User Fit of Public Digital Cultural Services: Conceptual Connotation and Structural Dimensions

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Abstract

[Purpose/Significance] Taking user engagement that emphasizes long-term relationships and focuses on emotional investment and interactive experience as the entry point, this study explores the conceptual connotation and structural dimensions of user engagement in public digital cultural services, aiming to inject new vitality into the high-quality development of public digital cultural services. [Method/Process] Literature research and deductive methods are employed to define the abstract concept of user engagement in public digital cultural services; interview methods and procedural grounded theory are used to distill its structural dimensions layer by layer, and interview data are combined to fully elaborate its conceptual connotation. [Result/Conclusion] User engagement in public digital cultural services is a high-order concept with rich connotations. Its structural dimension model is jointly constituted by three dimensions (i.e., cognitive engagement, emotional engagement, behavioral engagement), nine attributes (such as sense of value, passion, continuous use, etc.), and eighteen characteristics (such as resonance, concentration, satisfaction, etc.). This model can provide indicator references for the measurement of user engagement in public digital cultural services.

Full Text

User Engagement in Public Digital Cultural Services: Conceptual Connotation and Structural Dimensions

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Abstract

[**Purpose/Significance**] User engagement emphasizes long-term relationships and focuses on emotional investment and interactive experience. This study explores the conceptual connotation and structural dimensions of user engagement in public digital cultural services (PDCS) to inject new vitality into the high-quality development of PDCS. [**Method/Process**] This study employs literature research and deductive methods to define the abstract concept of PDCS user engagement, adopts interview methods and procedural grounded theory to systematically refine its structural dimensions, and fully explains its conceptual connotation based on interview data. [**Result/Conclusion**] PDCS user engagement is a high-level concept with rich connotations. Its structural dimension model consists of three dimensions (i.e., cognitive engagement, affective engagement, and behavioral engagement), nine attributes (e.g., perceived value, enthusiasm, continuance usage), and 18 features (e.g., resonance, focus, satisfaction). This model can provide indicator references for measuring PDCS user engagement.

Keywords: Public digital cultural services; User engagement; Grounded theory; Continued use; User information behavior

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Public digital cultural services (PDCS) constitute an essential component of public cultural services and contribute to achieving the goal of equalizing basic public cultural services. In 2022, the "Opinions on Promoting the Implementation of the National Cultural Digitalization Strategy" identified "enhancing the digitalization level of public cultural services" as a key task, requiring improved supply capacity of public digital cultural content and enhanced public sense of gain.

PDCS is a general term referring to public digital cultural facilities, products, and services formed by public cultural institutions through the reorganization, integration, and deep processing of diverse digital cultural resources. These include various types such as digital libraries and digital museums, and multiple forms including websites, mobile applications, and WeChat public platforms. Currently, despite the large number of PDCS platforms, actual user adoption remains low. For instance, Jiangsu Province has a permanent population of 85.26 million, yet the Jiangsu Public Cultural Cloud (WeChat public account) has only 5.16 million followers. A people-centered approach that focuses on public cultural needs and usage experiences, values broad participation, and encourages

value co-creation is the path to sustainable PDCS development. The concepts embedded in user engagement—emphasizing emotional investment, interactive experience, and value co-creation—can effectively address practical challenges such as high construction investment but low usage rates, large potential user bases but small actual user numbers, and user fatigue or churn. Therefore, research on PDCS from the perspective of user engagement provides opportunities to enhance user experience, improve user attitudes, increase user participation, encourage user interaction, and promote value co-creation.

The construction of public digital cultural resources, service development, and platform building ultimately aim to promote PDCS usage. Regarding PDCS usage, scholars have primarily focused on three aspects: user needs, user experience, and user behavior. First, user needs represent the internal driving force for PDCS usage. On one hand, researchers have identified needs for immersive experience spaces in PDCS and multilingual PDCS needs among ethnic minority users. On the other hand, scholars have attempted to classify PDCS user needs, such as dividing them into external needs (for organizations, platforms, and activities) and internal needs (motivations, expectations, and perceived value), or further categorizing expectations into learning new knowledge, enjoying fun, and gaining inspiration. Second, user experience research has primarily adopted an evaluative perspective, with some scholars proposing that PDCS user experience can be evaluated from three aspects—sensory experience, behavioral experience, and emotional experience—or from six dimensions for a more comprehensive evaluation: sensory experience, content experience, functional experience, service experience, value experience, and emotional experience. Third, user behavior research reveals the influencing mechanisms behind specific behaviors through model construction. Related studies have found that platform quality, performance expectancy, immersive experience, perceived playfulness, and cultural atmosphere are all important factors influencing user behavioral decisions (whether to use PDCS). Overall, although research on PDCS usage has not yet formed a large-scale body of literature, existing studies employ rich data sources, including both subjective data (user interviews, questionnaire data) and objective data (user comment data, eye-tracking data), and utilize diverse research methods, ranging from qualitative approaches such as grounded theory to quantitative methods including experiments, surveys, and web-based research.

