Usability Evaluation of Mobile Banking Applications in Digital Business as Emerging Economy

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Summary

Mobile Banking Applications (MBAPs) is one of the recent fads in mobile trading applications (Apps). MBAPs permit users to execute exchanges of money and many more whenever it might suit them; however, the primary issue for mobile banking Apps is usability. Hardly any investigation analyzes usability issues dependent on user's age, gender, exchanging accomplices, or experience. The purpose of this study is to determine the degree of usability issues, and experience of mobile banking users. The survey employs a quantitative method and performs user experiment on 240 participants with six different tasks on the application's interface. The post experiment survey is done with concerning participants. On the other hand, banking experts and Information Technology (IT) expert's group is also involved after the experiment. Expert's opinions about existing mobile banking Apps and suggestions for improving usability of MBAPs are collected through physical means (like questionnaire and interview) and online means like Google form. After that comparison of the opinions of users and experts about MBAPs is performed. The experimentation measures the tasks usability of various mobile banking apps with respect to its effectiveness, efficiency, trustfulness, learnability, memorability and satisfaction. The usability testing was led at different Universities and the outcomes acquired show that there are privacy and trust issues with their mobile banking apps. There is also a gap between users and experts which should be minimized by applying customized usability models, modes concept like other application software and also by adding complete features of banking in MBAPs. It will benefit mobile banking apps users, developers and usability engineers by providing user-friendly which are up to the mark of user's requirements.

Keywords:
Memorability, Learnability, Usability evaluation, Efficiency, Effectiveness, UCD model, Expert group

1. Introduction

With years of the mobile experience, the results show that there are not too many usability issues across the year categories. The reach and accessibility of mobile applications are growing quickly. With the expanded handling power accessible on versatile gadgets, designers are expanding the scope of administrations by embracing cell phones in their broad and different practices. The current usability models do not sufficiently catch the complexities of communicating with banking applications on a mobile platform [1]. Existing usability models for mobile banking applications are in their early stages worldwide yet with time and more exploration they may ultimately be received. Additionally, various classes of mobile apps like clinical, entertainment, and schooling have different functional and non-functional requirements subsequently customizable models are needed for assorted mobile Apps. As discussed the usability of banking Apps, it is basically effectiveness, efficiency, learnability, easiness, performance, and satisfaction of the mobile banking Apps users [2]. There are a lot of benefits of online banking but if talk about the online banking applications on mobile or smartphones then there is genuine ease, convenience, and a lot more. Real usability is achieved by the user if he or she uses mobile banking apps. On the other hand, there is a lot of issues to the banking sector for launching these types of apps like security, latency, functionality, performance, transfer delay, mobile-resources consuming apps, personal data disclosure [3]. In the pandemic situation of the corona users of mobile banking Apps increasing day by day. So for the ease, convenience, and satisfaction of users, there is a need for an hour to make the banking app more and more usable. Hence evaluation of mobile banking apps used in Asia in the context of improvement is necessary. Most of the banking apps locally in these countries are not up to the mark of usability criteria. As mobile banking apps are a new and emerging idea/concept in third-world countries [4].

The study of usability evaluation of mobile banking apps is not largely conducted especially in context with interface usability. it is very significant these days because it creates awareness about the usability evaluation of mobile banking apps. it is also discovering that new and significant solutions are available for developing more usable banking apps. but no adequate solution has been found till now due to incremental features, fast

development of banking apps, and lack of user-friendliness. It considers the following hypothesis for the development of more user-friendly and usable m-banking apps with these attributes like effectiveness, efficiency, learnability, performance, easiness, and satisfaction. The vendors and manufacturers need to understand the complexity, intensity of the performance, and failure of free products. The analysis provides the strength to develop error-free, efficient and best performer m-banking apps [5].

2. Literature Review

Mobile banking is a piece of versatile business or m-commerce benefits that permits the users to perform many financial transactions like balance inquiry and funds transfer using cell phones. Additionally, m-banking can be characterized as exchanging important information and administrations that are completed by users at their comfort at any place using smartphones [6]. As indicated by the reviewer in 2020, one of the Asian countries has around 82 million internet clients, making it the ninth biggest country of internet users on planet. Current development rate and business pattern show that concerning Information Communication Technology (ICT) industry will surpass $10-billion imprint by 2020. The report of Hootsuite and Kepios strength of cell phone users, which expanded to 164.9 million in January 2020, recording an expansion of 9.6 million (6.2%) new associations from January 2019. A larger part of individuals (75%) own a cell phone in the third-world country [7].

