

Investigating mobile application adoption and its switching behavior among university students



By

Fizza Hassan Khan

(Fall20 - MS CS&E - 00000327719)

Supervisor

Dr. Zamir Hussain

A thesis submitted in conformity with the requirements for

the degree of *Master of Science* in

Computational Science and Engineering

School of Interdisciplinary Engineering & Sciences (SINES)

National University of Sciences and Technology (NUST)

Islamabad, Pakistan

May 2023

DEDICATION

*I dedicate this dissertation to my Family.
For their endless love, support, and encouragement*

Declaration

I, *Fizza Hassan Khan* declare that this thesis titled “Investigating Mobile Application Adoption and its Switching Behavior Amongst University Students” and the work presented in it are my own and have been generated by me as a result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a Master of Science degree at NUST.
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at NUST or any other institution, this has been clearly stated.
3. Where I have consulted the published work of others, this is always clearly attributed.
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
5. I have acknowledged all main sources of help.
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Fizza Hassan Khan,
00000327719

Copyright Notice

Copyright in the text of this thesis rests with the student author. Copies (by any process) either in full or of extracts, may be made only in accordance with instructions given by the author and lodged in the Library of SINES, NUST. Details may be obtained by the Librarian. This page must form part of any such copies made. Further copies (by any process) may not be made without the permission (in writing) of the author.

- The ownership of any intellectual property rights which may be described in this thesis is vested in SINES, NUST, subject to any prior agreement to the contrary, and may not be made available for use by third parties without the written permission of SINES, which will prescribe the terms and conditions of any such agreement.

- Further information on the conditions under which disclosures and exploitation may take place is available from the Library of SINES, NUST, Islamabad

Acknowledgments

I would first like to thank my thesis supervisor Dr. Zamir Hussain of the School of Interdisciplinary Engineering & Sciences, NUST. The door to his office was always open whenever I was stuck on a problem related to my research. He always guided me in the right direction whenever he thought I needed it. I would also like to pay special thanks to Principal SINES Dr. Hammad Mehmood Cheema. He remained a source of motivation for this project with his timely support. I would also like to thank my other GEC members including Dr. Shahzad Rasool and Dr. Ammar Mushtaq for their support and help throughout the research phase.

I would also like to thank the Management of SINES, NUST was very supportive and was there to assist for arranging presentations and demos of this research work. During the research phase, my fellow researchers from Data Analyst Group (DAG) also helped me during research phase.

Table of Contents

Introduction.....	1
1.1 Background.....	1
1.2 Pakistan’s history of mobile technology	1
1.3 Advent of smartphone	2
1.4 Pakistan today	3
1.5 Global statistics	3
1.6 Problem statement	4
1.7 Research Question	4
1.8 Objectives:.....	4
1.9 Relevance to national needs	5
1.10 Structure of thesis	6
Literature Review.....	7
2.1 Technology Acceptance Model (TAM).....	7
2.2 TAM and Mobile Commerce	8
2.3 Mobile commerce and apps.....	8
2.4 TAM and mobile apps	9
2.5 More on app adoption and switching behavior.....	9
2.6 Gaps in the Literature.....	11

Methodology	12
3.1 Data collection.....	12
3.2 Questionnaire architecture	12
3.3 Statistical Reliability Check of Designed Questionnaire	13
3.4 Data Pre-processing and Analysis	21
3.5 Introduction of Demographic for Sample Representation	22
Results and Discussion	24
4.1 Statistical Analysis of the Statements of Questionnaire	24
4.1.1 Section 1 - User Screening:	24
4.1.2 Section 2 - User Info:.....	24
4.1.3 Section 3 - Phone Info:.....	28
4.1.4 Section 4 – Mobile Applications:.....	31
4.1.5 Section 5 – Users skill level:	40
4.1.6 Section 6 – App adoption and discontinuation:.....	42
4.1.7 Section 7 – App usefulness:	44
4.2 Bi variate analysis of data.....	48
4.2.1 Analyzing gender: Phone usage and comfortability	48
4.2.2 Analyzing gender: App usage frequency.....	50
4.2.3 Analyzing gender: Adoption and Switching factors	51
4.2.4 Analyzing age groups: Phone usage and comfortability	55
4.2.5 Analyzing age groups: App usage frequency	56
4.2.6 Analyzing age groups: Adoption and Switching factors.....	58
Chapter 5.....	64

Conclusion	64
5.1 Key findings	67
5.2 Limitations and Recommendations	67
References	69
Appendix	74

List of Tables

Table 1: Item Total Statistics of Pilot Information of Developed Questionnaire	14
Table 2: Inter-Item Correlation Matrix for Section 2 - User Info.....	17
Table 3: Inter-Item Correlation Matrix for Section 3 - Phone Info	17
Table 4: Inter-Item Correlation Matrix for Section 4 – Life Style Mobile Application	18
Table 5: Inter-Item Correlation Matrix for Section 4 – Social Media Mobile Application.....	18
Table 6: Inter-Item Correlation Matrix for Section 4 – Productivity Mobile Application	18
Table 7: Inter-Item Correlation Matrix for Section 4 – Entertainment Mobile Application	19
Table 8: Inter-Item Correlation Matrix for Section 4 – Future Mobile Application	19
Table 9: Inter-Item Correlation Matrix for Section 5 - User Skill Level.....	20
Table 10: Inter-Item Correlation Matrix for Section 6 - App adoption and discontinuation.....	20
Table 11: Inter-Item Correlation Matrix for Section 6 - App adoption & discontinuation	20
Table 12: Inter-Item Correlation Matrix for Section 7 – App Usefulness	21
Table 13: Inter-Item Correlation Matrix for Section 7 - App Usefulness.....	21
Table 14 Phone usage and comfortability of Gender.....	52
Table 15 App usage frequency of Gender	53

Table 16 Adoption and switching factors by gender	54
Table 17 Phone usage and comfortability of age groups	61
Table 18 App usage frequency by age group.....	61
Table 19 Adoption and switching factors by gender	62

List of Figures

Figure 1: Gender distribution of respondents	23
Figure 2: Education of respondents	23
Figure 3: Employment Status of respondents	23
Figure 4: Work experience of respondents	23
Figure 5: Age distribution of respondents	23
Figure 6: Profession of respondents.....	23
Figure 7 City of respondents	25
Figure 8 Association of respondents with university.....	26
Figure 9 Marital status of respondents.....	26
Figure 10 Travel history of respondents	27
Figure 11 Relatives abroad of respondents.....	27
Figure 12 Friends and family of respondents with smartphones	28
Figure 13 Acquirement of phone	29
Figure 14 Operating System of phone	30
Figure 15 Possession of phone.....	30
Figure 16 Time spent on phone	31
Figure 17 Frequency usage of careem	32
Figure 18 Frequency usage of indrive	32

Figure 19 Frequency usage of svwl	32
Figure 20 Frequency usage of uber.....	32
Figure 21 Frequency usage of bykea	33
Figure 22 Frequency usage of foodpanda.....	33
Figure 23 Frequency usage of grocerapp.....	33
Figure 24 Frequency usage of spotify.....	33
Figure 25 Frequency usage of sound cloud	33
Figure 26 Frequency usage of instagram.....	34
Figure 27 Frequency usage of facebook	34
Figure 28 Frequency usage of snapchat.....	34
Figure 29 Frequency usage of twitter	34
Figure 30 Frequency usage of whatsapp.....	35
Figure 31 Frequency usage of linkedin.....	35
Figure 32 Frequency usage of docs	36
Figure 33 Frequency usage of sheets	36
Figure 34 Frequency usage of email.....	36
Figure 35 Frequency usage of dictionary.....	36
Figure 36 Frequency usage of calculator	36
Figure 37 Frequency usage of notepad	36

Figure 38 Frequency usage of mobile banking	37
Figure 39 Frequency usage of wallet pay	37
Figure 40 Frequency usage of skype	37
Figure 41 Frequency usage of zoom.....	37
Figure 42 Frequency usage of teams	37
Figure 43 Frequency usage of teams (covid).....	37
Figure 44 Frequency usage of capcut	38
Figure 45 Frequency usage of google map	38
Figure 46 Frequency usage of youtube.....	38
Figure 47 Frequency usage of netflix	38
Figure 48 Frequency usage of tik tok	39
Figure 49 Frequency usage of PUBG	39
Figure 50 Frequency usage of ludo star	39
Figure 51 Frequency usage of subway surfer	39
Figure 52 Frequency usage of candy crush.....	39
Figure 53 Future Application preferences	40
Figure 54 Difficulty in downloading application.....	41
Figure 55 Time required to learn an application.....	41
Figure 56 Use mobile app without challenge	42

Figure 57 Influence on app installation	43
Figure 58 Advantages of mobile apps	43
Figure 59 Reasons to uninstall mobile apps	44
Figure 60 Purpose of using mobile apps.....	46
Figure 61 Usefulness of mobile apps.....	46
Figure 62 Statements about mobile apps	47
Figure 63 Comfortability with fin-banking apps	47
Figure 64 Use of credit card on mobile apps	48

Abstract

Mobile phones and the internet have revolutionized the communication realm in Pakistan. The country has come a long way from slow dial-up internet connections to fast and efficient 3G/4G connections. With the advancement of information and communication technology, smartphones have become ubiquitous. The operating system and more importantly, the applications differentiating smartphones from regular phones have received significant importance due to its expanding worldwide market. Mobile application space has risen exponentially in recent years, and companies are working tirelessly to remain market competitive when launching new applications. Therefore, it is important to study the current usage patterns of mobile apps and factors across gender and age groups.

Published international studies have revealed that the adoption of free mobile applications is influenced by enjoyment and facilitating conditions, perceived usefulness, and the attitude of consumers' social networks. In contrast, self-efficacy and peers influence are the key determinants of influence for the paid applications. Still, no extensive study has been conducted with respect to Pakistan. This study is designed to analyze determinants that affect mobile application adoption and switching behavior of students considering National University of Sciences and Technology (NUST) as a case study. Moreover, the determinants are analyzed against age and gender of the respondents. The study also highlights the most desirable features of future mobile applications.

A sufficient sample of 354 students, guided by literature and statistical measure, has been used to collect information through an online survey. The sampling schemes were snow-ball and convenient sampling. Results reveal that the most used applications are Whatsapp (99.4%), Youtube (99.7%), Instagram (89%), Facebook (85%), Snapchat (76%), and Email (73%). Social media has the highest influence of 64% on the respondents while installing an application, followed by friends (42%) and reviews and ratings (39%). Too many

advertisements and false advertisements with a percentage of 63.5% and 45.4%, respectively, are the major determinants for uninstalling an application. For future applications, the desirable features include Artificial intelligence (50.1%), Virtual shopping (38.1%), and Delivery drone (31%). Comparative analyses with respect to gender reveal that males are more inclined towards commuting applications (with an increase of 10%) and financial or banking applications (with an increase of 20%). With respect to daily time spent on mobile, 45% females spend 6+ hours daily compared to 30% males. In the group of social media applications, Instagram and Snapchat are preferred choices of females while males' preferences are Twitter and LinkedIn. For the time required to learn mobile application, majority of the respondent selected the category of 'few hours'. Specifically, 89.6% males opted for this option while the percentage of females was 84.5%.

The outcomes of the study provide a useful insight of the trends and tendencies of various determinants influencing the mobile application and switching behavior of the local community. The comparison of gender and various age groups can help understand the preferences, desires and specific details of the users for future developments and modifications with respect to the mobile applications.

Introduction

1.1 Background

Technological advances have enabled mobile devices to have advanced computing ability and data connectivity through wireless services, such as Wi-Fi and 4G. This has led to mobile phones having extra features, generally known as smartphones [1]. The increase in smartphone consumers has resulted in the growth and rising use of mobile applications (apps) to meet the various needs of the consumer for any plausible purpose; in other words, everything should be “appified.” During the last few years, mobile applications have become a fully-fledged market. Globally, users spend, on average, 82% of their mobile minutes with apps and just 18% with web browsers [2]. The easy availability of apps represents a significant reason consumers switch from traditional PC and mobile phones to smartphones.

1.2 Pakistan’s history of mobile technology

The advent of mobile phone technology and universal internet accessibility has revolutionized communication in Pakistan like nothing before. Pakistan has progressed from slow dial-up internet connections to fast and efficient 3G/4G connections. It has made profound changes to society at a global level.

Mobile and Internet have been available in Pakistan since the early 1990s. Paktel and Instaphone were the pioneers of mobile communication, but they soon lost their dominant market share to Mobilink (1998) and Ufone (2001) in the years ahead.

PTA and PTCL were founded under the telecommunication ordinance in 1994. Since this sector was highly regulated and a monopoly existed, the prices were high, and the quality was very poor. However, the deregulation policy of the telecommunication sector in 2003 encouraged foreign companies to invest. In 2004, the mobile cellular policy was introduced, which created fair competition among mobile and fixed-line operators. This resulted in a cost-effective and quality service provision. In 2005, Telenor and Warid were set up in the country, creating further competition among existing telecommunication companies. As the competition increased, the prices reduced, and the quality of service improved, which boosted the purchase of mobile phones.

1.3 Advent of smartphone

IBM developed the first smartphone and launched it in 1993. This smartphone featured with a calculator, calendar, contact book, and a world clock [3]. However, the definition of the smartphone today has been changed. Without a camera and Google map, a mobile phone is not said to be a smartphone today. Mobile phone and app development companies are persistently innovating, introducing new features, and enhancing user experiences to keep pace with the trends.

Nokia, Sony Ericson, BlackBerry, and some other names were the first to introduce the latest features in mobile phones to convert them into smartphones. However, new mobile companies such as Apple, Vivo, Samsung, Xiaomi, Huawei, and many others have completely changed the concept of mobile phones in the 21st century [4].

The smartphone revolution and the subsequent transition from GSM to 3G/4G networks catalyzed mobile phone adoption in Pakistan. Furthermore, the switch in messaging

applications from Yahoo and MSN Messenger to Facebook and WhatsApp has altered the modes of communication and interaction. The COVID-19 pandemic further underscored the essential role of mobile technology, propelling its prominence in everyday life.

1.4 Pakistan today

As of January 2023, Pakistan is amongst the top 25 largest population of internet users in the world, with about 87.35 million users [5] [6]. While at the same time, Pakistan is amongst the worst performers regarding internet access. This was revealed in the flagship annual report 'Pakistan's Internet Landscape report 2022' by Bytes for All. Pakistan's internet penetration rate rose from 21% in 2021 [7] to 36.7% in 2023 [6], and its mobile internet usage stands at 54% [8]. Similarly, its smartphone penetration rate is only 31% [9]. This gives much room for improvement in the IT sector, especially the local app development companies, to increase their ante in attracting more users. It is important to research the factors affecting mobile application adoption and discontinuance. This study is meant to be of service to such companies to assist them in improving their features.

According to a private markets intelligence platform report by Data Darbar, the number of apps downloaded in 2022 by Pakistanis rose by 35.4% compared to the preceding year. Making the country the fastest-growing apps market in the world [10]

1.5 Global statistics

The boom in mobile app industry is no surprise, with over 6.3 billion smartphone users worldwide [11]. With no signs of slowing down in the foreseeable future, smartphone penetration and app usage are still growing steadily.

People today have a vast number of apps to choose from. The popularity of smartphone apps is exploding, with iPhone's App Store offering more than 1.6 million apps and Android's Google Play offering more than 3.5 million apps [12].

1.6 Problem statement

Amid the rapidly changing mobile application landscape, continuous adaptation is paramount. Apps can quickly become obsolete if they fail to maintain with the latest trends, as witnessed by the decline of platforms like Yahoo Messenger, discontinued in 2016. App developers must understand the factors influencing app adoption, switching behaviour, and discontinuance to remain competitive. Insights into these factors can empower mobile app development companies to refine their offerings, enhance user experiences, and secure their market position.

1.7 Research Question

What are the significant factors influencing app adoption and switching behavior among smartphone users in Pakistan, and how can these insights inform and improve mobile application development practices. This research intends to provide valuable insights to mobile application developers and businesses, enabling them to refine their strategies, enhance user satisfaction, and foster enduring engagement with their applications.

1.8 Objectives:

Based on the above stated questions, the main objectives are:

1. Investigate the factors influencing app adoption and switching behavior through primary data gathered via a semi-structured questionnaire.

2. Identify widely used applications and explore the reasons for their popularity among users.
3. Determine the desirable features of mobile applications that lead to user satisfaction and engagement.

1.9 Relevance to national needs

The app development industry has become a pivotal force in recent years, and its growth trajectory is robust. The global revenue from mobile apps in 2020 was over 318 billion U.S. dollars. This was over a 60 billion U.S. dollar increase from 2019. It is further projected to reach \$613 billion by 2025. [13]. Pakistan's IT sector also shows significant potential, with its youthful talent positioning it to become the country's leading export industry [14]. The High Commissioner addressed Pakistan Tech Export Network (PTEN) meeting on 12 September 2019, where he spoke about the bright future of the country's IT industry.

As mentioned above, Pakistan's internet penetration rate and mobile broadband subscriptions are less, leaving substantial room for growth, especially in rural areas. The low smartphone penetration rate in Pakistan also suggests a vast potential for future smartphone adoption. Even Pakistan's top 3 cities (Karachi, Lahore, and Islamabad/Rawalpindi) have only 76% of Pakistanis connected to the internet [15]. To measure the advancement of the country's economy, the smartphone penetration rate may be used as one of the indicators. In countries with advanced economies, A smartphone penetration rate above 70% is common. United States and the Western Europe have the highest smartphone penetration [16], indicating Pakistan's potential for economic growth.

The advent of 5G technology is poised to revolutionize app development, enhancing speed and efficiency. With the rise in app downloads globally and Pakistan [17], app developers and companies must comprehend emerging trends. Failure to adapt to these trends may result in lagging or operating with a competitive disadvantage. The estimated average salary in Pakistan's IT industry is around 378 USD per month [18]. This makes Pakistan one of the most accessible in the region regarding prices. Pakistan has more than 246 companies that provide mobile app development services [19]. The increasing accessibility of technology in Pakistan and its burgeoning mobile app development sector provides significant opportunities for progress and development.

Pakistan's IT sector contributes \$3.5 billion to the national GDP [20]. This will further be increased because the country's internet and smartphone penetration is very low. The more people shift towards using smartphones, the more revenue is generated. Increasing the chances of employment at the same time.

The mobile app development industry has been genuinely redefining and altering businesses for quite some time now. Nearly every company needs to merge the latest app development features and outstretch its marketing strategy to effectively reach its targeted market and gain traction toward optimum growth.

1.10 Structure of thesis

The rest of this thesis is organized as follows. Chapter 2 has a literature review concerning the related studies worldwide and a link to empirical verification of the work. Chapter 3 discusses the applied methods, both conceptual and theoretical, used to analyze and explore the collected survey data. Chapter 4 discusses the data findings, which are concluded in Chapter 05.

Chapter 2

Literature Review

This chapter comprehensively reviews the literature on the significant factors influencing app adoption and switching behaviour. The review encompasses various theoretical frameworks and empirical studies related to mobile technology adoption, using the Technology Acceptance Model (TAM) and its extensions. Additionally, the chapter explores the relationship between mobile commerce (m-commerce) and mobile apps, highlighting their role in facilitating consumer adoption and driving engagement.

2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) has emerged as a widely used theoretical framework for explaining user intentions and behaviour toward adopting technological innovations [21]. TAM posits that perceived ease of use (PEU) and perceived usefulness (PU) are crucial determinants of an individual's attitude toward new technology and their intention to use it [22]. PEU refers to the extent to which an individual believes that using a particular system is mentally and physically easy, while PU refers to the perception that the system will enhance their performance or job effectiveness [21]. TAM has undergone several extensions, including TAM2 and TAM3, which introduced additional factors such as cognitive tools and subjective norms to further explain technology adoption [23]. TAM2 incorporated social influences, including compliance, identification, and internalization, to understand the impact of subjective norms on adoption [24]. TAM3 expanded the model's nomological network,

considering the role of expertise in the relationship between perceived ease of use, perceived usefulness, and behavioural intention [23].

2.2 TAM and Mobile Commerce

Mobile commerce (m-commerce) represents an extension of e-commerce that leverages the convenience and accessibility provided by mobile devices [25]. TAM and its extensions have been widely applied to investigate the adoption and usage of mobile services, including mobile apps, in m-commerce [26] [27]. Studies utilizing TAM in the context of mobile apps have examined the impact of perceived ease of use and perceived usefulness on user attitudes and behaviors [26]. These studies have also explored the influence of social networks and peer recommendations on technology adoption and usage.

It is crucial to understand consumer intentions and behaviors regarding the adoption and use of mobile apps in the context of m-commerce. The success of mobile marketing relies on the responsiveness of consumers, and investigating their intentions to shift from traditional PCs to mobile apps is of paramount importance [28]. Mobile apps offer convenience, personalization, and a range of services that support m-commerce, such as shopping, banking, and information retrieval. Understanding the factors influencing app adoption and switching behavior is vital for marketers to effectively engage with consumers through mobile apps and drive m-commerce growth [2].

2.3 Mobile commerce and apps

Mobile commerce has witnessed remarkable growth, with mobile devices and applications becoming key platforms for online transactions. Mobile apps provide users convenience, accessibility, and personalized experiences, enabling them to complete various tasks such as shopping, banking, browsing menus, or reviews of nearby establishments. The increasing

adoption of mobile apps for m-commerce reflects the changing consumer preferences and the potential of these platforms for generating new revenue streams [2]. The shift towards mobile app-based m-commerce has significant implications for marketers and businesses. Understanding the factors that drive consumers to adopt mobile apps for their shopping and transactional needs is crucial. By offering seamless experiences, personalized offers, and real-time information, mobile apps can enhance customer engagement, loyalty, and satisfaction in m-commerce.

2.4 TAM and mobile apps

An important question that interests academics and practitioners is what makes a consumer adopt an app. Unlike free music or social media, the stakes increase when the apps are commercial. This is where the adoption of technology becomes crucial. Research has concluded that the adoption of mobiles is influenced by the ease of use, perceived usefulness, and the attitudes and behavior of the consumers' social network [29]. Another research investigating the factors influencing user adoption of mobile apps revealed that enjoyment and facilitating conditions significantly influence user intention to use apps [30]. Moreover, self-efficacy, perceived usefulness, and peer influence were found to be the key determinants by users towards paid apps [31]. Social influence is also important in mobile apps since its adoption is often used to enhance the consumer's social status.

2.5 More on app adoption and switching behavior

Several studies have examined the factors affecting app adoption and switching behavior in different contexts. A researcher conducted factor analysis and structural equation modeling on the effects of behavior on switching intentions. The major findings indicated a significant effect of most predictor variables on the perceived usefulness and perceived ease of use of apps. It

was further found that there is a significant effect on switching intentions to apps from computers/laptops and behavioral intention on user behavior [32].

Senior Americans were surveyed on their motivations and adoption of smartphones, highlighting the need for modifications to the TAM model to better describe the behavior of this demographic. As per the STAM model, the results showed that seniors exhibit a broader range of motivations, influences, and behaviors. This research suggests significant modifications to the STAM to describe better what was observed and will be observed with seniors in other technological diffusion cycles [33].

Some researchers explored the adoption of mobile applications across different age groups and found variations in usage patterns and beliefs between Generation X and Generation Y users. They identified the influence of uniqueness and innovativeness in Generation Y users, driving their adoption of mobile applications. Compared to Gen X users, it was found that Gen Y used mobile apps much more extensively. Gen X users had negative beliefs about mobile apps, while both categories believed that mobile app usage made life easier. The findings also revealed the presence of uniqueness and innovativeness in Gen Y users, which leads to the adoption of mobile applications [34].

A study developed a holistic model for predicting consumer adoption mechanisms of third-party mobile applications. The study investigated the effects of various factors on behavioral intention, including price value, performance expectancy, effort expectancy, habit, social influence, hedonic motivation, and online rankings and reviews. The results indicated that certain constructs in the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model explained the user acceptance of mobile applications. These studies highlight the importance of understanding the factors influencing app adoption and switching behavior across different user groups and contexts. While TAM and its extensions provide a theoretical

foundation for explaining technology adoption, further research is needed to explore the specificities of mobile apps and their role in driving m-commerce [35].

2.6 Gaps in the Literature

While previous studies have explored app adoption and switching behavior using TAM and regression models, gaps still need to be addressed. Specifically, there is a need for further research on the specific factors influencing app adoption and switching behavior in the context of m-commerce. Understanding how social influences, user motivations, and perceived benefits impact users' intentions and behaviors can provide valuable insights for app developers, marketers, and businesses. Additionally, the role of online rankings and reviews in influencing app adoption and usage requires further investigation. As user-generated content and recommendations play a significant role in consumer decision-making, examining the impact of these factors on behavioral intentions can provide a deeper understanding of the app adoption process. Furthermore, there is a need to examine app adoption and switching behavior across different demographic groups, considering age, gender, and technology expertise. Exploring these variations can help identify specific strategies for effectively targeting and engaging different user segments.

Chapter 3

Methodology

In this section, we will discuss the methodology used in this research to achieve the objectives stated in Chapter 1. The main objective of this research is to investigate students' behavior regarding adopting and switching mobile applications. For this purpose, a survey uses structured and non-structured questions for a deeper insight into student opinions. Details of the survey, its sections, and the findings are provided in the following subsections.

3.1 Data collection

The designed questionnaire comprises 35 questions, including multiple-choice, rating scale, Open-ended, and Matrix questions. Survey responses are taken from 354 students of NUST.

3.2 Questionnaire architecture

A useful method of clustering/grouping the questions into seven meaningful sections has been adopted to make the results understandable and interpretable. The description of the seven sections is as follows:

Section 1: Consist of 1 screening question.

Section 2: Consists of 12 questions about user information, e.g., age, education, gender, etc.

Section 3: Consists of 4 questions about the user's phone.

Section 4: Consists of 7 questions about mobile applications.

Section 5: Consists of 3 questions about the user's skill level.

Section 6: Consists of 3 questions about app adoption and discontinuation.

Section 7: Consists of 5 questions about the app's usefulness.

The study is conducted in two stages. Stage 1 is the pilot study, where the validity and reliability of the collected data are checked. Other discrepancies related to survey response rate and class equivalence are made. Stage 2 covers descriptive as well as comparative analysis and its results.