Notably, user needs, user experience, and user behavior are not entirely independent. Different levels of need fulfillment may lead to different user experiences, which in turn shape different behavioral decisions. Therefore, a comprehensive analysis of user needs, experience, and behavior from a process perspective is necessary. User engagement reflects the quality of user experience over a period of time while simultaneously attending to early-stage user needs, mid-stage user experience, and later-stage user behavior, helping to explain the deep-seated reasons why products/services attract users to interact with them. Introducing user engagement into the PDCS domain not only enriches research on PDCS user behavior but also provides a new theoretical perspective for the compre-

hensive stimulation, long-term maintenance, and effective management of PDCS user relationships. It is important to note that user engagement exhibits strong context-dependency and adaptability, with variations in concept, nature, and structure across different contexts. Existing literature has primarily focused on user engagement in commercial contexts, limiting its applicability to the PDCS context, which has public service attributes. Therefore, this study focuses on the ontological issues of PDCS user engagement, dedicated to exploring the conceptual connotation and structural dimensions of PDCS user engagement.

1. Conceptual Definition of User Engagement in Public Digital Cultural Services

User engagement reflects a form of user experience quality. Obviously, only users themselves can describe their actual experiences or depth of participation during interactions with PDCS. Therefore, the exploration and identification of the rich connotations and specific structures of PDCS user engagement should be based on authentic user data. Semi-structured interviews allow interviewees (such as PDCS users) to narrate real-life experiences (such as PDCS usage experiences), helping interviewers deeply understand their thoughts, feelings, and behaviors. Consequently, semi-structured interviews are suitable for exploring the conceptual connotation and structural dimensions of PDCS user engagement. Before conducting interviews, it is necessary to define the abstract concept of PDCS user engagement to deepen understanding, help interviewers conduct interviews more effectively, and assist interviewees in articulating their feelings more appropriately, thereby improving overall interview quality.

User engagement is an imported term that has two similar concepts in foreign literature: user involvement and user participation. In domestic literature, these three terms are sometimes all translated as "user participation," causing confusion in Chinese academia, with some scholars even treating them as identical concepts. Comparing the concepts of user involvement, user participation, and user engagement and their interrelationships can enhance understanding of user engagement and facilitate better conceptual definition of PDCS user engagement. In terms of similarities, all three concepts reflect positive connections between users and products/services. In terms of differences, user involvement primarily refers to users' psychological processes and states, reflecting changes at the motivational, cognitive, and emotional levels. User participation mainly refers to specific user behaviors regarding products/services (such as purchasing, operating, and using behaviors). User engagement is a more richly connotative concept that simultaneously encompasses users' psychological processes, psychological states, and behavioral manifestations.

From a conceptual perspective, the psychological dimension of user engagement is similar to user involvement, while the behavioral dimension of user engagement resembles user participation but is not entirely identical. The behavioral dimension of user engagement places greater emphasis on interactive behaviors between users and products/services. Beyond conceptual connections, verified

causal relationships exist among the three concepts: both user involvement and user participation serve as antecedents of user engagement and as outcomes of user engagement. These findings are not contradictory. Given the dynamic and iterative nature of user engagement, the outcomes of user engagement in one instance may become antecedents for the next instance. In other words, user involvement and user participation both form the foundation for the psychological and behavioral formation of user engagement and constitute the results that user engagement produces at the psychological and behavioral levels. User engagement not only emphasizes users' psychological processes and states during interactions with products/services but also focuses on the level of behavioral investment driven by certain motivational factors.

In existing research, user engagement has been primarily applied in marketing and information systems domains. User engagement is viewed as a form of user experience or a quality of user experience, with different disciplines emphasizing different aspects. In marketing, user engagement places greater emphasis on maximizing enterprise/brand value. In information systems, user engagement focuses more on maximizing user value. Differences in stance or orientation lead to different disciplinary focuses on user engagement. Marketing pursues ultimate enterprise/brand success, emphasizing users' emotional commitment and behavioral investment in enterprises/brands—namely, whether users are willing to maintain long-term stable relationships with enterprises/brands. Information systems pursue high-quality user experiences, emphasizing users' actual gains from product/service usage (such as practical value, fun, and enjoyment). This study argues that users' levels of emotional and behavioral investment are closely linked and mutually influential with their experience quality. High-quality user experiences promote user investment, while high-level user investment also affects user experience. Furthermore, although information systems developers emphasize user experience-oriented product design, users' continuance usage intention/behavior is also regarded as a key factor in measuring information system success. Therefore, for information technology-related products/services, user engagement is reflected not only in high-quality user experiences but also in high-level user investment. Only when both conditions are met can a state of "engagement" be achieved.

