Building a Three-Level User Experience (UX) Measurement Framework for Mobile Banking Applications in a Chinese Context: An Analytic Hierarchy Process (AHP) Analysis

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Abstract: User experience (UX) has drawn the attention of the banking industry in the past few decades. Although banking systems have a complete service process to ensure financial safety for customers, the mobile banking UX has much potential to be improved. Most research in this field of study relies on existing criteria to describe a user's experience. However, these criteria are focused more on usability measurement, which neglects to identify the requirements of end-users. Users are asked to give feedback on the provided application, limiting the scope of the user study. Therefore, this study uses mixed methods research and in-depth semi-structured interviews to collect end-user UX requirements to build a UX measurement framework of five main services transfers, including financial management, loans, account openings, and credit cards. This study uses an online survey to validate and revise the framework by applying analytic hierarchy process (AHP) analysis to quantify criteria. We interviewed 17 customers and collected 857 online validation surveys, and 400 customers attended the AHP analysis. As a result, this study proposes a three-level measurement framework for mobile banking applications in a Chinese context. The first-level criteria are scenario requirements (24.03%), data requirements (20.98%), and function requirements (54.99%). We hope that the framework will guide designers and researchers to design better user-friendly user interfaces and improve customer satisfaction rates in the future.

Keywords: user experience; mobile banking; mobile application; measurement framework; analytic hierarchy process

1. Introduction

Mobile applications (i.e., mobile phone software) have become increasingly important in people's daily lives as mobile phone performance and wireless communication network performance have improved. Mobile banking, defined as the provision of bank-related financial services via mobile devices, is a critical component of mobile commerce [1]. Through mobile banking, banks can offer a variety of products and services to their consumers [2]. However, increased competitiveness due to technological advancements and globalization has created new challenges for banks [3]. Banks must provide a differentiated ultraconvenient mobile banking UX to gain a share in home markets. These opportunities strengthen client ties and enable banks to cross-sell risk-based and liability products [4,5]. Therefore, banks define narrative consumer groups and investigate their performance expectations, intention to use, and grievance redress, all essential positive consumer behavior predictors. Consumers' attitudes, social influence, and facilitating conditions affect their intention to use [6]. For example, Zhou investigated users' comments and opinions on Industrial and Commercial Bank of China (ICBC) mobile banking and found that the user interface content was too complex and rigid [7]. There were too many different ICBC mobile

applications, and their functions were scattered, which confused users. The customer service response was slow, the user information security was insufficient, the entry threshold of the personal microfinance business was too high, and the payment information was not synchronized and was inconvenient. However, we cannot evaluate a single application or justify applications simultaneously because we need standard criteria that provide a standardized way to evaluate every mobile banking application research. Due to the rapid development of mobile banking, the legal system involved in the supervision in developing countries such as China has not formed a complete system. Mobile banking primarily faces intelligence, scenario, customization, and simplification development trends, and users are at the center of these trends because users define using scenarios, features, and interactions. Although ergonomic criteria encompass the major ergonomic dimensions by which an interface can be evaluated or specified, several studies have been conducted to determine the comprehensibility and evolution of these criteria [8,9].

UX can be classified and divided into constituent elements and the concept's definition. Scholars in the United States and abroad have developed various conceptualizations of the constituent elements of UX, including the five-level theory and situational experience theory [10]. UX is a human factor that affects the way products are perceived. However, these criteria are fundamental and ambiguous [11–14]. We should thus evaluate the overall UX, which represents the UX of each service, even each feature. Therefore, this study aims to construct a UX measurement framework that evaluates features and services.