3.3 Statistical Reliability Check of Designed Questionnaire

An important step for conducting a survey is to evaluate the statistical reliability or validity of the questionnaire used to collect data from the respondents. This evaluation is useful to examine the connectivity of different questions in a survey so that useful/redundant information can be deleted at this stage. For Phase I, a pilot survey consists of 53 valid respondents. For the complete information of 53 valid respondents, a Google form link was shared with 70 respondents. Therefore, we have a response rate of 75.7%. The total number of students in all campuses of NUST is 21000+ as of 2022 (<https://nust.edu.pk/about-us/nust-today/>). Using a sample size calculator (<https://www.qualtrics.com/blog/calculating-sample-size/>) with a 90% confidence interval and an error rate of 5%, the ideal test sample size for the current number of students at NUST is 267. Keeping in view the response rate of 75.7%, the number of students to be reached to fill out the survey is 354. However, the number reached out is a lot more. In our analysis, the number of valid respondents is 354, indicating that the sample size used in this designed analysis is fully satisfied.

The total statistics of a few pilot information are provided in Table 1. The Cronbach's alpha for this information is 0.767, suggesting good statistical reliability. The last column of Table 1 shows the value of Cronbach's alpha after deleting the respective item/statement. It is clear in the table that the increase in Cronbach's alpha after the deletion of a few items/statements is almost negligible. Moreover, the inter-item correlation is shown in Table 2

– 13. Correlation is mostly weak or moderately correlated, i.e., having values varying less than or equal to 50%. A couple of variables have a Correlation above 50%. Therefore, we can conclude that the designed questionnaire comprising 68 questions is reliable and be used for the survey. The questionnaire has seven sections, and the first is just a screening question. Since each section of the questionnaire represented a different motive, the correlation of these six sections is found separately. The highest correlation between Careem & Uber (0.62) in Table 4 and Documents & Sheets (0.59) in Table 6 is found.

Table 1: Item Total Statistics of Pilot Information of Developed Questionnaire

	Scale Mean if Item Deleted	Scale Var if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Age (In years)	189.00	285.800	-.404	.776
Gender	188.91	278.491	-.111	.769
Education	186.18	278.964	-.139	.769
Department	187.27	225.818	.684	.734
Employment status	189.09	283.891	-.278	.775
Work Experience	189.36	274.855	.138	.766
Travelled abroad?	189.00	268.200	.491	.760
Relatives abroad?	188.82	276.164	.032	.767
Marital status	188.64	276.855	-.007	.767
FnF have smartphones?	187.09	291.091	-.532	.781
operating system?	189.36	282.655	-.437	.772
[Careem]	186.82	273.764	.187	.765
[Uber]	187.00	268.600	.346	.761
Owned a smartphone?	188.91	292.491	-.588	.782
[Foodpanda]	187.36	265.855	.542	.758
[Grocerapp]	186.73	276.818	-.008	.767
[Spotify]	187.36	269.455	.158	.765

[Instagram]	189.09	262.891	.433	.757
[Sound Cloud]	187.64	263.255	.283	.761
[Facebook]	188.91	267.491	.330	.761
[Snapchat]	189.00	263.000	.381	.758
[Twitter]	187.73	268.018	.163	.765
[LinkedIn]	187.45	255.873	.499	.752
[Docs]	188.09	257.291	.465	.754
[Sheets]	188.09	253.891	.517	.751
[Wallet/Pay]	187.18	257.564	.461	.754
[Mobile banking]	187.91	246.091	.722	.743
[Calculator]	188.82	263.764	.418	.758
[Notepad]	188.36	250.255	.592	.748
[Youtube]	189.36	276.655	-.007	.768
[Dictionary]	187.91	258.891	.394	.756
[PUBG]	186.82	286.964	-.356	.778
[Netflix]	187.82	256.964	.448	.754
Difficulty download & use app?	188.73	269.818	.219	.763
[Ludo Star]	186.73	273.618	.231	.764
[Skype]	187.09	257.691	.848	.750
[Teams]	187.09	264.091	.392	.758
Time on phone daily?	188.45	280.873	-.405	.771
[Indriver]	187.00	275.800	.046	.767
[Bykea]	187.00	269.800	.238	.763
[Email]	188.91	259.891	.541	.754
[Tik Tok]	187.64	283.855	-.182	.781
[Subway Surfer]	187.09	263.091	.426	.757
[Candy Crush]	186.91	262.691	.516	.756
[Cap cut]	187.18	261.764	.423	.757
[Google map]	187.91	266.291	.322	.760
[Zoom]	187.73	263.018	.405	.758

Phone acquired?	189.27	269.618	.459	.761
Use an app without any challenge?	188.18	273.364	.037	.770
reviews & ratings influence	188.82	269.764	.449	.761
social media influence	189.09	271.891	.273	.763
Friends influence	188.73	276.818	-.008	.767
Family influence	188.82	276.164	.032	.767
Advantage: 24/7 access	189.27	274.618	.132	.766
Advantage: use while traveling	188.82	269.564	.462	.761
Advantage: Ease of adoption	188.91	279.091	-.147	.770
Advantage: Easy/simple/user friendly	188.82	277.164	-.033	.768
Uninstall: Complexity of usage	188.82	268.164	.555	.760
Uninstall: False Advertisement	188.82	275.764	.057	.767
Uninstall: Too many Advertisements	189.27	270.418	.406	.762
Uninstall: Unfriendly User interface	188.73	271.618	.382	.763
Uninstall: Delay in refund after payment	188.64	277.055	-.027	.767
Uninstall: Poor customer service	188.73	275.818	.066	.766
Uninstall: Security concerns	189.00	271.400	.302	.763
Usefulness of apps in daily life?	186.64	292.255	-.404	.785
Purpose: Helps in educational needs	189.18	275.764	.051	.767
Purpose: Addresses job related needs	189.09	272.091	.262	.763
Purpose: Reduces effort & improves productivity	189.00	273.600	.174	.765
Purpose: Save time in various tasks	188.91	283.291	-.393	.773
Purpose: Saves money/good deals	188.91	276.091	.031	.767
Purpose: Makes life easier	189.18	282.964	-.374	.773
Purpose: Reduces mental effort	188.91	275.491	.067	.766
Statement: Accomplish things quickly	189.18	279.364	-.163	.770
Statement: achieve important things	189.18	277.164	-.032	.768
Statement: boring life	188.91	279.091	-.147	.770

Statement: difficulty in traveling	189.00	268.400	.479	.760
Comfortable with fin-banking apps?	187.09	289.091	-.262	.787
Safe using credit card on app?	188.09	285.691	-.342	.777
Mention your city	188.09	257.091	.285	.761
Your association with university	188.45	245.073	.623	.744
Future apps	187.55	267.673	.066	.776
Easy to use: Awareness	189.00	273.400	.185	.765
Easy to use: Personal Interest	188.82	282.964	-.401	.773
Easy to use: Video Tutorial	188.82	274.964	.109	.766

Table 2: Inter-Item Correlation Matrix for Section 2 - User Info

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Q1	1.00	-0.06	0.37	0.18	-0.02	0.02	-0.15	0.36	0.38	-0.12	0.05	-0.36	0.10
Q2	-0.06	1.00	0.13	-0.14	-0.17	-0.07	-0.23	-0.03	-0.13	-0.09	0.00	0.14	0.17
Q3	0.37	0.13	1.00	0.07	0.00	0.12	-0.70	0.40	0.19	-0.41	-0.08	-0.18	0.08
Q4	0.18	-0.14	0.07	1.00	0.03	0.37	0.04	0.28	0.23	-0.08	-0.11	-0.39	0.06
Q5	-0.02	-0.17	0.00	0.03	1.00	-0.11	0.07	-0.11	-0.18	-0.05	0.06	0.06	-0.13
Q6	0.02	-0.07	0.12	0.37	-0.11	1.00	-0.08	0.31	0.22	-0.08	0.00	-0.19	-0.12
Q7	-0.15	-0.23	-0.70	0.04	0.07	-0.08	1.00	-0.19	-0.09	0.31	0.01	0.15	-0.11
Q8	0.36	-0.03	0.40	0.28	-0.11	0.31	-0.19	1.00	0.39	-0.26	0.00	-0.22	-0.04
Q9	0.38	-0.13	0.19	0.23	-0.18	0.22	-0.09	0.39	1.00	-0.05	-0.03	-0.44	0.03
Q10	-0.12	-0.09	-0.41	-0.08	-0.05	-0.08	0.31	-0.26	-0.05	1.00	0.00	0.01	-0.14
Q11	0.05	0.00	-0.08	-0.11	0.06	0.00	0.01	0.00	-0.03	0.00	1.00	0.11	-0.23
Q12	-0.36	0.14	-0.18	-0.39	0.06	-0.19	0.15	-0.22	-0.44	0.01	0.11	1.00	-0.08
Q13	0.10	0.17	0.08	0.06	-0.13	-0.12	-0.11	-0.04	0.03	-0.14	-0.23	-0.08	1.00

Table 3: Inter-Item Correlation Matrix for Section 3 - Phone Info

	Q1	Q2	Q3	Q4
Operating system?	1.00	0.11	0.16	0.06
Phone acquired?	0.11	1.00	-0.01	-0.01
Owned a smartphone?	0.16	-0.01	1.00	0.13

Time on phone daily?	0.06	-0.01	0.13	1.00
----------------------	------	-------	------	------

Table 4: Inter-Item Correlation Matrix for Section 4 – Life Style Mobile Application

Lifestyle Applications									
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Careem	1.00	0.62	0.34	0.42	0.34	0.25	0.21	0.19	0.12
Uber	0.62	1.00	0.33	0.34	0.40	0.24	0.25	0.13	0.22
Svwl	0.34	0.33	1.00	0.23	0.33	0.20	0.36	0.08	0.17
Indriver	0.42	0.34	0.23	1.00	0.38	0.29	0.21	0.15	0.15
Bykea	0.34	0.40	0.33	0.38	1.00	0.21	0.21	0.12	0.13
Foodpanda	0.25	0.24	0.20	0.29	0.21	1.00	0.31	0.22	0.29
Grocerapp	0.21	0.25	0.36	0.21	0.21	0.31	1.00	0.15	0.29
Spotify	0.19	0.13	0.08	0.15	0.12	0.22	0.15	1.00	0.14
Sound Cloud	0.12	0.22	0.17	0.15	0.13	0.29	0.29	0.14	1.00

Table 5: Inter-Item Correlation Matrix for Section 4 – Social Media Mobile Application

Social Media Applications						
	Q1	Q2	Q3	Q4	Q5	Q6
Instagram	1.00	0.12	0.37	0.21	0.15	0.03
Facebook	0.12	1.00	0.19	0.19	0.19	0.19
Snapchat	0.37	0.19	1.00	0.24	0.15	0.04
Twitter	0.21	0.19	0.24	1.00	0.06	0.26
Whatsapp	0.15	0.19	0.15	0.06	1.00	0.07
LinkedIn	0.03	0.19	0.04	0.26	0.07	1.00

Table 6: Inter-Item Correlation Matrix for Section 4 – Productivity Mobile Application

Productivity Applications													
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Docs	1.00	0.59	0.29	0.27	0.37	0.31	0.20	0.14	0.13	0.19	0.15	0.04	0.24
Sheets	0.59	1.00	0.32	0.13	0.30	0.20	0.38	0.27	0.22	0.22	0.28	0.02	0.29
Email	0.29	0.32	1.00	0.20	0.27	0.22	0.38	0.21	0.05	0.14	0.24	-0.09	0.29

Dictionary	0.27	0.13	0.20	1.00	0.38	0.38	0.12	0.16	0.15	0.24	0.11	0.33	0.21
Calc	0.37	0.30	0.27	0.38	1.00	0.41	0.24	0.18	0.14	0.17	0.15	0.13	0.27
Notepad	0.31	0.20	0.22	0.38	0.41	1.00	0.26	0.28	0.19	0.18	0.12	0.14	0.21
E-bank	0.20	0.38	0.38	0.12	0.24	0.26	1.00	0.51	0.31	0.27	0.38	-0.01	0.38
E-wallet	0.14	0.27	0.21	0.16	0.18	0.28	0.51	1.00	0.33	0.25	0.21	0.18	0.33
Skype	0.13	0.22	0.05	0.15	0.14	0.19	0.31	0.33	1.00	0.41	0.30	0.39	0.26
Zoom	0.19	0.22	0.14	0.24	0.17	0.18	0.27	0.25	0.41	1.00	0.23	0.24	0.37
Teams	0.15	0.28	0.24	0.11	0.15	0.12	0.38	0.21	0.30	0.23	1.00	0.07	0.24
Capcut	0.04	0.02	-0.09	0.33	0.13	0.14	-0.01	0.18	0.39	0.24	0.07	1.00	0.14
G-Map	0.24	0.29	0.29	0.21	0.27	0.21	0.38	0.33	0.26	0.37	0.24	0.14	1.00

Table 7: Inter-Item Correlation Matrix for Section 4 – Entertainment Mobile Application

Entertainment/Games Applications							
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Youtube	1.00	0.17	0.12	0.05	0.07	0.07	0.02
Netflix	0.17	1.00	0.11	0.17	0.11	0.18	0.07
Tik Tok	0.12	0.11	1.00	0.29	0.28	0.29	0.14
PUBG	0.05	0.17	0.29	1.00	0.43	0.34	0.26
Ludo Star	0.07	0.11	0.28	0.43	1.00	0.64	0.30
Subway Surfer	0.07	0.18	0.29	0.34	0.64	1.00	0.41
Candy Crush	0.02	0.07	0.14	0.26	0.30	0.41	1.00

Table 8: Inter-Item Correlation Matrix for Section 4 – Future Mobile Application

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Virtual Shopping	1.00	-0.05	-0.02	0.20	0.05	0.07	0.21
Artificial Intelligence	-0.05	1.00	0.27	0.11	0.08	0.16	0.21
Augmented Reality	-0.02	0.27	1.00	0.28	0.28	0.33	0.27
Voice Shopping	0.20	0.11	0.28	1.00	0.24	0.33	0.34
Delivery Drones	0.05	0.08	0.28	0.24	1.00	0.27	0.36
Visual Product Search	0.07	0.16	0.33	0.33	0.27	1.00	0.41
Virtual Shopping Assistant	0.21	0.21	0.27	0.34	0.36	0.41	1.00

Table 9: Inter-Item Correlation Matrix for Section 5 - User Skill Level

	Q1	Q2	Q3	Q4	Q5	Q6
Difficulty download & use app?	1.00	-0.05	0.03	0.12	0.00	0.34
Required Awareness	-0.05	1.00	0.09	-0.17	-0.13	-0.01
Required Training	0.03	0.09	1.00	-0.05	0.18	0.04
Required Interest	0.12	-0.17	-0.05	1.00	-0.22	0.08
Required Video Tutorial	0.00	-0.13	0.18	-0.22	1.00	-0.14
Time to learn app	0.34	-0.01	0.04	0.08	-0.14	1.00

Table 10: Inter-Item Correlation Matrix for Section 6 - App adoption and discontinuation

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
reviews & ratings influence	0.13	0.05	0.05	1.00	0.12	0.19	0.19	0.12
social media influence	0.07	0.12	1.00	0.05	0.09	0.18	0.20	0.15
Friends influence	0.41	1.00	0.12	0.05	0.07	0.13	0.20	0.06
Family influence	1.00	0.41	0.07	0.13	0.20	0.06	0.12	0.05
Advantage: 24/7 access	0.20	0.07	0.09	0.12	1.00	0.20	0.16	-0.12
Advantage: use while traveling	0.06	0.13	0.18	0.19	0.20	1.00	0.31	0.14
Advantage: Ease of adoption	0.12	0.20	0.20	0.19	0.16	0.31	1.00	0.38
Advantage: Easy/simple/user friendly	0.05	0.06	0.15	0.12	-0.12	0.14	0.38	1.00

Table 11: Inter-Item Correlation Matrix for Section 6 - App adoption & discontinuation

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Uninstall: Complexity of usage	1.00	0.07	0.03	0.25	0.13	0.16	0.09
Uninstall: False Advertisement	0.07	1.00	0.16	0.24	0.26	0.34	0.18
Uninstall: Too many Advertisements	0.03	0.16	1.00	0.19	0.22	0.21	0.26
Uninstall: Unfriendly User interface	0.25	0.24	0.19	1.00	0.25	0.33	0.28
Uninstall: Delay in refund after payment	0.13	0.26	0.22	0.25	1.00	0.36	0.31
Uninstall: Poor customer service	0.16	0.34	0.21	0.33	0.36	1.00	0.24
Uninstall: Security concerns	0.09	0.18	0.26	0.28	0.31	0.24	1.00

Table 12: Inter-Item Correlation Matrix for Section 7 – App Usefulness

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Purpose: Helps in educational needs	1.00	0.46	0.26	0.23	0.29	0.20	0.15
Purpose: Addresses job related needs	0.46	1.00	0.32	0.35	0.40	0.34	0.17
Purpose: Improves productivity	0.26	0.32	1.00	0.43	0.44	0.30	0.24
Purpose: Save time in various tasks	0.23	0.35	0.43	1.00	0.49	0.43	0.19
Purpose: Saves money/good deals/cashback	0.29	0.40	0.44	0.49	1.00	0.36	0.12
Purpose: Makes life easier	0.20	0.34	0.30	0.43	0.36	1.00	0.30
Purpose: Reduces mental effort	0.15	0.17	0.24	0.19	0.12	0.30	1.00

Table 13: Inter-Item Correlation Matrix for Section 7 - App Usefulness

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Rate the usefulness of mobile app	1.00	-0.14	-0.26	-0.07	-0.08	0.18	-0.01
Statement: difficulty in traveling	-0.14	1.00	0.08	0.08	0.15	-0.12	0.06
Statement: boring life	-0.26	0.08	1.00	0.04	0.06	-0.14	0.00
Statement: achieve important things	-0.07	0.08	0.04	1.00	0.04	-0.05	-0.08
Statement: Accomplish things quicker	-0.08	0.15	0.06	0.04	1.00	-0.07	-0.09
Comfortable with financial apps?	0.18	-0.12	-0.14	-0.05	-0.07	1.00	-0.14
Safe using credit card on app?	-0.01	0.06	0.00	-0.08	-0.09	-0.14	1.00

3.4 Data Pre-processing and Analysis

It is beneficial to preprocess the data to get authentic results and investigate the analysis. Since the questionnaire only has multiple choice questions, which were made compulsory, no missing values exist. Before analysis, the minimum and maximum of all variables are checked to ensure that all data values are in the desired range. The data is coded at SPSS to find out the trends and tendencies of the variables. Data is analyzed using univariate and bivariate analysis whose results are discussed in the next chapter.

3.5 Introduction of Demographic for Sample Representation

Another important aspect of the survey research is the introduction of certain variables/demographics of the respondents to control the accumulation of information for these characteristics. For this study, five such variables are introduced, namely, Gender (Male/Female), Education (qualification of the respondents), Employment status, Work experience (Work experience in years of respondents), and age. A pictorial representation of these frequency distributions is shown in Figure 1 to Figure 6.

In Figure 1, the distribution of respondents concerning gender shows that 54.14 % of the respondents are male and 45.86 % are female. For the information in Figure 2 about the Education of respondents, Graduates (51.74%) and Undergraduates (29.9%) have the largest share since the survey is conducted amongst masters' students. Next in line are the postgraduates (26.6%). Figure 3 shows the frequency distribution of employment statuses of respondents. (59.2%) of the respondents are students, (19.5%) respondents are employed, (14.5%) respondents are unemployed while (6.8%) are self-employed. Figure 4 illustrates the frequency distribution of the work experiences of the respondents. The majority (89.6%) of respondents have experience of less than five years. In comparison, only 10.4% of respondents have experience in between 5-15 years. The categories of 15-25 years and 25+ years have zero respondents. Figure 5 shows the respondents and the frequency of age groups they lie in. Majority of the respondents are from age group 21-30 (77.8%), while some respondents are below 20 (18%). Very few respondents are above the age 31 (4%). The professions of the respondents are shown in Figure 6. More than half of the respondents are Students (66.3%). Then came the respondents who have professions such as Teaching (5.9%), Engineer (5.6%), Finance and Marketing (4.7%), Entrepreneurship (2.1%), Media & Arts (3%), Medical (5.9%), Freelancer (1.5%), others (5%).

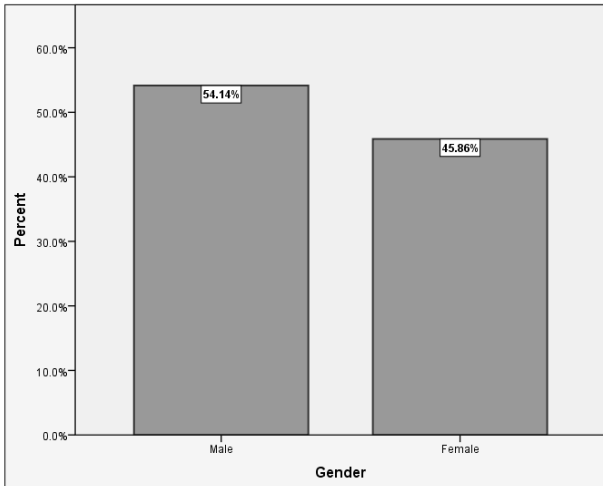


Figure 1: Gender distribution of respondents

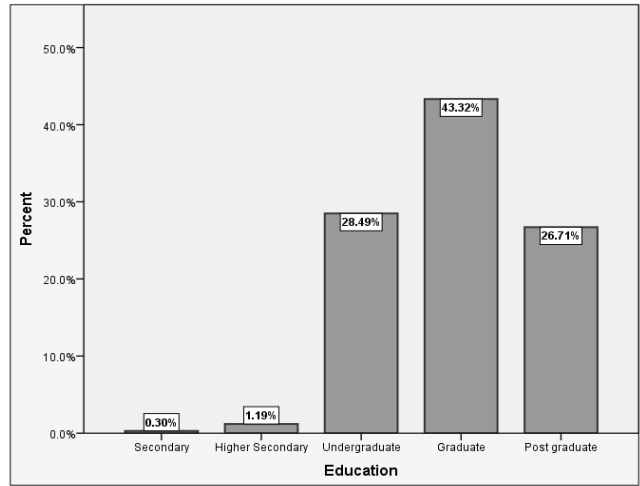


Figure 2: Education of respondents

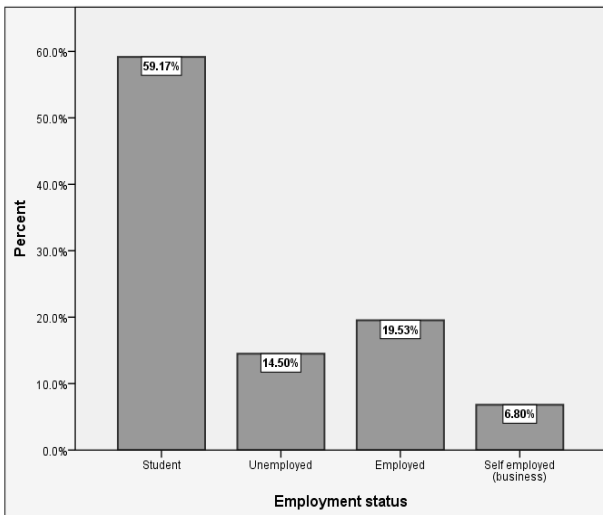


Figure 3: Employment Status of respondents

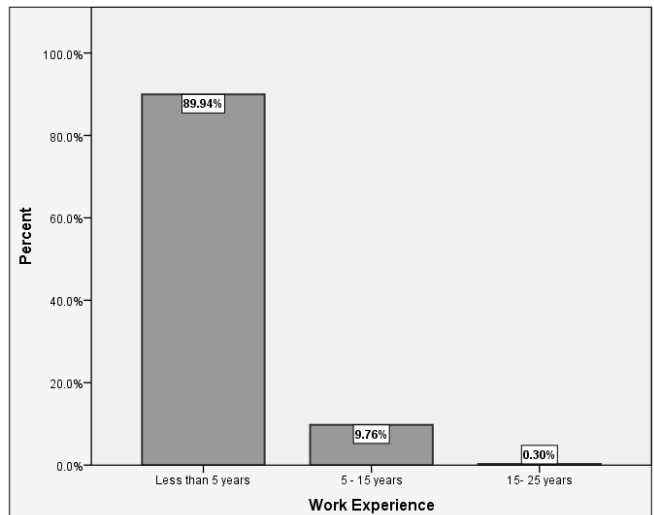


Figure 4: Work experience of respondents

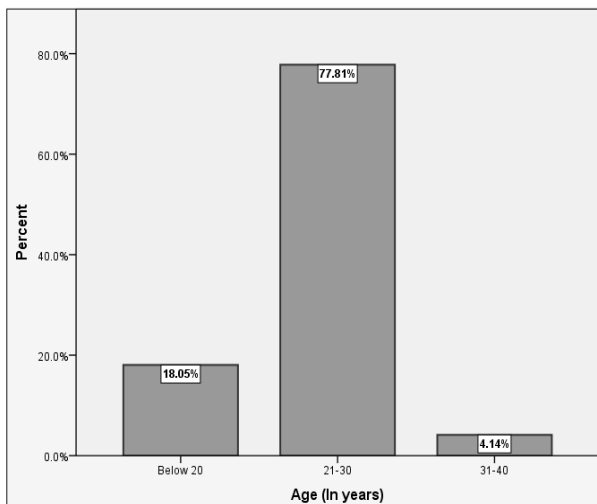


Figure 5: Age distribution of respondents

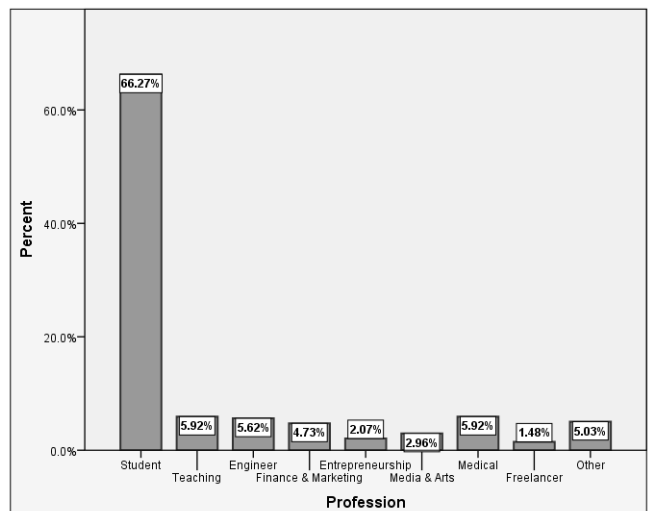


Figure 6: Profession of respondents

Results and Discussion

4.1 Statistical Analysis of the Statements of Questionnaire

This section deals with the survey results showing numerical estimates of the respondents for the 68 questions. General trends and tendencies of the collected information with respect to each variable and section are evaluated. Bar charts show percentages against each option. The total count differs for a few variables since some new questions were added after conducting the pilot study. The results for each variable and section are provided below:

4.1.1 Section 1 - User Screening:

The first section consisted of one question only. The purpose of this section is to screen the people who use smartphones. Out of 354 people who attempted the questionnaire, 338 people were smartphone users, while 13 were not.

