Mobile Library User Experience: A Review and Outlook (Postprint)

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Abstract

[Purpose/Significance] This study summarizes the current state of mobile library user experience research both domestically and internationally, analyzes the achievements and existing deficiencies in this field, and provides prospects for future research directions. [Method/Process] Through content analysis of the literature, this paper organizes current research findings from four aspects: the connotation and elements of mobile library user experience, mobile library user experience modeling, mobile library user experience evaluation, and mobile library user experience enhancement. [Results/Conclusion] Suggestions and prospects for future research include: theoretically, improving the theoretical system of mobile library user experience, emphasizing interdisciplinary research, and exploring new research directions; practically, investigating diversified research methods, strengthening sustainable research, and deepening user experience enhancement research.

Full Text

Preamble

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Abstract: [Purpose/Significance] This paper summarizes the current state of mobile library user experience research both domestically and internationally, analyzes the achievements and shortcomings of existing research, and provides prospects for future research directions. [Method/Process] Through content analysis of relevant literature, this study reviews current research findings from four perspectives: the connotation and elements of mobile library user experience, mobile library user experience models, mobile library user experience evaluation, and mobile library user experience enhancement. [Result/Conclusion] Future research suggestions and prospects include: theoretically, improving the theoretical system of mobile library user experience, emphasizing interdisciplinary research, and exploring new research directions; practically, investigating diversified research methods, strengthening sustainable research, and deepening user experience enhancement studies.

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With the rapid development of the internet and the continuous proliferation of mobile smart terminals, the advancement of ubiquitous information society is accelerating, heralding the arrival of the mobile era. Mobile learning, mobile office work, mobile payments, and mobile search have become new trends and lifestyles for the public. Accessing literature and information resources anytime and anywhere, and enjoying literature information services, have become new requirements that readers have for libraries. To adapt to the mobile era and meet the information needs of mobile users, mobile library services have emerged. According to statistics, among the world' s top 50 universities, 88% of libraries have already launched mobile library services [1]. China' s mobile library services began in 2003 and subsequently spread rapidly among university and public libraries. As of January 2018, all 42 "Double First-Class" universities in China have launched mobile library services. Mobile libraries represent a service model where libraries utilize mobile networks to provide users with library resources, reading materials, and business inquiries through mobile terminals such as smartphones, Kindle devices, and iPads. Service models include short message services, mobile website services, mobile application (APP) services, and WeChat libraries [2]. The object elements of mobile libraries include mobile devices, system platforms, mobile users, and mobile librarians, with mobile users as the service recipients being a key focus of academic research [3].

Current mobile library user research mainly concentrates on three aspects: user needs, user experience, and user adoption [4]. As mobile library services continue to proliferate and deepen, users have gradually transformed from passive recipients to active participants in deep interaction, placing greater emphasis on user experience [5]. The process of using mobile libraries is essentially an experience of their functions, content, and services. Therefore, mobile library user experience research explores the various factors affecting user experience from the user' s perspective to enhance mobile library services. In this "experience is king" era, mobile library services, as a new type of service, must focus on and improve user experience to increase user recognition and ensure sustainable development. Ni Feng et al. [6] found in their survey of mobile library user needs that "user experience enhancement" was a key concern for users. Shen Junwei et al. [7] and Wang Canrong et al. [8] discovered through user experience evaluation that users scored relatively low on technical experience and service experience, while also expressing low satisfaction with experience cost and experience risk indicators. Consequently, mobile library user experience urgently needs further improvement.

