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User Profile Research for Digital Cultural Resource Services in Public Libraries (Postprint)

Authors: 王毅, Wu Ruiqing

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Abstract

[Purpose/Significance] This study aims to identify and depict different user groups of public library digital cultural resource services through the construction of user personas, thereby accurately proposing functional optimization and differentiated service strategies that align with target users' expectations. [Method/Process] Through questionnaires and user interviews, employing quantitative and qualitative analytical methods, the study analyzes users' objectives, behaviors, and attitudes toward utilizing public library digital cultural resource services, subsequently clustering user types and constructing user personas. [Results/Conclusion] Four user personas are developed: "Self-directed Learner," "Dedicated Researcher," "Casual Entertainment Seeker," and "Information Enthusiast." By interpreting and analyzing the group characteristics and key differences across these user persona models, optimization strategies are proposed to enhance the targeting and applicability of user-oriented public library digital cultural resource services.

Full Text

Abstract

[Purpose/Significance] This study identifies and describes different user groups of digital cultural resource services in public libraries by constructing user personas, thereby accurately proposing function optimization and differentiated service strategies that align with target users' expectations. **[Method/Process]** Through questionnaire surveys and user interviews, this research employs quantitative and qualitative analysis methods to examine users' goals, behaviors, and attitudes toward utilizing public library digital cultural resource services, subsequently clustering user types and constructing user personas. **[Result/Conclusion]** Four user personas are formed: "Self-Directed Learner," "Intensive Researcher," "Lifestyle Dabbler," and

"Information Enthusiast." By explaining and analyzing the group characteristics and key differences present in these user persona models, optimization strategies are proposed to promote more targeted and applicable public library digital cultural resource services for users.

Keywords: public library; digital cultural resource service; user persona; service optimization

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1 Introduction

Public libraries undertake cultural services based on meeting knowledge resource needs, transmitting cultural knowledge, conducting social education, and providing cultural services under the philosophy of open and inclusive service. With the development and application of network communication and information technology, public library digital cultural resource services have become a channel for the public to access knowledge universally and equally, promoting the improvement of public cultural cultivation, spiritual needs, and lifelong learning. However, public library services have broad scopes and diverse user groups, with significant differences in goals, methods, approaches, and experiences among different user groups in utilizing digital cultural resources. Against the backdrop of surging digital cultural resources, expanding digital service functions, and prominent diverse user demands, providing applicable and precise resource services has become a pursuit for libraries.

Current research on digital cultural resource services mainly includes three aspects: (1) **Digital resource evaluation research centered on content quality.** Scholars focus on the content quality of high value-added digital resources, emphasizing evaluation and optimization of digital resource content quality, such as the CARS evaluation criteria for scientific research digital resources [1] and digital resource content quality evaluation [2]. (2) **Digital resource service research centered on user satisfaction.** Influenced by perceived service quality theory and the SERVQUAL model, this research emphasizes user-centered digital resource service evaluation, focusing on the degree to which digital resources meet user needs, such as user-perceived evaluation of digital information services [3] and user experience-oriented digital resource quality research [4], as well as digital resource research based on user data [5]. (3) **Digital cultural resource service research centered on resource integration.** This primarily involves digital cultural resource services from the perspective of library, archive, and museum (LAM) resource integration, such as LAM cultural resource integration and service stratification [6], issues concerning public digital cultural resource integration standards [7], and research on LAM digital cultural resource fusion services [8].

The concept of user personas was proposed by A. Cooper [9] as an effective tool for outlining target users, capturing user needs, and determining design direction. In recent years, scholars have applied user personas to library user service research, providing new ideas and methods for predicting user needs and achieving precise services. Examples include implementing intelligent resource recommendation in digital libraries based on user persona interest preferences [10], and providing library online service push and scenario-based services based on user persona information and situational awareness data [11].

Nevertheless, there remains room for further deepening and breakthroughs: (1) explaining users' activity goals and behavioral patterns when utilizing digital cultural resources; (2) exploring multidimensional experiences and behavioral differences among different user groups; and (3) optimizing digital cultural resource services from the perspective of user group differences. Therefore, this study begins with a comprehensive investigation of users' goals, behaviors, and attitudes regarding digital cultural resource services, progressing to user data statistical analysis and content interview analysis, then clustering and refining multi-group user personas. The goal is to minimize subjective speculation, understand what users truly want, deeply explain and comprehend the differentiated behavioral patterns of user groups, thereby making user-oriented public library digital cultural resource services more targeted and applicable.