4.1.2 Section 2 - User Info:

The second section, i.e., the first twelve questions of the survey, covers the user's information. Section 3.4 contains bar charts showing the percentage of the respondents for Age, Profession, Employment status, Education, Work experience, and Gender are already provided in Figures 1 to 6. The percentage of respondents concerning City, Association with the university, Marital status, Travel history, Relatives abroad, and Friends & Family with smartphones are shown in Figure 7-12.

Figure 7 shows that most respondents belonged to cities like Karachi (33.73%), Islamabad (26.33%), Faisalabad (11.24%), and Lahore (10.06%). This is mainly because these are the largest cities in Pakistan with the greatest pool of students. The remaining students belonged to cities like Hyderabad, Interior Sindh, Multan, etc.

Figure 8 shows the association of the respondents with the university. Around 86% of respondents are students since the survey is conducted at the university. While 8.88% are alums and 3.85% are faculty. Since most respondents are students, only 13% are married, as shown in Figure 9. While the remaining 87% are unmarried.

Figure 10 shows that 50% of the respondents have traveled abroad, and Figure 11 shows that 52% have relatives abroad. While Figure 12 shows that the majority of the friends and family of the respondents are smartphone users.

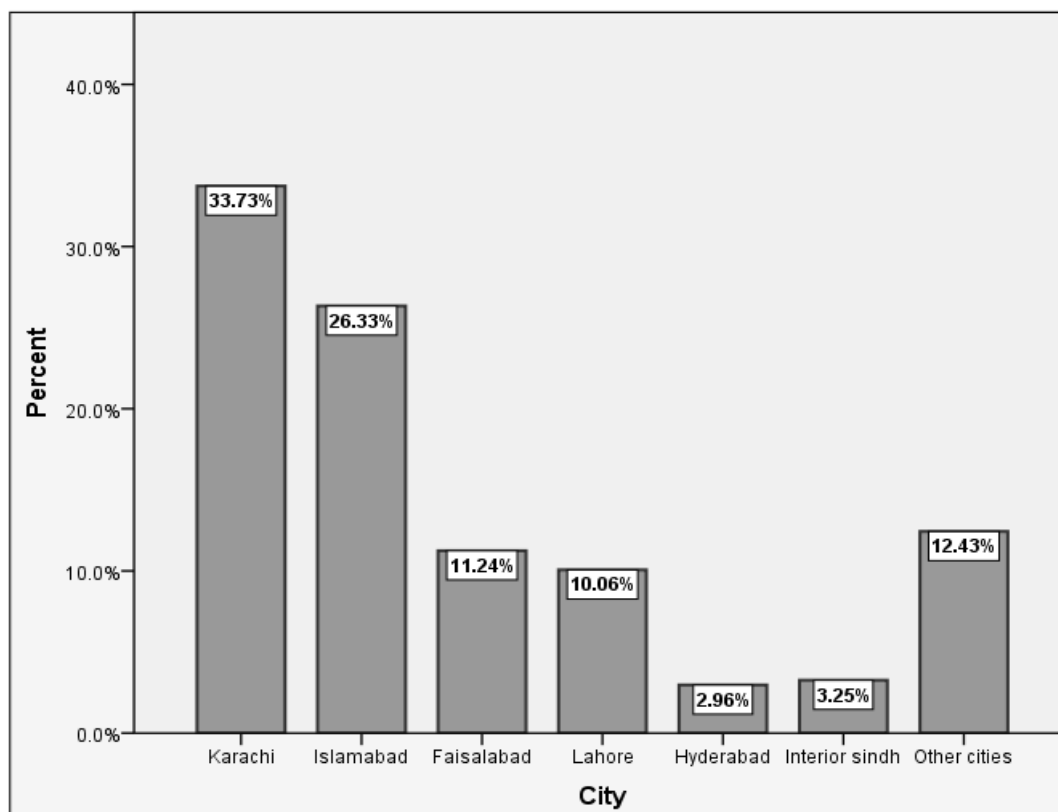


Figure 7 City of respondents

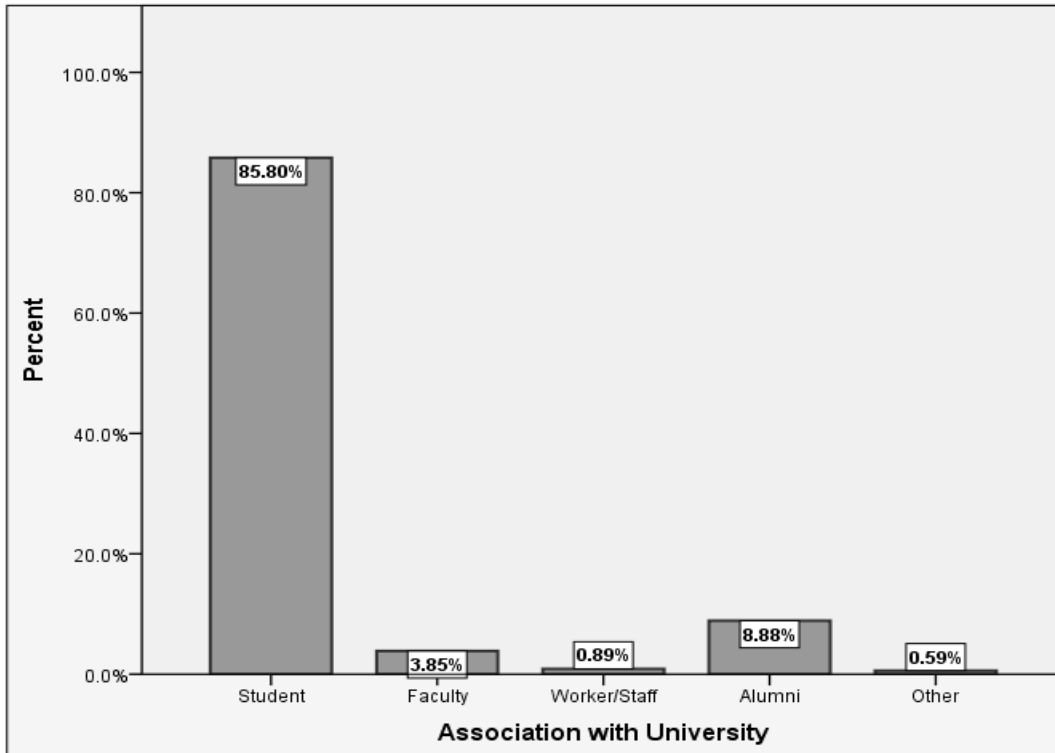


Figure 8 Association of respondents with university

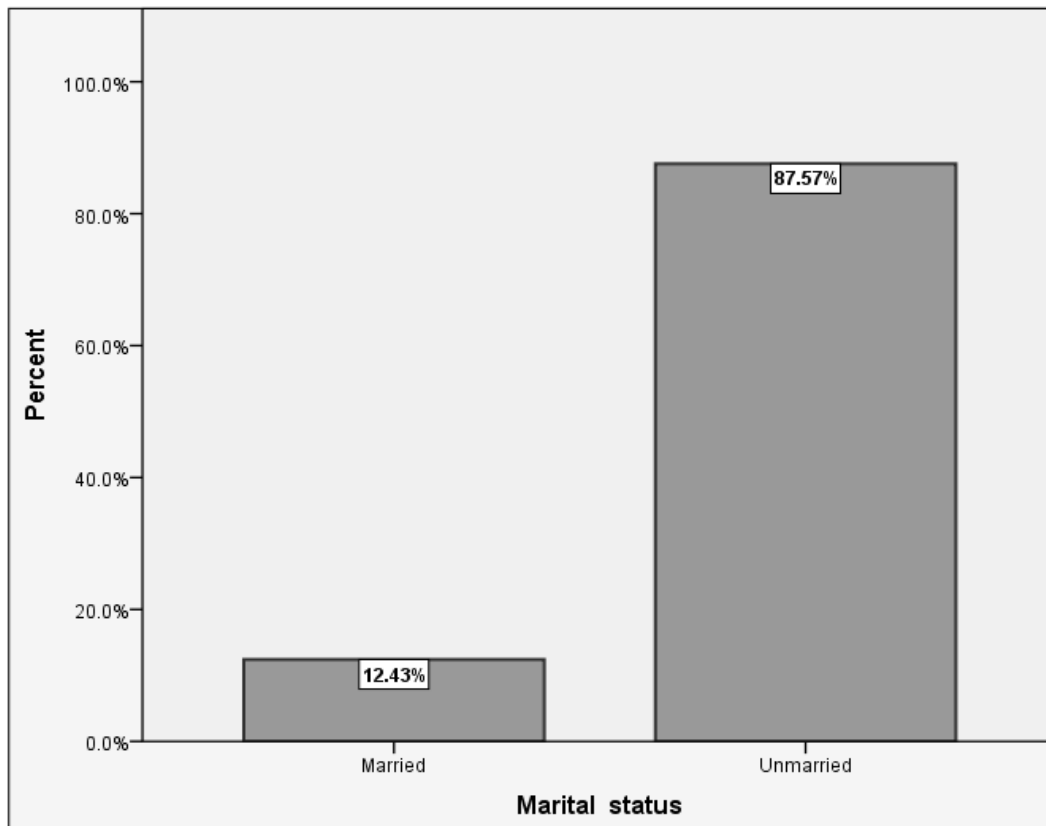


Figure 9 Marital status of respondents

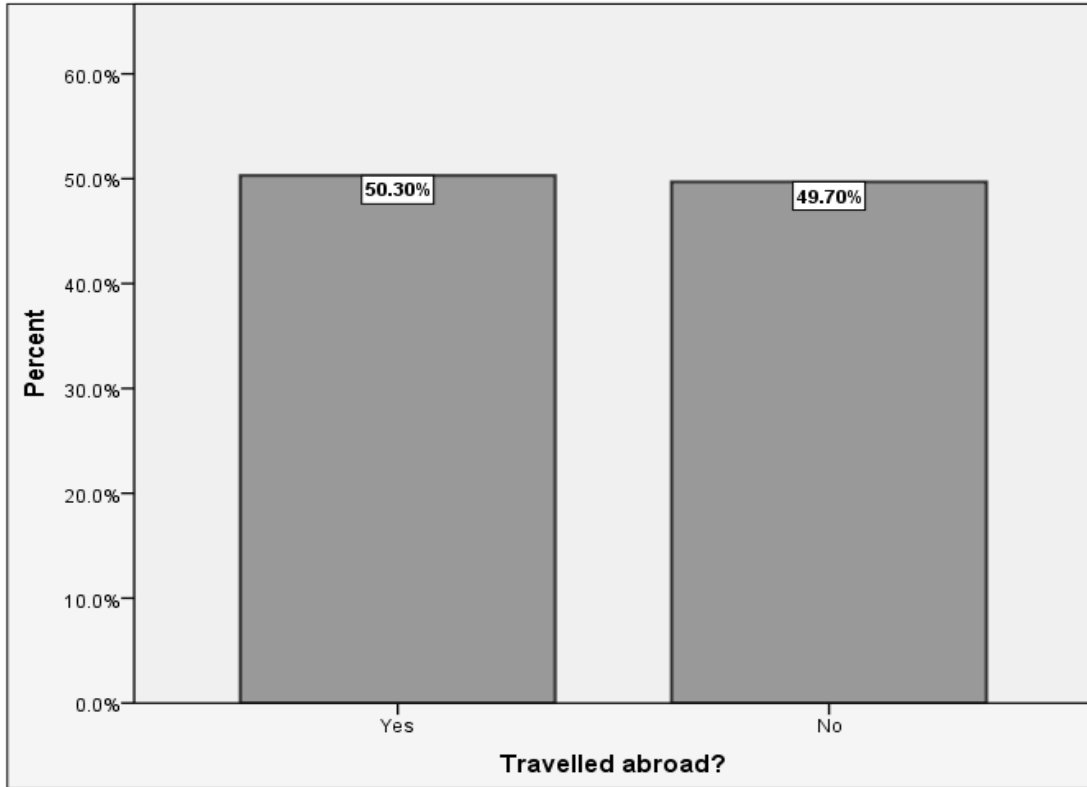


Figure 10 Travel history of respondents

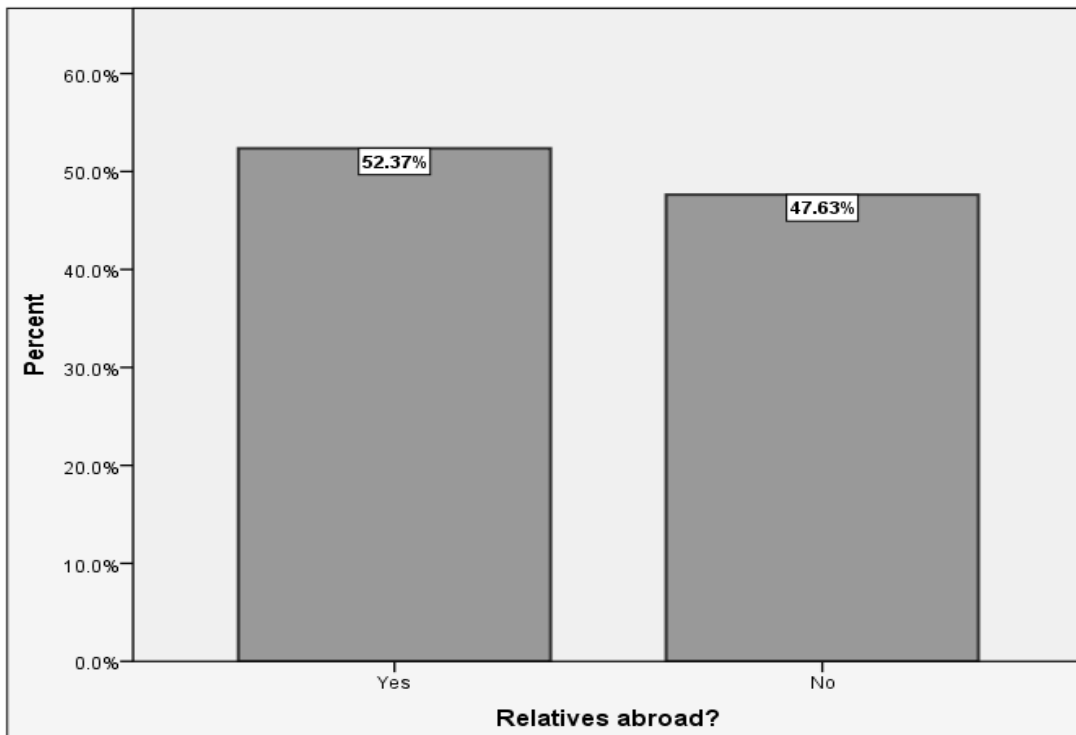


Figure 11 Relatives abroad of respondents

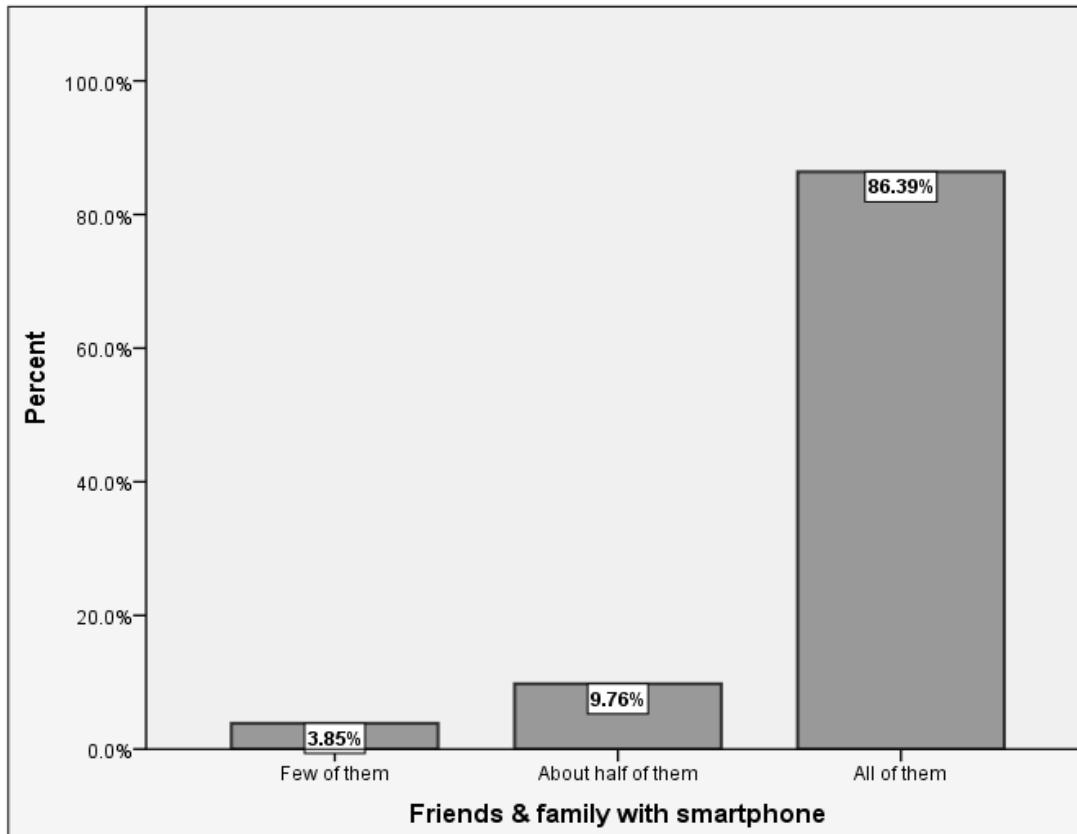


Figure 12 Friends and family of respondents with smartphones

4.1.3 Section 3 - Phone Info:

The third section comprises four questions. This section focused on collecting information about the phone and its usage. It is important to have this information to understand the adoption and switching of mobile applications. Figures 13 to 16 show the percentages of responses in section 3.

Figure 13 shows that 84.32% of respondents have purchased their mobiles while only 15.68% have gifted mobiles. Most respondents are Android users (79.29%), as shown in Figure 14. Second, are Apple users (18.93%), and the remaining are Windows (1.78%) users. This is mainly because Android's mobile operating system market share in Pakistan is very high [36] Figure 15 shows that almost half of the respondents have owned a phone for 5-10 years. 35.21% have owned it for less than five years, and 11.24% for 10-15 years. Whereas only

2.66% have owned it for more than 15 years. Since most respondents are young students, possession for longer years is less.

Figure 16 shows that 40.83% of respondents use their mobile for 3-6 hours, while 26.04% use it for 6-9 hours daily. 22.49% use the phone for less than 3 hours, while 10.65% use it for more than 9 hours. The average global screen time of mobile usage is 3 hours and 15 minutes [37], but students of Nust are using mobiles more than that.