There were 61.34 million web users in that third-world country in January 2021. There were 173.2 million mobile associations in the country in January 2021. The number of smartphone users in the country expanded by 6.9 million (+4.2%) between January 2020 and January 2021. The number of portable associations in the country in January 2021 was comparable to 77.7% of the complete population [8]. According to a usability point of view, financial institutions introduced the use of internet technology to satisfy their customers' needs and improve their services. The most popular one among the internet services is the m-banking application.

When indulged efficiency, effectiveness, learnability, trustfulness, security, errorless, and satisfaction in mobile banking Apps, it benefits a lot to provide a new way of convenience in the field of online mobile banking [9]. It is very easy to handle all your finance-related transactions/tasks through mobile with the help of mobile banking Apps at your place to make it convenient. Because most of the mobile banking Apps are not user-friendly, due to the users are not convenient and satisfied with online banking as this is the case of money. It is a new concept in underdeveloped countries like Asian countries. Usability is likewise characterized as "the degree to which an item can be utilized by indicated clients to accomplish determined objectives with viability, productivity and fulfillment in a predefined set of utilization" (ISO 9241−11, 1998) [10].

The study elaborates that due to the rapid increase of mobile users, there is a remarkable increase in mobile application users. Therefore, the retaining of mobile users, manufacturers of mobiles increases processing power, storage, functionalities, and services. Now there is a challenge for developers, software engineers, and interface designers to play their part in context with usability to retain mobile application users. But usability evaluation has not entered the phase of maturity yet because no appropriate model is developed till now. The reason is that every category of mobile applications like business, education, entertainment, medical, travel, utility, and social media has its own functional and non-functional needs [11]. So, mature and customizable models are required to improve the usability of mobile banking Apps.

In the view of this study, the usability of mobile apps is done based on these most popular attributes which are effectiveness, efficiency, trustfulness, and satisfaction [12].

According to the theory of paper social and technical factors are essential components for the usability and popularity of mobile applications. In the given study, the analysis shows that social factors are more effective in the popularity and usability of mobile applications. The study is limited because it applied only extracted data of two crowd-sourced web applications. There are some threats of validity and verification due to manual calculations and small data sets from the latest projects only [13].

The analysis of the paper provides an evidence-based usability evaluation framework in which used three levels for evaluation. In its first level, the user-centered design is used for user's tasks; in the second level usability evaluation is done with laboratory settings, and in the third level usability evaluation is done in the real-world environment. So it provides multilevel usability evaluation approaches. Mobile application developers can choose the best one or more according to the situation [14].

Further, the study concerned with usability evaluation of mobile Apps with 36 metrics to make user-centered applications. This study used three models for reliable evaluation; the models are QUIM, mGQM, and GQM. According to participated experts, the results achieved from this evaluation are reliable and verified with the help of metrics [15].

Mobile applications need attention as compared to big-screen computers like desktops or laptops because mobiles have a small screen with real-time notifications. In the coming days, mobiles are used for multitasking, so mobile interfaces should be designed accordingly. It should be simple and users friendly. Most of mobile applications are evaluated in a usability context with attributes where efficiency=100%, effectiveness=96%, and satisfaction=87%, but memorability, learnability, and cognitive load are not evaluated [16].

To a great extent, the study shows that the number of users of mobile and its applications increasing rapidly. There are 4.57 billion mobile users and 175 billion applications are used by users. So to retain the mobile users, software engineers and interface designers should follow the HCI-designed models for increasing the quality of mobile applications in context with usability. It introduces the UCD model with usability attributes as effectiveness, efficiency, satisfaction, understandability, errors, and accessibility [17].

Additionally, the study elaborates most of the developers are not keenly concerned with usability attributes like accessibility and learnability most of the time. Some clever developers are concerned with effectiveness and satisfaction but also not with user-side error protection. It is also discussed 27 issues of usability and recommendations and suggestions for those issues which will be helpful for developers and researchers [18].

The comparative analysis of different mobile banking apps is given in the table below in *Annexure A*.

3. Methodology

The purpose of this research is to explore and develop an understanding of critical concerns error-free, failure-free, more usable, and best performance m-banking Apps [19].