Customers' requirements describe the UX of mobile banking applications because customers' requirements present challenges to the expectation of the application. Such requirements include interactions with low affordance [15], user interfaces designed with less cognitive workload [16], and usability with safety [17]. Several issues affect banks, mobile handsets, and telecom operators, including mobile handset operability, security/privacy, service standardization, customization, and downloading and installing applications [18]. Because we are enhancing technology, these technical issues are addressed gradually, and the issues are apparent. For example, the fundamentals of affordance are not in conveying the design goal but in designing the activities required for the user-product interaction, as shown in the concept in which design resides [15]. However, we are not identifying ambiguous UX issues [19]. To adhere to the user-centered design (UCD) philosophy, the design must adhere to specific guidelines, principles, and specifications. Therefore, requirements analysis provides a new perspective to establish an evaluation framework. These findings could be used to evaluate existing mobile banking applications. Significant flaws have been explained, along with improvements and the impact of modern technologies. For example, Pousttchi and Schurig identified and assessed four typical types of current mobile banking applications and explained the primary failure reasons and improvements, including technical, usability, design, and security requirements [17]. However, these findings are based on four use cases: request of account balance, control of account movements, instant payment, and account administration. The four use cases do not match the user behavior of Chinese users. For example, the Chinese prefer to use third-party online payments to conduct instant payments, such as Alipay and WeChat pay. However, these studies neglect the holistic UX evaluation framework to regulate the mobile banking application design. Single features investigation could understand part of users' needs, but it cannot be used to guide the whole UX design. Therefore, this study aims to identify the primary use cases and user requirements to frame the holistic UX evaluation criteria of mobile banking applications.

2. Related Works

The mobile internet has profoundly changed people's lives and consumption habits. Mobile banking has high security, intense intimacy, and low service cost and has become an unavoidable product of traditional banks to promote Internet transformation. Mobile banking is a conduit for banks to exchange data and transact with users [2]. Therefore, mobile banking studies draw much attention, including applied existing models, design

theory, and usability evaluation. Based on the existing technology acceptance model, Iskandar et al. determine the elements that influence Indonesian clients' behavioral intention and use of mobile banking [20]. Aguirre et al. use a UCD paradigm previously proposed by the authors to design QR-based withdrawal transaction interfaces [21]. Usability has long been regarded as a critical quality factor that contributes markedly to the success of a mobile application [22]. Hamid et al. noted that few studies address usability concerns regarding the user's age, gender, swapping partners, or experience [23]. Their experiment assesses numerous mobile banking applications' effectiveness, efficiency, trustworthiness, learnability, memorability, and satisfaction. However, mobile banking also faces the problem of low levels of adoption and UX. The mobile phone installation usage rate is higher than that of core banking services, which can improve the utilization rate of mobile phone installation. Therefore, more research focuses on users' perspectives and identifying factors that impact the service quality, not only that of business [24–27].

Researchers have also proposed many evaluation frameworks to evaluate mobile banking applications and service quality. Some studies used big data technologies to analyze online customer reviews using a text mining technique [28]. One study explored the effect of perceived usefulness and perceived simplicity of use on respondents' attitudes and interests in using the transaction service with structural equation modeling [29]. However, these findings only describe a single perspective of the application. Because comments may not include all information we need, we cannot analyze the reason behind the comments. A single service also cannot represent the overall performance. Therefore, more studies use criteria that reflect more services and ask for self-report results.

Some studies quantify the weight of criteria to increase the accuracy of the UX evaluation. For example, a study used a modified SERVQUAL scale with 22 item pairs to assess participants' expectations and perceptions of the quality of banking services. On a seven-point Likert-type scale, respondents were asked to indicate their level of agreement with each item [30]. Another study used a fuzzy AHP that prioritized the relative weights of mobile banking quality parameters between low- and high-experience groups [31]. These criteria were functionality, content, customer service, and interface design. However, these criteria are too broad and cannot match the scenario directly, such as attractive printed materials and trust. We could thus not identify whether an overall interface or a specific service was attractive. It is not easy to define a trust level because we have different preferences and understandings of trust. Each attribute has the same weight, which affects the accuracy of the evaluation. Therefore, this study aims to identify the measurable criteria for different services.

3. Research Framework

This study focuses on the Chinese market's state-owned, joint-stock, and Internet banks. We thus collect qualitative and quantitative data to gain insight into users' core services when using mobile banking applications. The research process uses a mixed-methods methodology through identification, integration, validation, and quantification, which improves the validity of constructs and findings from investigations by leveraging intrinsic method strengths [32]. After discussions with five experts that work in the banking industry, we selected five core services with high frequency, strong impact, and large markets. These include transfers, financial management, loans, account openings, and credit cards. Therefore, this study uses interviews, an online survey, and AHP to develop the UX measurement framework of mobile banking applications on five core services.