In recent years, how to enhance the user experience of mobile library services has attracted widespread attention and research enthusiasm in the library community. To comprehensively grasp the current state of mobile library user experience research, this study conducted literature searches across multiple Chinese and foreign databases. Foreign literature was primarily sourced from Elsevier ScienceDirect, Web of Science, Springer Link, EBSCO, ACM, Emerald, and Taylor & Francis, searching for literature containing "mobile library" or "mlibrary" or "library' s mobile website" in keywords, titles, and subjects, along with "user experience" or "UE" or "UX" . Chinese literature was mainly sourced from CNKI, Wanfang, and VIP databases, searching for literature containing "mobile library" or "mobile phone library" and "user experience" or "user experience" in keywords, titles, and subjects. The literature search deadline was February 4, 2018. After removing duplicate and less relevant results, a total of 218 relevant documents were retrieved. Statistical analysis revealed that foreign research began earlier, while domestic literature has grown rapidly since 2010, with 2010-2017 being the most productive years.

Content analysis of the literature shows that although research on mobile library user experience continues to emerge, most studies focus on user experience design, empirical surveys, and evaluation, with only a few scholars reviewing usability aspects, which is insufficient to reflect the overall landscape of current mobile library user experience research. In summary, this study provides a necessary in-depth and rational review of the current state of mobile library user experience research from the perspective of user experience research content. Following a process from theory to practice, this study organizes and evaluates current research findings from four aspects: the connotation and elements of mobile library user experience, model research, evaluation research, and user experience enhancement research. Finally, future research directions for mobile library user experience are proposed.

2. Research on the Connotation and Elements of Mobile Library User Experience

As the focus of mobile library research has shifted from being library-centered to user-centered, user experience has become an important component of mobile library user research. User experience was first proposed by D. Norman et al. [9] and was initially widely applied in the field of human-computer interaction. The International Organization for Standardization (ISO) defines user experience as "a person' s perceptions and responses that result from the use or anticipated use of a product, system or service," including emotions, beliefs, preferences, perceptions, cognitive and psychological responses, behaviors, and accomplishments. User experience encompasses the periods before, during, and after product, system, or service use. System, user, and interaction environment are the three elements affecting user experience [10]. User experience is the result of multi-party interaction, including the user' s internal state (tendencies, expectations, needs, motivations, mood, etc.), system characteristics (complexity, purpose, usability, functionality, etc.), and the interaction environment (organizational/social environment, activity significance, voluntary use, etc.) [11].

In the library service field, Zhang Mingxia et al. [12] believe that library user experience is a purely subjective holistic feeling, representing the total impression and feelings users have throughout the process of using the library, which determines the library' s service quality, user satisfaction, and loyalty. Considering the characteristics of mobile network environments, Chen Tianyuan [13] argues that mobile library user experience refers to the psychological feelings users establish during the process of using mobile library information resources and services, influenced by numerous factors including users, information resources, website platforms, usage environments, and cultural factors. Shen Junwei et al. [6] believe that mobile library user experience is the continuous accumulation of perceptual psychological states and rational value cognition formed by users throughout the entire process of using mobile libraries, including initial impressions of mobile libraries, various emotional experiences during use, and emotional experiences after use.

2.1 The Connotation of Mobile Library User Experience

Mobile library service characteristics can be summarized into two dimensions and five aspects: the first dimension is mobility, including ubiquity, fragmentation, and personalization; the second dimension is sociability, including interactivity and shareability [14]. User experience has dynamic, environment-dependent, and subjective characteristics [15]. Combining the characteristics of library services and user experience in mobile environments, mobile library user experience exhibits the following features:

2.1.1 Dynamic Nature of Mobile Library User Experience

User experience results represent a gradual accumulation and dynamic process,

not determined by user feelings at a specific moment. As user-product contact deepens, user experience progressively advances through sensory experience, interaction experience, and emotional experience levels [12, 16]. Simultaneously, as a type of experience, mobile library user experience has clear beginnings and ends, with the experience process including feelings before, during, and after user-platform interaction [17-18].

2.1.2 Complexity of Mobile Library User Experience

The interaction environment of mobile library services includes complex network environments such as cloud computing and mobile internet, while mobile device performance, resources, and costs also affect user experience [7, 19].