The methodology will be based on quantitative inquiry. It is the systematic empirical investigation of observable phenomena via statistical, mathematical, or computational techniques [12]. The reading initiates a systematic study of the characteristics of usability evaluation of mobile banking apps and their impacts on the cyber world. This investigation compares user thinking to understand the usability of mobile banking apps with experts thinking based on collected data and proposed the best method and suggestions for the development of banking apps after analysis over historical information, and behavioral patterns and made available to the research community [20].

3.1 Efficiency

Efficiency of mobile banking Apps is evaluated three-dimensionally, first, either concerning app perform the specific task completely, accurately, and in short time. Secondly, App load and login or logout in short time as specified. Thirdly, either the concerning app is compatible with various mobiles and also human-computer interaction aptitude [21].

$$\text{Time based Efficiency} = \frac{\sum_{J=1}^{R} \sum_{i=1}^{N} \frac{n_{ij}}{t_{ij}}}{NR}$$

$$= \frac{1}{N} \sum_{i=1}^{N} \frac{n_{ij}}{t_{ij}} \qquad (1)$$

N= No. of Jobs
R= No. of Contestants
n_{ij} = Result of Job I by Participant j (in case of completion n_{ij}= 1 otherwise n_{ij} = 0)
t_{ij} = Time Taken by Participant I to Complete a Task j (in case of the unsuccessful task, the time taken is up to quitting the task)

3.2 Effectiveness

Before you begin to format effectiveness is measured with the help of logical appearance Apps, either interface design has important options and buttons more visible, readable, and easy to access. Secondly, either user moves around different options easily and logically to navigate on mobile banking App. Hence the effectiveness is a combination of logical appearance and navigability of user interface of mobile App [22].

$$\text{Effectiveness} = \frac{\text{Total number of tasks completed successfully}}{\text{Total number of tasks undertaken}} * 100$$

(2)

3.3 Trustfulness

Trustfulness is measured with the help of privacy and reliability. It means to take measures that make sure that no leakage of personal and financial data is related to the user [23]. The second measure is to make sure the error-free and trustworthy software are from the user side. Both measures give confidence to mobile banking Apps users to use online mobile banking [24].

3.4 Learnability

Learnability property means "how easy is it for the user to learn to use the system". It can be achieved if our software interface is simple and has conventionally similarities to the other software. Because people are not working any harder than necessary to use technology and do not like unique software as people learned from past experiences [25]. Different users have different difficulty levels; it is also a noticeable point to achieve/evaluate the learnability characteristic of mobile banking Apps [26].

3.5 User Satisfaction

Satisfaction can be achieved in three ways. First of all, interface text or content should value the user in context with the importance of user and achieving the goal of the user through App. Secondly, the interface should guide the user throughout the task for which he or she uses it. Thirdly different tasks for completing a transaction/achieving a goal should be well organized [27].

3.6 Selection of Banking App Features

A systematic study is initiated for the characteristics of more usable m-banking Apps and their impacts on the cyber world, and the banking industry. Evaluation of different m-banking Apps for six features as 1) balance inquiry, 2) mini statement ,3) transfer funds to same bank, 4) transfer funds to other bank, 5) pay utility bills, and 6) mobile top-ups, and proposed the best m-banking Apps. It is the model with features after analysis over historical information and behavioral patterns and made available to the research community.

A post-test is also conducted with the help of a questionnaire tool. After analysis real-time data are used for the verification and validation of results. These deduced results will apply to many other m-banking Apps in the fields of banking, software engineering, and computer science [28].

3.7 User-Centered Approach

The User Center Model (UCD) is a research method that optimizes mobile applications by strengthening their usability and reducing the cost. The main goals of the UCD model are satisfaction, memorable, learnable, effective, efficient, and customizable design or interface for the users. This model collects the requirements from users and experts, and then develops design accordingly, calculate usability attributes. In the end recommendations and suggestions are given based on comparison and evaluation of results.
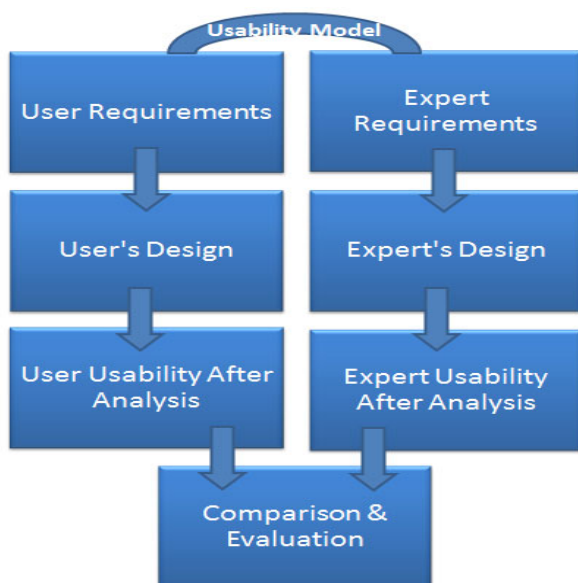

Fig. 1. Research Methodology

Fig.1. represents the customized UCD model according to the problem statement.