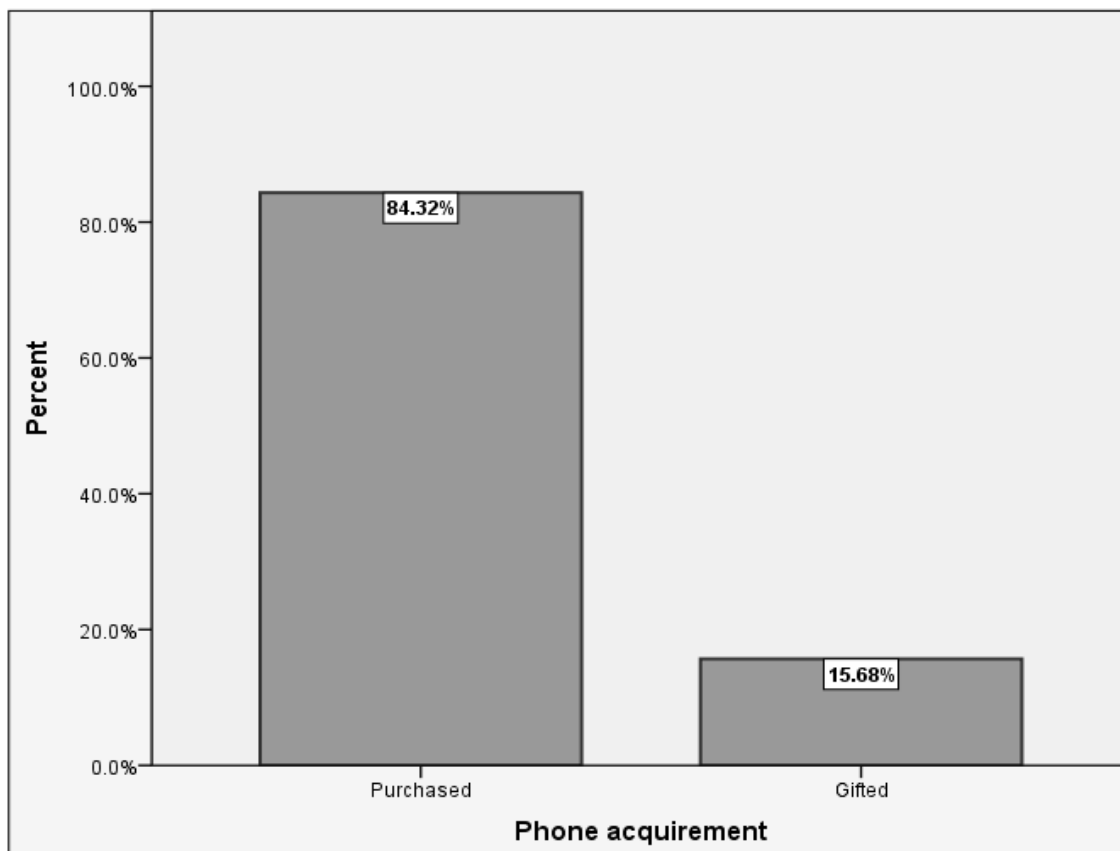


Figure 13 Acquirement of phone

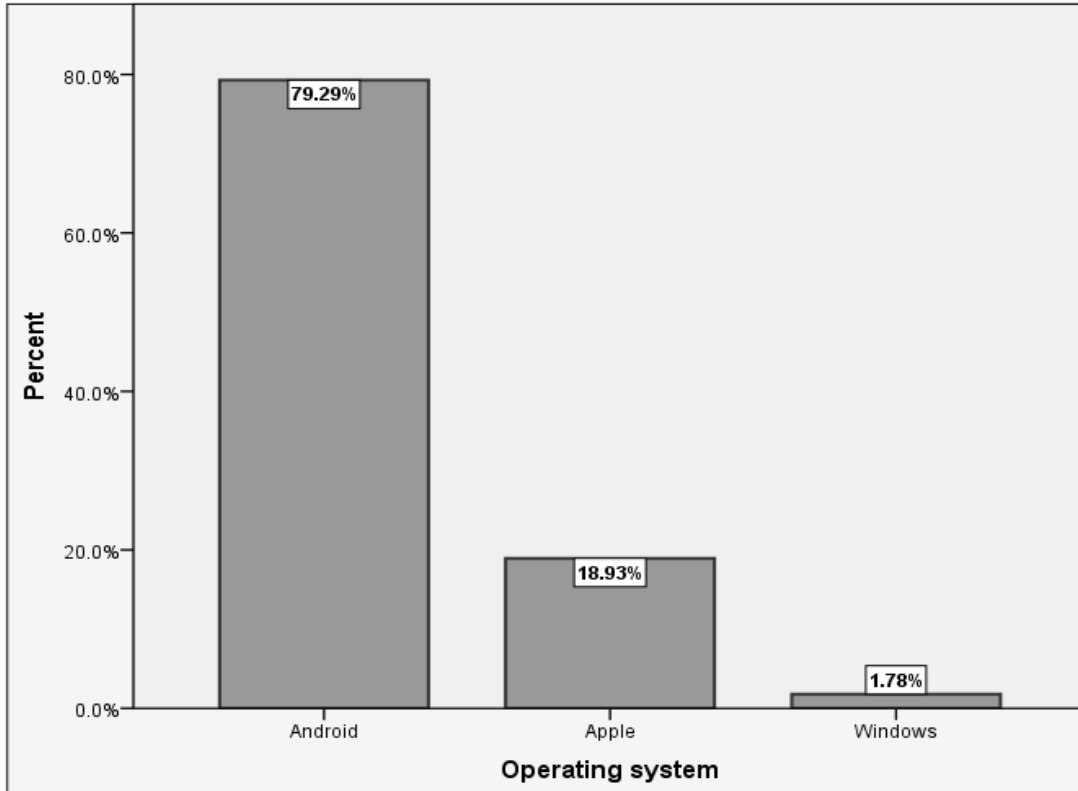


Figure 14 Operating System of phone

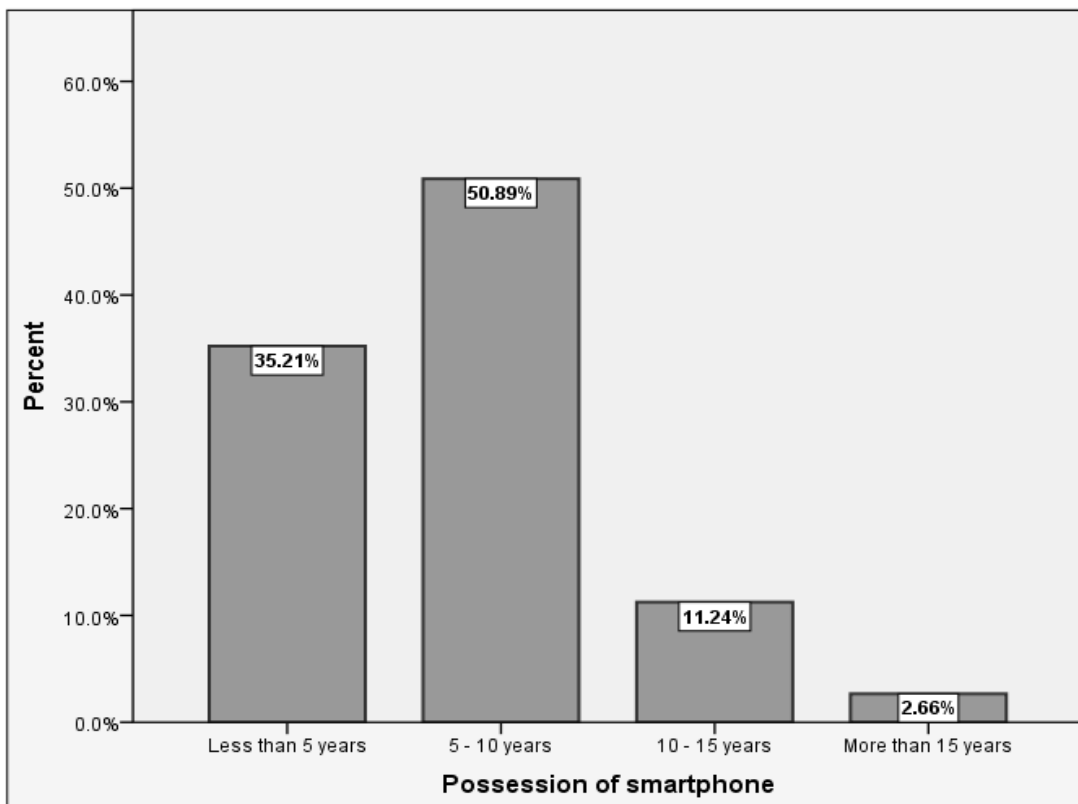


Figure 15 Possession of phone

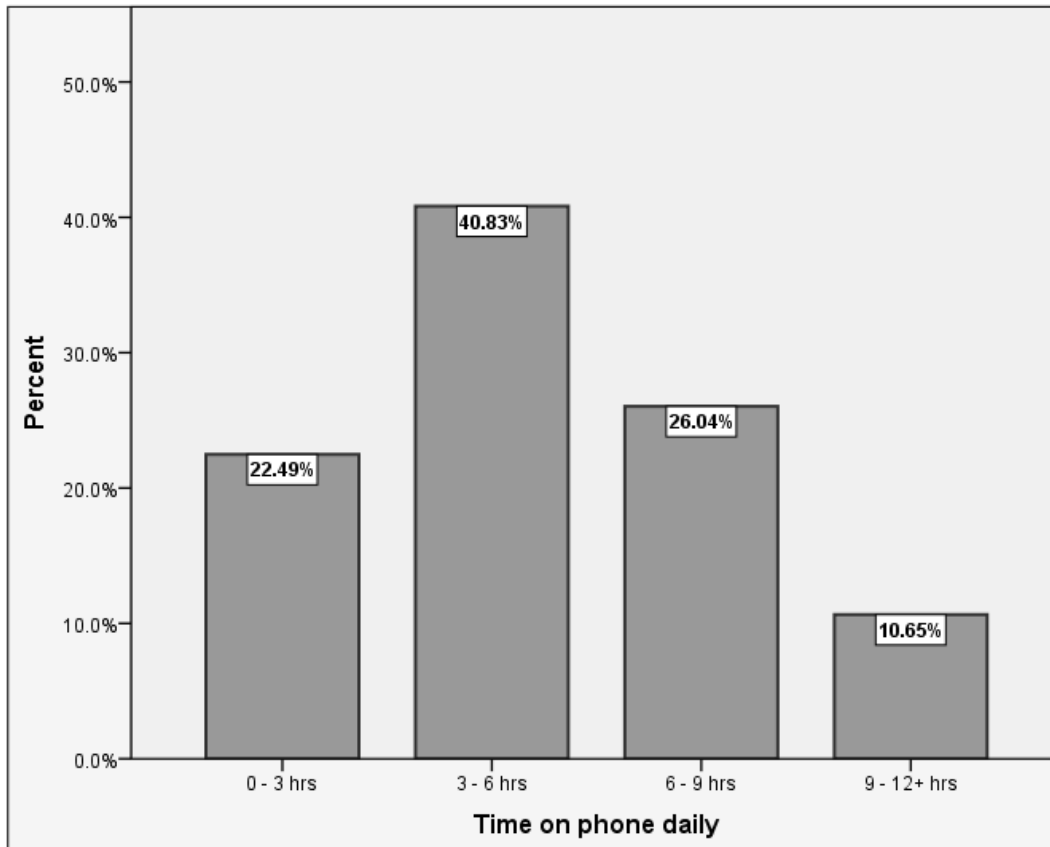


Figure 16 Time spent on phone

4.1.4 Section 4 – Mobile Applications:

The fourth section consisted of questions about the type of applications used and their frequency. Thirty-five such applications are chosen from the list of top-ranking applications in Pakistan [38]. Globally, mobile applications are divided into six categories [39] out of which five are used. The utility and productivity application category is combined into one. So, these 35 applications are divided into four categories for simplicity in general discussion. These are lifestyle, social media, utility & productivity, and games/entertainment applications. For all the applications, their frequency of usage is asked in four options, which is ‘Daily,’ ‘Weekly,’ ‘Monthly,’ and ‘Don’t use’.

Figure 17 to 24 shows the lifestyle applications. It can be seen that for traveling, people prefer Bykea, Careem, and Indriver more than Uber and Swvl. The reason for this could be that Bykea

and Indriver are more reasonable compared to others due to their rate setting option, and since the respondents are mainly students, these are the feasible choices. At the same time, Careem is the safest option, with the quickest customer service. In food delivery applications, Foodpanda is used more frequently than Grocerapp. While in music applications, Soundcloud is preferably more used than Spotify.

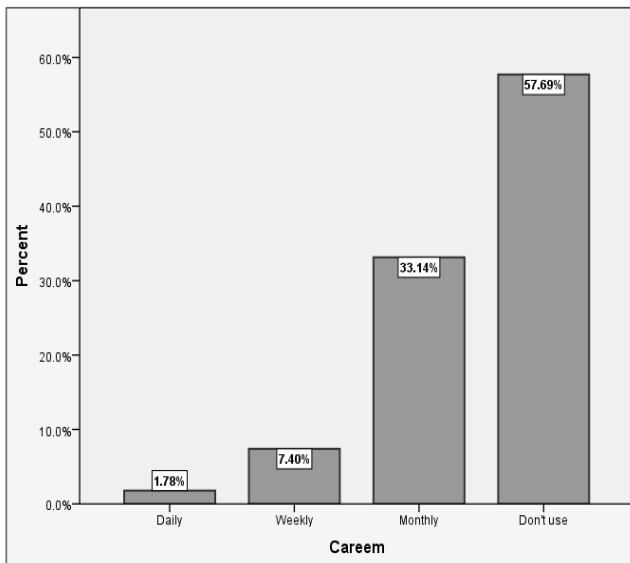


Figure 17 Frequency usage of careem

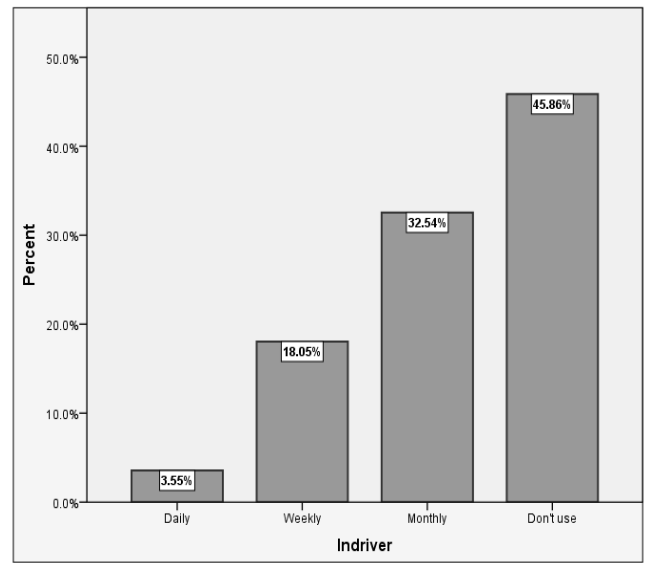


Figure 18 Frequency usage of indrive

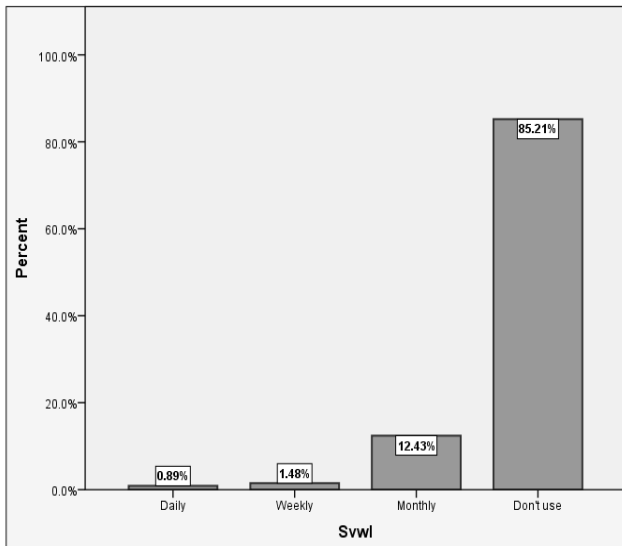


Figure 19 Frequency usage of swvl

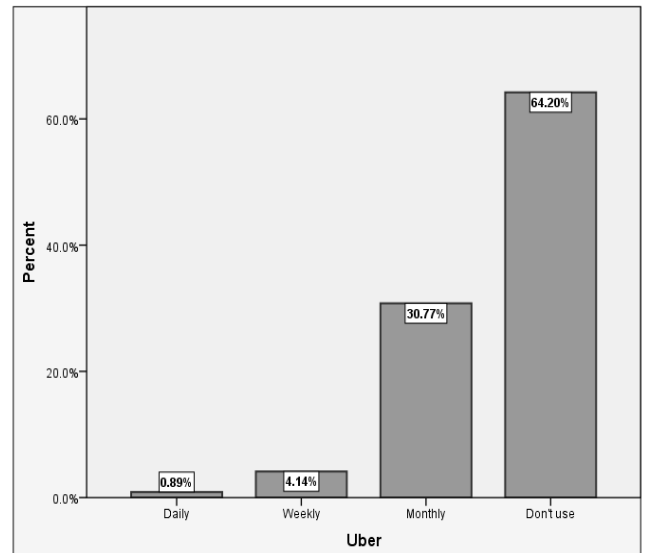


Figure 20 Frequency usage of uber

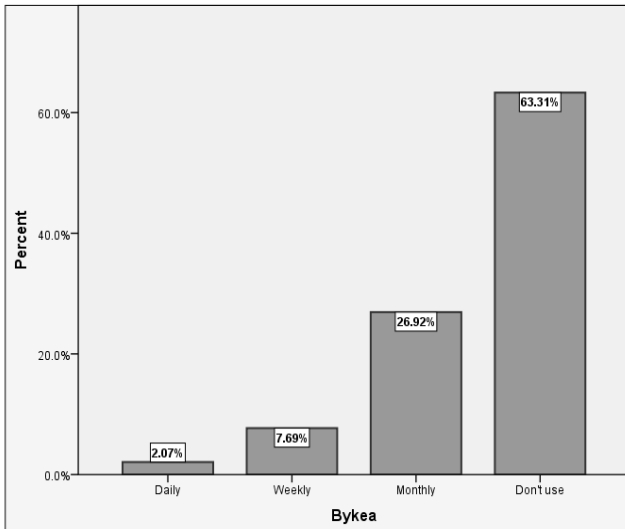


Figure 21 Frequency usage of bykea

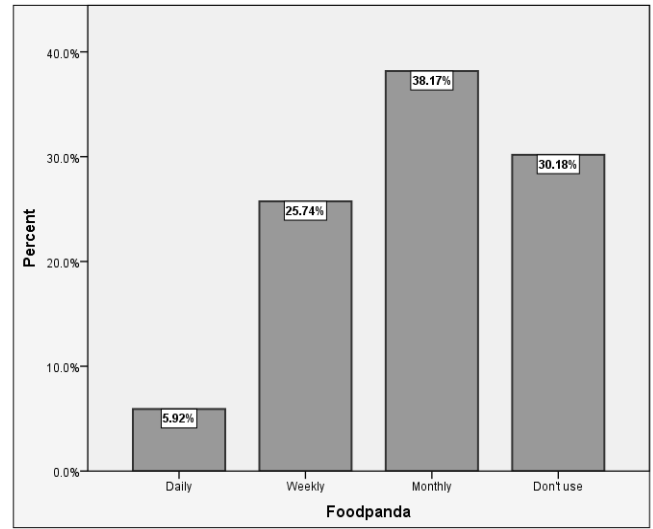


Figure 22 Frequency usage of foodpanda

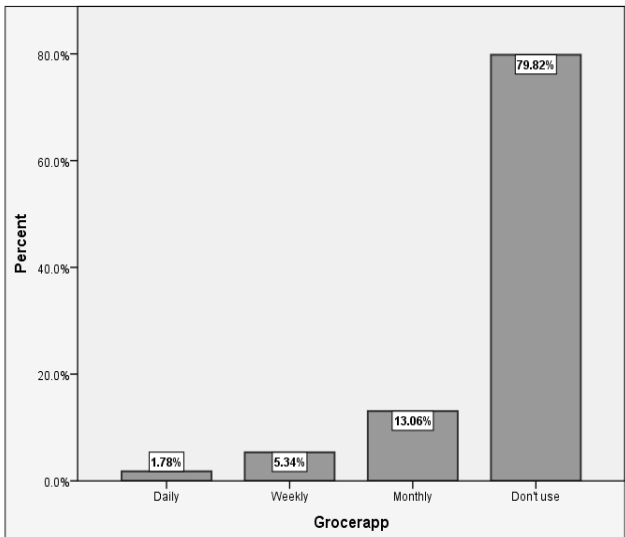


Figure 23 Frequency usage of grocerapp

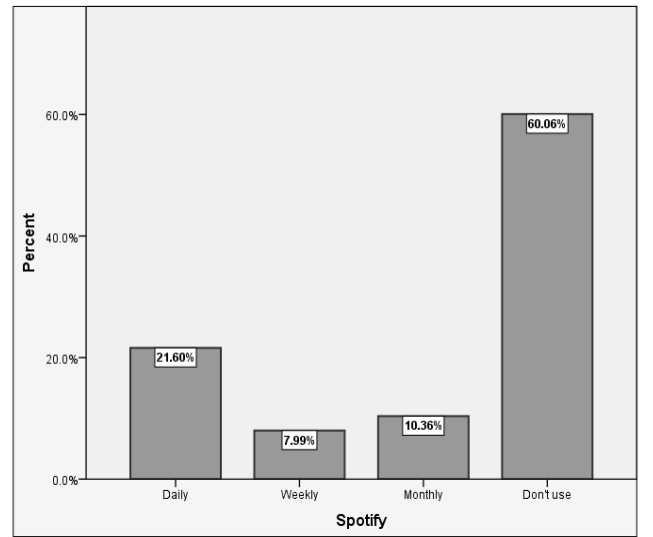


Figure 24 Frequency usage of spotify

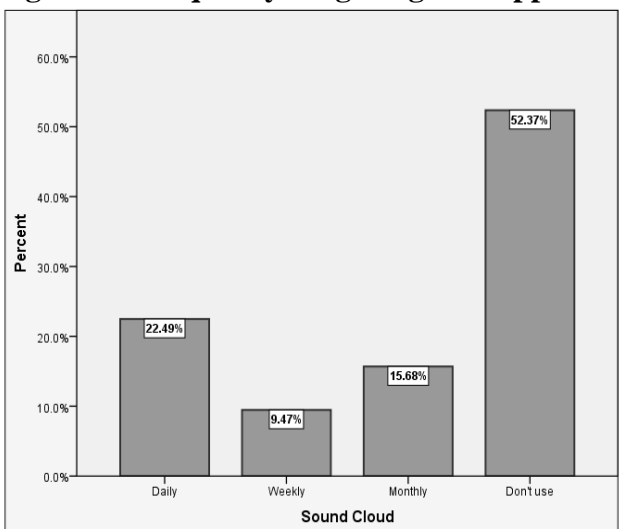


Figure 25 Frequency usage of sound cloud

Figure 25 to 30 shows the popular social media applications. The instant messaging social media app WhatsApp is the most used among the respondents, with almost 96% using it daily. Next came Instagram (78%) and Facebook (64%), with the highest daily usage. These were followed by Snapchat (58%), LinkedIn (23%), and Twitter (24%). LinkedIn and Twitter are the two social media applications with the largest non-using respondents.

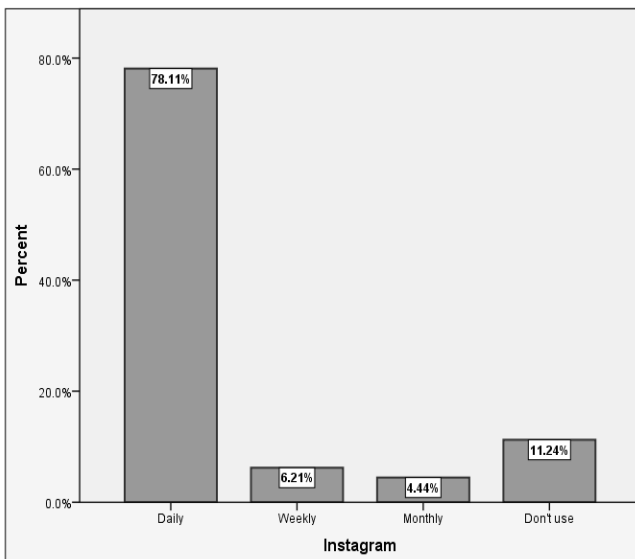


Figure 26 Frequency usage of instagram

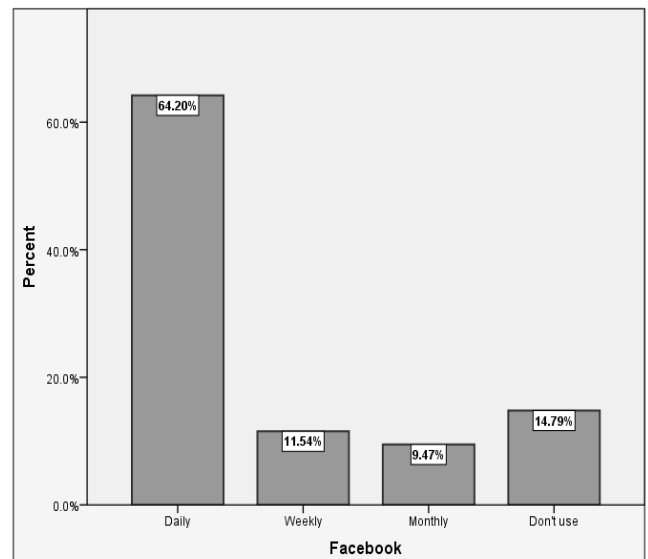


Figure 27 Frequency usage of facebook

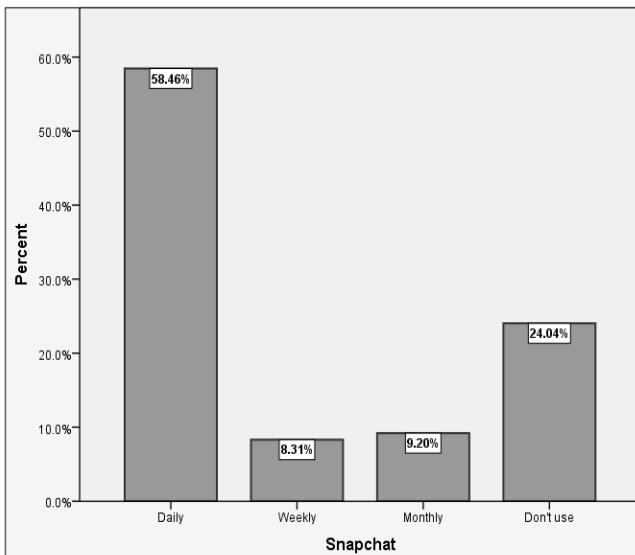


Figure 28 Frequency usage of snapchat

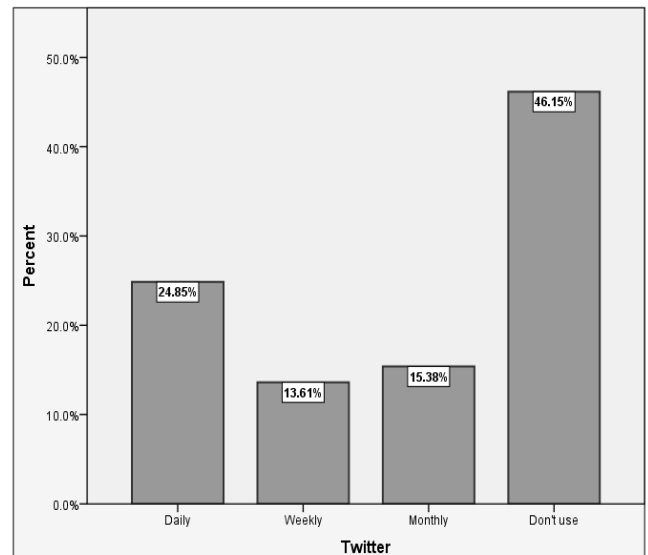


Figure 29 Frequency usage of twitter

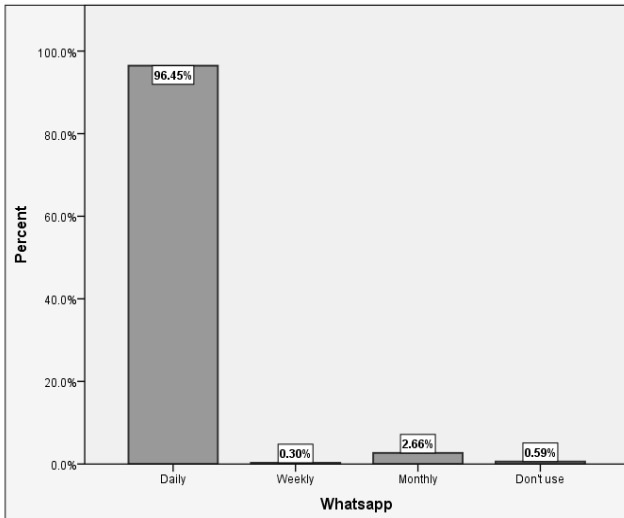


Figure 30 Frequency usage of whatsapp

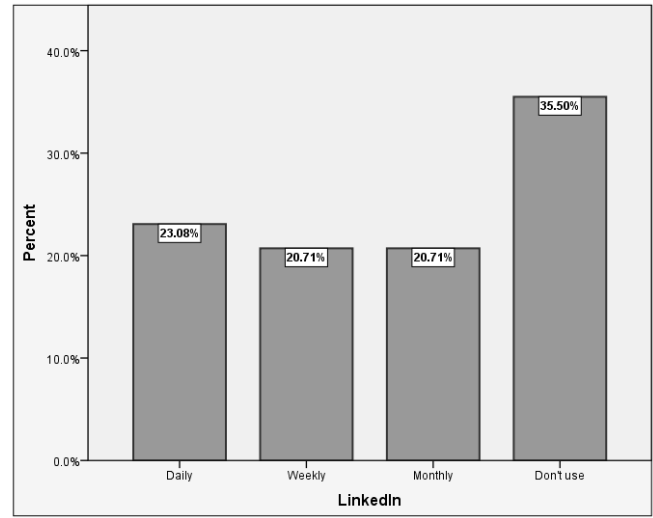


Figure 31 Frequency usage of linkedin

Figure 32 to 44 shows the utility and productivity applications. Email (73%) and Calculator (48%) are the two most frequently used daily applications. These are followed by Docs (44%), Notepad (36%), Sheets (27%), and Dictionary (24%). Teams (13.61%) was the most preferred application for online meetings and classes. However, the use percentage was high when the pilot survey was conducted. During Covid, 28% used teams daily, and 30% used them weekly. For online transactions, Mobile banking is used by 28.7% of respondents daily and 30.47% weekly. In comparison, Wallet pay apps are used at 13.91% daily and 16.86% weekly. Google Maps was another frequently used app, with only 8% of respondents not using it, while the majority did not use Cap Cut (72.9%).