2.1.3 User-Centered Subjective Experience

Good user experience must satisfy both users' practical and hedonic needs, with need fulfillment affecting users' perception of hedonic quality [20]. User experience is a perception of multi-party interaction, where the fulfillment of psychological needs for self-esteem perception and competence expression helps generate positive user experience [20-22].

2.1.4 Interactive Nature of Mobile Library User Experience

This is reflected in two aspects: first, users' experience of basic library services, including user-system interaction (such as borrowing queries, catalog searches) and user-librarian interaction (such as reference consultation); second, users' mobile reading has socialization needs, meaning users can interact, communicate, and share experiences with each other [23].

2.2 Elements of Mobile Library User Experience

Based on ISO' s classification of user experience elements, mobile library user experience can be divided into three aspects: system quality perception, user emotional perception, and interaction environment perception. Foreign scholars' research on user experience elements mainly focuses on system quality perception and user emotional perception. System quality perception research is mostly based on usability theory and technology acceptance model theory [24-26]. User emotional perception research mainly concentrates on user needs, user expectations, and emotional responses [21, 27-28]. Domestic scholars have conducted relatively less research on user experience elements, mostly drawing on foreign research results [29-35]. Some scholars have reviewed relevant foreign theories, such as Ding Yi et al. [30] summarizing user experience elements as usability, user emotional experience, and user demands. Jin Yan et al. [34] divided them into rational and perceptual elements. Some scholars have explored user experience elements in the information service field, such as analyzing user experience elements in information architecture from macro and micro perspectives, dividing them into functional experience, technical experience, and aesthetic experience [31, 33]; or dividing them into three levels—sensory experience, interaction experience, and emotional experience—according to the library user experience process [12]; or dividing elements into mobile service environment

interaction layer, mobile service platform interaction layer, and mobile service personnel interaction layer from the perspective of user interaction with digital library mobile service systems [35].

These research findings have laid a foundation for mobile library user experience element research. Based on domestic and foreign scholars' research results, user experience elements can be summarized into four aspects: (1) System quality perception elements, referring to users' perception of system functions and technology during interaction with mobile library platforms, mainly including practicality, usability, information architecture, information quality, perceived ease of use, and perceived usefulness of mobile library platforms [11, 24-25, 33, 36-37]; (2) Emotional perception elements generated from user-system interaction, reflecting users' subjective emotional feelings, mainly including hedonic value brought by the system, user expectations, user needs, and need fulfillment [7, 11, 21, 25, 28, 32, 37-39]; (3) Interaction environment perception elements, as systems and mobile users are always in complex interaction environments, including social influence, facilitating conditions, experience cost, experience risk, and experience benefits [7, 38]; (4) User experience design elements, covering elements for mobile library user experience design and enhancement [26, 32, 40-41]. Research results on mobile library user experience elements are shown in Table 1 .

3. Research on Mobile Library User Experience Models

Constructing mobile library user experience models is fundamental for systematic research and user experience evaluation. Based on domestic and foreign scholars' research results and their functions, mobile library user experience models can be divided into structural models and evaluation models. Structural models reflect the composition and structure of mobile library user experience, helping researchers more comprehensively and deeply understand the structural components and their interrelationships. These models can be used to design and improve mobile library user experience. Evaluation models aim to evaluate mobile library user experience, forming the basis for constructing evaluation indicator systems and guiding empirical research and evaluation, reflecting the basic content of user experience evaluation.

3.1 Structural Models

Domestic and foreign scholars have numerous research results on user experience structural models, such as experience layering theory for user experience design [41] and the APEC framework [26], basic user experience models constructed from different perspectives [21, 27, 42-43], mobile website and APP user experience design models [31, 44], and user experience design paradigms and principles [32, 45]. These research findings have laid a foundation for structural model research on mobile library user experience. Qian Guofu [46], drawing on the "Eight Golden Rules"of user interface interaction design and considering the limitations

of mobile phone browsing, proposed considerations for library WAP website design. Chen Tianyuan [13] constructed a mobile library website user experience design model. Huang Wulan et al. [47] built a mobile library user experience model and verified through structural equation modeling that effectiveness (help frequency and error frequency), ease of use (learnability and memorability), satisfaction (interface design and timeliness), and technical support (compatibility and security) significantly impact mobile library user experience. Qiao Hongli [48] proposed a mobile library user experience framework, finding through verification that sensory cognition, service perception, strategy perception, cognitive perception, emotional perception, user perception, application attitude, and application intention all have significant positive effects, with sensory cognition and cognitive perception having relatively greater impact.

