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Exploring the Application of Quantified Self Technology in Libraries (Postprint)

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Full Text

Preamble

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Abstract

[Purpose/Significance] This study examines the practical significance and development models of quantified self technology in library applications, aiming to enable libraries to provide users with the technical environment for self-quantification, enhance users' personal cognitive levels, and expand library service management models. **[Method/Process]** By investigating the current application status of quantified self technology across various fields domestically and internationally, this paper clarifies the significance of quantified self technology in the library domain. Based on an analysis of the similarities and differences between quantified self and traditional library service concepts, it establishes a library service management system grounded in quantified self technology and identifies user quantified self data applicable to library scenarios as well as domains for library application data. **[Result/Conclusion]** The paper proposes a service management model for quantified self technology in libraries and key technologies for quantifying user behavioral data. Libraries can create quantified self application systems through methods such as exploring users' digital footprints and establishing optimal reading directories. However, the application of quantified self in libraries still faces issues including data control rights acquisition, data portability, user information security, and liability for negative impacts, which require establishing trust relationships and relying on improved legal frameworks to resolve.

Classification Number: G250.7

Keywords: quantified self, library, big data, information sharing

1. Development and Application of Quantified Self Technology

1.1 Origin and Meaning

Historical records of quantified self can be traced back to the late 16th century when Italian physiologist S. Sanctorius recorded his personal weight before and after meals over 30 years and weighed his food, attempting to reveal correlations and study energy consumption in a growing organism. This early form of quantified self involved long-term recording of personal data through written forms to develop self-awareness. The contemporary concept of "quantified self" was

first proposed in 2007 by K. Kelly, editor-in-chief of *Wired* magazine, and technology columnist G. Wolf. In 2009, G. Wolf elaborated on the concept's essence as "self-knowledge through numbers" and established the Quantified Self organization in 2010. In his 2010 TED talk, he described quantified self as a mirror that reflects individuals through digital forms and promotes self-understanding. In domestic research, this term is frequently used in medical articles to denote real-time health monitoring and is translated as "量化自我" (quantified self).

The core of quantified self lies in individuals actively monitoring personal data to deepen self-cognition. In this process, wearable devices, applications, and other tools constitute complete quantified self technology. Within individual usage contexts, current wearable devices such as fitness bracelets represent one application form. Generally, any measurable behavior or experience can become part of a self-monitoring system. Library-based quantified self focuses on individual reading behaviors and learning activities. People tend to forget personal behaviors, but quantified self technology enables long-term observation and recording of personal data, thereby enhancing self-understanding. Today's quantified self emphasizes long-term data recording and analysis through technical means and smart devices, forming rapid, detailed, precise, and comprehensive data acquisition and transmission to achieve deep-level personal cognition.

1.2 Key Technologies

Currently, commonly used quantified self tools include wearable devices such as Fitbit smart bracelets for activity tracking, Sleepbot for sleep monitoring, and Happiness for mood tracking. Quantified self operates through various tools and devices, with mobile applications, wearable technology, wireless communication technology, and sensor technology forming its key technological components.

Sensor Technology: Sensor network technology constitutes an important component of IoT technology and represents a key technology for wearable devices. Wireless sensor networks can collaboratively detect physical information or objective environments of interest through autonomous sensor collections. Wearable devices can obtain health data, activity data, and other quantified self user data through different sensors. Sensors use wireless communication technologies such as Bluetooth to enable data transmission from wearable devices, forming analyzable visualized data.

Wearable Computing: Wearable computing is currently a crucial technology for practicing quantified self and the primary tool for individual use. Proposed by S. Mann in 1998, wearable computing broadly refers to any computer device that assists users in their activities. The wearable device field provides technical support for individual quantified self usage, promoting self-recording behaviors.

Mobile Applications: Smartphones read, record, and analyze data from internal sensors through mobile applications to form complete project information. For example, current mobile devices' step-counting functions analyze data from vibration and gravity sensors through mobile applications to generate personal

data for different users.

1.3 Research and Application Status of Quantified Self Technology

Domestic Status: Using CNKI and Wanfang Database as primary sources, a precise subject search (including titles, keywords, and abstracts) with “quantified self” as the search term yielded 62 articles from CNKI distributed across library science, basic and higher education, and communication technology fields, and 36 articles from Wanfang Database distributed across medical and education fields. A 2014 survey of domestic literature on this theme found that domestic research was limited in quantity and primarily focused on the medical field. However, following the mention of quantified self in the 2014 *NMC Horizon Report (Higher Education Edition)*, the number of quantified self-themed research articles in the education domain has nearly surpassed those in the medical field, with overall research volume doubling compared to three years prior.