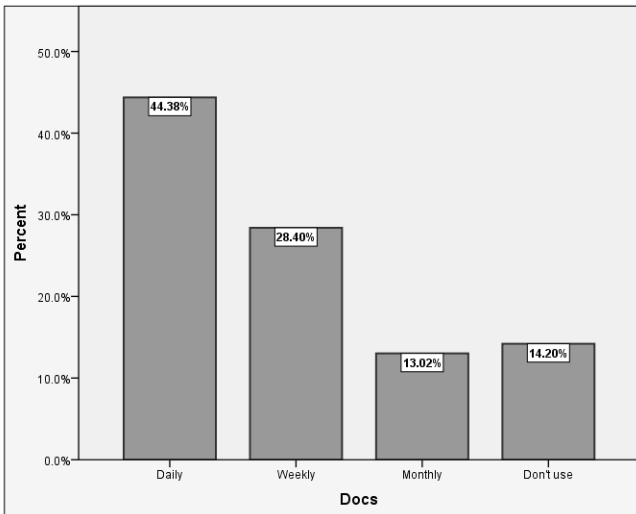


Figure 32 Frequency usage of docs

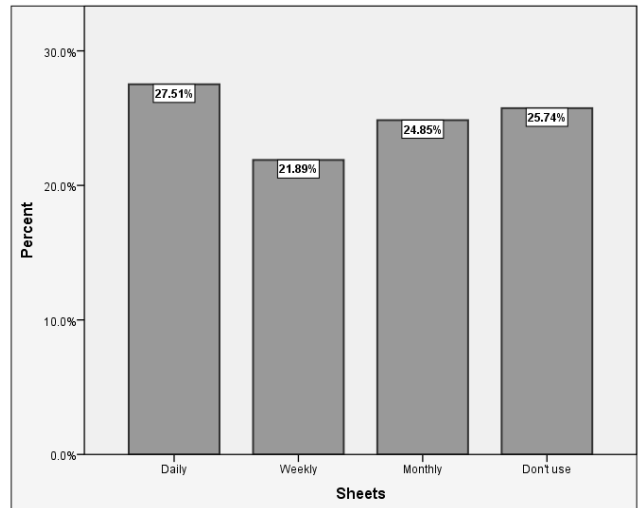


Figure 33 Frequency usage of sheets

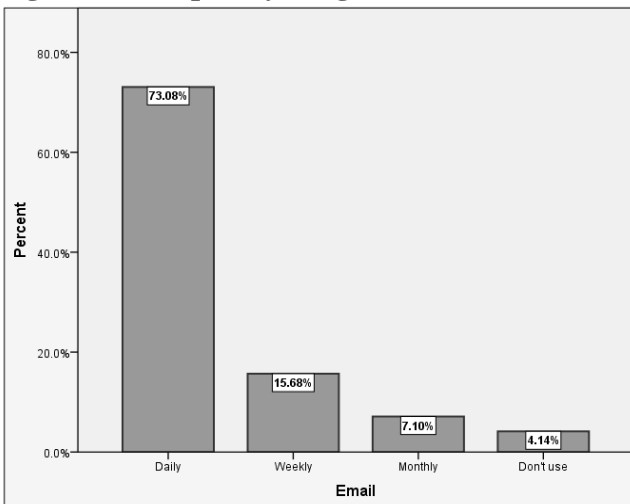


Figure 34 Frequency usage of email

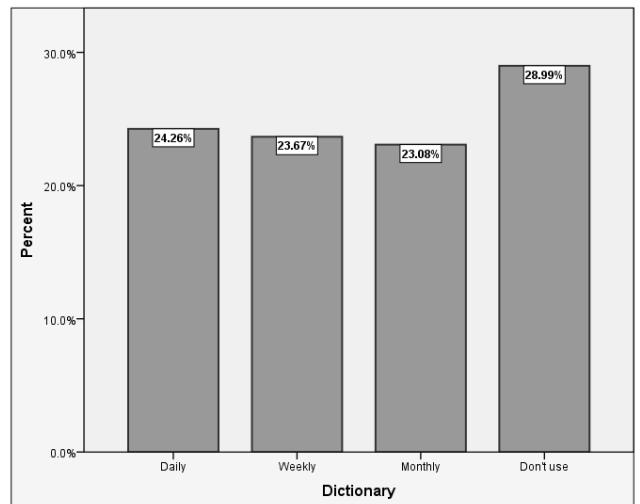


Figure 35 Frequency usage of dictionary

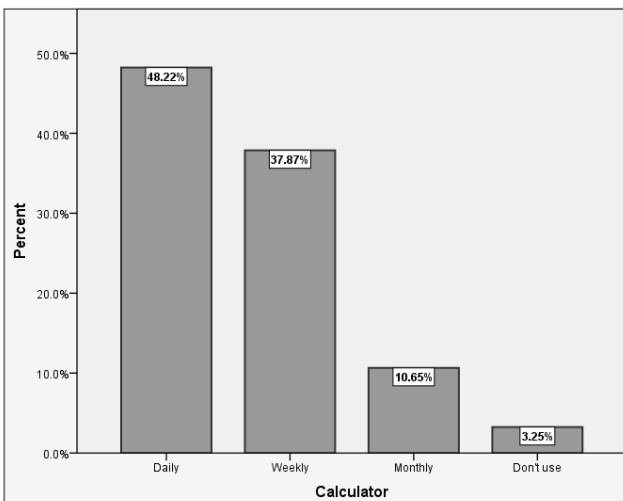


Figure 36 Frequency usage of calculator

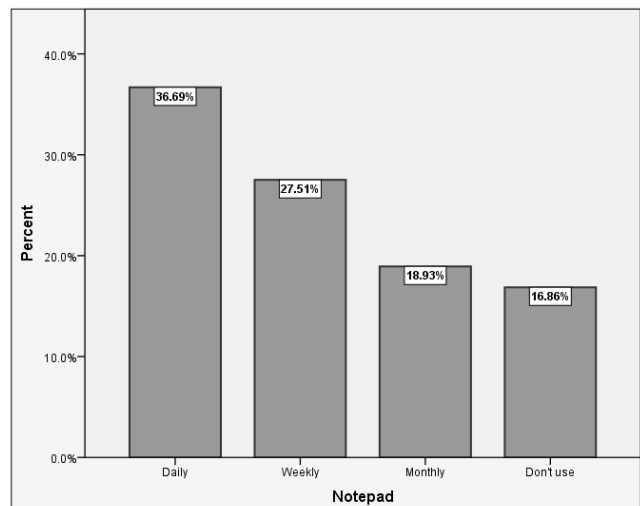


Figure 37 Frequency usage of notepad

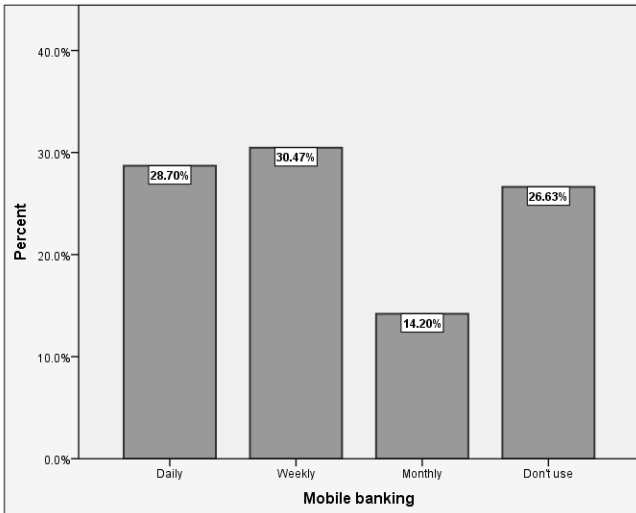


Figure 38 Frequency usage of mobile banking

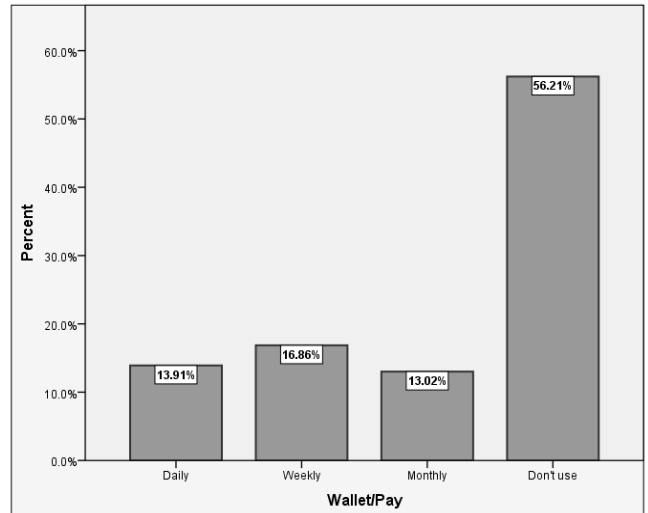


Figure 39 Frequency usage of wallet pay

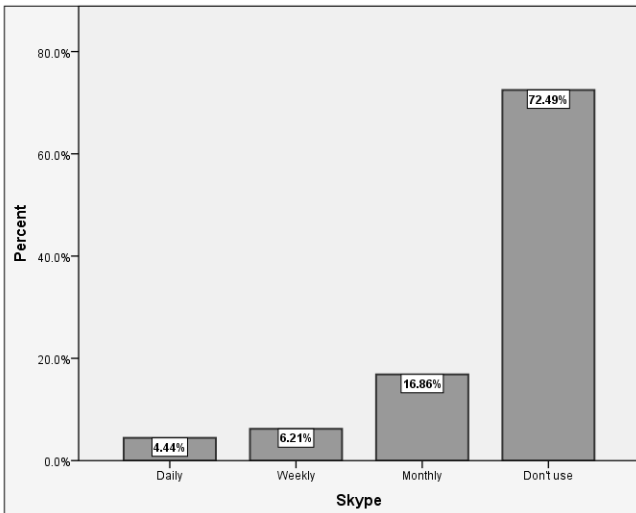


Figure 40 Frequency usage of skype

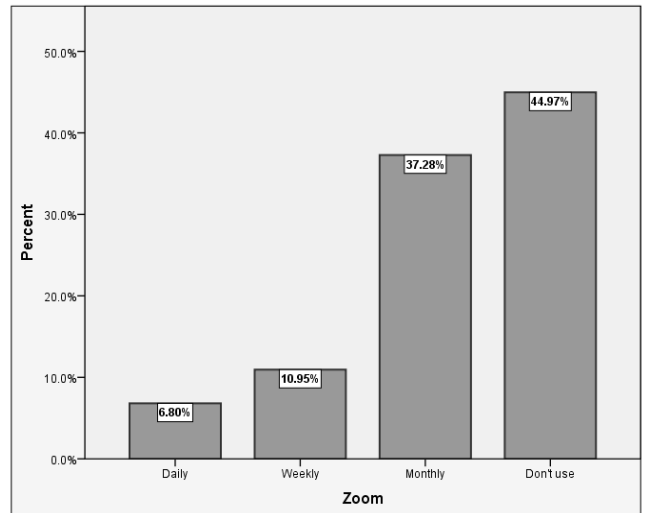


Figure 41 Frequency usage of zoom

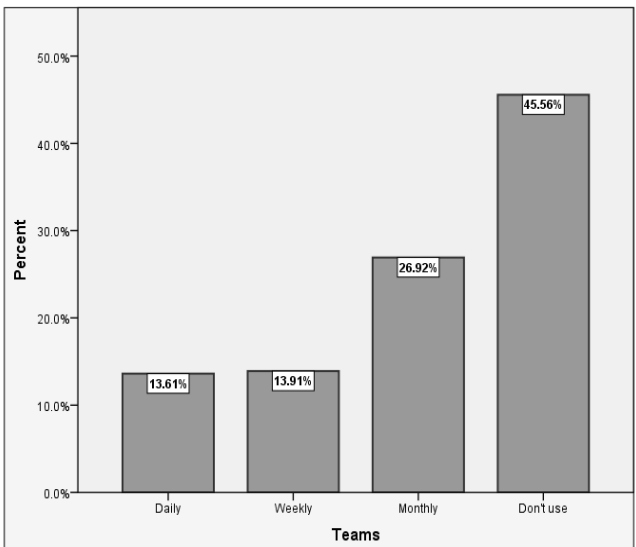


Figure 42 Frequency usage of teams

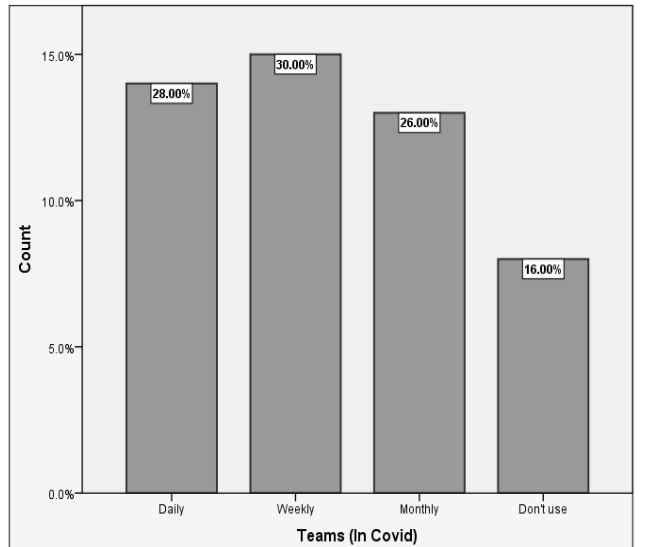


Figure 43 Frequency usage of teams (covid)

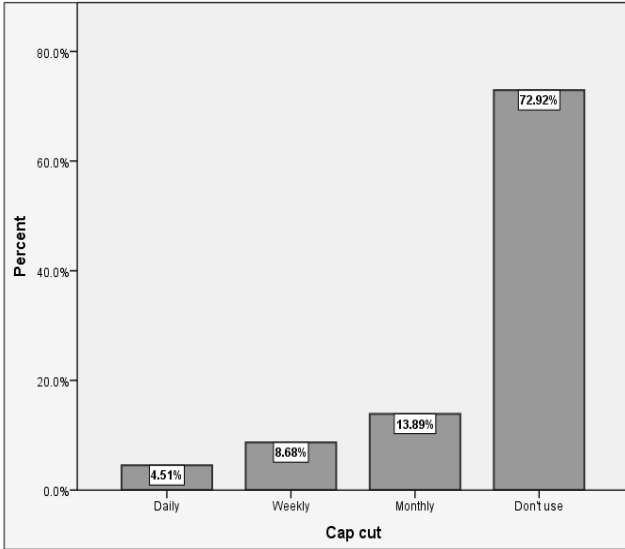


Figure 44 Frequency usage of capcut

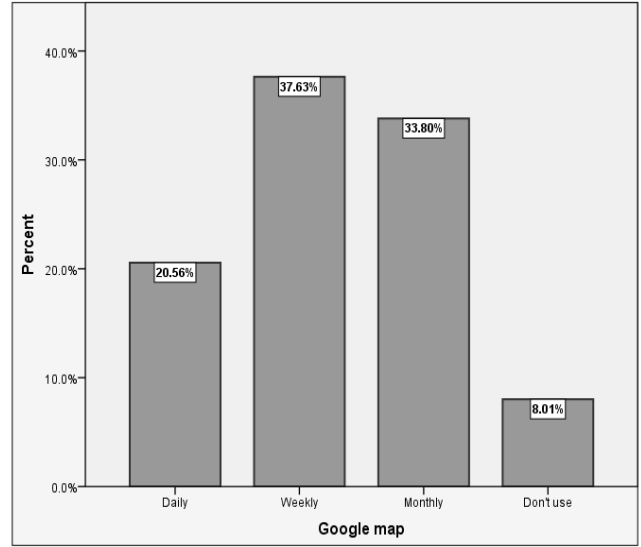


Figure 45 Frequency usage of google map

Figure 46 to 52 shows the game's entertainment apps. Youtube was the most frequently used app, with almost 82% using it daily. Netflix was next in line, with 29.59% using it daily and 30% using it weekly and monthly. Tik tok, on the other hand, was not used by the majority (70.41%). Gaming applications also are not used by the majority. Four games are selected out of Pakistan's top 100 downloaded games (<https://www.mobileaction.co/top-apps/games-27/android/pk>). These are Candy Crush, Ludo Star, PUBG, and Subway Surfers. More than 79% of the respondents did not use the applications.

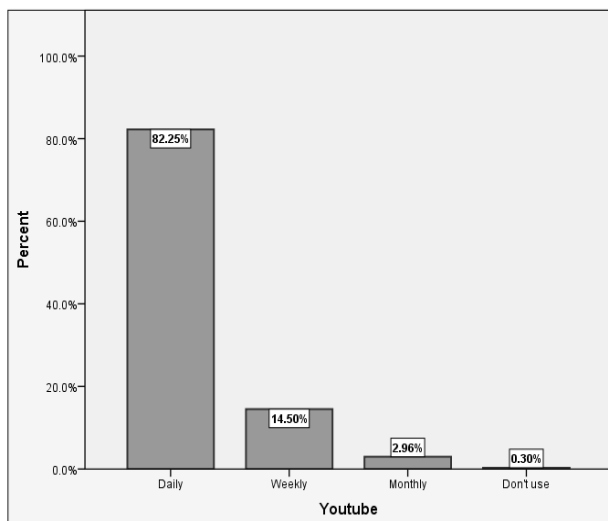


Figure 46 Frequency usage of youtube

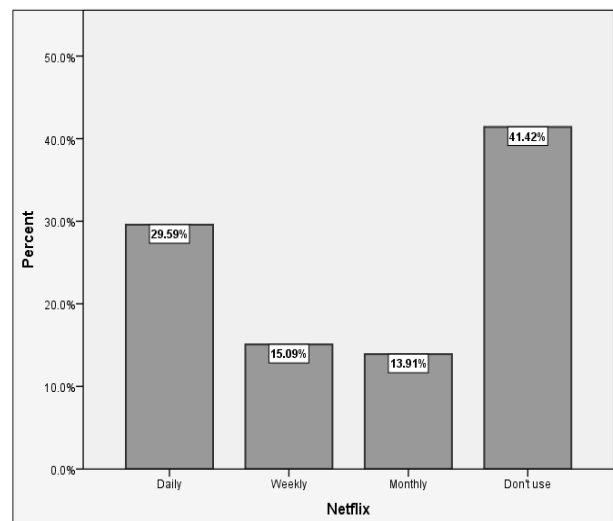


Figure 47 Frequency usage of netflix

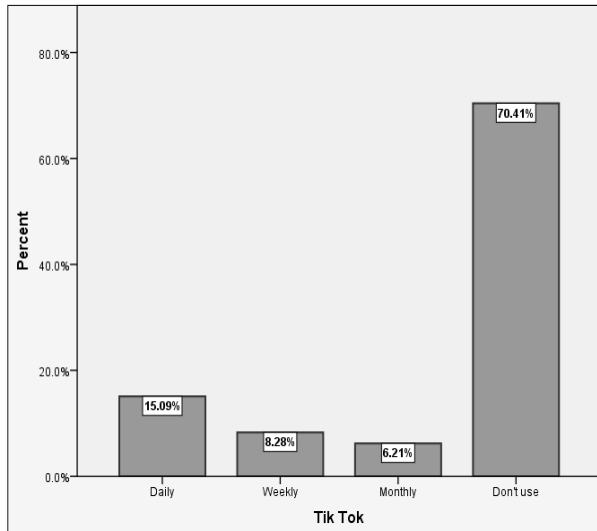


Figure 48 Frequency usage of tik tok

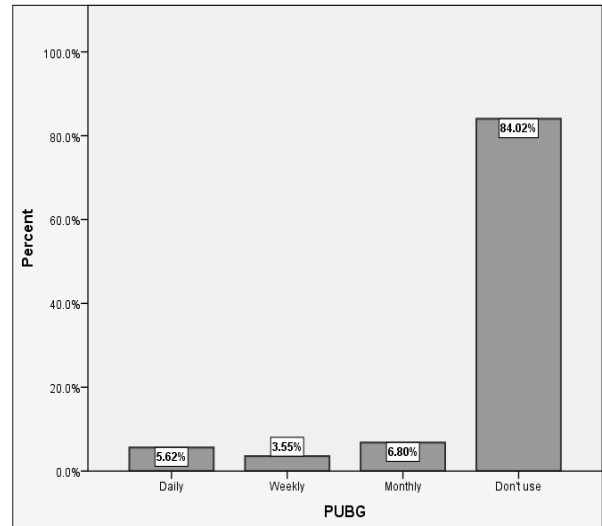


Figure 49 Frequency usage of PUBG

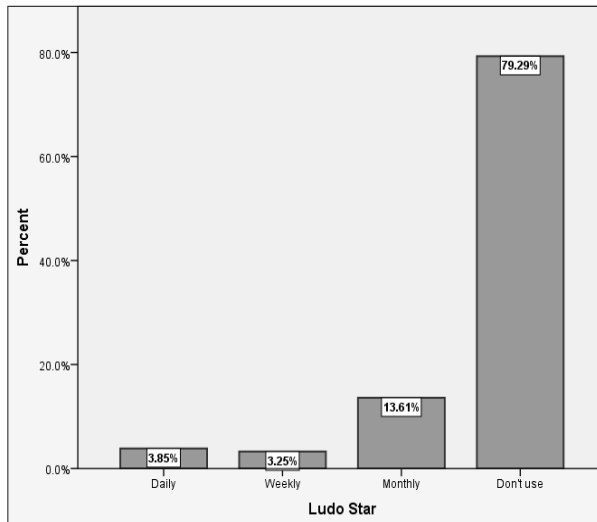


Figure 50 Frequency usage of ludo star

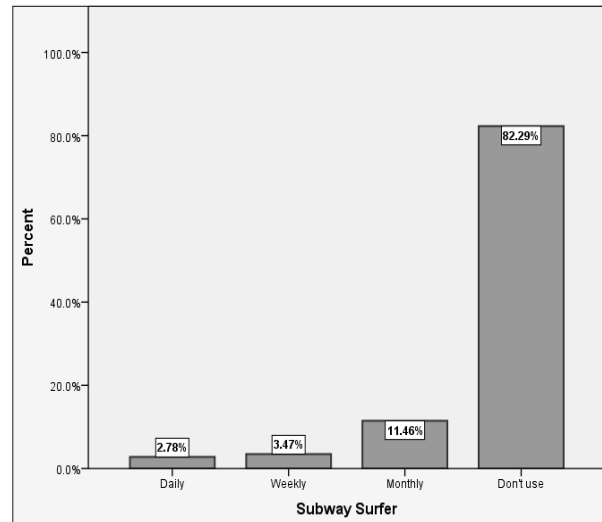


Figure 51 Frequency usage of subway surfer

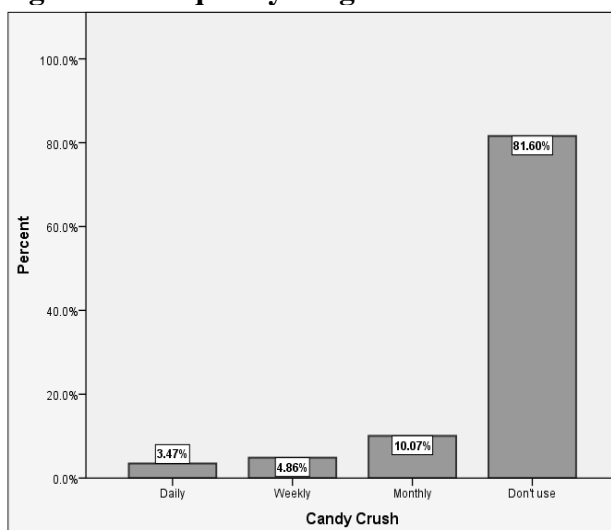


Figure 52 Frequency usage of candy crush

Figure 53 shows that Artificial intelligence, Virtual shopping, Delivery drones, and visual product search are the most preferred features that respondents want to see in applications in the future. While augmented reality, virtual shopping assistants, and voice shopping are next.

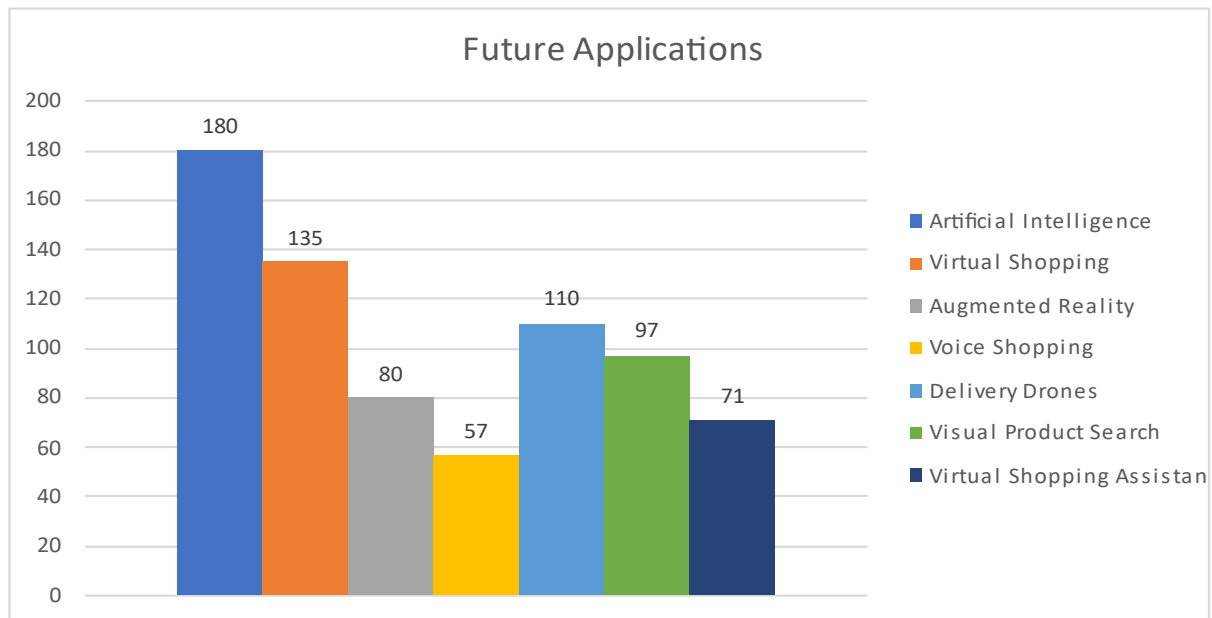


Figure 53 Future Application preferences

4.1.5 Section 5 – Users skill level:

The fifth section consisted of questions about how easy it is for the user to download and use the applications without any challenges.

It can be seen in Figure 54 that the majority of the respondents found it very easy to download the application. Only around 3% of the respondents found it difficult to download them. Similarly, it can be seen in Figure 55 that most of the respondents (88.76%) can learn an application in a few minutes only. As seen in Figure 56, personal interest and awareness are the two most important factors in using mobile applications without any challenge. Training is not considered an important factor since most respondents an application. Video tutorial is also not selected as an important factor by most of the respondents.