3.2 Evaluation Models

Current methods, techniques, and tools mostly come from traditional usability research, which is product-oriented [49]. K. Finstad [50] constructed a user experience usability measurement model from the user perspective, including 12 indicators around three dimensions: effectiveness, efficiency, and satisfaction. K. Rodden et al. [51] proposed the HEART framework for large-scale user experience testing, with metrics including happiness, engagement, adoption, retention, and task success.

Quality of Experience (QoE) originally emerged in the communications field, referring to the degree of pleasure or annoyance users experience after interacting with applications, services, or systems [17]. Some scholars have found that perceived characteristics of user experience are highly positively correlated with QoE and have attempted to integrate user experience with QoE research, summarizing applicable user experience evaluation tools and methods to capture users' subjective measurement results [52-54]. Wang Canrong et al. [7] constructed a Mobile Library User Experience Quality Evaluation (MUQoEE) system basic model, considering mobile library network environments, mobile users, and mobile service characteristics. Considering the dynamic nature of user experience, some scholars have introduced time factors into user experience models. For example, E. Karapanos et al. [16] verified a temporal experience framework, finding that user experience is influenced by gradual familiarity, functional dependence, and emotional dependence. Lin Chuang et al. [55] considered that previous user experiences affect current experiences, establishing a hidden Markov-based user experience quality evaluation model and providing application conditions for the model.

4. Research on Mobile Library User Experience Evaluation

From an empirical research perspective, in-depth study of mobile library user evaluation further refines evaluation models from theory to practice, mainly including exploration of evaluation methods and specific evaluation indicators.

4.1 Evaluation Methods

Literature review reveals that methods used in mobile library user experience evaluation include qualitative evaluation methods, quantitative evaluation methods, and comprehensive evaluation methods. Qualitative evaluation mainly employs heuristic evaluation to assess mobile library user experience [56-57]. Heuristic evaluation invites usability experts or software engineers to evaluate products, typically requiring only 3-5 people to identify over 80% of usability problems [58]. Quantitative evaluation mainly uses A/B testing, which provides different product or service variables to users under controlled experimental conditions to identify optimal-performing variables [59]. Comprehensive evaluation methods combine qualitative and quantitative approaches, primarily conducting usability assessments of mobile libraries to understand user experience status from utility, efficiency, and satisfaction perspectives [60-63]. Usability testing mainly targets ordinary users and can employ laboratory testing and field research methods. The choice depends on usability research objectives and testing attributes, though there is no consensus on the differences between these two methods in application [64-65]. Nevertheless, some scholars believe field research is more suitable for mobile application usability testing because user experience and behavior data obtained in real contexts can more objectively reflect mobile application usability [66-68].

In data collection, user emotions cannot be directly quantified. Some traditional usability evaluation scales can obtain users' product perception information [69]. M. Isomursu et al. [70] tested five self-report methods suitable for collecting emotions in mobile application user research. Shao Luo et al. [71] summarized several standardized scales for overall evaluation: QUIS (Questionnaire for User Interaction Satisfaction), SUMI (Software Usability Measurement Inventory), PSSUQ (Post-Study System Usability Questionnaire), and SUS (System Usability Scale). Other scholars have used practicality and hedonism scales, PrEmo emotion scales, and PANAS (Positive and Negative Affect Schedule) for user experience research [20, 72-73]. Additionally, some scholars have attempted to introduce psychological research methods into user experience research, such as applying the "just noticeable difference" theory to user experience quality evaluation and using facial expression capture, eye tracking, and pupil capture for data collection [55, 74-75].