4. Selection of Apps and Sample Size

The usability testing was led at different university campuses and 450 fellows were designated at a first level however after filtration 240 members were recruited for the investigation. There were thirty-one features mentioned in Annexure A but most likely twelve features of m-banking Apps concerning interface. It was decided to evaluate m-banking Apps for six features due to the availability of relevant participants. Participants were divided into six groups started from group I up to group VI. Each group was assigned a task for assessing and evaluating the usability of one feature at a time, all attributes like effectiveness, efficiency, learnability, memorability, and satisfaction [29]. Table IV in *Annexure A* shows 44 apps with their banks and concerning features.

4.1 Group I: Task (Balance Inquiry)

In the task, 30 words were given to the users for typing to his/her friend as a greeting message. The point was to analyze whether the action of Balance Inquiry on and off being performed may influence the effectiveness, efficiency, and satisfaction of the client. The most extreme time assigned for this errand was five minutes considering normal and most pessimistic scenario composing speed. The trial was noticed cautiously by keeping up with their record. The normal time for task finishing was 28.8 minutes [30].

4.2 Group II: Task (Mini Statement)

Users were directed to perform this task with their consent of them by using their mobile phones. The apportioned time was three minutes and determined by the idea of assignments that incorporates looking and choice of substance from the gadget. The undertaking fulfillment time is noted concerning the execution of each command. Normal undertaking fulfillment time was 1 minutes.

4.3 Group III: Task (Transfer Funds to Same Bank)

Selected participants were requested to transfer Rs. 500 to his friend having an account in the same bank with their consent. The participants were cross-examined to enroll their sentiments especially about different questions asked, messages displayed regarding security, PIN, and repeatedly asked about the PIN, etc. during funds transfer transactions.

4.4 Group IV: Task (Transfer Funds to Other Bank)

Selected participants were requested to transfer Rs.500 to his friend having an account in another bank with their consent. The participants were cross-examined to enroll their sentiments especially about different questions asked and messages displayed regarding security, PIN, and repeatedly asked about the PIN, etc. during funds transfer transactions.

4.5 Group V: Task (Pay Utility Bills)

Selected participants were requested to pay their utility bills like Gas Bill, Electricity Bill and Mobiles and telecommunication services Bill from their accounts with their consent. The participants were cross-examined to enroll their sentiments especially about different questions asked and messages displayed regarding security, PIN, and repeatedly asked about the PIN, etc. during the Pay Utility Bill transaction.

4.6 Group VI: Task (Mobile Top Ups)

Selected participants were requested to charge their mobile accounts like Jazz, Telenor, Ufone, and Zong from their accounts with their consent. The participants were cross-examined to enroll their sentiments especially about different questions asked and messages displayed regarding security, PIN, and repeatedly asked about the PIN, etc. during Mobile Top Ups transaction [31].

This test was overseen on a college campus student. The members were coordinated to perform three exercises, for example, the errands were arranged and executed for class length in the college. The normal errand finishing time was five minutes. Table 1 shows the real image of gatherings, assignments, sub-errands, members, time, and post undertaking assessment procedure [32].

Table 1: Activity Table

Sr. No.	Group	Task	Sub Task	Total Participants	Total Time Taken (In Minutes)	Post Test Evaluation
1	I	Balance Inquiry	Write Greeting Message to Friends of 30 Words	40	5 Minutes	Ask Questions
2	II	Mini Statement	N.A	40	2 minutes	Ask Questions
3	III	Transfer Funds to the Same Bank	N.A	40	5 Minutes	Ask Questions
4	IV	Transfer Funds to the Other	N.A	40	5 Minutes	Ask Questions

		Bank				
5	V	Pay Utility Bills	N.A	40	3 Minutes	Ask Questions
6	VI	Mobile Top Ups	N.A	40	3 Minutes	Ask Questions

Table 2: Most Frequently Used and Available Features

Sr. No.	Most Frequently Used Features	Percentage
1	Balance Inquiry	96%
2	Mini Statement	73%
3	Transfer Funds to Same Bank	91.11%
4	Transfer Funds to Other Bank	86.67%
5	Pay Utility Bills	89%
6	Mobile Top Ups	60%
7	Donation & Merchant Payments	44.40%

Table II. shows the most frequently used and available features of mobile banking apps.