3.1. Procedure

3.1.1. Stage 1: Identification

Research has indicated that consumers' intentions to use mobile payment systems are strongly influenced by their perceptions of performance expectations, social influence, compatibility, knowledge, and trust [33]. Specifically, performance expectations for mobile payment systems were the most predictive factor of U.S.A. consumers' intention to use

mobile payment systems. Therefore, we aim to identify the user needs in five primary mobile banking services and use processes at this stage. Desktop research was used to facilitate brainstorming. Based on the desktop research, an existing mobile banking application was preliminarily analyzed, and finally, the specific use scenarios of the five businesses were extracted. In the user research stage, the interview outline was designed using the situation, and the users were interviewed one-on-one. Then, we transcribed and reported the interview results, sorted user behaviors, and needs based on the five core services and priorities, and extracted the needs with high priority for classification and aggregation. The preliminary design criteria were derived from the user insight transformation of the final aggregation.

3.1.2. Stage 2: Validation

After constructing a draft measurement framework, we transferred each criterion through the online survey feedback data, and user needs were verified and quantified to verify the effectiveness and universality of the design criteria behind the needs. After the criteria were confirmed, the criteria were verified via a questionnaire survey. The related questions were designed according to the established criteria, and the output questions were reorganized and aggregated into new questions with broader coverage. After modifying the question description and sequence level many times, an online survey was published on the WeChat and microblog platforms. We revised the measurement framework based on the online survey feedback.

3.1.3. Stage 3: Quantification

AHP is a method for making systematic decisions incorporating qualitative and quantitative techniques. AHP is advantageous for calculating a single assessment value using multiple criteria and simplifies the decision-making process by decomposing a complex problem into a series of structured steps in which each element in the hierarchy of criteria is supposed to be self-contained. When criteria are interdependent, the analytic network process is used [9]. This study refined and iterated the criteria further based on the initial version. The four-level dimension criteria are gathered through group discussions. The analytic hierarchy process is used to determine the clarity and accuracy of the criteria, which are then adjusted and iterated until iterative design criteria are obtained. After all comparison matrices pass the consistency test, the weight corresponding to the criteria can be calculated. The eigenvector corresponding to the matrix's greatest eigenvalue was calculated and normalized, and the result corresponds to the element's weight, which is the weight of these elements compared to the corresponding elements of the upper layer.

3.2. Participants

We included participants aged 24–40 who live independently and have a fixed income source. Each participant had two or more mobile banking applications (e.g., state-owned/joint-stock/urban and business/Internet) and used three or more core banking services. Each participant used a mobile banking application at least once a week to ensure accurate experience memory. In the identification study, we recruited 17 users to attend interviews. In the validation study, we collected 993 online surveys, of which 857 were valid, and the ratio of men to women was 11:9. These participations were recruited from an online recruitment service, i.e., wjx.cn. Participants should be aged 24–40, and they are using one more mobile banking application. In the quantification study, we collected 30 online surveys to revise the framework and 400 online surveys of AHP.

3.3. Data Collection and Analysis

Because each research approach has its advantages and weaknesses, using different methodologies for gathering data for human–computer interaction (HCI) studies can provide higher strengths [34]. As shown in Table 1, this study combined interviews and online surveys to collect audio recordings and documents. This study collected data from

various sources, including written, audio, and numeric content. As a result, various data processing techniques were applied to extract valuable data from each study.

Table 1. Summary of data collection methods and analysis.