International Status: An investigation of quantified self research status was conducted primarily using the Web of Science database with the search formula: Topic = “Quantified Self” OR “Self-Tracking,” yielding 350 papers. Annual publication volumes are shown in [Figure 1: see original paper]. Among these, 13 papers (3.72% of the total) were published before G. Wolf proposed the “quantified self” concept in 2007, with relatively low relevance to the theme. The number of related research articles reached its first peak in 2007, after which publication numbers showed rapid growth, reaching an overall peak in 2016. The survey found 25 articles in the “information and libraries” research direction, 10 in “education and educational technology,” with the remainder primarily focusing on computer technology, mathematics, and medical fields.

Quantified Self Technology in Medicine: The “quantified self” concept originated from personal physical condition data and health quantification. G. Wolf spent considerable time in his 2010 TED talk explaining the quantification of personal physical and health data to guide audiences in understanding this concept. Quantified self is applicable to chronic disease management and prevention. The FDA-approved G5 Mobile CGM System represents the first portable blood glucose monitor that can monitor patients’ blood glucose levels in real-time and issue alerts when values are abnormal. Similar tools have been applied in formal medical systems abroad, and domestic research systems have also been developed for chronic disease treatment and early warning. The application of quantified self technology tools in the medical and health system represents an inevitable trend.

Quantified Self Technology in Education: The 2014 *Horizon Report (Higher Education Edition)* first listed quantified self as a key technology that would influence educational development within 4-5 years. The 2016 *Horizon Report (Higher Education Edition)* identified learning analytics as a short-term development trend and important technology. The 2017 edition continued to emphasize learning measurement as a key focus. Current edu-

education domain quantified self research primarily concentrates on establishing machine intelligent learning paths, designing self-learning systems, and applying quantified self tools, with some articles analyzing the role and application status of quantified self in education. International scholars have monitored teacher-student interactions in quantified self experimental contexts, finding that quantified self tools can effectively record individual learning conditions, though semantic context significantly impacts monitoring results. Research in the education domain can confirm the important influence of individual quantified self practice on reflective learning states.

Quantified Self Technology in Libraries: Through investigation and analysis of domestic and international journal databases, research articles applying quantified self to library science, library services, or librarianship are scarce. As of November 30, 2017, fewer than 10 papers related to quantified self themes have been published in domestic library and information science journals. Relevant research content involves concept popularization, knowledge mapping analysis, and development status in medical aspects and MOOC learning. Some scholars have drawn inspiration from quantified self to create MOOC self-learning systems, using quantified self technology data collection to build learner characteristic databases and knowledge graph repositories to support adaptive learning recommendation engines, constructing MOOC system learning environments and enhancing learner monitoring and feedback of learning processes. Two articles address quantified self application in library contexts. Xu Dejun explored quantified self concepts and technologies in library environments and proposed application recommendations, though his research focused more on introducing quantified self concepts and technologies with limited discussion in library contexts. Zhang Chunlan et al. studied quantified self applications in digital reading to address common reading problems, focusing on users' personal reading quantification behaviors without including library data processing and user interaction sharing, concentrating more on digital reading theory exploration.

2. Theoretical Discussion on Library Application of Quantified Self Technology

Technological advancements have enabled emerging technologies such as AR (augmented reality) to be applied in libraries, allowing knowledge to be presented to readers through multidimensional effects. The popularization trend of wearable devices will promote the application and development of quantified self technology in library reading environments. Through conceptual analysis, libraries can establish quantified self application models. When technical conditions mature, theoretical models can facilitate the development of quantified self applications.

2.1 Application Significance

The significance of quantified self lies in enabling individuals to fully understand themselves, bringing positive impacts and changes to their learning, work, and life. Quantified self can also enhance reflective learning, thereby improving learners' efficiency and capabilities. Reflective learning enables individuals to accurately assess their personal learning states and form personalized learning approaches. The *2017 Horizon Report (Higher Education Edition)* proposes that continuous learning measurement is crucial for understanding learners' needs, a perspective equally applicable to quantifying library reading processes. If semantic environments significantly impact monitoring results, combining learning behavior data with life information and data may reveal different correlations among various aspects of quantified self. For instance, exploring relationships between exam scores and reading habits could reveal how reading environment changes improve learning outcomes. Strengthening readers' cultural literacy and improving group cultural levels represent goals of library development.