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2 Research Topic and Design

2.1 Research Topic

Public digital cultural services are funded primarily by government finance, utilizing digital networks and intelligent technology to provide cultural information resources, aiming to safeguard the public's basic cultural rights and interests [12]. Public library digital cultural resource services rely on their own digital collections, using modern science and technology and digital communication means to provide public cultural resource services, including exhibitions, utilization, education, consultation, and a series of other services.

To clarify the research topic, the authors visited and investigated Shanghai Library and 16 district-level libraries in Shanghai, summarizing digital cultural resource service content in Shanghai's public libraries as: cultural resource services provided to the public through digital technology means (websites, WeChat public accounts, Weibo, mobile apps, in-library multimedia equipment) based on collection resources, mainly including: (1) **Digital cultural resource reading and utilization services:** providing public query, utilization, and reading of digital cultural resources through various media channels, such as e-books, e-newspapers, audiobook services, and mobile digital reading. (2) **Digital cultural resource exhibition and education services:** including digital cultural exhibitions of Shanghai-style culture, opera culture, Jiangnan culture, calligraphy and painting art, and New Year customs; online cultural lectures on

literature and art, Chinese etiquette, diet and health preservation, and tea culture. (3) **Digital cultural resource construction and research services:** referring to building digital cultural resource databases and conducting digital compilation and research services, such as local characteristic cultural resource databases, intangible cultural heritage self-built databases, Shanghai folk culture resource databases, and Chinese family tree cultural resource databases. (4) **Digital cultural resource sharing and consultation services:** including digital integration and sharing of cultural information, cultural activities, and cultural resources, as well as providing consultation and feedback for digital cultural resource services.

2.2 Research Design

2.2.1 User Persona Scale Design Stage To make questionnaire design more user-centric, this study conducted one-on-one user interviews before scale design. The interview purpose was to deeply discover users' goals, reasons, duration, approaches, and content when utilizing public library digital cultural resource services, obtain scenario descriptions, attitude viewpoints, and satisfaction evaluations when using services, and also provide content support for questionnaire design. Interviews were conducted in early June 2020 at public libraries in Shanghai, randomly inviting library readers for interviews in a natural and relaxed form to exchange experiences and feelings about using digital cultural resource services, with appropriate probing for reasons and details. After the interview discussion, small gifts were given to each participating user. More than 20 users were interviewed, with effective interview information from 11 library users. Demographic information and interview outlines are shown in Table 1 .

The scale design originated from three aspects: (1) **Dimension design** from the three-dimensional role creation 思路 proposed by American scholars S. Mulder and Z. Yaar in their highly influential work *The User Is Always Right: A Practical Guide to Creating and Using Personas for Web Design.* (2) **Element design** referenced relevant elements in the VALS2 (Values and Lifestyle Survey 2) user segmentation scale, with further support sought through theoretical literature. (3) **Scale design** initially conducted one-on-one user interviews to incorporate user viewpoints and suggestions into the scale design and improvement process.

2.2.2 User Persona Data Analysis Stage Data analysis included three aspects: (1) verifying the reliability and validity of the survey scale through statistical analysis tools; (2) conducting cluster analysis on sample data through variance analysis and clustering methods to obtain quantitative analysis results; and (3) conducting sampling interviews for users in each category to supplement and improve user clustering feature descriptions from a qualitative analysis perspective.

2.2.3 User Persona Depiction Application Stage Based on quantitative and qualitative analysis data, user personas were constructed by combining virtual yet representative character features. On the basis of analyzing and explaining different user personas, key differences among different user groups were clarified, and targeted optimization strategies for public library digital cultural resource services were proposed.

2.3 Scale Design

Compared with user persona construction methods based solely on user needs [13] and user tag collections [14], S. Mulder and Z. Yaar explored user personas from three aspects of "goals, behavior, and attitude," taking users' own cognition or experience as the basis for division, and studying user personas from a three-dimensional perspective, which has been widely recognized. They pointed out that "what people say is important," revealing people's goals and viewpoints; "what people do is equally important," because compared with what people say, actual behavior can reveal more information about people. Both aspects must be clearly understood—what people say and what people do—to fully comprehend users [15]. User personas are closely related to market segmentation, requiring multi-dimensional customer classification and continuous intersection and overlay to generate rich attribute tags that present various behavioral characteristics of users [16]. Based on Maslow's needs theory and motivation theory, the VALS2 model is a mainstream market segmentation method, where users' values, lifestyles, behavioral patterns, and attitude beliefs can all serve as references for user scale construction [17].