"PDCS user engagement" belongs to a subcategory of "user engagement." It is not a simple combination of the two concepts but rather an organic integration of user engagement within the PDCS context. Therefore, PDCS user engagement is also a multi-dimensional concept with rich connotations that requires simultaneous attention to users' psychological and behavioral characteristics. Moreover, as an information technology-related product/service, PDCS user engagement must satisfy both high-quality user experience and high-level user investment. Based on deductive reasoning, this study proposes that PDCS user engagement refers to: the positive valence experience generated by users during PDCS interactions and users' positive investment levels in PDCS, manifested as the psychological states, psychological processes, and behavioral responses through which users establish positive relationships with PDCS.

2. Research Methodology

2.1 Grounded Theory

The preceding section defined the abstract concept of PDCS user engagement, yet its connotations and dimensions require further deconstruction grounded in user interview data. Grounded theory is a research approach rather than a substantive theory, with the core principle of discovering and building theory from empirical data. As a typically contextualized research methodology, grounded theory is well-suited for analyzing user engagement, a concept with strong context-dependency. Among the three mainstream schools, procedural grounded theory emphasizes explaining and predicting problems in objective phenomena. The purpose of this study is to identify and explain the connotations and structure of PDCS user engagement based on empirical data, which aligns well with the "interpretivist" philosophy of procedural grounded theory. Therefore, selecting the procedural grounded theory represented by Strauss for subsequent qualitative research is appropriate. The implementation steps of procedural grounded theory include: (1) data collection, (2) three-level coding, and (3) theoretical saturation testing.

2.2 Data Collection

(1) Interview Protocol Design
This study collected data through semi-structured interviews. Building upon McCarthy et al.'s user experience analysis framework (including four main lines: sensory, emotional, cognitive, and spatiotemporal, and six processes: anticipating, connecting, interpreting, reflecting, appropriating, and recounting) and previous interview surveys on user engagement connotations and structures, this study designed 19 interview questions. The question sequence follows a logic from general to specific, beginning with interviewees describing any event they felt engaged with, along with their feelings, thoughts, and behaviors at the time, then projecting this engaged state onto the PDCS context and sequentially unfolding descriptions of PDCS usage experiences according to the six processes of the user experience analysis framework.

(2) Sample Selection and Data Preparation
Interviewees were ordinary users with experience using any type of PDCS. This study ultimately selected 32 PDCS users as interviewees, with 20 participating in focus group interviews and 12 in depth interviews. Focus group interviews were conducted face-to-face, with the first group (2 males, 8 females) lasting 75 minutes and the second group (4 males, 6 females) lasting 60 minutes. Depth interviews were conducted face-to-face or via remote video, with each interview lasting 30 to 60 minutes. Considering interview effectiveness, this study employed purposive sampling to screen interviewees. The 20 focus group members were master's students in library and information science at XX University, aged 22 to 23. These students were recruited for three reasons: first, they are true "digital natives," born and raised in the digital age, proficient in and dependent

on digital products/services; second, they possess both strong communication skills and professional knowledge in library and information science, enabling them to more clearly understand research questions and accurately express personal views; third, they are familiar classmates who can relax and interact with each other during group interviews.

While these students could ensure optimal interview effectiveness to some extent, to balance demographic heterogeneity and interviewee representativeness, this study selected depth interview members with diverse genders, ages, education levels, occupations, and PDCS usage experiences (basic information see). Depth interview members were sourced through two channels: first, from the researchers' relatives and friends, as the researchers were familiar with their personal situations and could quickly assess who met the study' s requirements; second, through recommendations from members who had completed depth interviews, which not only broke through the limitations of the researchers' personal social circles but also enriched the composition of interview members. Additionally, acquaintance introductions could bridge the distance between researchers and interviewees, helping create a relaxed interview atmosphere and improving interview success rates. With interviewees' consent, all interviews were audio-recorded. After converting audio to text and removing content unrelated to the research theme, this study obtained approximately 120,000 words of interview transcripts for subsequent coding analysis.