5. Results and Discussion

5.1 Effectiveness

$$Effectiveness = \frac{(169*6 + 55 + 80 + 45 + 45 + 10)}{240*6} * 100$$

$$Effectiveness = \frac{1249}{1440} * 100$$

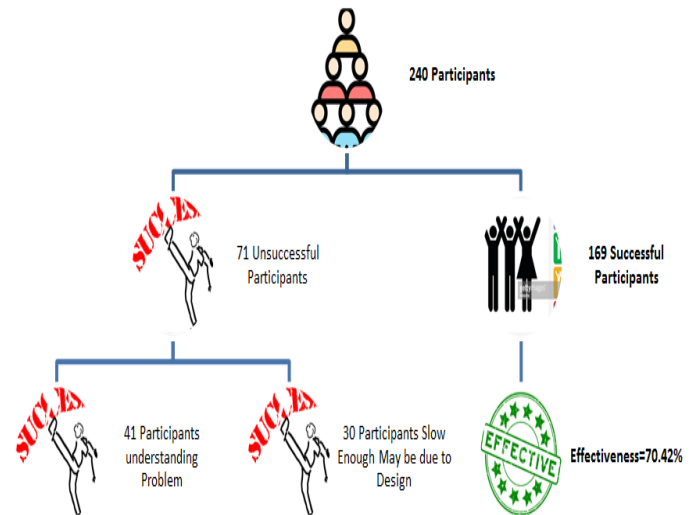$$Effectiveness = 86.74\%$$

Fig. 2: Mobile Banking Apps Effectiveness [25]

Fig.2. shows the effectiveness of mobile banking apps with the help of percentage of successful participants
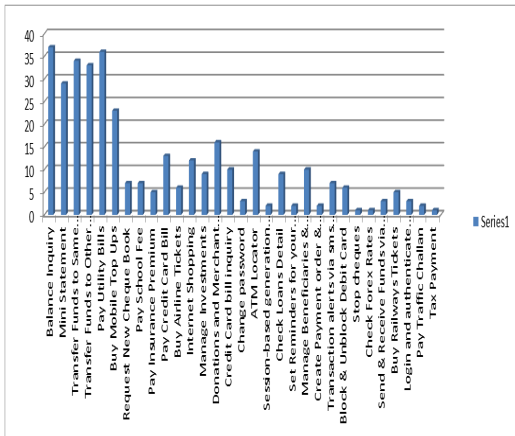
Fig. 3: Number of Times Features Used

Fig.3. shows the number of time features used in collected mobile banking apps.

5.2 Efficiency

Efficiency=
$$\frac{(51.5+46.27+46.53+46.12+50.15+46.50)}{6} * 169$$
Efficiency = 0.28

OR

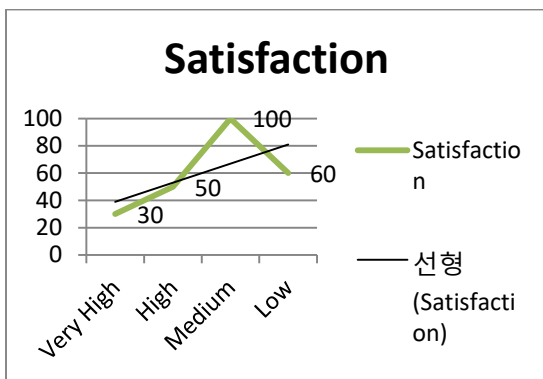Efficiency= $\frac{(51.5+46.27+46.53+46.12+50.15+46.50)}{6}$.
Efficiency = 47.32