Libraries have entered the digital reading era, where abundant digital reading resources and the utilitarian nature of popular reading can cause readers to lose direction and struggle to form systematic reading habits. Through quantified self, individuals can develop metacognitive knowledge about their reading, form personal cognitive strategies, and clarify reading directions. Quantified self enables library professionals to analyze user behaviors from different perspectives, and applying users' quantified data to library management and services will create a win-win situation for both libraries and users.

2.2 Clarification of Adjacent Concepts

Library user services require user data support, including traditional user surveys, library personalized services, and construction of personal digital libraries. Both quantified self and these library services involve collecting and organizing large amounts of user data. Before analyzing library quantified self, existing library services should be conceptually distinguished from quantified self to clarify their respective application scopes. In the process of applying quantified self technology, libraries function more as a medium, providing users with the technology for quantified self behaviors and shortening the distance for individuals to use quantified self technology. Libraries provide environments and motivation for users to employ wearable devices and other quantified self tools, promoting enhanced self-cognition. Currently, quantified self's main characteristic is data collection through individual active behaviors using new technical tools and smart devices. Data results from library application of quantified self technology not only improve user experience from service and management perspectives but also enhance users' self-cognition at a deeper level.

Quantified Self vs. User Surveys: Library user demand surveys can take two forms: (1) questionnaires distributed directly in paper or electronic formats to deeply understand user needs; (2) targeted user research where users trig-

ger embedded survey questionnaires through click behaviors while using digital libraries. Due to length limitations, questionnaire results often have certain constraints. Quantified self includes not only data from user-initiated actions but also detailed data detected by quantified tools. Quantified self possesses deeper data analysis significance and greater analytical complexity. Significant differences exist between quantified self and user surveys in terms of data volume, content, and analysis processes.

Quantified Self vs. Personalization: Personalized services have several models. Libraries provide different levels of knowledge services based on users' varying needs. Shallow-level services involve broad information recommendations based on general user needs, while deeper-level services explore specific user information needs to provide content, with deep personalized services offering information decisions and strategy formulation based on user requirements. The commonality between library personalized services and quantified self technology applications lies in that data-generating individuals are all library user groups, with differences in data generation methods, collection pathways, and varying effects and impacts. Personalized services are based on libraries collecting data from users' library service usage, while quantified self data sources include more detailed data inadvertently generated by users' active use of quantified tools. This data includes not only service usage data but also long-term data generated from library-related reading and learning behaviors, which are directly processed visualized results from quantified tools that can be used more quickly and accurately by libraries and users. Quantified self tools include but are not limited to quantified applications and wearable devices. Library personalized services track and mine user behaviors through Web log mining, semantic web construction, and other technologies, while quantified self captures user behaviors, emotions, and environments through sensor technologies to provide deep-level experiences.

Quantified Self vs. Personal Digital Libraries: Currently, there is no clear definition of personal digital libraries in academia. Some scholars argue that personal digital libraries must include two important aspects: a complete digital resource collection and user information collection, storage, and effective utilization. From the user perspective, quantified self overlaps to some extent with personal digital library construction behaviors. Both employ combined active and passive approaches when collecting and organizing personal data, and both can record reading topics. The differences lie in that quantified self technology has a broader scope beyond reading, capable of quantifying reading topics, reading time, and even reading emotional changes. Personal digital libraries generally store users' reading history, collections, and notes. Wearable devices and other tools practicing quantified self technology can deliver quantified information to users in real-time, differing in data collection content, direction, and convenience.

2.3 Application Model

For libraries, quantified self technology represents a means and method for collecting individual data. Libraries analyze and process user data generated through quantified self technology, with data analysis results providing guidance for library management and services and directly affecting user groups. Libraries will implement changes in both service and management aspects through quantified self, forming a library quantified self application model shown in [Figure 2: see original paper].

In this cyclical working system, users remain the data source and beneficiaries, serving as the center of library quantified self technology services and management. Libraries are the providers of quantified self environments and technologies, with librarians being both library managers and providers of service and management data. Users interact with libraries through quantified self technology provided by libraries, constituting the service module in the application model. Librarians and users obtain different behavioral data through quantified self technology, which is processed for corresponding library management segments, thereby forming a management module under the quantified self technology background.