2.3 Data Analysis

Before conducting in-depth analysis using procedural grounded theory, this study followed established research protocols by randomly selecting three-quarters of the 32 interview transcripts for data coding, reserving the remaining quarter for theoretical saturation testing. To ensure a standardized and transparent coding process, this study used the qualitative research analysis software NVivo11 for coding work. To ensure coding credibility and validity, two coders independently conducted line-by-line coding and wrote memos for 24 interview transcripts, regularly checking phased coding results, discussing inconsistent parts to reach consensus, and inviting experts in information systems and marketing to help judge parts where consensus could not be reached after discussion.

(1) Open Coding

Open coding follows the principle of maximum possibility. After completing line-by-line coding of 24 interview transcripts, the two coders identified 70 initial concepts (all appearing more than twice). Through repeated discussion, the coders reached consensus on clustering similar initial concepts, condensing the 70 initial concepts into 18 categories such as A1 interface aesthetics, A2 production quality, and A3 reliability. Throughout the open coding process, both coders adhered to the principle of allowing concepts and categories to emerge naturally without incorporating any personal subjective ideas or preferences. shows the condensation process for some categories. To facilitate presentation of different

interviewees' viewpoints, 24 interviewees were marked in the form of "a+n" ("n" representing numbers 1 to 24).

(2) Axial Coding

Axial coding requires careful consideration of logical relationships among categories at the same level and hierarchical relationships between different levels. To enhance the scientific rigor of axial coding, the researchers connected their own understanding, original data, and existing literature through continuous searching, comparing, and thinking, ultimately condensing the 18 categories into 9 main categories: B1 aesthetic appeal, B2 perceived usability, B3 sense of value, etc. (see). Furthermore, the 9 main categories distilled from user interview data could be reflected in the three main dimensions of user engagement summarized in previous literature (cognitive engagement, affective engagement, and behavioral engagement), demonstrating that PDCS user practices have, to some extent, validated the scientificity and rationality of existing user engagement theory.

(3) Selective Coding

The goal of selective coding is to find an overarching core category that can encompass all main categories and to depict the storyline of the interview data by analyzing relationships among different categories. The main categories condensed in this study can reflect the conceptual definition of PDCS user engagement (i.e., the positive valence experience generated by users during PDCS interactions and users' positive investment levels in PDCS, manifested as the psychological states, psychological processes, and behavioral responses through which users establish positive relationships with PDCS). Therefore, the core category points to "PDCS user engagement," simultaneously forming the corresponding storyline—the structural dimensions of PDCS user engagement.

(4) Theoretical Saturation Testing

After completing the three-level coding work, the two coders conducted open coding on the reserved 8 interview transcripts. The results of this new round of open coding indicated that no new important concepts, categories, or hierarchical relationships emerged, thus determining that the first-round coding results had achieved theoretical saturation. Additionally, this study used the reserved 8 interview transcripts (marked as "a25" to "a32") as supplementary materials to corroborate the identified and distilled categories and main categories.

3. Structural Dimensions of User Engagement in Public Digital Cultural Services

Based on the three-level coding results of procedural grounded theory, this study constructed a structural dimension model of PDCS user engagement (see [Figure 1: see original paper]). PDCS user engagement comprises three dimensions, nine main categories (attributes), and 18 categories (features).

[Figure 1: see original paper]

3.1 Cognitive Engagement

(1) Aesthetic Appeal

Aesthetic appeal primarily refers to users' subjective perception of PDCS interface aesthetics and production quality. In user engagement research within the information systems domain, aesthetic appeal (or interface evaluation, aesthetic taste) is typically considered an important attribute, defined as users' perception or preliminary evaluation of an application' s visual appearance. In this study, aesthetic appeal was also found to be an important attribute of PDCS user engagement. However, beyond interface aesthetics, "aesthetic appeal" here also includes users' perception of cultural content production quality. This is understandable, as PDCS platforms provide cultural resources and services, with cultural and artistic attributes being their inherent characteristics. Therefore, PDCS needs to balance both interface design aesthetics and content production quality (such as whether the digital presentation of collection artifacts is vivid and diverse, whether artistic works are appreciable, and whether cultural resources highlight local characteristics). For example: "Using digital means to display the full appearance of some difficult-to-restore exhibits, this presentation method really amazed me" (a7); "I pay more attention to the aesthetics of PDCS interfaces and the design aesthetics of online exhibitions" (a10); "The calligraphy and art works provided by PDCS brought me an aesthetic enjoyment, and after viewing them, I wanted to exclaim, 'This is truly a cultural platform' " (a30).