Therefore, this study references the modeling method of S. Mulder and Z. Yaar and the VALS2 user segmentation attitude scale. Based on theoretical literature research and user interviews, three dimensions of users' utilization of public library digital cultural resource services were extracted: **Goals** (why use, what to do, what to want), **Behavior** (how to use, how to use, which preferences), and **Attitude** (how is it? Which aspects are liked/disliked, willingness, and evaluation) and influencing factors, providing a basis for questionnaire design.

2.3.1 "Goals" Dimension Goals and reasons are explanations for why things are as they are, including internal and external factors that lead to purposes, reasons, needs, and possibilities. Users' goals and reasons for utilizing information mainly include internal and external motivations: the former refers to action demands, problem-solving, knowledge supplementation, and work needs triggered by users' psychological motivations such as seeking convenience, comprehensiveness, and novelty; the latter refers to users being passively changed due to work pressure, learning pressure, network environment changes, and social environment transformation, continuously enriching their knowledge structure to meet external environmental information needs. Public library digital cultural resource service user research mainly explores why users choose to utilize public library digital cultural resources, understanding their utilization purposes,

methods, goals to be achieved, and which methods or devices are used to access public library digital cultural resource services. Interview results show that users access library cultural resources through official websites, in-library equipment, WeChat, and other channels. Under the influence of social pressure and self-motivated knowledge seeking, users obtain rich, authoritative, and economical digital cultural resource services through libraries, including learning, research, decision-making, consultation, and leisure goals.

Based on relevant theories, literature, and interview results, the constituent elements of the "Goals" dimension are shown in Table 2 .

2.3.2 "Behavior" Dimension Behavior refers to activities manifested under the control of thought [20]. Human behavior can be divided into explicit and internal behavior: the former includes actions such as making sounds, taking actions, and making reactions that others can directly observe, i.e., demeanor and actions; while internal behavior refers to psychological activities such as consciousness and thinking activities that cannot be directly observed by others. This article approaches from both internal and explicit aspects of behavior, further subdividing the behavior dimension into "psychological behavior preference" and "usage behavior preference."

(1) Psychological Behavior Preference Dimension. VALS2 is based on the theoretical model of basic human social values, with strong applicability, higher measurement validity, and relatively stable clustering results, which is very conducive to user persona construction and grouping. This article adopts the three validated motivation orientations in the VALS2 scale—principle, status, and action orientation—combined with previous user interview results, including Chinese academic databases, news, messages, friend circles, lotteries, lectures, etc., to extract corresponding tag elements, as shown in Table 3 .

(2) Usage Behavior Preference Dimension. Information behavior is a unique human behavior, referring to the action process where, under the control of information needs and cognitive thinking, the subject adopts information query, collection, selection, processing, utilization, and exchange to achieve a specific goal [21]. Previous interviews revealed that in the usage behavior preference dimension, user behavior manifests as "in-library + out-of-library," "computer + mobile phone," and "website + public account" methods to browse, search, find, consult, obtain, and share library digital cultural resources. Therefore, three aspects are selected for analysis: **search behavior**, **selection behavior**, and **communication behavior**. Search behavior is the information search strategy adopted by users due to perceived information needs, obtaining corresponding information based on a series of external information activity processes. Research found that both goal-oriented users who directly search library databases (research or decision-making type) and knowledge or leisure-type users without specific goals who casually browse cultural lecture resources exist. Selection behavior is the process where users match and identify resources based on information needs and resource content, including selection behavior

during the search process and re-selection behavior after becoming familiar with the content. In interviews, users mainly focused on the comprehensiveness, applicability, authority, and timeliness of digital resources, with some users caring more about free access to resources within the library IP range. Communication behavior is the transmission, exchange, and sharing of information, an information behavior conducted by each individual through a common symbol system [21]. Research shows that library users' communication behavior is the exchange, supplementation, and sharing of information between users and users, and users and librarians. In the era of mobile networks and handheld devices, information sharing and online communication have become more convenient and common. The "Usage Behavior Preference" dimension and constituent elements are shown in Table 4 .