Fig.4: Users Satisfaction Intensity

As seen from Fig. 4. Most of the mobile banking users have not fully trust and satisfaction on them. Less than 50% of mobile banking users have high and very high satisfaction level on mobile banking apps. More than 66% users have medium and low satisfaction level mobile banking apps.
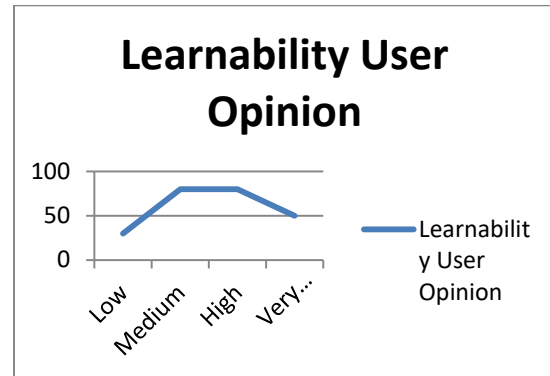

Fig. 5: Users Learnability Intensity

As seen from Fig. 5. Most of the mobile banking users think that these apps are learnable. More than 60% of mobile banking users think that our apps are learnable. More than 58% users said that our mobile banking apps have the quality to learn from it as they used more and more.
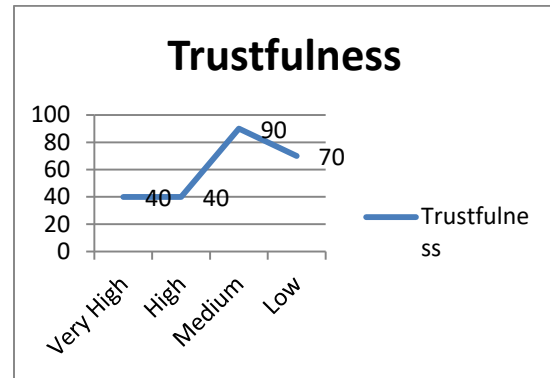

Fig. 6: Users Trust Intensity

As seen from Fig. 6. Most of the mobile banking users have not fully trust on mobile banking apps. Less than 34% of mobile banking users have high and very high trustfulness level on mobile banking apps. More than 65% users have medium and low trustfulness level on mobile banking apps.
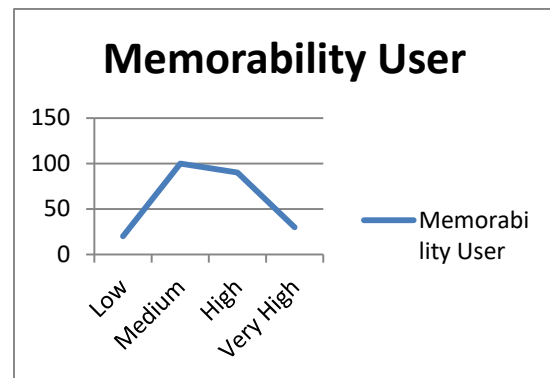

Fig. 7: Users Memorability Intensity

As seen from Fig. 7. More than 75% mobile banking users think that these apps are memorable. Only 15% of mobile banking users think that our apps have not the quality of memorability. Most of the users said that our mobile banking apps have the quality memorability.
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5.3 Comparison of Usability Measures in Mobile Banking Apps
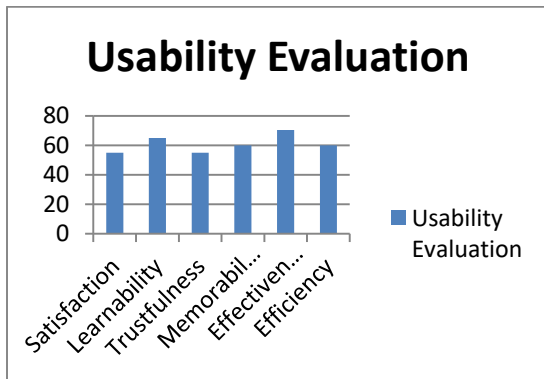

Usability Evaluation

Fig. 8: Comparison of Usability Measures

Fig.8. represents the comparison between different attributes of usability. As satisfaction and trustfulness have low rank in the above graph.

5.4 Expert Group

For the purpose 250 IT and banking experts are requested to participate in the study of usability evaluation of current banking apps used in under developed countries like Asian countries at first level however after filtration 240 members agreed for the investigation performed for six features of m-banking apps with reference to interface. Different questions are asked about usability evaluation in context with effectiveness, efficiency, learnability, memorability, and satisfaction [33]. Questionnaire in hard form and on Google form is used for collecting their responses due to corona pandemic, also conduct zoom meeting for guidance about this study and fill up the responses. It is also guide through SMS, WhatsApp messages and phone calls to our IT experts and bankers about the questionnaire on Google form [34].