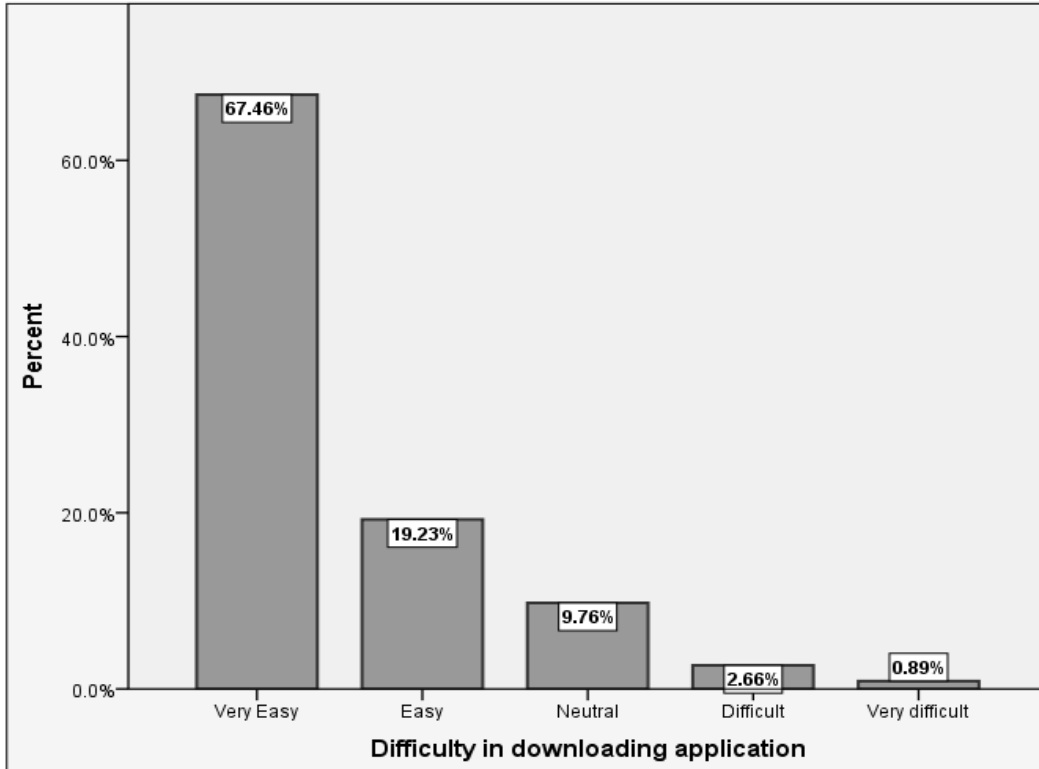


Figure 54 Difficulty in downloading application

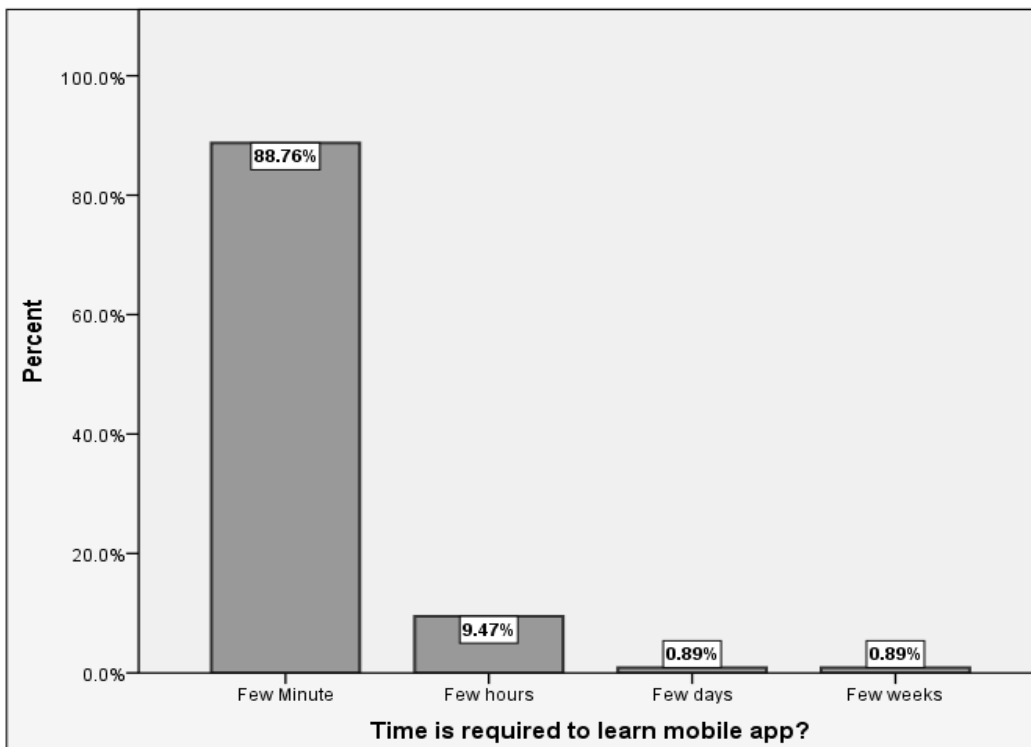


Figure 55 Time required to learn an application

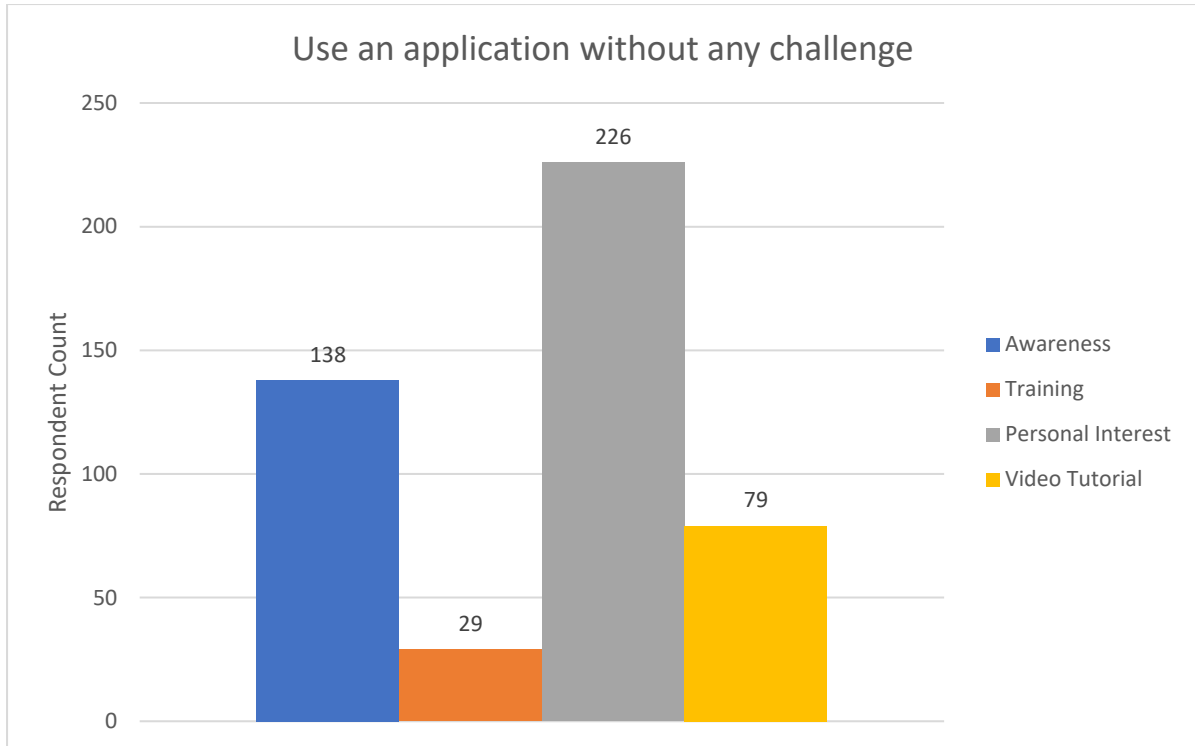


Figure 56 Use mobile app without challenge

4.1.6 Section 6 – App adoption and discontinuation:

The sixth section included questions about what influences the respondents to download and uninstall an application.

Since the 21st century is known as the age of information, the most important factor influencing an application's downloading is social media, as seen in Figure 57. Social media is a place full of information on how to use an application, and free publicity can be done along with paid advertisement. The influence of reviews and ratings and friends also seemed significant. While family influence is low.

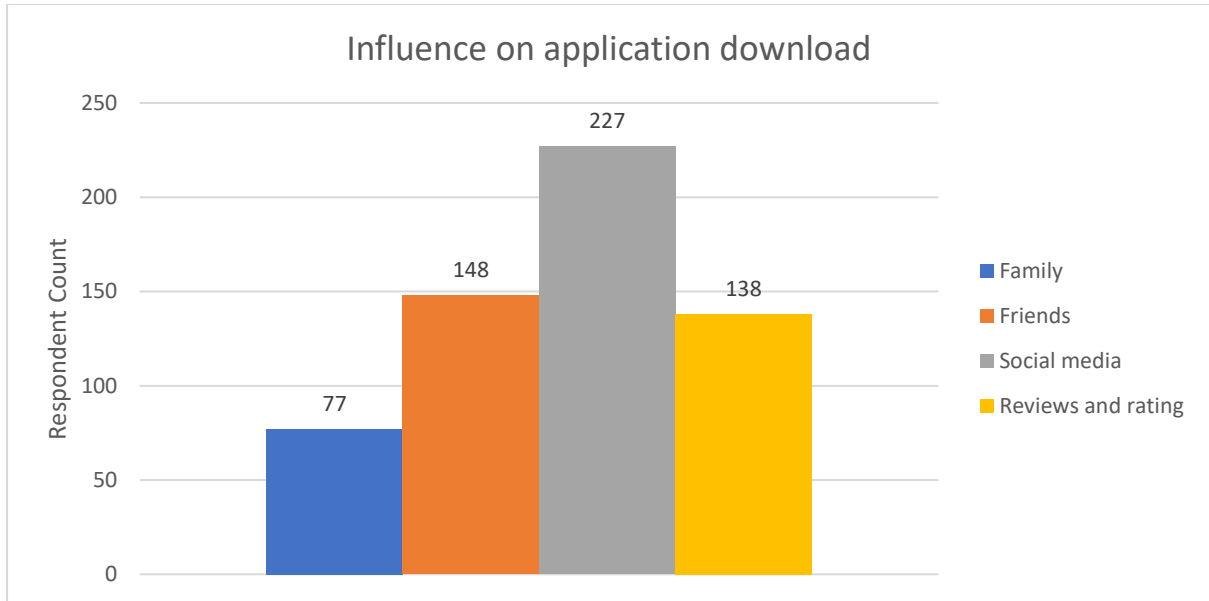


Figure 57 Influence on app installation

The respondents consider All four options important for choosing mobile applications over web applications, as seen in Figure 58. However, 24/7 access in mobile applications is selected by the most.

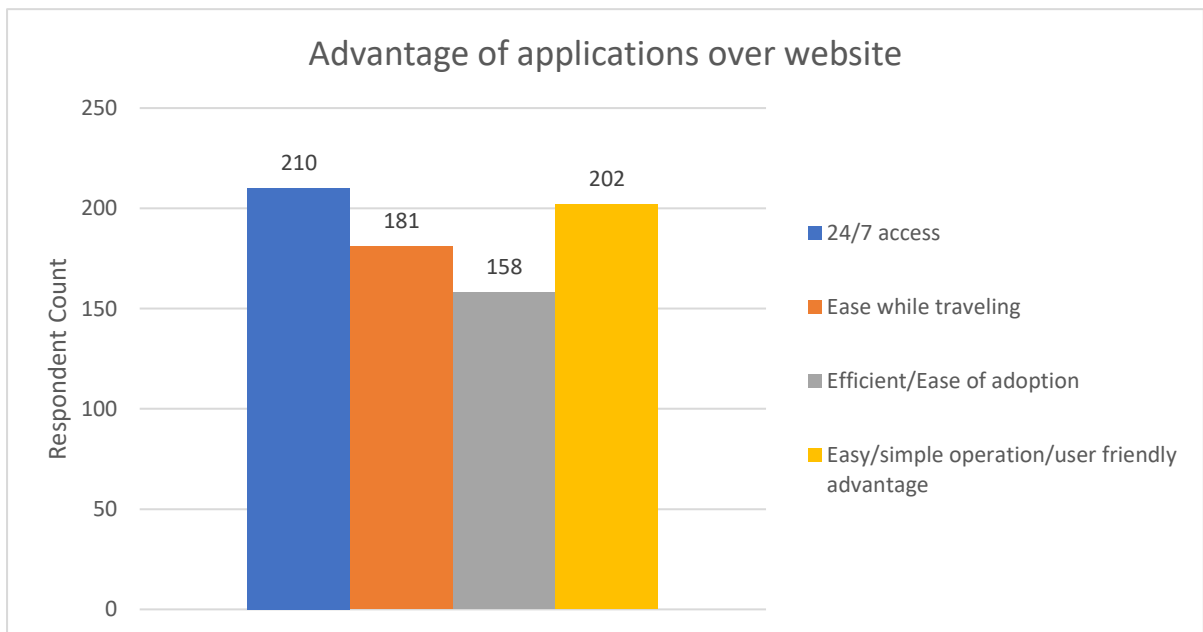


Figure 58 Advantages of mobile apps

When it comes to uninstalling an application, the reason selected by most respondents is the unnecessary advertisements while using it, as seen in Figure 59. At the same time, false advertisements, unfriendly user interface, poor customer service, security concerns, and complexity of usage are a few other reasons that significantly affect application usage. However, delay in a refund after application payments is not considered an important factor since most downloaded apps are free [40].

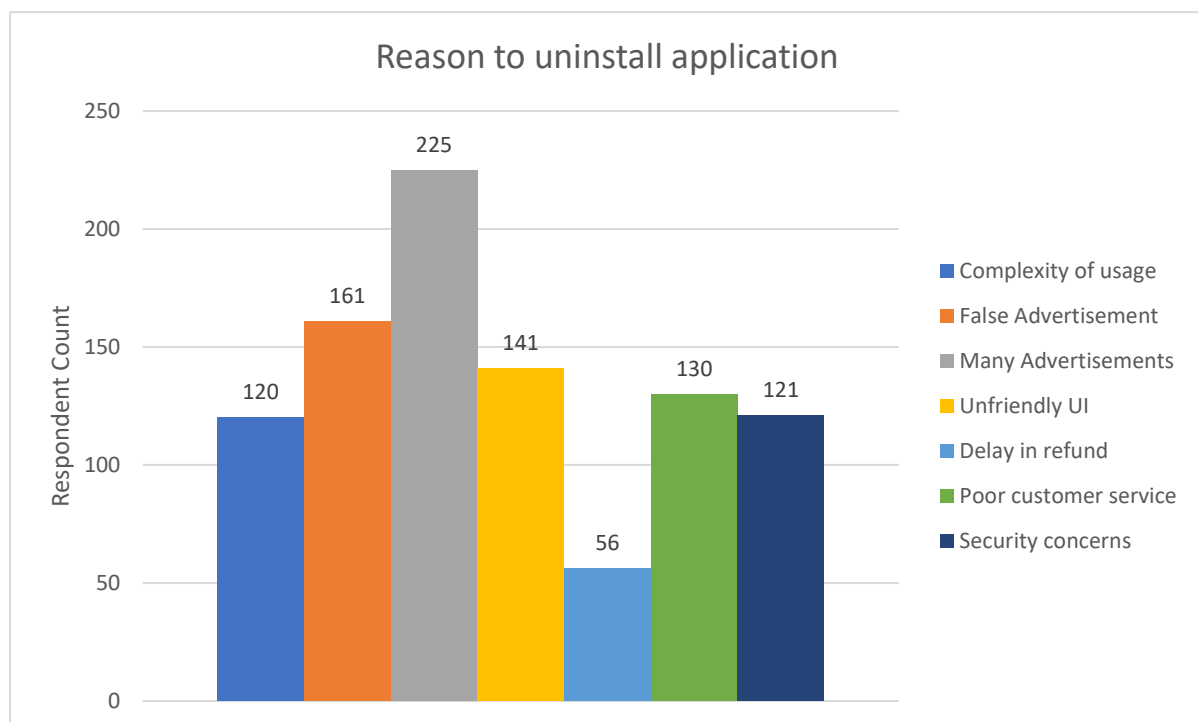


Figure 59 Reasons to uninstall mobile apps

4.1.7 Section 7 – App usefulness:

The seventh section consisted of questions about whether the users find mobile applications useful or not.

Mobile applications have become a critical component of modern life, and their importance is only expected to grow. This can be seen by the results, where around 70% of the respondents

find mobile applications useful, and only 6% find them unuseful. While the remaining find it neither useful nor unuseful, as shown in Figure 60.

Overall, the purpose of using a mobile application is to provide a more convenient and personalized experience for users, whether through access to information, entertainment, or services. Respondents are asked about different purposes for using an app. The most selected reason is that it helps with educational needs since most respondents are students. Users also found that mobile apps save time on various tasks and make life easier. The purpose selected the least by users is that it reduces mental effort, as shown in Figure 61. The respondents were also asked some other statements about using mobile applications. The two most selected options for using mobile applications are that they help achieve important things and accomplish things quickly.

Users are then asked about their comfortability using finance-banking applications. Users' comfort level with finance and banking applications can vary depending on several factors, such as age, experience, and trust. Generally, younger users who have grown up with mobile technology may be more comfortable using finance and banking applications than older users who are less familiar with the technology. It can be seen in Figure 63 that only 23% of the users are uncomfortable with such applications, while around 50% are comfortable. The remaining 24% have neutral views. However, concerning the use of credit cards on mobile applications, 37% are uncomfortable entering the details, 23% are comfortable, and 39% have neutral views, as seen in Figure 64.

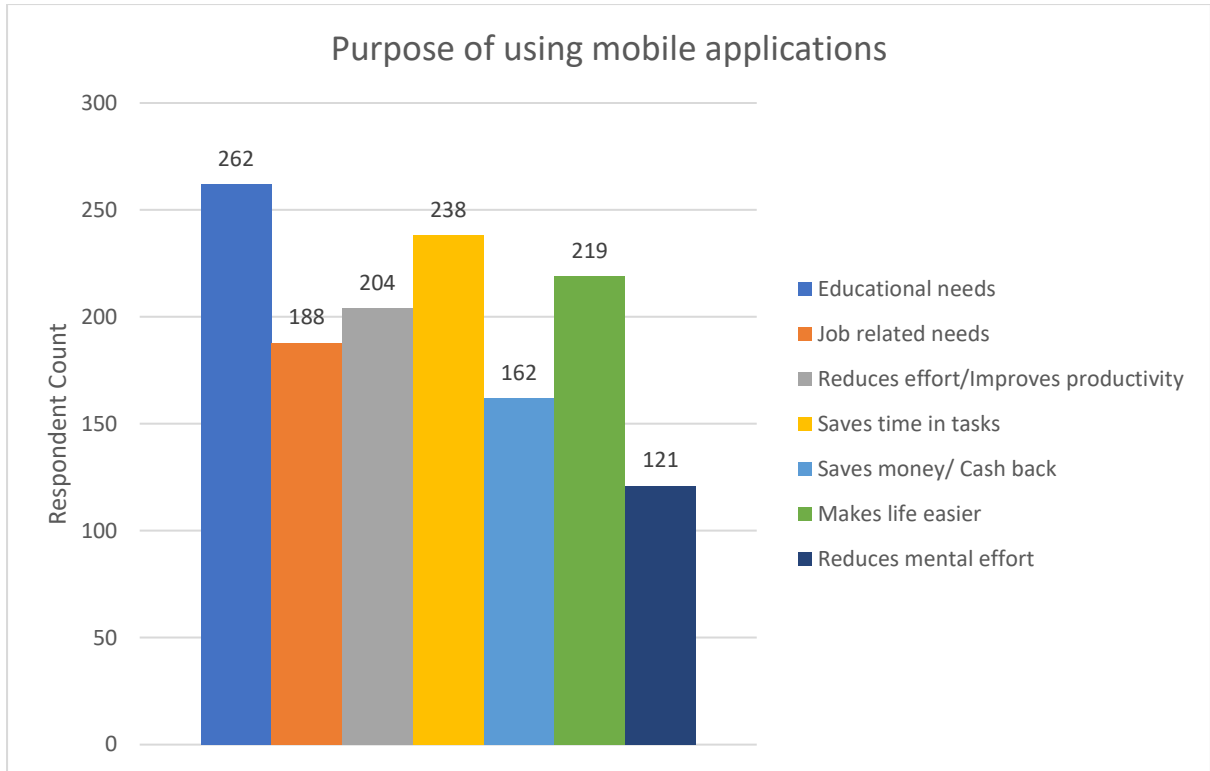


Figure 60 Purpose of using mobile apps

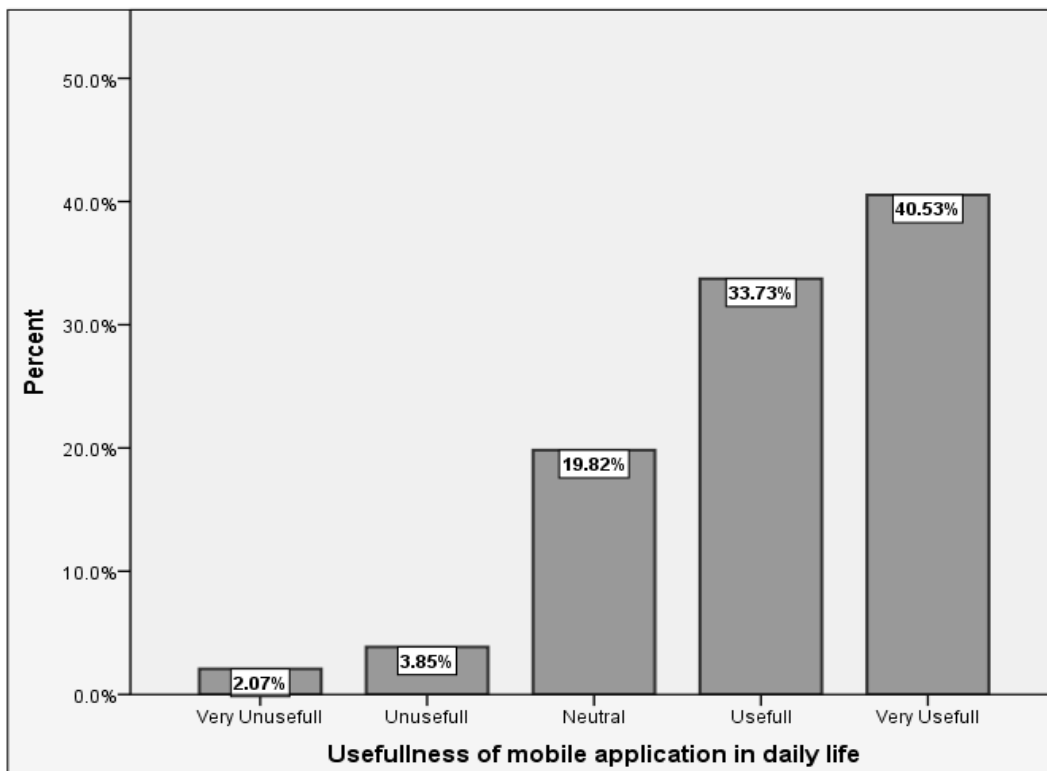


Figure 61 Usefulness of mobile apps

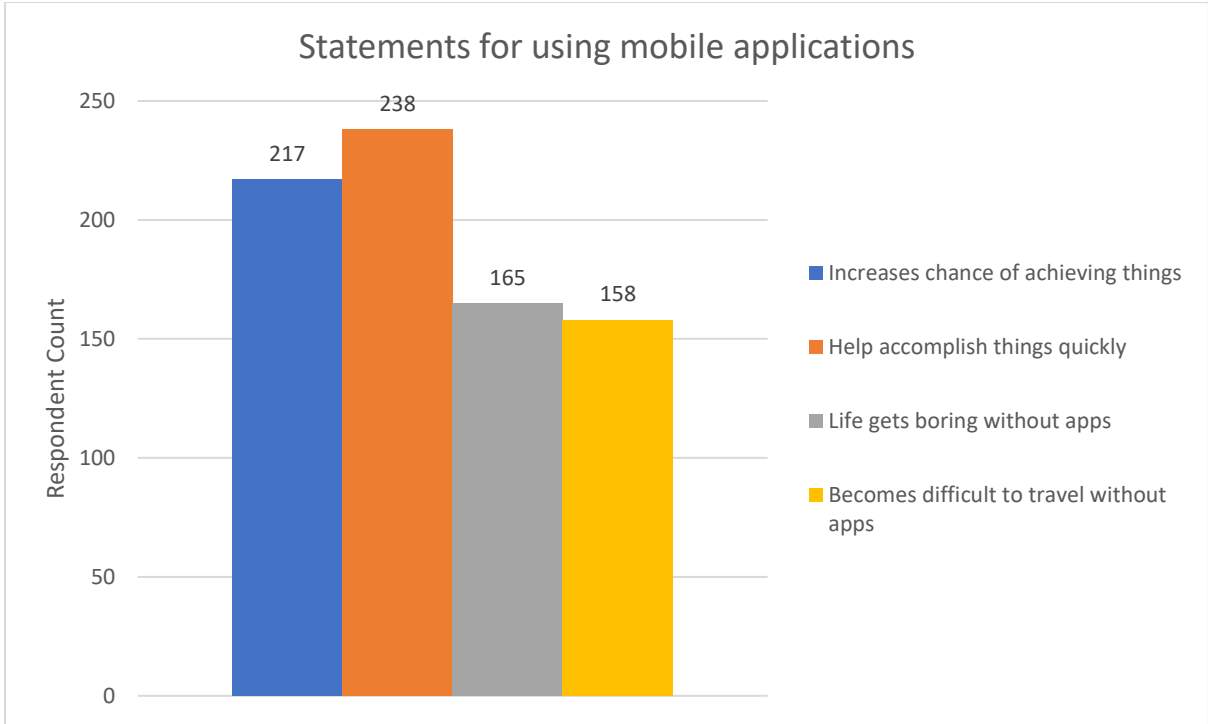


Figure 62 Statements about mobile apps

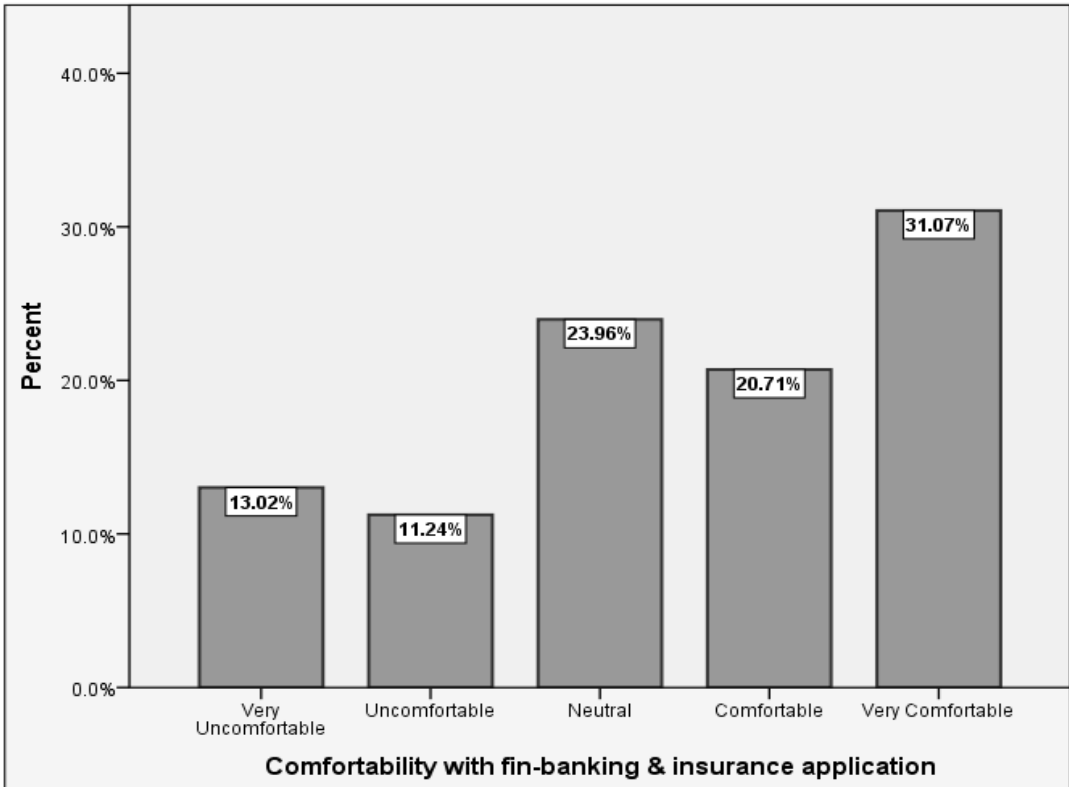


Figure 63 Comfortability with fin-banking apps

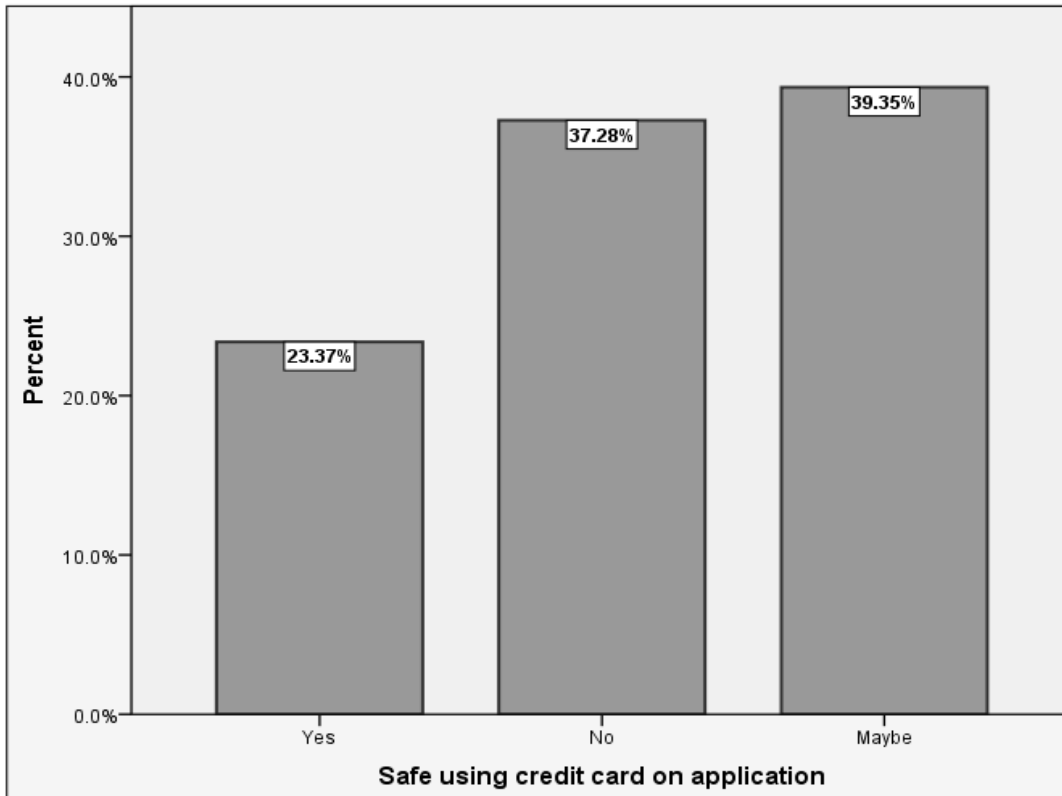


Figure 64 Use of credit card on mobile apps

4.2 Bi variate analysis of data

To analyze the empirical relationship between variables, two qualitative variables, namely Age and Gender, are chosen. These variables are analyzed against all the remaining variables to achieve our research objective in the following section.

