
Knowledge of disadvantages	2.086[a]	2	.352
N of Valid Cases	178		

4.5.4 Nonparametric Tests

4.5.4.1 Wilcoxon rank sum test

Wilcoxon rank sum test is equivalent to the t-test however measures nonparametric distribution. The test compares ranks rather than means (Sedgwick, 2015). The sum of Table 28 and Table 29 shows the relationship between adoption of mobile wallets to attitude p- value (0.96) is greater than the significant value of 0.05 and therefore the null hypothesis is accepted.

Table 28: Wilcoxon signed rank test Attitude and mobile wallet adoption

Total N	178
Test Statistic	4173.000
Standard Error	393.999
Standardized Test Statistic	-.049
Asymptotic Sig.(2-sided test)	.961

Table 29: Wilcoxon Signed rank test summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The median of differences between Mobile wallets adoption and Attitude of mobile wallets	Related-Samples Wilcoxon Signed Rank Test	.961	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

Table 30 below measured the relationship between adoption of QR codes and attitude and reveal that the p-value (0.07) is greater than a significance level of 0.05 which concludes that the null hypothesis is accepted.

Table 30: Wilcoxon Signed Rank test attitude and QR code adoption

Total N	178
Test Statistic	3366.000
Standard Error	388.448
Standardized Test Statistic	-1.797
Asymptotic Sig.(2-sided test)	.072

Table 31: Wilcoxon signed rank test attitude and QR code adoption summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The median of differences between Attitude and QR code adoption equals 0.	Related-Samples Wilcoxon Signed Rank Test	.072	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

4.5.4.2 Spearman rank-order correlation coefficient

The spearman's correlation measures the direction plus strength of the relationship of the two variables (Sedgwick, 2015). The p-value is 0.00 which is less than the significance value. And this is indicating a weak and positive correlation between the adoption of QR codes and mobile wallets and attitude as shown in table 32.

Table 32: nonparametric correlation for attitude

			Attitude	Usefulness
Spearman's rho	Attitude	Correlation Coefficient	1.000	-.208**
		Sig. (2-tailed)	.	.005
		N	178	178
	Usefulness	Correlation Coefficient	-.208**	1.000
		Sig. (2-tailed)	.005	.
		N	178	178

**. Correlation is significant at the 0.01 level (2-tailed).

CHAPTER 5

5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

5.1.1 Introduction

This study is based on a population sample of 178 adult respondents residing in different province within the country who completed a questionnaire. The data collected from the

questionnaire was used for descriptive analyses as well as inferential statistics which is contained in Chapter 4 above with the aim of presenting the findings on the adoption of QR codes and mobile wallet. The aim of this study is to respond to the research questions and research objective. This chapter focuses on the conclusion of the entire study, research limitations and provide recommendation to improve the similar studies related to the adoption of mobile payments.

5.1.2 Research problem, Research objective and Research questions

South Africa has experienced the low rates when it comes to the adoption of QR codes and mobile wallets as opposed the pace at which these mobile payments channels and instruments are rolled out. According to literature mobile payments can offer benefits such as convenience, safety and are less expensive than the other payment channels. This study aims to provide the research answers to why there is a low adoption rate of QR codes and mobile wallets in South Africa. This study also analyses the relationships between the dependent variables used in the TAM model to confirm the alignment to the research problem, objectives and able to answer the research questions. A mediating variable (nudging) is introduced in the TAM model to check whether the is an association to the dependent variables and which attributes of nudging can be more impactful in increasing the adoption rates using hypothesis tests.

5.1.3 Descriptive Statistics

5.1.3.1 Demographics

Descriptive statistics were conducted with the used of SPSS version 28.0 statistical software to analyse the data of 178 participants. Participants in this study are from different provinces in South Africa and between the age 18 and 60 years. Demographics. The study aimed at covering all the difference provinces in South Africa to provide a view that the diverse population in the country can relate to. 20.8% of participants reside in Gauteng province and the least respondents are from Northern Cape and account for 6.7%. The age group of participants are between 18 and 60 years old. The highest number of participants are age groups 26-34 and 36-46 with 40 % and 37% respectively. Adults in the age group 18-24 were the least participants as three of the provinces (Kwa-Zulu Natal, Western Cape, and Eastern Cape) were not represented in this age group. The highest participants between age 25-34 were from

Limpopo and account for 24% of the responses. Overall, the demographics for provinces was well balanced considering the population numbers per province.

5.1.3.2 Reliability

Reliability tests were conducted using Cronbach's Alpha. From the data of 24 statements only 18 statements resulted in a Cronbach's alpha coefficient of 0.731 which was the only combination above the required minimum of 0.700. Six statements we not included in the study and subsequently deleted.