2.3.3 "Attitude" Dimension Attitude is an individual's relatively stable psychological tendency toward specific objects (people, concepts, emotions, or events), containing the user's subjective evaluation of matters and resulting behavioral tendencies. The main sources of attitude evaluation are user satisfaction and experience feelings. Satisfaction is a psychological reaction after user needs are met, a judgment of the degree to which product features or services themselves satisfy users' own needs [27]. User experience is a purely subjective psychological feeling established by users in the process of obtaining and utilizing resources or services. In this study, attitude mainly refers to users' overall evaluation and reaction to services, i.e., measuring "how" users feel after receiving services, including the ease of use (resources, retrieval, facilities) and usefulness (whether it helps and influences work, studies, decision-making) of digital cultural resource services, as well as overall satisfaction and usage recommendation of library digital cultural resources. Based on interview results and literature support, the "Attitude" dimension and constituent elements are obtained, as shown in Table 5 .

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3 Data Collection and Analysis for Public Library Digital Cultural Resource Service User Personas

This survey was conducted through offline paper questionnaires and online "Wenjuanxing" questionnaires simultaneously from June 30, 2020, to August 30, 2020. Offline paper questionnaires were distributed on-site with small gifts at Shanghai Library and various district public libraries in Shanghai (including Pudong, Jiading, Hongkou, Putuo, Xuhui, Huangpu, Baoshan, Minhang, Changning, and Yangpu District Libraries). Online questionnaires were distributed to public library users in Shanghai in the form of "online + red packets," using Wenjuanxing to create electronic questionnaires forwarded through WeChat, QQ, etc. Before the survey, respondents were first asked whether they had experience using library digital cultural resource services. If yes, they were asked to recall their most recent experience and fill out the questionnaire

accordingly.

The questionnaire consists of a preface and three parts: the preface explains the survey purpose and defines public library digital cultural resource services; Part 1 measures basic user information, including age, education, occupation, and digital cultural resource usage; Part 2 is the main structure, measuring users' goals (reasons, methods, content), behavior (psychological behavior preferences and usage behavior preferences), and attitudes (user evaluations and satisfaction with services). The "Goals" dimension uses multiple-choice questions, while "Behavior" and "Attitude" use 1-7 Likert scale measurements; Part 3 collects users' opinions and suggestions on current public library digital cultural resource services, and invites users to leave contact information for follow-up interviews.

A total of 631 questionnaires were collected through "online + offline" methods. The collected questionnaires were preprocessed to exclude those without digital cultural resource service experience (respondents who selected "No" for "Have you ever used"), as well as questionnaires with obviously careless responses, missing data, extreme options, single options, or unclear filling. The final number of valid questionnaires for statistical analysis was 469, with a valid response rate of 74.3%.

3.1 Questionnaire Overview

Statistical analysis of basic questionnaire information revealed: users under 20 years old accounted for 16.4%, 20-30 years old accounted for 59.5%, and 31-40 years old accounted for 17.9%, indicating that current users of library digital cultural resource services are still primarily young people. Users with education levels above undergraduate accounted for as high as 82.9%, showing that most users are learning knowledge and enriching themselves through library digital cultural resource services. Among survey participants, students, technical personnel, and management personnel accounted for the largest proportions, indicating that such users are familiar with channels for utilizing library digital cultural resource services. Users who use library digital resource services at least once a week accounted for 53.7%, and 74% use them for more than one hour each time.

3.2 Reliability and Validity Analysis

Statistical software SPSS and AMOS were used to analyze the 469 screened questionnaires. Excluding demographic characteristic variables and the subjective "reasons" dimension, the "behavior" and "attitude" dimension items designed with the 7-point Likert scale were included in reliability and validity analysis.

Reliability was measured from two aspects: Cronbach's α coefficient is more suitable for measuring internal consistency of attitude/opinion scales. The overall scale Cronbach's α coefficient was 0.930, with each dimension's Cronbach's α values between 0.645-0.914, indicating good internal consistency reliability. Composite reliability (CR) was used to test dimension reliability coefficients, with

results showing each dimension's composite reliability between 0.6748-0.9193, indicating ideal internal quality formed by each dimension combination.