(2) Perceived Usability

Perceived usability primarily refers to users' subjective perception of PDCS reliability and ease of use. Users' concern for reliability focuses on whether PDCS can operate without failure: "For PDCS, improving platform performance is important. During special periods, such as holidays, the platform needs certain buffering and carrying capacity. When facing large numbers of user visits, it cannot experience system crashes" (a12). Users' concern for ease of use focuses on whether PDCS is simple to operate and convenient to use: "PDCS has very rich resources, but every time I want to register for 'master teacher courses,' I need to repeatedly fill in information, such as phone numbers and graphic verification codes, which is quite troublesome" (a30). Multiple interviewees expressed negative experiences regarding PDCS usability, possibly because, compared to positive information, people are more sensitive to negative information and have more profound impressions of it. Additionally, user engagement in other contexts (such as mobile healthcare, video games, and information search) has also been found to include perceived usability as an attribute, and previous studies explaining perceived usability have also emphasized the negative impacts that products/services bring to users. Considering these factors, although interviewees' relevant expressions in this study tended to be negative, the researchers still identified, distilled, and retained this attribute of PDCS user engagement.

(3) Sense of Value

Sense of value primarily refers to users' subjective perception of PDCS emo-

tional value and practical value. "Emotional value" is mainly manifested in emotional resonance. Resonance specifically refers to the alignment and connection between users' thoughts and feelings and those expressed by other users or PDCS content. For example: "When watching related video livestreams, I look at the bullet comments. Some bullet comments catch my eye, and I find them very fun and funny. The bullet comments resonate with me and bring me a lot of happiness" (a8); "I found that many videos in PDCS are of high quality, and some videos touched me deeply and resonated with me" (a23). Notably, the "resonance" proposed in this study shares certain similarities with the core dimension of user engagement, "identification," identified in previous research, both reflecting users' initiative, selectivity, and voluntariness, as well as users' perceived sameness with other users or products/services.

"Practical value" is mainly manifested in rewards and usefulness. Rewards specifically refer to incentive activities planned by PDCS marketers to attract more users. These activities can, to some extent, mobilize users' enthusiasm for interacting with PDCS. For example: "I think PDCS' s activity of collecting likes to receive cultural and creative products is quite good. I' m happy to participate in such activities, and after participating once, if there are similar activities next time, I will be more proactive in participating" (a30). Furthermore, if the prizes themselves are also attractive to users, users' willingness to interact with PDCS will be further strengthened: "Participating in activities will reward cultural and creative prizes, and if I also like these prizes, I will interact with PDCS or with other users on the platform" (a10). Previous research proposed that rewards can be subdivided into hedonic and utilitarian types. Based on interview data, the "rewards" proposed in this study belong to the latter—(non)users may be willing to (continue) interacting with PDCS because they want to obtain a particular prize.

Usefulness specifically refers to users' perception of PDCS utilitarian benefits, such as: "During special periods, PDCS can promptly post adjusted opening hours of physical museums, so I won' t make a wasted trip" (a18); "Using PDCS can compensate for my regret of not being able to visit physical museums" (a21). Given that PDCS is essentially an information-based product/service, users have greater needs/expectations for practicality compared to social and hedonic aspects. However, it is precisely these practical needs/expectations that largely drive users' behaviors of interacting with PDCS: "I think using PDCS is a very deliberate behavior. When I have strong or precise needs, such as looking for a book, I will use it" (a24). The "usefulness" here overlaps to some extent with the "endurability" attribute of user engagement in previous research. Endurability has richer connotations, including users' evaluation of overall interaction success (such as considering the use of a product/service worthwhile and beneficial) and users' willingness to continue using and recommending the product/service to others. The former corresponds to the usefulness attribute in this study, while the latter two correspond to the continuance usage and recommendation attributes, respectively.

(4) Attention

Attention primarily refers to users' subjective perception of their investment level in PDCS, including attention, focus, and activation. Attention specifically refers to the degree to which users pay attention to PDCS and its content: "After visiting a physical museum, I actively followed its WeChat public account and its accounts on Bilibili and Weibo" (a1); "Content in PDCS that has practical use for me will capture my attention, and high-quality content will also attract my attention" (a31). Many scholars emphasize that attention is a key aspect of user engagement. Whether consciously or unconsciously, engaged users tend to invest substantial attention in the engagement object. During interviews, one interviewee also stated, "Engagement mainly depends on whether there is real investment, depends on attention and investment levels" (a19).