4.2.1 Analyzing gender: Phone usage and comfortability

Table 14 shows that female comparatively need slightly more time to learn mobile applications. Male students are comparatively more confident in learning new technology than female [41]. However, there is not much empirical evidence to support the statement.

As for the survey results, females spend more time on the phone daily. Around 45% of females spend more than six hours on the phone compared to only 30% of males. As per the United

Kingdom Online Measurement (UKOM) study, females spend more time on mobile than males. [42] [43]. Apart from making calls, playing games, and searching the internet for information, women also use their smartphones for other activities. They mostly pick up their smartphones to check social media updates. Women are more inclined than males to use smartphones for networking and communication.

The percentage of iPhone and Android users are about the same in both the genders. However the percentage of purchased cellphones are more in males compared to females. 20.6% females have gifted cell phones compared to only 11.5% of males.

Males are more comfortable using financial banking mobile applications than females. Males are more tech-savvy than women because women feel less confident when using technology [44]. However, in recent years, significant efforts have been made to promote gender equality and inclusivity in technology to bridge the gender gap and provide equal opportunities for everyone. As a result, more females have been entering and excelling in various technology-related fields lowering the difference gap. Another reason for women using fewer technology applications is that the manufacturers do not consider their needs while making a product, and marketers do not target them while selling it. To successfully market tech to women, companies must think beyond pink. Women already control 75% of consumer spending, and according to, Catalyst, they are also closing the gap with men on consumer electronics purchases [45].

When it comes to using credit cards on mobile applications, the majority of both genders are not comfortable doing it. However, the reluctance shown by females (38.7%) is slightly more than that of males (36.1%). It is important to note here that the respondents of this survey are mainly students from Pakistan only. Globally, the usage of cards is very common. According

to a finding by the PEW research center, more than 80 percent of mobile payment users connect a credit or debit card or bank account to fund the mobile application transactions they use most often [46].

4.2.2 Analyzing gender: App usage frequency

It can be seen in the Table 16 that the percentage of males selecting future applications is comparatively more than that of females. Artificial intelligence, augmented reality, and delivery drones are the three most selected future applications by both genders, while voice shopping is the least preferred. Artificial intelligence and augmented reality are in high demand due to their enhanced capabilities, automation, and personalized data-driven approach for users. While delivery drones, on the other hand, have a bright future for developing countries like Pakistan. Drones can be particularly valuable for last-mile delivery, which is often the most challenging and costly part of the delivery process. Drones can quickly transport small packages and reach remote or hard-to-access areas more efficiently than traditional delivery methods at a lower cost.

Both males and females have preferred personal interest as a factor in using a mobile application without difficulty. Personal interest in a mobile application makes you more likely to be motivated to invest time and effort into learning how to use it effectively. This motivation can drive your curiosity and exploration, making the learning process more enjoyable and rewarding.

Social media has the strongest influence on males (67.8%) and females (66.5%) in downloading the application, while family influence has the least influence. Overall, males have selected the advantages of mobile applications over web applications more in quantity.

For males, simple and easy user interface (64.5%) is the most selected advantage, while for females, it is 24/7 access (62.6%). Females mostly use mobile phones for communication and social networking services, while males use them for business purposes, sports, and finances [47]. Therefore, the biggest advantage for females is to have access to it all the time only, while males have more advantages.

The two most selected reasons for uninstalling an app by males and females are too many advertisements and an unfriendly user interface. In contrast, the most selected reasons to use apps are helping with educational needs, addressing job-related needs, reducing effort and improving productivity, saving time in various tasks, and making life easier.

More than 50% of both the males and females disagrees to the statement that without mobile applications travelling becomes difficult. While more than half of the males (53.6%) disagreed to the statement that life becomes boring without mobile applications, 51.6% females agreed to it. This is mainly because females are more fond of using communication and social apps, without which life might appear to be boring to them.

4.2.3 Analyzing gender: Adoption and Switching factors

Compared to females, Males use commuting apps like Careem, Uber, Bykea, and Indrive more often as seen in Table 15. While food delivery apps like Grocerapp and Foodpanda are used more by females. The music apps SoundCloud and Spotify are also used more by males. A study conducted in UAE states that 55% of users of Careem are males while only 45% are females [48]. Safety is still the biggest concern in these commuting apps, so the number of female users is still comparatively low. Similarly, the music streaming platforms like Spotify and SoundCloud are used more by males than females. This may be because of the male

domination in the top genres in these apps [49]. In contrast, females use food delivery apps more, especially when outside. This is mainly due to the convenience of their busy lifestyle [50] [51].

In the social media apps, LinkedIn, Twitter, and Facebook are used more by the males, while Snapchat and Instagram are used more by the females. Instagram and Snapchat have more of an influencer culture with visual content and aesthetics that appeal to women [52]. While LinkedIn, Twitter, and Facebook are more professional platforms to connect with people for career purposes or to raise awareness [53].

Mobile wallets and mobile banking apps are more frequently used by males than females. Financial management preferences are more for males, and their technology adoption rate is also higher. Therefore their access to banking services is more. As per the results, males use productivity applications more than females. Men generally show more interest in technology and productivity applications, but women have a greater need to satisfy their social needs via a social media application [54]

As per the results, Females use more gaming and entertainment apps than males. Although males are fonder of playing games on applications, the games selected in the survey have more of a social and community aspect involved with a casual gaming appeal, due to which their popularity in females is more. However, the users of PUBG are more males than females.

Table 14 Phone usage and comfortability of Gender

		Gender	
		Male	Female
Time is required to learn mobile app?	Few Minutes	1.6%	1.3%
	Few hours	89.6%	84.5%
	Few days	7.7%	11.6%
	Few weeks	0.0%	1.9%

	Few months	1.1%	.6%
Time on phone daily?	0 - 3 hrs	29.5%	14.2%
	3 - 6 hrs	41.5%	40.0%
	6 - 9 hrs	19.7%	33.5%
	9 - 12+ hrs	9.3%	12.3%
operating system?	Android	77.6%	81.3%
	Apple	19.1%	18.7%
	Windows	3.3%	0.0%
	Other	0.0%	0.0%
Phone acquired?	Purchased	88.5%	79.4%
	Gifted	11.5%	20.6%
	Other	0.0%	0.0%
Comfortable with fin-banking & insurance apps?	Very Uncomfortable	12.0%	14.2%
	Uncomfortable	9.8%	12.9%
	Neutral	21.3%	27.1%
	Comfortable	23.0%	18.1%
	Very Comfortable	33.9%	27.7%
Safe using credit card on app?	Yes	26.2%	20.0%
	No	36.1%	38.7%
	Maybe	37.7%	41.3%

Table 15 App usage frequency of Gender

		Gender					
		Male			Female		
		1	2	3	1	2	3
Lifestyle	Careem	8%	39%	52%	10%	26%	64%
	Uber	5%	35%	60%	5%	26%	70%
	Svwl	3%	16%	81%	2%	8%	90%
	Indriver	23%	33%	44%	20%	32%	48%
	Bykea	17%	38%	45%	1%	14%	85%
	Foodpanda	29%	38%	33%	35%	38%	27%
	Grocerapp	5%	13%	81%	9%	13%	78%
	Spotify	33%	11%	56%	26%	10%	65%
Sound Cloud	34%	14%	51%	29%	17%	54%	
Social media	Instagram	81%	5%	14%	88%	3%	8%
	Facebook	81%	7%	12%	70%	12%	18%
	Snapchat	64%	9%	26%	69%	9%	21%
	Twitter	45%	15%	40%	30%	16%	54%
	Whatsapp	96%	3%	1%	97%	3%	0%
	LinkedIn	49%	19%	32%	38%	23%	39%
Productivity / Utility	Docs	75%	9%	16%	70%	18%	12%
	Sheets	55%	18%	27%	43%	33%	24%
	Email	89%	8%	4%	89%	6%	5%
	Dictionary	47%	25%	28%	49%	21%	30%

	Calculator	89%	8%	4%	83%	14%	3%
	Notepad	62%	19%	19%	66%	19%	15%
	M-banking	71%	11%	17%	45%	17%	37%
	Wallet/Pay	39%	13%	48%	21%	14%	66%
	Skype	14%	17%	69%	7%	17%	76%
	Zoom	21%	37%	42%	14%	38%	48%
	Teams	33%	25%	43%	21%	30%	49%
	Cap cut	16%	16%	69%	10%	12%	78%
	Google map	68%	24%	8%	46%	45%	9%
Games/ Entertainment	Youtube	96%	4%	1%	98%	2%	0%
	Netflix	41%	17%	42%	49%	10%	41%
	Tik Tok	22%	4%	74%	25%	8%	66%
	PUBG	11%	8%	80%	6%	5%	88%
	Ludo Star	7%	11%	83%	8%	17%	75%
	Subway Surfer	4%	9%	87%	9%	14%	77%
	Candy Crush	5%	8%	87%	13%	13%	75%
1: Frequent use, 2: Monthly use, 3: Don't use							

Table 16 Adoption and switching factors by gender

		Gender			
		Male		Female	
		Yes	No	Yes	No
Future Application	Virtual Shopping	41.0%	46.4%	38.7%	43.9%
	Artificial Intelligence	65.0%	22.4%	39.4%	43.2%
	Augmented Reality	29.5%	57.9%	16.8%	65.8%
	Voice Shopping	19.7%	67.8%	13.5%	69.0%
	Delivery Drones	37.2%	50.3%	27.1%	55.5%
	Visual Product Search	33.9%	53.6%	22.6%	60.0%
	Virtual Shopping Assistant	24.0%	63.4%	17.4%	65.2%
Requirements to use apps easily	Awareness	38.3%	61.7%	43.9%	55.5%
	Training	10.9%	89.1%	5.8%	94.2%
	Personal Interest	67.8%	32.2%	65.8%	34.2%
	Video Tutorial	23.5%	76.5%	23.2%	76.8%
What influences to download app	Family	24.0%	76.0%	21.9%	78.1%
	Friends	43.7%	56.3%	43.9%	56.1%
	social media	67.8%	32.2%	66.5%	33.5%
	reviews & ratings	40.4%	59.6%	40.6%	59.4%
Advantage of mobile apps over web apps	24/7 access	61.7%	38.3%	62.6%	37.4%
	Use while traveling	56.8%	43.2%	49.7%	50.3%
	Ease of adoption	51.9%	48.1%	40.6%	59.4%
	Easy/simple/user friendly	64.5%	35.5%	54.2%	45.8%
	Complexity of usage	33.3%	66.7%	38.1%	61.9%

Reasons to uninstall apps	False Advertisement	55.2%	44.8%	38.7%	61.3%
	Too many Advertisements	68.3%	31.7%	64.5%	35.5%
	Unfriendly User interface	44.8%	55.2%	38.1%	61.9%
	Delay in refund	20.2%	79.8%	12.3%	87.7%
	Poor customer service	39.9%	60.1%	36.8%	63.2%
	Security concerns	38.3%	61.7%	32.9%	67.1%
Purpose of using apps	Helps in educational needs	77.0%	23.0%	78.1%	21.9%
	Addresses job related needs	56.3%	43.7%	54.8%	45.2%
	Reduces effort & improves productivity	63.4%	36.6%	56.8%	43.2%
	Save time in various tasks	72.7%	27.3%	67.7%	32.3%
	Good deals/for cashback	48.6%	51.4%	47.1%	52.9%
	Makes life easier	64.5%	35.5%	65.2%	34.8%
	Reduces mental effort	36.6%	63.4%	34.8%	65.2%
Mobile application helps:	Accomplish things more quickly	72.7%	27.3%	67.7%	32.3%
	Achieve important things	70.5%	29.5%	56.8%	43.2%
Without mobile app:	Life gets boring	46.4%	53.6%	51.6%	48.4%
	Traveling becomes difficult	46.4%	53.6%	47.1%	52.9%

4.2.4 Analyzing age groups: Phone usage and comfortability

The survey results in Table 17 shows that most users require only few hours to learn a mobile application. Since mobile applications aim to make things more convenient, the developers make simple mobile applications with a straightforward interface and simple workflow [55]. This makes it easier for all age groups to use mobile applications.

Most age groups spend about 3-6 hours on the phone daily. With the increase in age, the time spent on the phone is decreasing. The age group 21-30 spends the highest time on mobile. As per the App usage statistics of 2023 by ComScore, the heaviest mobile app users are aged 18-24 [56].

Around 80% of users below 30 are Android users compared to 90% of users above 30. This shows that with the increasing age, iPhone users are decreasing. As per research, younger people prefer using iPhones compared to adults [57].

Majority of the users aged 31-40 have purchased mobile phones; however, this number decreases with age. Users below 30 have more percentage of gifted mobile phones.

As per the results, adults are more comfortable using finance banking and insurance applications. 57% of 31-40 age group users are comfortable with financial apps, while only 34% of users below 20 are comfortable with them. Adults have more experience with financial management and have a greater need for financial applications to manage their finances, which could make them more likely to use financial applications on mobile devices. However, 43% of 31-40 age group users do not feel safe when it comes to using credit cards on mobile applications. The younger users, in contrast, are more comfortable with it.

4.2.5 Analyzing age groups: App usage frequency

Table 18 shows that Indrive is the most used commuting app in all age groups, especially 30+ users. This is probably because of their rate-setting option, which is also recently made available in other apps. Foodpanda is preferred over Grocerapp and is used the most by the age group 21-30. Spotify is preferred over SoundCloud by the youngest age group since they are looking for music and connecting with people, and Spotify has a larger audience. While the adults prefer Soundcloud more as its library size of user-generated music and podcast is greater, which may appeal to the older generation who are interested in a wider range of music and audio content [58].

WhatsApp is the most used social media application by all the age groups. Users below 20 use Instagram (90%) and Snapchat (79%) more frequently compared to Facebook (59%) and Twitter (28%). While users between 21-30 use Instagram (85%) and Facebook (79%) more compared to Snapchat (66%) and Twitter (42%). The users between 31-40 use Facebook (93%)

the most, while Instagram (50%), Snapchat (29%), and Twitter (21%) are used comparatively less. We can also see from the results that the LinkedIn app is used more with the growing age. Users below 20 use it the least (20%), while those aged 31-40 use it the most (86%). Adults use LinkedIn more because it is a professional social networking platform primarily designed for business and career purposes. They tend to have more established careers and professional networks, making LinkedIn a natural fit for them. In comparison, younger people use Snapchat and Instagram more than other age groups. These platforms are popular among younger generations for their visual and social features, which allow users to share photos and videos with their friends and followers. When it comes to Facebook, it used to be the most popular social media application, however, younger people have abandoned using Facebook. It is now more commonly used by adults above the age of 40 [59].

The three most used productivity apps by users of all age groups are Docs, Emails, and Calculator. The use of dictionary apps is decreasing with increasing age since older people have a better vocabulary and understanding of words. At the same time, the use of mobile banking apps is increasing with the increasing age. One possible reason is that older people have more assets and financial responsibilities than younger people, such as savings, retirement accounts, and investments. The use of Google map apps is used least by the users below 20 since their requirement to navigate is less compared to adults who are allowed to drive.

YouTube (97%) is the most used entertainment app by all age groups. Free gaming apps like PUBG, Ludo Star, Subway Surfer, and Candy Crush are comparatively used more by users below 20. The use of TikTok is decreasing with age since its content is largely focused on short-form videos designed to be entertaining and shareable, which tends to appeal more to

younger audiences. As per comScore, the majority of TikTok users are under 30, with the largest demographic being in the 10-19 age group [60].

4.2.6 Analyzing age groups: Adoption and Switching factors

Artificial intelligence is the most wanted future app in all age groups, especially age group 31-40 as shown in Table 19. The least desired mobile application in the future by the youngest group is augmented reality, while for the users above 20 it is voice shopping. With the increasing use of AI and ML, mobile applications that leverage these technologies to provide personalized recommendations and automate tasks are in high demand. For example, AI and ML-powered chatbots that can answer questions, offer customer support or provide personalized recommendations are used by many companies. [61]

More than 60% of all age groups choose personal interest as the factor that helps use mobile applications without any challenge; however, for the age group 31-40, awareness factor is equally important. While training is the least selected factor by all age groups, but for the age group 31-40, video tutorial is equally unimportant. Users who are not motivated to use the application or who have little interest in its features find it more challenging to use the application effectively. While training is not required to use a mobile application in most cases. Mobile applications are designed to be user-friendly and intuitive, with clear and simple user interfaces that make it easy for users to navigate and use the application. [62]

Social media has the greatest influence in installing a mobile applications in all age groups by roughly 60%. This is mainly because of social media advertising and recommendations from media influencers. In contrast, the family has the least influence in all age groups. Family

influence is usually on the younger users, where parental control comes into play. Since the data collected is mainly from adults, family influence is the least.

For the age group below 20 and 21-30, user friendliness and 24/7 access are the most selected advantages of mobile apps over web applications. The age group 31 - 40 selected easy to use while traveling the most, while of 24/7 access, ease of adoption, and user-friendliness are also important for them.

The three most selected reasons to uninstall a mobile application by users are too many advertisements, false advertisements, and unfriendly user interface by all age groups. However, the age group 31-40 found these reasons more affecting than younger age groups. When mobile applications display too many ads or ads that are irrelevant to the user, it can disrupt the user's flow and reduce their engagement with the app. This can lead to a decrease in user satisfaction and ultimately result in the user uninstalling the app. Unless the users have specifically consented to it, they generally have negative attitudes toward mobile advertising [63]. A user interface that is difficult to navigate, confusing, or unattractive can frustrate users and decrease their engagement with the app. [64]

Users were asked about different purposes for using mobile applications. Most age groups agreed that mobile applications help with educational needs, especially those below 20 and 21-30. Many apps nowadays are specifically designed to help with educational needs. Starting from information-providing apps like Khan Academy to testing apps like Quizlet. Interactive classroom sessions can also be conducted via apps like Zoom, teams, and google classroom. About 50% of each age group agree that mobile apps also help with job-related needs. LinkedIn and Rozee apps are used for networking, job search, and industry insights. Instead of dropping

the CVs, interviews can be easily scheduled after scanning the profiles of candidates with these apps.

The second most selected purpose of using mobile applications is saving time. While improving productivity and making life easier are also among the selected purposes. Mobile apps save time and improve productivity through their streamlined process and automation [65]. The real-time updates and personalization make life of the user easier.

Only the users above 30 agree that traveling becomes difficult without mobile apps. However, most of the younger users do not agree with this. Adults may find mobile apps helpful for navigation, finding local attractions and activities, and staying in touch with family and friends. For example, translation apps can be useful for communicating with locals who may not speak the same language. Additionally, mobile apps that provide information about accessibility and mobility can help them plan their trips and ensure they can navigate their surroundings comfortably. These features can be helpful to younger people as well. However, not all younger people are reliant on mobile apps for travel. Some may prefer traditional methods such as guidebooks or simply asking locals or their friends and family for recommendations. Moreover, there may be situations where mobile apps are not practical or reliable, such as when traveling to remote areas with limited internet access.

Half of the users above 30 agree that life becomes boring without mobile apps, while majority of those below 30 disagree. Life does not necessarily get boring without mobile applications. While mobile applications can provide entertainment, convenience, and access to information, they are not essential to living a fulfilling life. There are many other ways to stay entertained, connect with others, and access information without mobile applications. For example, you can

participate in outdoor activities, spend time with friends and family in person, attend events and gatherings, and engage in hobbies and interests that do not require mobile technology.

Table 17 Phone usage and comfortability of age groups

		Age (In years)		
		Below 20	21-30	31-40
Time required to learn app:	Few hours	85.2%	89.4%	92.9%
	Few days	13.1%	8.7%	7.1%
	Few weeks	0.0%	1.1%	0.0%
	Few months	1.6%	0.8%	0.0%
Time on phone daily:	0 - 3 hrs	26.2%	22.1%	14.3%
	3 - 6 hrs	41.0%	39.9%	57.1%
	6 - 9 hrs	26.2%	26.2%	21.4%
	9 - 12+ hrs	6.6%	11.8%	7.1%
operating system:	Android	80.3%	78.3%	92.9%
	Apple	19.7%	19.4%	7.1%
	Windows	0.0%	2.3%	0.0%
Phone acquired:	Purchased	78.7%	85.2%	92.9%
	Gifted	21.3%	14.8%	7.1%
Comfortable with fin-banking & insurance apps:	Uncomfortable	42.6%	20.2%	21.4%
	Neutral	23.0%	24.3%	21.4%
	Comfortable	34.4%	55.5%	57.1%
Safe using credit card on app:	Yes	23.0%	24.3%	7.1%
	No	34.4%	37.6%	42.9%
	Maybe	42.6%	38.0%	50.0%

Table 18 App usage frequency by age group

		Age (In years)								
		Below 20			21-30			31-40		
		1	2	3	1	2	3	1	2	3
Lifestyle	Careem	10%	21%	69%	9%	37%	54%	7%	21%	71%
	Uber	7%	23%	70%	5%	33%	63%	7%	29%	64%
	Svwl	0%	11%	89%	3%	13%	84%	0%	0%	100%
	Indriver	11%	31%	57%	23%	33%	44%	36%	29%	36%
	Bykea	10%	25%	66%	10%	28%	62%	7%	14%	79%
	Foodpanda	28%	30%	43%	32%	41%	26%	36%	14%	50%
	Grocerapp	5%	11%	84%	7%	13%	79%	14%	14%	71%
	Spotify	34%	5%	61%	29%	12%	59%	21%	7%	71%

	Sound Cloud	30%	10%	61%	33%	16%	51%	29%	29%	43%
Social media	Instagram	90%	0%	10%	85%	5%	10%	50%	14%	36%
	Facebook	59%	11%	30%	79%	10%	12%	93%	0%	7%
	Snapchat	79%	10%	11%	66%	9%	25%	29%	14%	57%
	Twitter	28%	16%	56%	42%	15%	43%	21%	14%	64%
	Whatsapp	100%	0%	0%	96%	3%	1%	100%	0%	0%
	LinkedIn	20%	21%	59%	47%	21%	32%	86%	14%	0%
Productivity / Utility	Docs	74%	10%	16%	72%	14%	14%	86%	0%	14%
	Sheets	46%	28%	26%	49%	25%	26%	79%	0%	21%
	Email	80%	11%	8%	91%	6%	3%	86%	0%	14%
	Dictionary	56%	13%	31%	46%	25%	28%	43%	21%	36%
	Calculator	84%	11%	5%	86%	11%	3%	100%	0%	0%
	Notepad	62%	23%	15%	65%	18%	17%	57%	14%	29%
	M-banking	34%	18%	48%	63%	14%	23%	93%	0%	7%
	Wallet/Pay	28%	16%	56%	32%	13%	55%	14%	0%	86%
	Skype	7%	18%	75%	12%	16%	72%	7%	21%	71%
	Zoom	18%	43%	39%	17%	36%	47%	29%	43%	29%
	Teams	15%	28%	57%	30%	27%	43%	36%	21%	43%
	Cap cut	23%	21%	56%	11%	13%	77%	8%	0%	92%
	Google map	52%	33%	15%	58%	35%	7%	92%	8%	0%
Games/ Entertainment	Youtube	97%	3%	0%	97%	3%	0%	100%	0%	0%
	Netflix	30%	16%	54%	49%	13%	38%	36%	21%	43%
	Tik Tok	39%	5%	56%	20%	7%	73%	21%	0%	79%
	PUBG	8%	10%	82%	10%	6%	84%	7%	0%	93%
	Ludo Star	10%	15%	75%	7%	14%	79%	0%	0%	100%
	Subway Surfer	10%	13%	77%	6%	11%	83%	0%	8%	92%
Candy Crush	7%	13%	80%	9%	9%	82%	8%	8%	83%	
1: Frequent use, 2: Monthly use, 3: Don't use										

Table 19 Adoption and switching factors by gender

		Age (In years)					
		Below 20		21-30		31-40	
		Yes	No	Yes	No	Yes	No
Future Application	Virtual Shopping	34.4%	65.6%	50.2%	49.8%	50.0%	50.0%
	Artificial Intelligence	57.4%	42.6%	63.7%	36.3%	66.7%	33.3%
	Augmented Reality	9.8%	90.2%	33.0%	67.0%	25.0%	75.0%
	Voice Shopping	11.5%	88.5%	22.3%	77.7%	16.7%	83.3%
	Delivery Drones	27.9%	72.1%	40.9%	59.1%	41.7%	58.3%
	Visual Product Search	24.6%	75.4%	36.7%	63.3%	25.0%	75.0%
	Virtual Shopping Assistant	16.4%	83.6%	26.5%	73.5%	33.3%	66.7%

Requirements to use apps easily	Awareness	37.7%	62.3%	40.5%	59.5%	64.3%	35.7%
	Training	9.8%	90.2%	8.4%	91.6%	7.1%	92.9%
	Personal Interest	60.7%	39.3%	68.4%	31.6%	64.3%	35.7%
	Video Tutorial	18.0%	82.0%	25.5%	74.5%	7.1%	92.9%
What influences to download app	Family	18.0%	82.0%	24.0%	76.0%	28.6%	71.4%
	Friends	34.4%	65.6%	46.8%	53.2%	28.6%	71.4%
	social media	62.3%	37.7%	68.8%	31.2%	57.1%	42.9%
	reviews & ratings	32.8%	67.2%	41.4%	58.6%	57.1%	42.9%
Advantage of mobile apps over web apps	24/7 access	52.5%	47.5%	64.6%	35.4%	57.1%	42.9%
	Use while traveling	34.4%	65.6%	57.0%	43.0%	71.4%	28.6%
	Ease of adoption	37.7%	62.3%	48.3%	51.7%	57.1%	42.9%
	Easy/simple/user friendly	50.8%	49.2%	62.0%	38.0%	57.1%	42.9%
Reasons to uninstall apps	Complexity of usage	31.1%	68.9%	35.7%	64.3%	50.0%	50.0%
	False Advertisement	45.9%	54.1%	47.5%	52.5%	57.1%	42.9%
	Too many Advertisements	50.8%	49.2%	68.8%	31.2%	92.9%	7.1%
	Unfriendly User interface	32.8%	67.2%	42.6%	57.4%	64.3%	35.7%
	Delay in refund	8.2%	91.8%	18.6%	81.4%	14.3%	85.7%
	Poor customer service	31.1%	68.9%	40.7%	59.3%	28.6%	71.4%
	Security concerns	27.9%	72.1%	37.3%	62.7%	42.9%	57.1%
Purpose of using apps	Helps in educational needs	78.7%	21.3%	77.6%	22.4%	71.4%	28.6%
	Addresses job related needs	44.3%	55.7%	58.2%	41.8%	57.1%	42.9%
	Reduces effort & improves productivity	47.5%	52.5%	62.4%	37.6%	78.6%	21.4%
	Save time in various tasks	63.9%	36.1%	71.1%	28.9%	85.7%	14.3%
	Saves money/good deals/cashback	41.0%	59.0%	49.4%	50.6%	50.0%	50.0%
	Makes life easier	62.3%	37.7%	65.0%	35.0%	71.4%	28.6%
	Reduces mental effort	32.8%	67.2%	36.9%	63.1%	28.6%	71.4%
Mobile application helps:	Accomplish things more quickly	65.6%	34.4%	70.7%	29.3%	85.7%	14.3%
	Achieve important things	60.7%	39.3%	65.0%	35.0%	64.3%	35.7%
Without mobile app:	Life gets boring	44.3%	55.7%	50.2%	49.8%	42.9%	57.1%
	Traveling becomes difficult	42.6%	57.4%	47.1%	52.9%	57.1%	42.9%

Chapter 5

Conclusion

This study is an exploratory analysis to determine the factors affecting mobile app adoption and switching behavior. The data used for this study is collected via a semi-structured survey from 354 students of NUST University. The analysis is based on uni-variable and bi-variable analysis of the collected variables. Gender and Age groups are analyzed against all variables. The gender distribution of respondents is roughly equal. Most respondents are in the age bracket 21-30, some are below 20, and very few are above 31. The survey respondents are using mobiles more than the average global screen time.