Data Collection Methodology	Type of Data	Phase of the Study	Data Analysis Method
Interview	Audio recordings	Identification	Thematic analysis
Online survey	Survey documents	Validation	Statistical analysis
Online survey	Survey documents	Quantification	AHP analysis

3.3.1. Thematic Data Collection and Analysis

We collected audio recordings of interviews to identify the UX criteria of mobile banking applications, and the transcripts were coded into different themes based on the user needs. A theme encapsulates an essential aspect of the data concerning the research question and signifies some patterned needs or meaning within the interview transcripts [35]. We collected 300,000-word transcripts about their experience of using mobile banking applications. We had one associate researcher with Ph.D. degree and six master's students in applied psychology. We selected one of the transcriptions with adequate information. Every team member read and summarized the needs of the transcription. After the discussion, we defined the codebook and the definition of the needs. One transcription has two students to codes. When students met the conflicts, the associate researcher helped them to solve the conflict. If students found new needs, we set a meeting to involve new code. In the end, we extracted 242 user needs for using mobile banking. These needs were prioritized within five services by experts in the banking industry and research team members. Table 2 shows an example of the analysis. Finally, we clustered all selected needs into different criteria. One of the most critical tasks was to decompose the customer's overall goals into the core customer demand and the primary job to be performed [36]. These needs are connected as innovation opportunities to potential product-service systems, laying the groundwork for designing customer-centric value propositions to facilitate product implementation [37]. Therefore, we used the Jobs-to-be-Done format to standardize the criteria, including scenarios, objects, and behavior. After discussion with experts from WeBank, we clustered the needs twice, until the themes are within nine because the cognition volume is between five to nine. Therefore, we identified the third-level criteria when we clustered jobs to be done that shared the design criteria's same meaning. Then, we clustered three levels of criteria hierarchy.

Table 2. Example of integrating the UX criteria from the interview transcripts.

Transcripts	Services	Scenarios	Jobs to Be Done	Third Level Criteria
When handling a new credit card, I do not know when I can obtain this card. It is always done when I do not know	Credit Card	Apply for a new credit card	G23-5 I hope to receive important notifications from the bank in time when applying for a credit card	Give timely and continuous feedback on information changes
I have set up automatic repayment for my loan. I regularly deposit my money in advance and inform me when the bank deducts. This is very good, otherwise, I'm always uneasy.	Consumer Loan	Repayment	G41-5 I hope to keep abreast of the information and trends of the loan at any time	

3.3.2. Statistical Data Collection and Analysis

Numerical data were collected through the WJX online platform (wjx.cn, accessed on 1 July 2022) as survey data, including the validation of the requirements and the weight of each criterion. The requirements were analyzed using descriptive methods. The descriptive statistical analysis results showed that participants feel empathy for each requirement, and we must eliminate those requirements that are not widely recognized. To collect the weight

of each criterion in the same layer of hierarchy, we transformed the pairwise comparison of sub-criteria into single-choice questions, which followed the outline of AHP [38]. The relative importance of decision criteria in AHP is determined through pairwise comparisons. To determine the priority value a_{ij} for each criterion, the participant as a decision-maker considers two alternatives while considering one criterion and indicates a preference. The standard numeric scale for AHP is 1–9, with values ranging from "equal importance" to "extreme importance". We provided nine options including −9 score (extreme low importance), −8 score, −7 score, −6 score, −5 score, −4 score, −3 score, −2 score, 1 score (equal importance), 2 score, 3 score, 4 score, 5 score, 6 score, 7 score, 8 score, 9 score (extreme high importance). A value of −9 indicates that one factor is markedly less important than another, while a value of 1 indicates equal importance. We obtained an n × n square matrix at each level of the criteria hierarchy, where n is the level's element count.

4. Results

After three research stages, we summarized a three-level UX measurement framework to evaluate the mobile banking UX. We conducted a pilot study to ensure that the framework could pass the consistency test in a small scope. The second level dimension cancels the "provide follow-up service" criteria and combines its corresponding third- and fourth-level criteria into A-2. In the corresponding three-level criteria of A-1, the original "rigorous password setting method (global)" is canceled and merged into A-1-3. We replace "explains proper nouns" with A-2-1. The feature vector corresponding to the maximum feature root is calculated to be (0.2402, 0.5499, 0.2098). The three values in the vector correspond to the weights of context demand, data demand, and function demand, and the sum is 1. To obtain the overall weight, we need to transfer and multiply the weight layer by layer and complete the calculation from top to bottom. The result is shown in Table 3.

Table 3. The UX measurement framework.