Focus specifically refers to users being completely immersed in PDCS interactions: "When I want to learn about knowledge in a certain area, if it recommends a lot of related, highly relevant content to me, then I will keep scrolling and can' t stop" (a18). Both attention and focus have been confirmed as important attributes of user engagement. Although some scholars have distinguished between attention (or concentrated attention) and focus, scholars have undoubtedly emphasized users' states of complete concentration in their interpretations of both attention and focus. This is a state highly similar to flow experience, in which users typically experience time distortion: "When I stop using PDCS and look at the time, I realize so much time has passed, and it feels like time flew by" (a31).

Activation is another manifestation of concentrated attention, specifically referring to the increase in users' physical vitality and psychological positivity caused by interacting with PDCS. Unlike previous literature that defined activation as an attribute on the behavioral engagement dimension (emphasizing the level of energy, effort, and time users expend), activation in the PDCS context belongs to the cognitive engagement dimension. It is a positive high-arousal state that can physically manifest as rhythmic movement: "When the melody I hear is very close to my mood at the time, I can' t help but sing along or move rhythmically with the music" (a14). Psychologically, it mainly manifests as excitement, exhilaration, and even forgetting fatigue: "When I' m in a very tired state, I will use it to increase my excitement level" (a11); "During use, I feel very exhilarated and forget that I was very tired" (a20).

3.2 Affective Engagement

(1) Enthusiasm

Enthusiasm primarily refers to users' degree of interest in and liking for PDCS. Interest specifically refers to the positive attitude and tendency that draws users' special attention to PDCS. For example: "Interest will make me want to learn more" (a11); "If it' s content I' m interested in, I will stay longer and also want to share it with others" (a27); "Interesting content or presentation methods like mini-games will make me more interested and more engaged" (a31). Liking

specifically refers to users holding favorable feelings toward PDCS content or interactions with PDCS: "As I see more and more content I like, my emotions become more uplifted, and the level of engagement deepens"(a9); "It gave me the feeling that I really liked that video, and since then, I' ve especially liked using it" (a23). Previous research exploring the conceptual model of user engagement in virtual corporate social responsibility co-creation also identified liking as an attribute, indicating that liking is a characteristic of user engagement not only in digital environments but also in virtual relationships. Additionally, in existing research on user engagement scale development, many scholars have considered user interest, but interest rarely exists as an independent attribute, usually combining with excitement, liking, curiosity, and enjoyment to form new attributes or dimensions, and being renamed as "enthusiasm," "novelty," "sense of participation," etc. Building on previous experience, this study combines interest and liking with similar emotional colors to form the enthusiasm attribute.

(2) Pleasure

Pleasure primarily refers to users feeling happy and satisfied during PDCS interactions. Happiness specifically refers to the positive emotional experience users obtain from interacting with PDCS, including enjoyment, joy, delight, and cheerfulness. For example: "During use, I don' t feel bored; I enjoy it very much" (a1); "I' m quite willing to use PDCS for reading because reading is already a pleasant thing for me, so I' m already happy from the moment I open PDCS" (a30). Satisfaction specifically refers to users' positive emotional responses to PDCS interaction experiences. In video game contexts, satisfaction has also been found to be an attribute of user engagement, but the "satisfaction" there emphasizes the hedonic aspects of user experiences. Different product/service types (experiential and informational) have different orientations. Video games are experiential, thus emphasizing social and hedonic benefits. PDCS is essentially informational, but its natural cultural and artistic attributes require it to also focus on experience. Therefore, PDCS must attend to both goal-oriented and utilitarian benefits and social and hedonic benefits. In other words, user satisfaction in the PDCS context needs to simultaneously address both utilitarian and hedonic aspects of user experiences. For example: "If I can always find what I' m looking for in PDCS, I will feel very satisfied" (a21); "I think the experience of viewing exhibitions in PDCS is better than offline viewing because I can see more details, and the introductions in PDCS are also richer" (a32).

Additionally, pleasure has been found to be an attribute of user engagement in multiple contexts, though different scholars have used different names. For example, in tourism service contexts, So et al. named this pleasurable state "focus." In virtual relationships, Jiang Sibo treated pleasure and enjoyment as two different attributes incorporated into the "focus"and "connection"dimensions, respectively. In social media contexts, Dessart et al. collectively referred to the pleasure and well-being users obtain from interactions as "enjoyment." In online shopping environments, O' Brien et al. collectively referred to users' feelings of being attracted, interested, and enjoying themselves during interactions as "sense of participation."