In the service model application, libraries provide technical support and environments for users' quantified self behaviors and establish incentive mechanisms for quantified self usage. Analysis of quantified self research status in the education domain reveals that context and equipment issues hinder development. Libraries should become technical supporters for users employing quantified self technology, providing quantified tools. Users can enjoy library-provided technical support without spatial limitations to quantify their learning and reading behaviors. Individuals reflect on, monitor, repeatedly explore, and correct reading habits through quantified self technology. While quantifying, users grant libraries rights to access and use data. Data obtained by users during quantification is fed back to libraries, which process and feed data analysis results back to users. In this cycle, libraries achieve the goal of improving service capabilities and perfecting public service systems, while users improve reading speed and knowledge acquisition under the premise of self-cognition. Unlike traditional service models, quantified data generated by users in this cyclical model is visualized data analyzed in the first stage by tools, representing more comprehensive and accurate data. Libraries can easily form deeper analysis results from processed data, providing users with more suitable data and service feedback.

In the management model application, librarians and users are the focus of library management and development. Using technology-driven force as the basic driver for service and management innovation, libraries obtain quantified self data from librarians and users. User behavioral data generated through quantified self technology directly enters library information resource management systems, including user reading behaviors and library visit behaviors, with in-

formation resources including library circulation and acquisition processes operated through user data. Libraries strengthen library management construction through user behavioral data. Librarians transmit personal physical data and work behaviors to library environmental management systems through quantified self technology, with environmental management information including library human resource management, librarian health, and user relationship management, forming a management cycle between users and libraries. Libraries obtain detailed work dynamics from librarians' quantified information for library operation management and feedback results, forming a management cycle between libraries and librarians. Under the background of library quantified self technology application, the management cycle formed among users, librarians, and libraries includes not only traditional quantitative indicators but also behavioral data, emotional perceptions, and physical data recorded in detail through quantified tools.

3. Main Applications of Quantified Self Technology in Libraries

Since quantified self data originates from individuals while libraries provide technology and conduct analysis, applying quantified self to libraries should be discussed from both user and library perspectives. This section first analyzes quantifiable data from user behaviors that may apply to libraries, such as recording personal reading habits and capabilities, then proposes library quantification behaviors from the library perspective to clarify service and management directions.

3.1 Quantifying User Reading Data

Through relevant technologies provided by libraries, users can quantify various behavioral data generated during personal reading. This data involves not only reading time and book information but also reading emotion detection and intelligent processing of reading topics. Emotional changes during reading directly reflect the degree of reception toward books. Accurate quantification of readers' emotions provides a basis for machine reading recommendations. Libraries can use such data to judge literature preferences of different user groups. Libraries can directly extract reading information for different users from quantified self tools. For example, if a user shows excitement and fast reading speed when reading a book, their quantified self device will transmit such information to the library. Libraries can then establish mapping tables for different feedback information to analyze relationships between feedback information and actual reader conditions. Based on long-term data monitoring, smart devices can provide optimal reading book recommendations for individuals through reading difficulty matching and reading emotion matching.

Quantifying Reading Habits: Reading habit quantification factors include

reading time, frequency, and single-session reading volume, which can be discussed separately for digital and paper resources. Digital resource reading quantification is relatively easy, achievable through sensors on reading devices or related applications such as e-readers. Paper resource quantification requires long-term recording through wearable devices. Quantified self data on reading habits, including time and frequency, from different users provides directional guidance for library services and management. Currently, wearables are primarily used for quantifying exercise and sleep data, while paper resource reading behavior quantification awaits more convenient and popular wearable devices.

Quantifying Reading Topics: Through eye movement monitoring, emotion detection, and other technologies, libraries can conduct quantitative analysis based on the impact of different literature and books on readers. Scholars have conducted experimental research on the relationship between eye movement and reading difficulty, demonstrating that eye movement frequency per unit time correlates with text difficulty, establishing an association between eye movement and reading content. Using emotion detectors during reading helps computers deeply understand readers' preferences and corresponding literature content. Libraries can utilize such data to allocate books to users based on quantification results.

(1) Reading Difficulty Quantification: Scholars have established Chinese reading difficulty quantification models using artificial neural networks and detected reading difficulty through eye movement technology. Eye movement monitoring technology has interfering factors (see [Figure 3: see original paper]). Using smart devices to detect eye movements quantifies the content quality of personal reading objects and judges the impact of literature with different topics and difficulty levels on individuals. Libraries can allocate texts with different topics and difficulty levels based on smart device quantification results. Quantified self requires not only quantifying eye movements during normal reading but also analyzing and learning eye movement behaviors under different reading conditions such as instantaneous comprehension. Although people feel their gaze moves smoothly across pages during reading, eyes actually perform a series of rapid movements. The complexity of monitoring is far higher than described, and currently mature eye monitoring devices are not yet oriented toward the general public.