First-Level Criteria	Priority	Second-Level Criteria	Priority	Third-Level Criteria	Priority
A. Context Requirement	0.2403	A-1 Sense of Safety	0.1717	A-1-1 Active record keeping	0.0281
				A-1-2 Prompt before irreversible operation	0.0926
				A-1-3 Provides security settings	0.0510
		A-2 Exceeded Expectation	0.0343	A-2-1 Actively provide related follow-up services	0.0171
				A-2-2 Provide users with appropriate information filtering categories according to scenarios	0.0172
		A-3 Personalization	0.0343	A-3-1 Give users the right to choose	0.0300
				A-3-2 Provide personalized function layout for different users	0.0043
B. Data Requirement	0.2098	B-1 Provide Appropriate Clue	0.1049	B-1-1 Present only critical information to users	0.0262
				B-1-2 Provide reasonable guidance information	0.0525
				B-1-3 Visual presentation of information	0.0262
		B-2 Reduce Cognitive Load	0.1049	B-2-1 Description consistency	0.0105
				B-2-2 Clear navigation and easy identification of information	0.0445
				B-2-3 Appropriate segmentation of presentation information	0.0107
				B-2-4 Clear and accurate information presentation	0.0392

Table 3. *Cont.*

First-Level Criteria	Priority	Second-Level Criteria	Priority	Third-Level Criteria	Priority
C. Function Requirement	0.5499	C-1 Reduce Operational Error	0.0899	C-1-1 Rationalization of information prompt mode	0.0600
				C-1-2 Reduced manual operation through technical means	0.0299
		C-2 Help	0.1633	C-2-1 Provide explanation and help	0.0327
				C-2-2 Improve customer service function	0.1306
		C-3 Provide Reminder and Feedback	0.2967	C-3-1 Provide timely and continuous feedback on information changes	0.2225
				C-3-2 Automatic reminder of important messages	0.0742

4.1. Context Requirement

Context requirements rely on contextual factors and individual performance, such as different services and different amounts of transactions.

4.1.1. A-1 Sense of Safety

The second stage of Maslow's hierarchy of needs is security needs, which emphasizes ensuring security and stability and avoiding fear threats [39]. Kahneman believes that in most cases that can be calculated, people estimate the "value of what is lost" twice as much as "the value of the same thing". People are more sensitive to loss [40]. Therefore, an application should ensure safety and lead consumers to recognize that it is a safe operation.

- A-1-1 Active record keeping. Users often must save the corresponding operation records for subsequent viewing and confirmation when performing essential operations. Concurrently, users should try reducing the repeated input of recorded information, reducing unnecessary execution costs, and improving efficiency. Therefore, it is necessary to actively keep these vital operation records for users in case of need. For example, users can query their transfer or operation records involving account funds. After entering the transfer account information, the transferred personal information can be automatically saved for the next quick transfer.
- A-1-2 Prompt before irreversible operation. In an irreversible operation, it is necessary to confirm the operation result/current operation, reduce the secondary operation's execution cost, and avoid unnecessary property loss. For example, when purchasing a financial product, a user is informed that the confirmation is the final purchase confirmation and cannot be refunded.
- A-1-3 Provides security settings. We should provide users with account-related security settings to ensure account security and increase users' sense of security by opening these settings. For example, when users use mobile banking, they provide users with relevant settings for security monitoring and guarantees. For example, users can choose whether to prohibit night purchases. Users obtain a sense of security through the user's settings for these security functions.

4.1.2. A-2 Exceeded Expectation

Customers' expectations are based on experiences that symbolize their previous experience using such services. We summarized two primary mobile banking expectations, particularly some features achieved in third-party payments.

- A-2-1 Actively provides related follow-up services. Therefore, we should provide users with complete process services and pay attention to relevant services after the business operation. For example, after a transfer is completed, the application should provide users with account information such as the balance on the card.
- A-2-2 Provide users with appropriate information filtering categories according to scenarios. Users cannot analyze complex information when viewing bills or reports. Thus, they can filter the information according to their needs and provide appropriate infor-

mation filtering categories to help users filter the specific categories they want to see. For example, we should provide users with more meaningful bill screening categories, such as electronic products, books, and magazines, rather than online shopping.