3.3 Behavioral Engagement

(1) Interaction

Interaction primarily refers to interactions between users and users within PDCS, including behaviors such as sending bullet comments, liking bullet comments, replying to comments, and liking comments. For example: "I very much hope to communicate with others, to exchange feelings and experiences with people who have read the same book" (a14); "If I see someone in the comment section who shares my views, I feel a sense of mutual recognition and will give their comment a like" (a28). Given that different behaviors have different target objects and underlying motivations, "interaction" here does not include original commenting behavior. Regarding original commenting, it is an information need-driven behavior occurring between users and PDCS. Regarding sending bullet comments, liking bullet comments, replying to comments, and liking comments, they are social interaction need-driven behaviors occurring between users and users. Previous research exploring user engagement in online news contexts also distinguished between original commenting and replying to comments as two high-level engagement behaviors, considering original commenting as user feedback to content creators and replying to comments as dialogue between users. Building on this, this study, combined with PDCS' s specific functions, expanded behaviors representing user feedback to include liking, collecting, and commenting, and expanded behaviors representing user dialogue to include sending bullet comments, liking bullet comments, replying to comments, and liking comments.

(2) Recommendation

Recommendation primarily refers to recommending PDCS to other people (non-user groups) or sharing PDCS content with other people (including both users and non-users). For example: "I will promote this mini-program to my family group chat, calling on everyone to experience it together" (a1); "As long as I think it' s good, I really want to recommend it to others" (a23); "I think 'Panoramic Forbidden City' is really well done, and I will share it with my family and friends to let them feel the charm of technology" (a32). Compared to directly recommending PDCS, more interviewees expressed a tendency to indirectly recommend PDCS to other people (non-user groups) by sharing specific PDCS content. For example: "I will share content that I find very novel with people around me because I want to discuss the topic with them, and in the process, I will incidentally recommend PDCS to them" (a27).

(3) Continuance Usage

Continuance usage primarily refers to users' willingness to repeatedly use PDCS in the future. Habitual usage and enhanced usage are the two characteristic manifestations of continuance usage. It is important to note that "usage" here not only covers specific operational behaviors in PDCS, such as browsing cultural information, appreciating cultural exhibitions, listening to cultural audio, watching cultural videos, and booking cultural venues, but also includes behaviors that reflect user feedback, such as liking, collecting, and commenting on

cultural works.

Continuance usage is one of the behavioral manifestations of user engagement, a conclusion that has become academic consensus, and this study once again confirms the scientificity and universality of this conclusion: "During use, I don' t care about the length of time; as long as my phone still has battery, I can continue" (a1); "Especially when I feel happy and satisfied, I will hope even more to continue using PDCS" (a31).

Habitual usage specifically refers to users integrating PDCS interactions into their daily lives and developing habits of using PDCS: "I feel that using PDCS every day is a must-do thing for me; I' ve already developed a habit of using it" (a22); "I think using PDCS is a natural thing" (a24). Enhanced usage specifically refers to users spending more time and energy and exerting more effort in PDCS interactions: "I think it' s my destined APP; I like it very much, so later I developed many ways to use it myself" (a23); "I' ve used some PDCS websites and WeChat public accounts, and I even specifically searched for its APP in mobile app stores because I wanted to compare which one is better" (a30). The "enhanced usage" here aligns with previous interpretations of user behavioral engagement in social media contexts. Although PDCS is a non-profit platform focusing on providing cultural resources and services, it also has some features of social media platforms in its functional settings (such as the National Public Cultural Cloud website offering functions for sending bullet comments, liking, commenting, and sharing in video livestreams), and some PDCS directly use social media platforms to provide cultural resources and services to the public (such as the Nanjing Museum WeChat public account and Jiangsu Public Cultural Cloud WeChat video channel). Therefore, it is reasonable that PDCS and social media contexts share some similar features in user engagement, and this similarity also, to some extent, validates the scientificity of previous research.

4. Conclusions and Implications

4.1 Research Conclusions and Implications

Successful information products/services should not merely remain at the level of usability but should achieve a high degree of user engagement. This study introduces user engagement into the PDCS domain. By comparatively analyzing the similarities, differences, and relationships among the three similar concepts of user involvement, user participation, and user engagement, it deepens understanding of user engagement. Through deductive reasoning, it defines the abstract concept of PDCS user engagement, clarifying that PDCS user engagement refers to the positive valence experience generated by users during PDCS interactions and users' positive investment levels in PDCS, manifested as the psychological states, psychological processes, and behavioral responses through which users establish positive relationships with PDCS.