5.1.3.3 Normality

Numerous tests used to conduct normality analyses include Kolmogorov-Smirnov which reveal a significant value less than 0.00 and therefore a non-normal distribution then skewness and kurtosis test revealed that 50% of statements have a normal distribution while 11% had a non-normal distribution and 27% were inconclusive. Graphical test that included the grouping of the statements or variables (Security, norms, ease of use, nudging, attitude, and usefulness) were tested using the Q-Q plots and histograms indicated that and five out of six had normal distribution while attitude had a non-normal distribution which informed the decision for parametric and nonparametric analyses.

5.1.3.4 Hypothesis

The t-test and chi- square were used for parametric hypothesis testing and nonparametric test included the influence/relationship of tested variables to adopting of QR code and another test analysed the influence of tested variables to the adoption of mobile wallets. Hypothesis testing provide the following results for the below research question.

- What are the factors that influence QR code and mobile wallets adoption?

The t-test for mobile wallet indicated a null hypothesises accepted for norms and security and is rejected for ease of use. The test for or code adoption indicated that null hypothesis is rejected for security and accepted for norms and ease of use. In the nonparametric test used to test attitude influence on QR mobile payments, the resulted indicated that attitude has a significant p-value and therefore null hypothesis is rejected.

In analysing the dependent variables, the chi-square indicated a relation between security and norms for both QR codes and mobile wallet adoption. And null hypothesis is rejected base of the higher p-value than critical value.

- Is nudging influence the adoption of QR codes and mobile wallets?

The t test revealed that nudging is significantly greater than critical value and null hypothesis must be accepted. The chi-test confirmed that there is a relationship between Nudging and the adoption of mobile wallets as well as nudging and the adoption of QR codes and indicated by a higher p-value than the critical value and the null hypothesis was rejected. The chi-square indicated that there is a much stronger relationship between nudging and mobile wallets than QR codes.

- What attributes of nudging have the most and least influence on the adoption of QR codes and mobile wallets?

The t-test revealed that incentives, regulation, knowledge on advantages, and knowledge on disadvantages has higher p-value than the critical value of 0.05, therefore the null hypothesis is accepted. Chi-square revealed that all attributes have a relationship to adoption of mobile payments tested and the strongest relation with mobile payments adoption is with incentives and the least with knowledge of advantages.

5.1.3.5 Correlation

This part covers all the research questions and research aim.

Pearson's correlation indicated a positive correlation between all the variables tested and the adoption of mobile payments. The highest correlation is between norm, nudging and ease of use to adoption of mobile payments, the lowest correlation to adoption of mobile payments is security. The attributes of nudging similarly have a positive relationship with the adoption of mobile payments with the highest correlation between education, knowledge of advantages and lower correlation with incentives and knowledge on the disadvantages of mobile payments.

5.2 Research limitations and challenges

Firstly, this study population sample has most people that are working in formal employment and less people in the informal sector and those that are unemployed. This provide a research limit for the people with different work statuses which could mean that different outcomes could have been possible due to their interaction or lack of interaction with mobile payments. Secondly, the population sample size was not large and therefore future research should consider making the sample larger for a larger population generalisation. Thirdly, this study does not consider the many diverse cultures and religions within the provinces in South Africa, and this can have an influence on how people relate to mobile payments and mobile payments adoption. Future studies can concentrate on the diverse cultures in South Africa and how they have influenced the adoption of mobile payments. The research was aimed at covering the population sample across the nine provinces in South Africa. There is a probability that the responses received may not cover all provinces and this provides a possible limitation whereby the stratified population sample is not achieved. This sampling error will be minimised by tracking responses received and follow up where necessary to ensure representation of nine provinces. The study envisages a sample size between 200 to 300 respondents to achieve a high confident level of the results if there is insufficient sample size it may affect the results. Future researchers can minimise this challenge by testing a larger sample size for the results to be generalised to a larger population.

5.3 Recommendations

The following recommendation are recommended for the payments sector including payments regulator, financial institutions and fin-tech companies:

Recommendation 1: Increasing awareness and knowledge. There is a need for mobile payments to be recognised by customers and potential customers to encourage potential customers to think of mobile payments first before cash and include this payment channel as part of their everyday lives. Awareness can be raised by the usage of social media, using analytics for customers immediate access to information. The payments sector has to collaborate their efforts and resources in increasing awareness and knowledge about mobile

payments. A collaborated approach to increase awareness can result in an increased coverage and target marketing.

Recommendation 2: Human behaviour to be considered when policy, regulation, product development and marketing. Using analytics to gather information of people's perception mobile payments to ensure that as part of product developments customer needs are considered. Monitoring and evaluating the changes in perception overtime is an important consideration to ensure that the payments sector is abreast with the changing needs and behaviour which will inform the business strategy, policy, regulation and product development.

Recommendation 3: Using the attributes of nudging to inform strategic and marketing methods. According to this study nudging has a strong influence on the adoption of mobile payments and the financial institutions and fintech companies should consider the implementation of the nudging attributes such as incentives and free educational short courses on mobile wallets amongst the others.

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