4.2 Evaluation Indicators

Domestic and foreign scholars have produced abundant research results on mobile library user experience evaluation indicator systems. Xia Qianlong et al. [76] believe mobile library service quality includes four dimensions: information quality, environmental quality, interaction quality, and outcome quality. User experience is one of the main factors affecting mobile application quality [77]. Chen Shengwei [78], Shen Junwei et al. [6], and Wang Canrong et al. [7] constructed applicable user experience evaluation indicator systems based on mobile library platform characteristics. K. D. Pendell et al. [61], C. Wang et al. [79], S. T. Yeh

et al. [63], Yuan Jing et al. [80], and Wei Qunyi [81] explored mobile library user experience usability testing indicators and conducted empirical studies. D. Zhang et al. [64], C. Courage et al. [82], Y. S. Ryu et al. [83], Huang Xiaobin et al. [84], and Zhao Fazhen et al. [85] proposed user experience evaluation indicators applicable to mobile reading applications.

Furthermore, some scholars have attempted to introduce new content into user experience evaluation. E. Bocchi et al. [86] introduced SpeedIndex into network user experience measurement indicator systems. J. Park et al. [43] verified the possibility of explaining user experience with a single variable. Jin Yu et al. [87] introduced user subjective feeling factors into user experience quality evaluation, proposing to dynamically change QoE key quality indicator weights through user complaints. Extensive literature on mobile service user experience evaluation indicator systems provides valuable references for mobile library user experience evaluation. Research results on mobile library user experience evaluation indicators are shown in Table 2 .

5. Research on Mobile Library User Experience Enhancement

Discovering and satisfying user needs and creating good user experiences to achieve higher user satisfaction have always been the direction of mobile library efforts. Domestic and foreign scholars have conducted user experience enhancement research on mobile libraries from different perspectives. Based on research methods and emphases, existing results are summarized from three aspects: mobile library usability enhancement research, emotional experience enhancement research, and comprehensive user experience enhancement research.

5.1 Usability Enhancement Research

Survey results of domestic and foreign scholars show that mobile library usability enhancement research mainly targets WAP websites and mobile applications (APPs), with commonly used research methods including heuristic evaluation and usability testing. These research findings reflect user experience status at different stages of mobile library use. According to the mobile library lifecycle, usability research can be divided into pre-launch, during use, and post-improvement stages.

First, usability research conducted before mobile library launch to understand user experience design effects and achieve further improvement. L. J. Chanlin et al. [88] conducted user experience enhancement research before library mobile website launch, with results showing that mobile libraries are more efficient than PC websites and that students responded positively to the new system. R. E. Miller et al. [60] explored the usability of a mobile library developed by Boopsie for medium-sized academic libraries, finding that simple interfaces represent an advantage of mobile libraries over traditional libraries.

Second, usability research conducted during mobile library use to understand and enhance current user experience. A. Eidaaroos et al. [56] used heuristic evaluation to assess the usability of mobile libraries in Saudi Arabian public universities, identifying deficiencies in links and navigation, user help, data entry forms, visual design, and accessibility for visually impaired users. R. H. Y. Fung et al. [57] conducted usability research on the University of Hong Kong library' s mobile website based on Nielsen' s ten heuristic design principles, comparing it horizontally with Harvard University and Chinese University of Hong Kong. They found issues such as inability to notify users of waiting times, illogical information display, content consistency problems, lack of advanced search for expert users, and insufficient error prompt messages, finally proposing improvement suggestions. C. Wang et al. [79] conducted usability evaluation of two services—due date reminders and book reservations—at the Oriental Institute of Technology library in Taiwan, with results showing 71.2% and 87.5% of participants were particularly satisfied with these services, respectively. K. D. Pendell et al. [61] used different types of mobile phones to conduct usability testing of Portland State University' s mobile library, identifying a series of issues in website design, wireless network connectivity, and mobile phone hardware and software, finally proposing user experience improvement suggestions based on test results. Q. Wei et al. [62] and Peng Xiaodong et al. [89] conducted usability testing on Chongqing University' s mobile library APP and WAP website, respectively, revealing deficiencies in effectiveness, efficiency, and satisfaction, and proposing usability enhancement suggestions. Chen Shengwei [78] conducted usability research on Shanghai Mobile Library' s WAP website and APP using usability testing, post-test questionnaires, and interview methods, identifying deficiencies in learnability, ease of use, effectiveness, error and feedback, layout and design. J. A. Rosario et al. [90] redesigned the mobile website of New York Medical College' s health sciences library through usability research.