Validity was measured from the perspective of convergent validity: since the scale's structural framework was derived from theoretical literature analysis, confirmatory factor analysis (CFA) was needed to determine the degree of fit between collected data and researchers' expectations [30]. Through structural equation model verification, standardized loading coefficients of measurement elements on each dimension were between 0.433-0.855. Average variance extracted (AVE) is the ratio of indicator variable variance explained by latent variables, effectively presenting convergent validity. This scale's AVE values were between 0.2974-0.6210. Except for the "search behavior" dimension's AVE value being slightly low, other dimensions' AVE values were above the general criterion of AVE > 0.40, reflecting good scale validity.

For statistical convenience, elements in the psychological behavior preference dimension (principle orientation, status orientation, action orientation) are represented by YZ1, YZ2, YZ3, YZ4, DW1, DW2, DW3, XW1, XW2, XW3, XW4 respectively; elements in the usage behavior preference dimension (search behavior, selection behavior, communication behavior) are represented by CX1, CX2, CX3, CX4, CX5, XZ1, XZ2, XZ3, XZ4, XZ5, JL1, JL2, JL3, JL4, JL5 respectively. Results are shown in Table 6 .

3.3 Variance Analysis

Analysis of Variance (ANOVA) is used for significance testing of differences between two or more sample means. ANOVA results show that this study's F values are between 22.620-157.211, with two-tailed P values < 0.001, indicating that each factor has a significant effect on clustering results. Research results are shown in Table 7 .

3.4 Cluster Analysis

The goal of cluster analysis is to collect data for classification based on similarity, maximizing distances between samples in different clusters while minimizing distances within the same cluster. This study uses the K-means algorithm, whose basic idea is to randomly select K cluster centers and assign all data objects to each cluster according to the nearest principle. Based on prior analysis of users' "Goals" dimension in the questionnaire, there are goal differences in knowledge learning, scientific research, cultural leisure, and information acquisition. Attempting to divide the sample into 3 categories showed equal intervals between the three categories, unable to present inter-category differentiation; dividing into 5 categories resulted in obvious redundancy between two categories, failing to effectively explain the samples. After trial, clustering 469 samples into 4 categories based on "Behavior" dimension variables showed discriminant analysis correctly classified 95.1% of samples, with Wilks' lambda coefficients showing significant differences, indicating good clustering results. In these 4 user groups,

192 users were classified as Type A, 76 as Type B, 106 as Type C, and 95 as Type D.

The scores of these 4 user groups on each element are presented as means. For example, "DW1" represents the "online lectures" element in the "user psychological behavior preference" dimension. Clustering analysis found that Type 3 users' recognition and participation level is higher than Type 1 and Type 4 users, while Type 2 users have the lowest recognition of library online lectures. Final clustering results are shown in Table 8 .

Based on the "Behavior" dimension cluster analysis, the "Attitude" dimension was further analyzed. The "Attitude" dimension was measured using a 7-point Likert scale, and after averaging, results are shown in Table 9 .

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4 Construction and Depiction of Public Library Digital Cultural Resource Service User Personas

4.1 User Data Display Based on Quantitative Statistics

In the final clustering results table, quantitative analysis results show 1-7 scale scores indicating user agreement levels from low to high. Types A, B, C, and D correspond to four different lines in the figure, with the scores of the 4 user groups on scale measurement elements forming scatter points on the line chart. The four main line shapes are shown in Figure 1 [Figure 1: see original paper].

4.1.1 Type A User Persona Data Display Analysis Type A user group scores on "Behavior" elements fluctuate slightly above the 4-point mark, belonging to a medium-high level.

(1) Psychological Behavior Preference: This group has high evaluations of library interface guidance, resource richness, access convenience, and information updates. They show average interest in functional operations, prize activities, and fragmented usage.

(2) Usage Behavior Preference: (1) Compared with other resource search methods, users prefer convenient and fast simple searches; (2) This group has high requirements for platform ease of use, correctness and applicability of search results, and free and convenient access to digital cultural resources, preferring associated selection and saving of digital resources; (3) They like customized push services, have certain requirements for communication platforms, and will seek help through online consultation.

(3) User Satisfaction: This group has a relatively satisfactory overall attitude toward library digital cultural resource services, with an overall satisfaction score of 5.45. Evaluations of content, function, platform, and interface are all relatively satisfactory, with scores of 5.32, 5.47, 5.41, and 5.36 respectively. They will continue to use and recommend digital cultural resource services.

4.1.2 Type B User Persona Data Display Analysis Type B user group scores on "Behavior" elements show large fluctuations and low stability.