4.1.3. A-3 Personalization

Provide targeted services according to the characteristics of users and give users the right to choose and adjust some settings, such as function adjustment and information push. Users can choose services and adjust the scope of the application independently. Users can filter information according to their own needs or provide appropriate filtering categories to help users filter the specific information categories they want to see.

- A-3-1 Give users the right to choose. Give users the right to choose and adjust some settings. Users can choose services and independently adjust the application's scope for available services with operation space, such as function adjustment and information push. For example, because banks can increase a credit card limit, users can choose whether to increase the limit [41]. Users can choose the saving time on transferring records by themselves. Users can select the type of information push.
- A-3-2 Provide a personalized function layout for different users. When users manage a business, they hope to find a layout suitable for their characteristics. They can obtain a targeted service experience, or they can also describe their own identity or cultural symbols. For example, users can choose their favorite interface skin according to their usage habits and preferences.

4.2. Data Requirement

Data requirements consider how information is presented to the users. Because users have limited cognitive resources, if they are lost in information, particularly in banking applications that have many terms and logic, they cannot make the right decision in a short time. Therefore, we should provide appropriate clues and reduce the workload of cognition.

4.2.1. B-1 Provide Appropriate Clue

Clues support users with less experience using mobile banking applications or specific features. Many applications design some clues to support certain users, but that are invisible to other users. Therefore, we should consider how we can design appropriate clues to support users.

- B-1-1 Present only critical information to users. When users manage a business, there is some information that users care about and focus on. If this information is presented with unnecessary information, and users cannot intuitively obtain the required information, it significantly reduces users' efficiency when handling business. Therefore, it is necessary to present the critical information that users care about in the interface as much as possible to save the cost of users' self-learning. For example, in handling credit cards, the user is presented with a card's annual fee, rights and interests, and other information about various credit cards.
- B-1-2 Provide practical guidance information. It is easy for a user to enter a card number according to the function number of the bank, for example, if the user does not understand the function number of the card or does not manually understand the function number of the bank [42]. If the user does not understand the function number of the card, it is easy to ignore the function number of the bank. For example, when inputting the card number for the first time, we must remind the user of the optical character recognition (OCR) function's existence and cooperate with the guidance information.
- B-1-3 Visual presentation of information. From the user side, in addition to professional terms, we must highlight vital information to save users' learning costs. For example, on the display page of financial products, in addition to professional terms, visualize important information and cooperate with sentences that nonprofessional users can understand so that users can master the product overview at once.

4.2.2. B-2 Reduce Cognition Load

When users must read or fill in a large amount of information or materials, presenting all the information content at once increases the cognitive burden on users. Thus, it is necessary to present the information in batches according to a certain logic to simplify the complex content. When presenting information, attention should be given to keeping the description consistent and accurate. Navigation must be visible, making it easier for users to find and find the desired functions. Users prefer to select links on the web that have the highest information smell when determining which ones to click, which is a combination of clues from the link label, the context in which the link is shown, and their prior experiences [43]. Presenting too much information at one time can quickly increase the cognitive burden of users.

- B-2-1 Description consistency. To consistently show information, colors can be more systematic and meaningful. For example, icons of the same business type should use the same color. The description of terms should be consistent across the applications and ensure each feature is consistent.
- B-2-2 Clear navigation and easy identification of information. Navigation shall be clear and direct, making it easier for users to find the desired function. The navigation area and content area should be clear and distinguishable. The navigation name shall be expressed in a way that users understand to avoid ambiguity. For example, the user can clearly define the location of the navigation area in the interface, and various functions are easy to find and call.
- B-2-3 Appropriate segmentation of presentation information. When users fill in a large amount of information in batches or present it logically, it is not easy to fill in a large amount of information simultaneously, particularly when it needs more than two units. For example, when users fill in loan application materials, they must separate information such as paging or stowing and expanding according to different material information. This process would reduce the cognitive burden caused by users when processing information and processing materials and information batches within a reasonable range.
- B-2-4 Clear and accurate information presentation. Because the same type of information may have many different meanings, when presenting the information, the description of the information should be as accurate as possible so that users can clearly and accurately understand what type of information is presented. For example, the banking business includes login, initial, query, transaction, cash advance, online transaction, and other passwords. When a transfer password must be entered, clearly tell the user the type of password required at this time.