5.5 Improvement Needed in the Usability Dimension
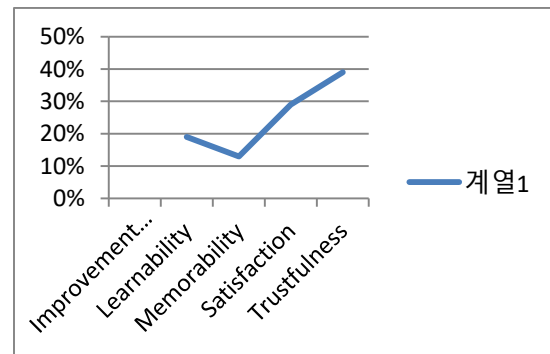
Fig. 9: Improvement Needed

Fig.9. shows that improvements needed in memorability and to some extent in learnability measures of usability.

5.6 Efficiency and Effectiveness according to IT & Banking Experts

Table 3: Efficiency & Effectiveness

IT & Banking Experts Point of View		
No.	Usability Dimension	Frequency
1	Efficient	51
2	Effective	92
3	Both	103
4	None	25

Table III. Shows how much effective and efficient are today's mobile banking apps in expert's point of view. It enables us to find gap between users and developers.

Fig. 10: Efficiency & Effectiveness

Fig.10. shows that most of the experts think that present mobile banking apps are effective and efficient both, many of them think that effective and few of them think that need to enhance efficiency.

5.7 Comparison of Opinions of Users and Experts in Context of Usability

Fig.11: Learnability Comparison Experts & Users

As seen from Fig.11. Most of the mobile banking users think that these apps are not learnable but our experts think that our mobile banking apps are learnable. Less than 50% of mobile banking users think that our apps are learnable but more than 66% experts think that MBAPs are learnable. More than 58% users said that our mobile banking apps have the quality to learn from it as they used more and more. So, there is a gap between users and expert which should be minimized.
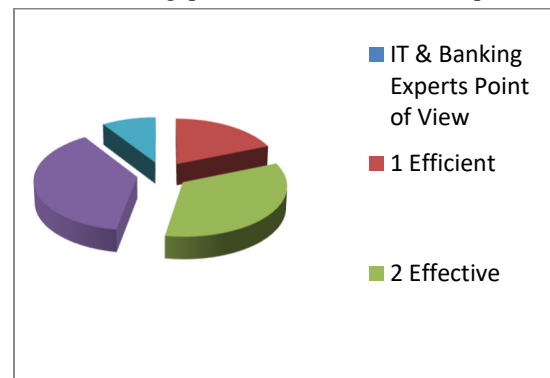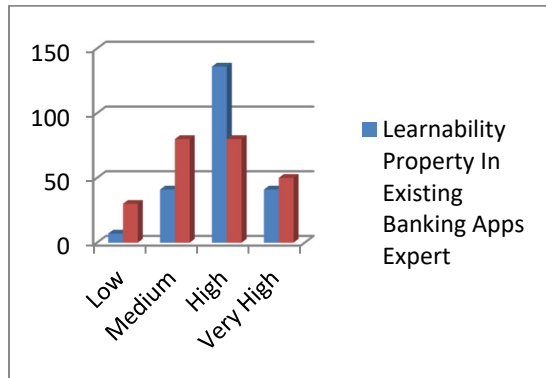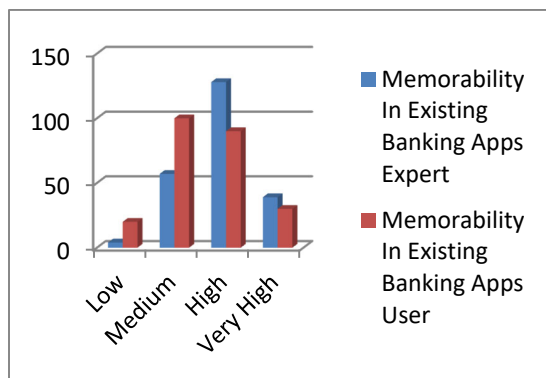