Additionally, some scholars have conducted usability testing on improved mobile library platforms to explore user experience enhancement effects. S. T. Yeh et al. [63] conducted usability evaluation of the optimized health sciences library at the University of Colorado Anschutz Medical Campus, with results showing significantly improved effectiveness and efficiency, and higher participant satisfaction with the optimized website.

5.2 Emotional Experience Enhancement Research

Domestic and foreign scholars have conducted emotional experience enhancement research on mobile library platforms from different perspectives, mainly including user needs, user expectations, user willingness, and user differences.

In mobile library user needs research, Li Yujia et al. [39] drew on Maslow' s hierarchy of needs to divide mobile library user needs into five levels: sensory needs, information needs, emotional needs, social needs, and self-actualization needs, using system dynamics to analyze the elements of user needs and their interre-

lationships and dynamic changes. Ye Shasha et al. [91] theoretically discussed the types, characteristics, patterns, and user preferences of mobile library user information needs. Zheng Dejun et al. [92] proposed 10 mobile library usability design principles through empirical evaluation. Nie Hua et al. [19] constructed a "Peking University Library" service system based on the WAP protocol after investigating and evaluating mobile service status, reader needs, and mobile device ownership. Ni Feng et al. [5] proposed an improvement needs structure system for mobile library service platforms from three categories: "functional improvement needs,""technical improvement needs,"and "user care improvement needs."

In terms of mobile library user expectations, user willingness, and user differences, J. Seeholzer et al. [93] used focus groups to explore students' usage and expectations of library mobile websites. Gao Chunling et al. [94] investigated teachers and students at Liaoning Normal University, revealing factors influencing users' willingness to read library electronic resources from perspectives of user reading behavior and facility characteristics. Zheng Dejun et al. [95] found that different users have varying perceptions of mobile library service quality due to gender, academic background, and usage experience. A few scholars have conducted mobile library user emotional experience enhancement research from psychological perspectives. X. Zha et al. [96] found that users experience less immersion when using mobile libraries compared to digital libraries, making it essential to examine user experience and improve immersion during the early stages of mobile library construction.

5.3 Comprehensive User Experience Enhancement Research

Comprehensive user experience enhancement research involves grasping the overall status of mobile library user experience and proposing enhancement solutions from three aspects: system quality, user emotion, and interaction environment. Wang Qian et al. [97-98] conducted two user experience surveys on Tsinghua University' s Wireless and Mobile Digital Library System (TWIMS). The first survey, conducted after TWIMS launch, focused on user satisfaction with system function settings and various indicators. The second survey examined the user experience enhancement effects of the improved TWIMS. Zeng Manjiang et al. [99] proposed using content adaptation technology to achieve hierarchical optimization of mobile library user experience for mobile terminal devices with different performance levels, and formulated corresponding optimization strategies.

6. Conclusion and Prospect

6.1 Conclusion

This study reviewed existing research findings and provided a comprehensive overview of mobile library user experience from four aspects: elements and connotation of mobile library user experience, mobile library user experience mod-

els, mobile library user experience evaluation, and user experience enhancement research.