4.3. Function Requirement

Function requirements include the requirements for interaction, features, and technology. These requirements primarily affect the UX of mobile banking applications.

4.3.1. C-1 Reduce Operational Error

Due to variations in recall intensity, some prompt material requires different prompt techniques. Inconsistent information prompts can cause users to overlook critical information. The information prompt method should match the reminder intensity to remind people more fairly. Attention is a group of cognitive resources or talents used to classify and recognize inputs. This resource is limited, as is the user's attention. High cognitive load means too little attentiveness. Thus, technical assistance should be provided to reduce human errors.

- C-1-1 Rationalization of information prompt mode. Because the types of prompt information have different reminder intensities, the corresponding prompt methods are also different. If a particular type of information prompt is inconsistent with the reminder intensity corresponding to its information, it may cause users to miss

important information. Therefore, the method used by an information prompt should correspond to its reminder intensity to remind users more effectively. For example, different forms of reminders are used for information with different importance.

- C-1-2 Reduced manual operation through technical means. Use technical means to automate simplified operations (i.e., acceptable information input) and reduce human errors, such as OCR, smart reading clipboard account information, prompt transfer, automatic repayment, and other functions.

4.3.2. C-2 Help

Users expect speedy solutions to issues such as professional jargon and product specifics. Users want intelligent customer service to solve problems more correctly and effectively. Eighty-five percent of consumers dislike being actively bothered and prefer to explore products by themselves. Therefore, they must provide users with a self-help channel to guide them to understand and learn by themselves.

- C-2-1 Provide explanation and help. Users hope to find solutions and entrances quickly for possible problems and incomprehension, such as professional vocabulary and product details. For example, for places where further detailed information may be required, such as professional bank vocabulary, income risk of financial products, and other detailed information, set up links or floating windows for users in advance.
- C-2-2 Improve customer service function. Intelligent customer service cannot accurately solve a problem, and search results can be incorrect. The application of manual customer service is typically tricky and often requires waiting. Users hope that customer service can solve problems more accurately and efficiently. For example, by reducing the process of transferring to manual customer service, intelligent customer service statement recognition is more accurate.

4.3.3. C-3 Provide Reminder and Feedback

The user may not be able to identify changed content at first. Therefore, the bank must actively highlight it to the user, update the account information status, and provide timely feedback on every information change. Subjective control is the antithesis of objective control and refers to how much power users feel over their lives. Providing timely feedback helps decrease users' waiting anxiety and increase their control sensation to a certain extent.

- C-3-1 Provide timely and continuous feedback on information changes. When fund information, progress, and service content in the account information change, if the user does not obtain immediate feedback on the fund change information the first time, the user would feel insecure about the fund flow. The user may not be able to perceive the changed content the first time. Therefore, the bank must highlight it to the user activity and update the status of the account information in time. Every piece of information changes after that and can be given timely feedback. For example, users can timely grasp the progress and status of the transaction after transfer.
- C-3-2 Automatic reminder of important messages. Before the user must perform essential operations, the user often lacks awareness of the upcoming operations because many upcoming operations are only displayed in the interface without a timely reminder to the user before the operation. Therefore, it is necessary to remind the user before these events to ensure they receive the operation information. For example, before the credit card repayment date, the bank would automatically inform the upcoming deduction behavior to remind the user of the upcoming deduction operation of the user's funds so that the user can have an expected understanding of the changes in his funds in advance.