(2) Reading Emotion Quantification: Psychological states, emotions, and attitudes all fall within the scope of quantified self (see Table 1). Some have attempted to develop more accurate emotion quantification programs that combine sensor data with personal records to calibrate emotion quantification results. Research has found that in wearable device experiments, using EEG for emotion detection achieves accuracy rates as high as 90%. Existing emotion detectors can detect emotional changes based on human physiological data. Wearable devices can use emotion detectors and conduct emotion detection through a series of sensors including intonation, heart rate, and thermal sensors.

3.2 Quantifying Other User Data

Libraries use user quantified self data for analysis and processing, forming new service domains and service models. Applicable user quantified data includes not only behavioral data such as reading but also detailed physical and health data. Foreign libraries have already created quantified self environments to expand new service domains and cultivate new management talents. As early as 2013, the Health Sciences Library at the University of Central Florida College of Medicine began a research project using quantified self-related technology to study how wearable devices could be used for health condition quantification in work environments. In this project, the library and college shared the goal of promoting active and healthy lifestyles among faculty, students, and staff. The library emphasized enhancing librarians' relevant capabilities, including new technology usage skills, user popularization, and interaction abilities. The project's data analysis results will guide organizations in understanding employee health conditions in workplace scenarios. Library application of quantified self technology can create new service domains and research directions. Another case of libraries providing quantified self technology comes from the Claremont Colleges Library, which was invited to join Google Glass project research to achieve quantified self for users and librarians through wearable devices (such as Google Glass), including tracking user environments and detecting user language learning abilities. This project research satisfies the interests of both library users and Google. By providing quantified self tools and technologies such as wearable devices, libraries can conduct deeper-level research activities, expanding from user reading-related behavioral data research to data analysis across various domains.

3.3 Enhancing Library Services

The process of user quantified reading generates self-learning behaviors, which promote better learning states, subsequently improving library usage efficiency and frequency and facilitating library services. Library-provided quantified self technology environments can also assist individuals with disabilities in learning. For example, libraries for the blind can provide quantified self devices that automatically record blind users' physical and reading data and transmit it to the library. Through quantified self tools tracking blind users' reading speed and habits, blind libraries can recommend appropriate books or directly push audio e-books to their smart devices, and judge reading suitability based on users' physical conditions. Applied quantified smart devices can feed tracked data back to blind users through voice playback. Libraries can use users' quantified self data to form analysis results and serve users through three different service pathways:

(1) Establishing Reading Directories: Libraries can analyze users' quantified self data to summarize high-frequency books for user groups with different educational backgrounds, cultural levels, and professions, incorporating these book directories into book recommendation systems. Other users can retrieve

corresponding book directories in their fields and levels of interest through library book recommendation systems. Libraries establish optimal paths between books and knowledge goals for users, thereby improving knowledge acquisition efficiency.

(2) Recommending Books by Call Numbers: Integrate book recommendation systems with multi-library retrieval systems. While recommending books to users, the system can identify users' other frequently used libraries and provide call numbers for the book in different libraries.

(3) Exploring User Footprints and Mining Potential Users: Libraries monitor user behavioral footprints through quantified applications, including not only library usage behaviors but also forwarding, commenting, and promotional behaviors related to library information. By deeply mining users' text information on various social media platforms, libraries can form complete user profile databases and identify potential and stable users through behavioral monitoring.

3.4 Optimizing Library Management

Quantified management can be implemented from two aspects: librarian data and basic library data. First, librarian data can be applied to library human resource management. Libraries can establish librarian performance indicators and health records through quantifying work data and physical data, mastering librarians' work trends and health conditions. Innovation drives leadership changes, and quantified self promotes blood circulation and personnel turnover in library personnel systems. Librarians' cultural literacy and comprehensive capabilities represent library service capabilities.