(1) Psychological Behavior Preference: This group has high evaluations of library interface guidance, information updates, access convenience, and resource richness. They dislike online activities and social sharing, have average willingness for online consultation, believe librarians' online response timeliness is not high, and dislike fragmented usage of library digital cultural resources.

(2) Usage Behavior Preference: (1) Compared with tracking browsing and category queries, users prefer free browsing and simple searches, with average usage of advanced search; (2) This group has strict requirements for correctness and applicability of search results, preferring free and convenient digital cultural resource services, with relatively high requirements for resource association selection and saving; (3) Communication behavior: They have no requirements for customized services like "good book recommendations," prefer simplified and easy-to-use communication platforms, have average subjective initiative for online consultation, dislike communication and sharing, and dislike participating in online communication feedback activities like online surveys.

(3) User Satisfaction: This group has a relatively high overall attitude toward library digital cultural resource services, reaching 5.36. Comparatively, evaluations of content and interface are not very high (5.12 and 5.14 respectively), while evaluations of function and platform are higher (5.54 and 5.30 respectively). Analysis suggests this may be because these users have high requirements for resources, and providing richer research materials could promote satisfaction improvement. Meanwhile, clear and concise functional interfaces can help users quickly locate needed resources. Results show this group will continue using library digital cultural resource services, with high user stickiness (score 5.91), but low willingness to recommend services (score only 4.62).

4.1.3 Type C User Persona Data Display Analysis Type C user group scores on "Behavior" elements are in a stable fluctuation state, with quite high recognition of library digital cultural resource services.

(1) Psychological Behavior Preference: Users have high recognition of library interface guidance, resource richness, access convenience, and information update speed. Additionally, they show high tendencies toward social sharing, online consultation, and online lectures, with high fragmented usage.

(2) Usage Behavior Preference: (1) Users like free browsing of library digital cultural resources, category queries, and tracking browsing of specific topics, while also liking simple or advanced searches; (2) Users prefer updated, simple, free, and convenient digital cultural resource service platforms, with correctness and applicability of search results greatly influencing them, and are good at saving resources; (3) Users like simplified communication platforms and customized push services, willing to seek help through online consultation, like

multiple communication and sharing methods, and like participating in online surveys.

(3) User Satisfaction: This group has a good overall attitude toward library digital cultural resource services, with a score of 6.15. All other scores are above 6, with content, function, platform, and interface ratings of 6.00, 6.08, 6.23, and 6.02 respectively, indicating high evaluations of all aspects of digital cultural resource services. Analysis suggests this may be because these users have no clear usage goals and prefer casual browsing and leisure entertainment, with lower demand satisfaction for various service contents. They will continue to use and recommend to friends, representing important users of library digital cultural resource services with strong library stickiness (scores 6.37 and 6.13 respectively).

4.1.4 Type D User Persona Data Display Analysis Type D user group scores on "Behavior" elements show large fluctuations, at a medium-low level, with average recognition of library digital cultural resource services.

(1) Psychological Behavior Preference: This group has average evaluations of library interface guidance, resource richness, access convenience, and information updates, low online activity participation, dislikes social sharing functions, has low evaluations of librarians' online consultation response efficiency, low familiarity with library digital service functions, dislikes prize activities, average device accessibility, and low fragmented usage.

(2) Usage Behavior Preference: (1) Users prefer simple rather than complex search methods, with relatively low attention to free browsing, category queries, and tracking browsing of specific topics; (2) Users prefer updated digital cultural resource service platforms, with high requirements for free convenience and correctness/applicability of search results, but relatively low requirements for resource association selection and saving; (3) This group has average participation in customized push services like "new book recommendations" and online consultation, no requirements for communication platforms or multi-method communication sharing, and does not like participating in online communication feedback activities.

(3) User Satisfaction: This group has a not very satisfactory overall attitude toward library digital cultural resource services, with an average score of only 4.60. Evaluations of functional usefulness, platform ease of use, content satisfaction, and interface simplicity are all not high, with scores of 4.48, 4.36, 4.40, and 4.33 respectively. Analysis suggests this may be because these users prefer library activity information and have not been much involved in other services provided by libraries, hence scores are at the medium level of 4 points. Additionally, this group will continue to use digital cultural resource services when needed, but has low willingness to recommend and promote public library digital cultural resource services, with scores of 5.04 and 4.11 respectively.