5. Discussion

This study proposed three domains of UX: context, data, and feature. The experience of functions primarily determines the UX of a mobile banking application since feature requirements account for 54.99% priority (C, 0.5499 priority). Bank applications are clas-

sified as efficiency applications in the Apple App Store and the Google App Market. For this product, users pay more attention to how to operate the application correctly, obtain timely feedback and reminders, and seek help. The context and users would not change these features. Therefore, researchers could investigate user mental models and develop design patterns. Shahbudin and Chua implemented design patterns in mobile application development to overcome the constraints of present methodologies and boost efficiency, usability, and reusability [44]. As we found that reminders and feedback are the most important needs (C-3, 0.2967 priority) in functional requirements and all second-level criteria. Participants reported that they prefer human customer services due to the low accuracy of automatic customer services. Help (C-2, 0.1633 priority) the function participants need when using the application. The technology and the inclusive design of asking questions may affect the technology's accuracy. Users typically use vernacular rather than banking terms. For example, they ask how to transfer money to others instead of how to do accounting transactions. Users expect to reduce operational error (C-1, 0.0899). Therefore, we should investigate how normal users frame the questions, improving customer service satisfaction.

Context requirements (A, 0.2403 priority) rely on contextual factors and user characteristics. These requirements are based on data requirements and functional requirements. After people's low-level needs are met, they would seek high-level needs: the higher the needs are, the stronger the personalized performance. Therefore, users may expect that the mobile banking application may exceed their expectations (A-2, 0.0343 priority). This trend of social development and the need for individuals to realize themselves is essential. To achieve better UX, we should consider the context of using it. In a different context, the same user may have different needs. Sense of safety is another consideration (A-1, 0.1717 priority). If we want to create a sense of security beyond expectation and customized services, we should investigate the meaning to the users. To design better banking applications, we should not follow the design of gaming applications, which require more customization. A game could propose avatars and multiple sensory feedback. Some applications introduce gamification to the design [45]. However, the banking application should allow users to make decisions and customize the application (A-3, 0.0343 priority). They prefer to customize feature layouts that support high-frequency use. The banking industry relies on data to ensure safety, display, and promptness. Safety issues were mentioned in the study of issues and challenges in mobile banking [18].

As technology develops, users have higher confidence in using mobile banking applications. They still must consider the data requirements that provide appropriate prompts and reduce the cognitive burden of users (C, 0.5499 priority). However, the banking industry is driven by quantitative criteria, such as the number of deposits and conversion rate. Therefore, users are constantly bothered by the feeds. We found that users focus on critical information with appropriate prompts. The other challenge is the cognitive workload of the interfaces (B-2. 0.1049 priority). Because mobile banking has many features, designers want to display more information on the same page. However, we should try to reduce user workload using consistent descriptions, straightforward navigation, appropriate segments, and accurate presentation because users care about and focus on specific facts when conducting business. If these data are displayed with other superfluous data and users cannot intuitively acquire the relevant data, this reduces user efficiency in business. Thus, it is critical to offer vital information to consumers through a compelling interface that can reduce user self-study and suitable assistance material for new features or modules to help users understand and use them (B1, 0.1049 priority). User attention is a valuable resource that should be allocated wisely. Therefore, we must simplify content that takes up brain resources but does not genuinely help people.

Although users should understand their expectations of mobile banking applications, the design is usually considered a professional activity. Normal users without economic or innovation backgrounds cannot specify their needs regarding UX, and the company is afraid a few users cannot make decisions with too many options. Therefore, researchers

prefer to refer to the articles or contact several experts in related industries. However, it neglects the voice of real users. AHP is a multi-criteria decision-making method that could solve this challenge. It can involve more stakeholders joining in the decision-making process, and only compare two criteria, which could be transferred into the online survey. However, most studies prefer to involve experts in making the decision [46,47]. Therefore, we practice the AHP method with users because they are the experts in understanding themselves [14]. After the qualitative research, we proposed the criteria structure based on users' ideas, and we involved nearly one thousand users to compare each criterion. It proved that users could join in the decision-making process.

6. Conclusions

This study primarily investigates the requirements of the five core services: transfers, financial management, loans, account openings, and credit cards. These five essential types of banking are those most interacted with by users. Relevant content and design methods directly affect their experience and future. The essential requirements are function requirements, which include reducing operational errors, helping, and providing reminders and feedback. The second essential criteria are scenario requirements, including a sense of security, exceeded expectations, and personalization. Data requirements are less essential and include appropriate prompts and reducing cognitive burden. These five essential banking types are core services for banks and directly affect the benefits. In the future, we plan to evaluate mobile banking applications to test the UX measurement framework in the field setting.

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