Furthermore, this study, through rich qualitative data and using procedural grounded theory, systematically distilled the structural dimensions of PDCS

user engagement, ultimately discovering that PDCS user engagement is a complex high-level concept that can be divided into three major dimensions: cognitive engagement, affective engagement, and behavioral engagement. Among them, the cognitive engagement dimension includes 4 attributes and corresponding 10 features: aesthetic appeal (interface aesthetics and production quality), perceived usability (reliability and ease of use), sense of value (resonance, rewards, and usefulness), and attention (attention, focus, and activation). The affective engagement dimension includes 2 attributes and corresponding 4 features: enthusiasm (liking and interest) and pleasure (happiness and satisfaction). The behavioral engagement dimension includes 3 attributes and corresponding 4 features: interaction (interaction), recommendation (recommendation), and continuance usage (habitual usage and enhanced usage).

Based on the research results, this study proposes feasible solutions to promote PDCS user engagement, hoping to provide some ideas and inspiration for PDCS practitioners. (1) In promoting cognitive engagement, PDCS practitioners need to not only emphasize platform/system reliability and ease of use and the usefulness of resources and services in the development of public digital cultural resources and services but also focus on interface aesthetics, design service content around themes that can resonate with users, and establish reward mechanisms that can mobilize user enthusiasm, regularly holding various forms of reward activities to promote users' proactive participation. In particular, many interviewees mentioned that problems encountered during PDCS interactions, such as "system crashes" and "unsmooth page transitions," affect their usage experience and even lead to interruption of "engagement." In response to this objectively existing "disengagement" phenomenon, PDCS practitioners should prioritize technical solutions to platform/system instability and unsmoothness issues, conducting regular maintenance to ensure platform/system usability. (2) In promoting affective engagement, PDCS practitioners can first conduct thorough investigations of user needs and expectations, then construct user portraits for different preference groups. By developing personalized recommendation functions, they can push content that users are interested in and like to them, using precise services to mobilize users' enthusiasm and enhance user satisfaction. As some interviewees stated, when PDCS recommends resources they are not interested in, they may find it difficult to enter into or maintain "engagement," subsequently losing the desire to continue using PDCS. Therefore, PDCS practitioners' ability to accurately and timely grasp user needs is key. (3) In promoting behavioral engagement, PDCS practitioners can attempt to develop more interactive functions, providing more diversified channels for communication between users and between users and PDCS. For example, by setting up an "intimacy spark" lighting mechanism to strengthen relationship bonds among users, and by incorporating gamification elements to increase the fun of PDCS usage, thereby stimulating users' curiosity and exploration desire and promoting users' enhanced usage. Additionally, many interviewees mentioned that different content in exchanges with other users in PDCS brings different experiences. Positive and friendly interactions enhance "engagement," while negative and

aggressive language weakens or even interrupts "engagement." To avoid or reduce the negative impact of inappropriate comments, PDCS practitioners can set reminders in user communication areas, advocating civilized communication and harmonious discussion, while strengthening supervision to timely detect and delete uncivilized comments and impose moderate penalties on corresponding accounts (such as warnings or temporary bans). PDCS practitioners have the obligation to create a good communication environment for users, enabling them to express themselves relaxedly in PDCS and reducing obstacles to users entering or maintaining "engagement."

4.2 Research Contributions and Outlook

This study makes certain contributions at both theoretical and practical levels. At the theoretical level, reconstructing the connotation of user engagement in the PDCS context provides exploratory insights into the nature and dimensions of this concept, thereby extending and expanding user engagement theory to some extent. It also enriches the research context of user engagement and broadens its research scope. Additionally, the 9 attributes and 18 features distilled in this study can provide specific indicator references for measuring PDCS user engagement, and the corresponding PDCS user interview data can also provide data support for PDCS user engagement scale development. At the practical level, introducing user engagement, a cutting-edge concept from relationship marketing, into the PDCS domain and clarifying the conceptual connotation and structural dimensions of PDCS user engagement can help PDCS practitioners better understand users and adopt relevant strategies to optimize PDCS, thereby achieving good user interaction and relationship management and enhancing users' positive usage.

This study also has certain limitations. First, it only defined the abstract concept of PDCS user engagement based on existing literature, without considering the operational definition of PDCS user engagement from a measurement perspective. Second, it only divided the structural dimensions of PDCS user engagement based on qualitative data, without empirically testing the scientificity of these structural dimensions. Third, it only focused on the ontological issues of PDCS user engagement, without considering the causes and effects of PDCS user engagement from a causal perspective. These limitations provide directions for future research. In the next stage, the researchers will follow standardized scale development procedures, combining qualitative and quantitative data to construct a scientific and reasonable PDCS user engagement measurement scale, making PDCS user engagement observable and operable. On this basis, the researchers will further explore the internal and external mechanisms of PDCS user engagement and analyze the roles and value that PDCS user engagement brings to users, public cultural institutions, and the public digital cultural cause.

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