Fig. 12: Memorability Comparison Experts & Users

Fig.12. shows that the less than 50% of the mobile banking users think that these apps are not much memorable but most of the experts think that there is a much existence of memorability property in our MBAPs. Only 50% of mobile banking users think that our apps have the quality of memorability but more than 60% experts think that our MBAPs have memorability property. Our experts think that there is a little need to improve the memorability in MBAPs.
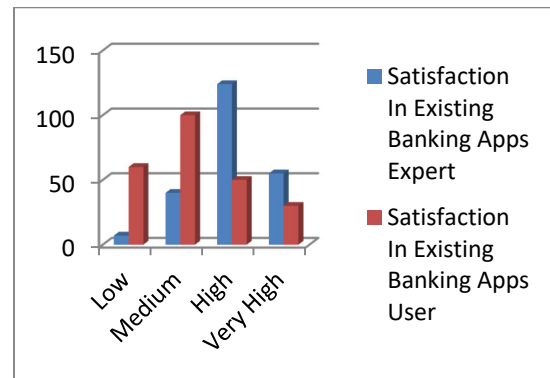
Fig.13: Satisfaction Comparison by Expert & Users

Fig.13. shows that most of the mobile banking users have not fully trust and satisfaction on them. Less than 50% of mobile banking users have high and very high satisfaction level on MBAPs but more than 66% experts satisfied with their MBAPs. More than 66% users have medium and low satisfaction level on MBAPs but experts not agree with that.
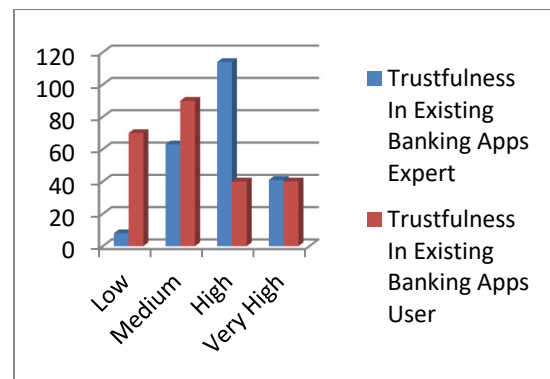
Fig. 14: Trustfulness Comparison by Expert & Users

Fig.14. represents that the users and experts are medium and high level of trust on MBAPs. In case of very high level users and experts are on same page but in case of low level there is a huge difference between users and experts.

5.8 Analysis

According to above results and discussion there is much improvement needed to develop trustful, memorable and efficient mobile banking apps. It is clear that there is a gap between users and experts in context with usability which should be removed by understanding the needs and requirements of the users[35]. There is also a suggestion during development to introduce the mode concept as developer introduced in other application software like[36]

- Expert Mode
- User Mode
- Friendly Mode

From the above discussion it is also suggested to provide all features of banking in mobile banking apps for the satisfaction and effectiveness of MBAPs. Another suggestion deduced from the discussion and experiment performed that there should be a provision to trained the users of MBAPs[37]. According to expert's opinion and data gathered from users, there are two sections where improvements are needed which are Satisfaction and trustfulness and little bit in learnability.

6. Conclusion and Future Work

Mobile banking applications have become one of the largest new mobile commerce applications today, making it easy and convenient for users to execute transactions without any problems. This study investigates usability issues in MBAPs, compares different features and experiences from a user and professional perspective, and opens gaps to improve the usability of mobile banking in transactions. The results of this study show that it is very important to consider user satisfaction and trust in MBAPs for future development of mobile banking apps interfaces. As many users use mobile banking apps to perform transactions, developers use modes concepts to improve them and their interfaces, just like any other application software and provide the facility of customization. In addition, further research can focus on the reliability, security aspects of MBAPs; minimize the gap between users and experts for the improvement of MBAPs. The last one is that addition of all banking features to improve the user satisfaction and user convenience level. It is recommended that usability evaluation of mobile banking apps should be conducted sub task wise in every transaction to improve the satisfaction level of users.

Acknowledgment

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ANNEXURE A.

TABLE. IV. BANKING APPS & FEATURES COMPARISON

FINCA Bank Pakistan Limited	FINCA Pakistan	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
RazorPay	RazorPay	Yes	No	Yes	No	No	No	Yes	No	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No	No
Google Pay	Tez	No	No	Yes	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Finja	Finja	Yes	No	Yes	Yes	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	No	Yes	No	No	No
Auto Soft Dynamics	Auto Soft Dynamics	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No	No
HabibMetro Bank	Avama Solution	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Yes	No	Yes	No	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Karandaz	Karandaaz	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Sada Pay	Sada Pay	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No
Yes= Feature Available							**&**											**No= Feature Not Available**									

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