4.2 User Scenario Depiction Based on Qualitative Content Analysis

The previous section clustered 4 types of public library digital cultural resource service user groups through quantitative analysis, but the results were too thin, only reflecting key differences in behavior and attitude dimensions. The "Goals" dimension key differences need to be supplemented, intending to improve from both questionnaire data and user interviews. Therefore, this study randomly selected 10 users from each user group for follow-up visits to verify and further supplement the classification results through user interviews and the "Goals" dimension.

The follow-up interview outline design is as follows: 1. Please talk again about your purpose for using library digital cultural resource services. 2. Which digital cultural resource services provided by the library do you use most/least? 3. Which devices or platforms do you mainly use to access library digital cultural resources? 4. Can you describe how you utilize digital cultural resource services? 5. What preferences do you have when using library digital cultural resource services? 6. Do you particularly prefer certain types of digital cultural resource services? (Asked based on user clustering results) 7. Which services are you satisfied/dissatisfied with during your use of library digital cultural resource services? Are you satisfied overall? 8. What suggestions do you have for the above dissatisfactory aspects?

This user follow-up used telephone interviews. Considering users' willingness to accept interviews, interview times were agreed upon with users, still focusing on users' goals, behaviors, and attitudes in accessing digital cultural resources. Interview time was October 12-20, 2020. Ten users were randomly selected from each user group for follow-up visits, with each interview lasting about 20 minutes. Small gifts were given after interviews. Text analysis refers to the representation of text and selection of its feature items, quantifying extracted feature words to represent text information, which is a basic problem in text mining and information retrieval. This study conducted text analysis on interview content, visualized the 4 groups through word cloud tools, and summarized key differences through qualitative analysis results, as shown in Figure 2 [Figure 2: see original paper] and Table 10 .

4.3 Digital Cultural Resource Service User Persona Presentation

Through questionnaire data analysis, interview data analysis, and visualization word clouds, relatively virtual user identifiers were integrated to name each type of user group and explain key differences in declarative language. However, the results were only unordered, dry feature lists or boring digital support. To make user personas more vibrant, more details need to be added to activate the personas. Therefore, drawing on S. Mulder and Z. Yaar's suggestions [15], to make characters richer and more realistic, brief introductions were written for each user type, adding virtual names, jobs, personalities, hobbies, and other information to make user group personas more complete and vibrant. The four

user personas are shown in Tables 11 through 14 .

5 Optimization Strategies for Public Library Digital Cultural Resource Services Based on User Personas

5.1 "Self-Directed Learner" User Persona Service Optimization Strategy

For "Self-Directed Learner" users who are long-term self-disciplined and knowledge-seeking, public library digital cultural resource service quality can be optimized in the following aspects: (1) **Strengthen resource equipment maintenance and management:** Libraries should strengthen maintenance management of in-library digital cultural resource carrier equipment, maintaining availability, compatibility, and experience, and timely update cultural education resources to ensure timeliness, organization, applicability, and easy access. (2) **Enrich professional knowledge resources:** While meeting public cultural resource needs, libraries should strengthen the update and construction of professional digital cultural resources, focusing on technology, tool, and skill-based digital resources, and can regularly hold online professional lectures to strengthen user knowledge and skill training. (3) **Create virtual learning spaces supporting user interests:** Public libraries can rely on websites or mobile micro-platforms to provide digital learning environments for users pursuing knowledge improvement and interest satisfaction, including study plan formulation, related video courses and e-book recommendations, and digital resource utilization navigation to enhance learning convenience and effectiveness.

5.2 "Intensive Researcher" User Persona Service Optimization Strategy

For "Intensive Researcher" users who grasp professionalism and control the frontier, public library digital cultural resource service quality can be optimized in the following aspects: (1) **Strengthen librarian professional skill training and enhance knowledge service levels:** To meet academic research needs and grasp the professionalism, academic nature, and frontier nature of literature resources, librarians should master research project dynamics, be familiar with knowledge trends and information retrieval approaches of projects, and be able to effectively respond to user needs, providing specialized knowledge services. (2) **Promote "integrated" resource construction and "one-stop" services:** Further promote the integration of digital cultural resources, reduce restrictions on digital resource access, break down barriers, and promote "integrated" resource construction and "one-stop" user services. (3) **Achieve systematic and comprehensive resources in special fields:** Libraries can organize digital cultural resources according to hot fields, professional fields, and frontier fields, with comprehensive and in-depth resource organization from

books, journals, newspapers, networks, and other knowledge sources, while aggregating text, data, web pages, images, audio, video, and other resource types to build systematic and comprehensive thematic digital cultural resource databases.