Regarding research on the elements and connotation of mobile library user experience, foreign research began earlier with relatively rich and mature theories. The limitation is that most research targets the information technology field, with few studies specific to mobile libraries. Domestic scholars have explored the definition, connotation, and elements of mobile library user experience in the context of information services and mobile library service characteristics. The limitation is that the content is not comprehensive or in-depth enough. Analysis of domestic and foreign mobile library user experience models and evaluation research reveals current problems: at the theoretical level, there are no unified standards for model and system construction, with different scholars constructing user experience models and evaluation indicator systems from different perspectives. Most constructed models and systems lack empirical validation, with only a few scholars using structural equation modeling for testing. At the practical level, mobile library user experience evaluation quality is not high, and evaluation results cannot truly reflect the actual status of mobile library user experience, with main problems including non-standard evaluation models, single data sources, non-rigorous data analysis processes, and incomplete survey content. Current mobile library user experience enhancement research focuses heavily on usability enhancement. However, usability is only part of user experience. Only through comprehensive research on mobile library user experience from the user' s perspective can effective user experience enhancement strategies be explored.

6.2 Prospect

Mobile library development has always been user-centered, with user research running through the entire mobile library service process. As an important component of user research, user experience has significant impact on mobile library development. Based on the complexity characteristics of mobile library user experience, research can be horizontally extended through multidisciplinary integration and vertically elevated from theory to practice and back to theory. Through reviewing domestic and foreign scholars' research findings, this study suggests that future mobile library user experience research should deeply explore the following content:

6.2.1 Theoretical Aspects Future mobile library user experience research should focus on improving the theoretical system of mobile library user experience, conducting interdisciplinary research, and exploring new user experience research directions.

(1) Improve the theoretical system of mobile library user experience. Research can be conducted from two aspects: definition and elements of mobile library user experience. A concept' s definition and scope are the most basic requirements for its development and practical application. Current research

emphasizes empirical studies but lacks in-depth exploration of factors affecting mobile library user experience.

(2) Emphasize interdisciplinary research. For example, introducing relevant psychological theories and research methods, incorporating immersion experience into mobile library user emotional perception research, and using eye-tracking technology to monitor user emotional changes, enabling researchers to comprehensively and meticulously capture user emotional changes and gain deeper understanding of user experience.

(3) Explore new user experience research directions, such as in-depth research on interaction environments and user expectation experiences. Mobile libraries have environment-dependent characteristics. The continuous development of mobile networks, mobile service technologies, clients, and operating systems raises questions about how these changing interaction environmental factors affect mobile library user experience and how mobile library services should improve to address these changes. Current research mainly focuses on users' current experiences, but user expectations also affect user experience and further influence user satisfaction with services. Therefore, the direction of user expectation experience also warrants exploration.

6.2.2 Practical Aspects Future mobile library user experience research should adopt diversified research methods, strengthen sustainable research, and deepen user experience enhancement research.

(1) Adopt diversified research methods. Current mobile library user experience research mostly uses questionnaire surveys, which facilitate data collection but easily lead to single data sources and insufficiently in-depth results. Future research should emphasize qualitative research methods to gain deeper understanding of user experience.

(2) Strengthen sustainable research. Lack of feedback and tracking of users' information acquisition processes means that technological improvements cannot bring about user experience enhancement [29]. Sustainable research aligns with the dynamic nature of mobile library user experience. Future research should focus on long-term user experience studies to explore important factors influencing user experience changes and user stickiness.

(3) Deepen user experience enhancement research. Most current research only evaluates the current status of mobile library user experience and proposes suggestions, with few follow-up studies on enhanced systems. The ultimate goal of mobile library user experience research is to create good experiences for users. Whether mobile library user experience enhancement measures and improvements are effective should also be a key focus of mobile library user experience enhancement research.

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Wei Qunyi: Proposed research ideas and revised the paper;
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Note: Figure translations are in progress. See original paper for figures.