Respondents are mainly from Karachi, Islamabad/Rawalpindi, Faisalabad, and Lahore. About 50% of them have traveled and have relatives abroad. The majority of respondents are Android users with purchased phones. A major proportion of respondents are graduates, while the remaining are undergraduates and post-graduates with work experience of less than five years of majority.

The respondents use Bykea, Careem, and Indriver more than Uber and Swvl. While Foodpanda is preferred over Grocerapp and Soundcloud over Spotify. In social media apps, WhatsApp is the most used messenger. While Instagram and Facebook are used more than Snapchat, LinkedIn, and Twitter. In utility and productivity apps, google maps, email, and calculator are the top-used apps, while in entertainment apps, Youtube has the highest number of users.

The respondents found it very easy to download and use the applications. They also selected personal interest and awareness as the factors for using mobile apps without any challenges.

Artificial intelligence, Virtual shopping, and Delivery drones are the three most preferred features that respondents want to see in mobile apps in the future.

Social media is the most influencing reason to download an application. The influence of reviews and ratings, and friends also seemed significant. While family influence is found to be low. However, when it comes to uninstalling the application, too many advertisements and false advertisements are the most. The greatest advantage of mobile apps over web apps is 24/7 access and easy and simple operations.

Most of the respondents found mobile applications to be useful. The most selected purposes of using mobile applications are that they help with educational needs, save time, and make life easier. When it comes to using finance and banking apps, half of the respondents are comfortable using them. While the remaining half are either uncomfortable or have neutral views. However, concerning the use of credit cards on mobile applications, only some are comfortable entering the details, while the majority are either uncomfortable or have neutral views.

The female respondents needed slightly more time to learn mobile apps, and they spent more time on their phones than males. Conversely, males are more comfortable with financial banking applications and using credit cards on mobile apps. Both genders selected artificial intelligence, augmented reality, and delivery drones as the most demanded future applications. They also selected personal interest as a major factor in using mobile apps without any challenges. The influence of social media was about equality for both genders. While the advantages of mobile apps are chosen more by males than females.

Both genders selected too many advertisements and unfriendly user interfaces as the major reason to uninstall an app. Both genders disagreed that traveling is made easier by mobile apps, while more males disagreed that life becomes boring without mobile apps.

Males use commuting apps like Careem, uber, and Bykea more than females. They also use music apps SoundCloud and Spotify. In contrast, females use food delivery apps like Foodpanda and groceapp more. Social media apps like LinkedIn, Twitter, and Facebook are used more by males, while females use Snapchat and Instagram more. Males more frequently use mobile wallets and mobile banking apps, while the casual gaming apps mentioned in the survey are used more by females.

With the increase in age, the time spent on the phone is decreasing, and the respondents in the age group 21-30 spend more time on mobile. Most of the respondents are Android users, while the iPhone users are mainly in younger groups. Younger respondents are less comfortable using finance and banking apps but more comfortable using credit cards.

Indrive is the most used commuting app in all age groups, especially 30+ users. Foodpanda is preferred over Grocerapp and is used the most by the age group 21-30. The younger groups prefer Spotify, while the adults use Soundcloud more. Users below 20 use Instagram and Snapchat more frequently, while users between 21-30 use Instagram and Facebook, whereas 30+ users use Facebook the most. The LinkedIn app is used more with the growing age.

The use of dictionary apps is decreasing with increasing age since older people have a better vocabulary and understanding of words. At the same time, the use of mobile banking apps is increasing with the increasing age. Free gaming apps are used more by users below 20. While the use of TikTok is decreasing with age.

Artificial intelligence is the most wanted future app in all age groups, especially age group 31-40. Augmented reality is least preferred by respondents below 20, while the users above 20 least preferred voice shopping.

For users below 30, user friendliness and 24/7 access are the most selected advantages of mobile apps over web applications. While for users above 30, easy to use while traveling is the

most selected advantage. The three most selected reasons to uninstall a mobile application are too many advertisements, false advertisements, and unfriendly user interface by all age groups. However, the age group 31-40 found these reasons more affecting than younger age groups. Most of the respondents, especially those below 30, agreed that mobile apps help with educational needs. Respondents also agreed that apps save time, improve productivity, and make life easier. Users above 30 agreed that mobile apps make traveling easier.

5.1 Key findings

- Social media is the most influencing reason to download an application. The influence of reviews and ratings, and friends also seemed significant. While family influence is found to be low.
- Too many advertisements and false advertisements are the reasons that results in uninstalling of mobile apps
- Indriver, Foodpanda and Soundcloud are the most used lifestyle applications. While Instagram and Facebook are two most used social media applications. In entertainment applications, most respondents use youtube while in utility and productivity applications, google maps, email and calculator are used most.
- Artificial intelligence, Virtual shopping, and Delivery drones are the three most preferred features that respondents want to see in mobile apps in the future.

5.2 Limitations and Recommendations

Certain limitations of our study create scope for future research without undermining the value of the present study. The proposed study will proceed with the following limitations:

1. The study is conducted in Pakistan, and the findings are specific to the Pakistani market. Thus, future studies could investigate the same factors with data from different markets. Such a comparative study would increase the generalizability of the present study and bring out contrasting results (if they exist).
2. The research is based on the survey responses from young and young adults known to be technology ready. Thus, a future study could address whether the same results are good for aged audiences or even those with low technology readiness.

Despite the limitations, the study's novelty lies in its application, and the findings generated provide thoughts to ponder for academicians and marketers.

References

- [1] C. Middleton, "Delivering services over next generation broadband networks: Exploring devices, applications and networks," Toronto Metropolitan University, 2010.
- [2] S. Gupta, "For Mobile Devices, Think Apps, Not Ads," Business Administration at Harvard Business School, 2013.
- [3] Webforum, "IBM created the world's first smartphone 25 years ago," 2018. [Online]. Available: <https://www.weforum.org/agenda/2018/03/remembering-first-smartphone-simon-ibm/>.
- [4] Tigermobiles, "Evolution of the mobile phone," 2019. [Online]. Available: <https://www.tigermobiles.com/evolution/>.
- [5] Ani Petrosyan, "Countries with the largest digital populations in the world as of January 2023," 2023. [Online]. Available: <https://www.statista.com/statistics/262966/number-of-internet-users-in-selected-countries/>.
- [6] S. Kemp, "DIGITAL 2023: PAKISTAN," Datareportal, 13 february 2023. [Online]. Available: <https://datareportal.com/reports/digital-2023-pakistan/>.
- [7] World Bank, "Individuals using the Internet (% of population) - Pakistan," 2021. [Online]. Available: <https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=PK>.
- [8] PTA, "Telecom indicators," 2023. [Online]. Available: <https://www.pta.gov.pk/en/telecom-indicators>.
- [9] F. Laricchia, "Penetration rate of smartphones in selected countries 2022," 2022. [Online]. Available: <https://www.statista.com/statistics/539395/smartphone-penetration-worldwide-by-country/>.
- [10] Dawn News, "Pakistan fastest growing apps market worldwide in 2022: report," 2023. [Online]. Available: <https://www.dawn.com/news/1734936>.
- [11] Statista, "Number of smartphone mobile network subscriptions worldwide from 2016 to 2022, with forecasts from 2023 to 2028," 2023. [Online]. Available: <https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/>.
- [12] Statista, "Number of apps available in leading app stores as of 3rd quarter 2022," 2022. [Online]. Available: <https://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/>.
- [13] Statista, "Revenue of mobile apps worldwide 2017-2025, by segment," 2021. [Online]. Available: <https://www.statista.com/forecasts/1262892/mobile-app-revenue-worldwide-by-segment>.
- [14] N. Zakaria, "Pakistan IT Sector Poised to Become the Largest Export Industry of the Country: Nafees Zakaria Islamabad:," in *PR No. 91*, islamabad, 2019.

- [15] Geo News, "Google research highlights digital revolution overtaking Pakistan," 2021. [Online]. Available: <https://www.geo.tv/latest/362818-google-research-highlights-digital-revolution-overtaking-pakistan>.
- [16] Statista, "Penetration rate of smartphones in selected countries 2021," 2022. [Online]. Available: <https://www.statista.com/statistics/539395/smartphone-penetration-worldwide-by-country/>.
- [17] Statista, "Number of mobile app downloads worldwide from 2019 to 2021, by country(in billions)," 2022. [Online]. Available: <https://www.statista.com/statistics/1287159/app-downloads-by-country/>.
- [18] Techbehemoths, "There are 2 Companies in Pakistan," 2023. [Online]. Available: <https://techbehemoths.com/companies/expert-testimony/pakistan>.
- [19] Techbehemoths, "There are 246 Companies in Pakistan," 2023. [Online]. Available: <https://techbehemoths.com/companies/mobile-app-development/pakistan>.
- [20] Express Tribune, "IT sector contributing \$3.5b to GDP: minister," 2022. [Online]. Available: <https://tribune.com.pk/story/2338165/it-sector-contributing-35b-to-gdp-minister>.
- [21] F. D. Davis, "User acceptance of information technology: System characteristics, user perception," *International Journal of Man-Machine Studies*, 1993.
- [22] Davis, F.D, Bagozzi, R.P and P. Warshaw, "User acceptance of computer technology: A comparison of two theoretical models," 1989.
- [23] V. Venkatesh and H. Bala, "Technology acceptance model 3 and a research agenda on interventions," *Decision Sciences*, 2008.
- [24] V. Venkatesh and F. Davis, "A theoretical extension of the technology acceptance model: Four longitudinal field studies.," *Management Science*, 2000.
- [25] S. Balasubramanian, R. Peterson and S. Jarvenpaa, "Exploring the implications of m-commerce for markets and marketing.," *Journal of the Academy of Marketing Science*, 2002.
- [26] C. López-Nicolás and F. J. Molina-Castillo, " An assessment of advanced mobile services acceptance: Contributions from TAM and diffusion theory models.," *Information & Management*, 2008.
- [27] D. G. Taylor and T. A. Voelker, "Mobile application adoption by young adults: A social network perspective.," *International Journal of Mobile Marketing*, 2011.
- [28] K. Heinonen and T. Strandvik, "Consumer responsiveness to mobile marketing. International," *Journal of Mobile Communications*, 2007.
- [29] J. Lu, J. E. Yao and C. Yu, "Personal innovativeness, social influences and adoption of wireless internet services via mobile technology.," *The Journal of Strategic Information Systems*, 2005.
- [30] W. Shi, "An empirical research on users' acceptance of smart phone online application software," *International Conference on Electronic Commerce and Business Intelligence*, 2009.

- [31] L. Wu, M. Kang and S. Yang, "What makes users buy paid smartphone applications? Examining app, personal, and social influences.," *Journal of Internet Banking and Commerce*, 2015.
- [32] S. Roy, "App adoption and switching behavior: applying the extended tam in smartphone app usage," *Journal of Information Systems and Technology Management*, 2017.
- [33] J. M. Reneau, "An examination of the acceptance, adoption, and diffusion of smartphone devices with senior citizens.," *Doctoral dissertation*, 2013.
- [34] N. Arora, M. Garima and C. Deepak, "Factors Affecting Consumer Adoption of Mobile Apps in NCR: A Qualitative Study," *Global Business Review*, 2020.
- [35] V. Vinnik, "User Adoption of Mobile Applications : Extension of UTAUT2 Model," *Norwegian school of economics*, 2017.
- [36] Global stats, "Mobile Operating System Market Share Pakistan," February 2023. [Online]. Available: <https://gs.statcounter.com/os-market-share/mobile/pakistan/#monthly-202202-202302-bar>.
- [37] J. Howarth, "Time Spent Using Smartphones (2023 Statistics)," 9 January 2023. [Online]. Available: <https://explodingtopics.com/blog/smartphone-usage-stats>.
- [38] Similarweb, "Top Apps Ranking," 2023. [Online]. Available: <https://www.similarweb.com/apps/top/google/store-rank/pk/all/top-free/>.
- [39] Duckma, "What Are the Different Types of Mobile Apps?," 2022. [Online]. Available: <https://blog.duckma.com/en/types-of-mobile-apps/>.
- [40] buildfire, "Mobile App Download Statistics & Usage Statistics (2023)," 2023. [Online]. Available: <https://buildfire.com/app-statistics/>
- [41] H. K. Yau and A. L. F. Cheng, "Gender Difference of Confidence in Using Technology," Honk Kong.
- [42] C. Allison, "Woman spend more time using the internet on their mobile phones than men, study finds," 2016. [Online]. Available: <https://www.digitalspy.com/tech/smartphones/a796313/woman-spend-more-time-using-internet-on-mobile-phones-than-men-study-finds/>.
- [43] Statista, "Time spent on smartphone compared with partner in the U.S. 2021, by gender," 2021. [Online]. Available: <https://www.statista.com/statistics/1224535/time-spent-on-smartphone-and-with-partner-by-gender-us/>.
- [44] J. He and L. A. Freeman, "Are Men More Technology-Oriented Than Women? The Role of Gender on the Development of General Computer Self-Efficacy of College Students.," 2009.
- [45] Samsung, "Women Shop For Tech Differently Than Men Do -- And Why That Matters," 2017. [Online]. Available: <https://www.forbes.com/sites/samsung/2017/11/13/women-shop-for-tech-differently-than-men-do-and-why-that-matters/?sh=1a073a3257a8>.
- [46] R. Replogle, Interviewee, *executive vice president and cash product manager, Federal Reserve System's Cash Product Office*. [Interview]. 19 June 2019.

- [47] Rain, "Battle of the Sexes: How Men and Women Use Apps," 2020. [Online]. Available: <https://rainlocal.com/2020/02/17/battle-of-the-sexes-how-men-and-women-use-apps/>.
- [48] A. Sharma, "Careem records 4.3 million rides in first 10 months of 2021," 2021. [Online]. Available: <https://www.thenationalnews.com/business/technology/2021/11/30/careem-records-43-million-rides-in-first-10-months-of-2021/>.
- [49] E. Petersen, "Highlighting the Gender Gap on Music Streaming Platforms," 2021. [Online]. Available: <https://medium.com/blokur/highlighting-the-gender-gap-on-music-streaming-platforms-d4dab1bab150>.
- [50] H. Norris, "Battle of the Sexes – Who Orders Online Food More?," 2019. [Online]. Available: <https://www.restroapp.com/blog/battle-sexes-orders-online-food-more/>.
- [51] S. Thomsen, "Women love food delivery more than men – and millennials most of all," 2021. [Online]. Available: <https://www.startupdaily.net/topic/business/women-love-food-delivery-more-than-men-and-millennials-most-of-all/>.
- [52] H. Seligson, "Why Are More Women Than Men on Instagram?," 2016. [Online]. Available: <https://www.theatlantic.com/technology/archive/2016/06/why-are-more-women-than-men-on-instagram/485993/>.
- [53] L. Rao, "LinkedIn: Men Are More Savvy Networkers Than Women," 2011. [Online]. Available: <https://techcrunch.com/2011/06/22/linkedin-men-are-more-savvy-networkers-than-women/>.
- [54] D. Kumar and A. Sriram, "The Attitude towards Smartphones and its Influence on Process, Social and Compulsive Usage," 2018.
- [55] SimbirSoft, "10 Things to Keep in Mind While Developing an App in 2021," SimbirSoft World, 2021. [Online]. Available: <https://medium.com/simbirsoft/10-things-to-keep-in-mind-while-developing-an-app-in-2021-8af8ecf49f86>.
- [56] Techjury, "55+ Jaw Dropping App Usage Statistics in 2023 [Infographic]," 19 april 2023. [Online]. Available: <https://techjury.net/blog/app-usage-statistics/>.
- [57] P. BANDARA, "Gen Z Shunning Android Phones in Favor of the iPhone's Camera," 2 march 2023. [Online]. Available: <https://petapixel.com/2023/03/02/gen-z-shunning-android-phones-in-favor-of-the-iphones-camera/>
- [58] wikipedia, "soundcloud," [Online]. Available: <https://en.wikipedia.org/wiki/SoundCloud/>
- [59] A. Silberling, "US teens have abandoned Facebook, Pew study says," 12 august 2022. [Online]. Available: <https://techcrunch.com/2022/08/11/teens-abandoned-facebook-pew-study/>.
- [60] S. Nover, "TikTok Statistics – Updated Mar 2023," 2023. [Online]. Available: <https://wallaroomedia.com/blog/social-media/tiktok-statistics/>.
- [61] L. jorge, "The Future of Mobile Apps: Building Intelligent Apps with Artificial Intelligence and Machine Learning," 28 february 2023. [Online]. Available: <https://medium.com/@livajorge7/the-future-of-mobile-apps-building-intelligent-apps-with-artificial-intelligence-and-machine-5716da563c15>.

- [62] N. Deshdeep, "Mobile App Or Website? 10 Reasons Why Apps Are Better," 23 march 2023. [Online]. Available: <https://vwo.com/blog/10-reasons-mobile-apps-are-better/>.
- [63] M. T. Melody and S. C. Ho, "Consumer Attitudes Toward Mobile Advertising: An Empirical Study," 2004.
- [64] Y. H. Kim and J. K. Dan, "A study of mobile user engagement (MoEN): Engagement motivations, perceived value, satisfaction, and continued engagement intention," Decision Support Systems, 2013.
- [65] Technogiq, "How Can Mobile Apps Help Save Time and Money," july 2022. [Online]. Available: <https://www.technogiq.com/blogs/how-can-mobile-apps-help-save-time-and-money/>.

Appendix

6/14/23, 2:49 PM

App adoption and switching behavior (NUST)

App adoption and switching behavior (NUST)

This survey is to research the factors which contribute to adoption of a mobile application and its discontinuous use. A careful and honest response would be appreciated. The survey consists of 6 sections.

Your participation in the survey is completely voluntary and all of your responses will be kept confidential. No personally identifiable information will be associated with your responses to any reports of these data.

** Indicates required question*

1. Do you use a smartphone? *

Mark only one oval.

- Yes *Skip to question 2*
 No

User Info

2. Name

3. Age (In years) *

Mark only one oval.

- Below 20
 21-30
 31-40
 41-50
 Above 50

4. Gender *

Mark only one oval.

- Male
- Female

5. Education *

Mark only one oval.

- Secondary
- Higher secondary
- Undergraduate
- Graduate
- Post graduate
- Other: _____

6. City *

7. Your association with NUST *

Mark only one oval.

- Student
- Faculty
- Worker/Staff
- Alumni
- Visitor
- Other: _____

8. Profession - Department *
(e.g. Professor - SEECs)

9. Employment status *

Mark only one oval.

- Student
- Unemployed
- Employed
- Self employed (business)
- Retired

10. Work Experience *

Mark only one oval.

- Less than 5 years
- 5 - 15 years
- 15- 25 years
- Above 25 years

11. Marital status *

Mark only one oval.

- Married
- Unmarried
- Other: _____

12. Select the statements that apply to you *

Check all that apply.

- I have travelled abroad
 I have close relatives abroad
 None of the above

13. How many of your friend and family have smartphones? *

Mark only one oval.

- None of them
 Few of them
 About half of them
 All of them

Phone Information

14. Which operating system do you have? *

Mark only one oval.

- Android
 Apple
 Windows
 Other: _____

15. How was the phone acquired?

Mark only one oval.

- Purchased
 Gifted
 Other: _____

16. How long have you owned a smartphone? *

Mark only one oval.

- Less than 5 years
- 5 - 10 years
- 10 - 15 years
- More than 15 years

17. How much time do you spend on phone daily? *

Mark only one oval.

- 0 - 3 hrs
- 3 - 6 hrs
- 6 - 9 hrs
- 9 - 12+ hrs

Mobile Applications

18. Do you use mobile apps on phone? *

Mark only one oval.

- Yes
- No

19. Tick the Lifestyle apps in your use *

Mark only one oval per row.

	Daily	Weekly	Monthly	Don't use
Careem	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Uber	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Svvl	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Indriver	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bykea	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Foodpanda	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grocerapp	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spotify	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sound Cloud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

20. Tick the Social media apps in your use *

Mark only one oval per row.

	Daily	Weekly	Monthly	Don't use
Instagram	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Snapchat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Twitter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whatsapp	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
LinkedIn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21. Tick the Utility & Productivity apps in your use *

Mark only one oval per row.

	Daily	Weekly	Monthly	Don't use
Docs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sheets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Email	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dictionary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Calculator	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Notepad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mobile banking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wallet/Pay	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skype	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Zoom	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cap cut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google map	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22. Tick the Entertainment/Games apps in your use *

Mark only one oval per row.

	Daily	Weekly	Monthly	Don't use
Youtube	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Netflix	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tik Tok	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PUBG	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ludo Star	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Subway Surfer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Candy crush	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23. Mention other apps in your use *

24. What other types of mobile application do you think will be useful in the future? *

Check all that apply.

- Virtual Shopping
- Artificial Intelligence
- Augmented Reality
- Voice Shopping
- Delivery Drones
- Visual Product Search
- Virtual Shopping Assistant
- Other: _____

Users skill level

25. How difficult do you find to download & use applications on mobile? *

Mark only one oval.

Easy

1

2

3

4

5

Difficult

26. What is required to use an app without any challenge? (Check all that apply) *

Check all that apply.

- Training
- Video tutorial
- Awareness
- Personal interest
- Other: _____

27. How much time is required by you to learn and use a new mobile application? *

Mark only one oval.

- Few minutes
- Few days
- Few weeks
- Few months
- Other: _____

App adoption and discontinuation

28. What influences you to download & use an app? (Check many if applicable) *

Check all that apply.

- Family
- Friends
- Media/Social Media
- Reviews and Ratings
- Other: _____

29. Advantages of mobile app over web pages? (Check many if applicable) *

Check all that apply.

- 24/7 access
- Easy to use while traveling
- Efficient/Ease of adoption
- Easy/simple operation/user friendly
- Other: _____

30. What makes you uninstall an app? (Check many if applicable) *

Check all that apply.

- Complexity of usage
- False Advertisement
- Too many Advertisements
- Unfriendly User interface
- Delay in refund after unsuccessful payment
- Poor customer service
- Security concerns
- Other: _____

App Usefulness

31. Rate the usefulness of mobile application in daily life? *

Mark only one oval.

Not Usefull

1

2

3

4

5

Very Usefull

32. Purpose of using Mobile Apps? (Check all that apply) *

Check all that apply.

- Helps in educational needs
- Addresses job related needs
- Reduces effort & improves productivity
- Save time in various tasks
- Saves money/good deals/for cashback
- Makes life easier
- Reduces mental effort
- Other: _____

33. Do you agree with the following? (Check many if applicable) *

Check all that apply.

- Mobile app increases your chance of achieving things that are important to you
- Mobile apps help accomplish things more quickly
- Life get boring without mobile apps
- It would get difficult to travel / books cabs without apps

34. How comfortable are you to use finance banking and insurance apps? *

Mark only one oval.

Uncomfortable

1

2

3

4

5

Comfortable

35. Do you feel safe while entering your credit card info in app? *

Mark only one oval.

Yes

No

Maybe

This content is neither created nor endorsed by Google.

Google Forms