5.3 "Lifestyle Dabbler" User Persona Service Optimization Strategy

For "Lifestyle Dabbler" users who value worth and love sharing, public library digital cultural resource service quality can be optimized in the following aspects: (1) **Ensure service stability and enhance publicity coverage:** Attention should be paid to ensuring the stability and responsiveness of digital cultural resource services, avoiding service interruptions caused by network restrictions or technical updates, especially focusing on long-term user experience. "Good wine also fears deep alleys"—attention should be paid to publicity and promotion of digital cultural resources so the public can more conveniently obtain useful resources. (2) **Promote digital cultural exhibitions and popular education activities in multiple forms:** For cultural exhibitions and cultural lectures held by public libraries, synchronous online and offline services should be maintained. "People always like to waste time on beautiful things"—the value and applicability of cultural resource content should be maintained, while focusing on long-term preservation to form digital cultural education resource databases. (3) **Provide fragmented digital reading and cultural resource comment sharing functions:** Public libraries should provide fragmented digital reading through various network communication channels to adapt to people's fast-paced lives and diversified scenarios, delivering suitable cultural knowledge. Meanwhile, virtual communication spaces should be created to promote exchanges among digital cultural resource user groups, allowing users to comment on and share content, and promoting resource completeness and service optimization through user-generated content.

5.4 "Information Enthusiast" User Persona Service Optimization Strategy

For "Information Enthusiast" users who prefer information and fragmented reading, public library digital cultural resource service quality can be optimized in the following aspects: (1) **Optimize public account interface design and enhance micro-service levels:** Library WeChat public accounts have actively promoted information dissemination, information push, and digital reading due to their convenient and easy-to-use attributes. Service function design should be further optimized, resource organization and access strengthened, and user consultation and answer modules provided to better enhance user experience and stickiness of digital cultural resource micro-services. (2) **Strengthen retrieval and utilization of mobile digital cultural resources:** Mobile network development has promoted users' acquisition of digital cultural resources through mobile devices, especially for multimedia resources such as picture books, ancient books, animations, and images. Attention should be paid to resource

compatibility and availability, optimizing digital cultural resource retrieval approaches for mobile ports. (3) **Promote high-quality and applicable information content:** Public libraries should collect feedback from digital cultural resource users, statistics on WeChat article reading, liking, and commenting, analyze user attention to resource content, and push digital resource content that is popular and applicable to the public.

Limitations

This study still has some limitations: (1) Using questionnaire surveys to obtain user persona tag data, with survey objects selected from public libraries in Shanghai, there are still issues of relatively small sample size and insufficient structural diversity due to time and energy constraints. (2) Due to various factors, this study used telephone interviews for user follow-up, which is less effective than face-to-face interviews, with deficiencies in facial expression recording and capture; the number of follow-up participants is relatively small, and the richness of persona descriptions needs improvement. In future research, the user persona model for public library digital cultural resource services should be continuously revised, evaluated, expanded, and verified to better, more objectively, and more comprehensively reflect the characteristics and dynamic changes of public library digital cultural resource service users, and to optimize service processes and effects through continuous revision and interaction of user persona models, enhancing user satisfaction and experience.

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Author Contributions:
Wang Yi: Proposed research ideas and wrote the paper;
Wu Ruiqing: Conducted questionnaire surveys and user interviews.

Abstract: [Purpose/significance] This paper identified and described different user groups of digital cultural resource services in public libraries by building user personas, and accurately proposed function optimization and differentiated service strategies that meet target users' expectations. [Method/process] Through questionnaire surveys and user interviews, using quantitative and qualitative analysis methods, users' goals, behaviors, and attitudes in utilizing public library digital cultural resource services were analyzed, and user classification clustering and persona construction were conducted. [Result/conclusion] Four user personas were formed: "self-study type," "intensive research type," "life recreation type," and "information preference type." By explaining and analyzing the group characteristics and key differences in different user persona models, optimization strategies were proposed to promote more targeted and applicable public library digital cultural resource services for users.

Keywords: public library; digital cultural resource service; user persona; service optimization

Note: Figure translations are in progress. See original paper for figures.

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