Second, basic library data quantification can be applied to space management and user management. Such quantified data includes user circulation rates, book borrowing rates, and usage frequency of different functional areas. By quantifying users' library visit duration and footprints in different functional areas, libraries can identify strengths and weaknesses in current functional layouts to achieve functional and spatial transformation. Through quantified self tools worn by users, libraries can obtain real-time location information for each user, with statistics on usage frequency of functional areas providing basis for library space transformation. Libraries can explore new causal relationships between user knowledge acquisition effects and reading habits/environments. By recording users' quantified data on reading habits and effects and analyzing it in combination with library building space data and user usage conditions, libraries can verify whether environmental changes can improve and influence knowledge acquisition effects.

4. Application Challenges of Quantified Self Technology in Libraries

Quantified self technology development still faces certain limitations in medical and computer fields, and similar challenges exist in library applications. In a data-sharing environment, libraries face increased difficulty in obtaining data control rights, as well as information security and data adaptability issues. Integrating quantified self technology into library environments requires addressing several challenging problems and proposing solutions.

4.1 Data Control Rights Acquisition

In the medical field, patients providing health data plays an important role in medical research. Although providing personal medical data can help medical progress, most people are unwilling to disclose personal health information, and medical teams often pay high costs to obtain potentially valuable health data. If this is the case in the medical industry, libraries face even greater difficulty in obtaining user-shared data.

With the widespread application of mobile devices, public information has increased, and social behaviors have become traceable. More organizations and enterprises are willing to invest time and skills to obtain data from individuals' publicly available information. Libraries can reduce data acquisition difficulty by identifying information interaction motivations of different users and establishing trust relationships. Providing users with relevant digital devices, timely feedback of data analysis results, and participating in the entire user quantification process are key to establishing trust between libraries and users.

4.2 Data Portability

Data portability, or the universal applicability of data results, is an issue to be addressed in establishing library quantified self data analysis systems. Different user groups and individuals within groups all have data differences. Libraries using quantified self data from different user groups must consider the impact of data differences on data portability. To improve the universal applicability rate of quantified data analysis results, libraries need to conduct detailed user group classification and establish targeted user quantified data systems.

4.3 Startup Costs

Initial application of quantified self in libraries will be challenging because libraries need to provide quantified self tools for users. Under digital development backgrounds, deep understanding of digital environments promotes users' subjective adaptation to new environments. If libraries economize on digital devices and do not provide wearable devices and other quantified tools, the price of quantified tools will become a barrier for users to access library services, hindering the universal implementation of new technology services. Quantified

self application consumes not only library digital equipment procurement costs, data storage, and management maintenance costs but also involves space transformation construction costs and human resource costs. Libraries must consider startup cost issues and calculate return on investment based on their specific circumstances.

4.4 User Information Security

“Benefits are public while costs are personal” represents a universal problem in information-sharing society. Long-term personal data recording is not an easy process, and entrusting large amounts of personal data to an organization inevitably carries risks of personal privacy leakage. Users’ information-sharing behaviors provide valuable data to industries, and libraries must assume responsibility for maintaining user information security and protecting privacy. Proper use of user data is an important way to eliminate user anxiety, requiring libraries to appropriately handle user information security issues. Article 43 of the *Public Library Law of the People’s Republic of China*, implemented on January 1, 2018, stipulates that “public libraries shall properly protect readers’ personal information, borrowing information, and other potentially privacy-involved information, and shall not sell or illegally provide it to others.” This provides legal protection for user information security in library environments.

4.5 Liability for Negative Impacts

During the process of using quantified data, libraries may cause negative impacts due to data analysis errors and other reasons. In such cases, libraries need to consider self-protection and liability attribution issues. Library application quantified self data originates from both libraries and users, with libraries being the party that uses and processes quantified self data to serve users but cannot guarantee the authenticity and accuracy of user-generated quantified self data. Multiple factors can cause negative impacts in this process. First, libraries may employ improper data processing methods. Second, the accuracy of user quantified self data needs verification. Additionally, data result distortion may occur due to tool quality issues during library data processing. Libraries should consider potential negative impacts, clarify their responsibilities, investigate other influencing factors, protect user rights while safeguarding library interests, and eliminate the possibility of involuntary involvement in legal disputes.

Lawrence Lessig and others proposed the Creative Commons model, allowing creative works to be shared and recreated by more people. The Creative Commons (CC) license agreement primarily refers to the licensing mechanism for digital works on the internet, reducing some copyright holders’ rights while enhancing information sharing possibilities. Libraries can propose more detailed disclaimers before using quantified self data, specifying and defining the rights, risks, and obligations of parties potentially affected by library research, and suggesting that “professional issues should be consulted with experts.” In addition to statements, libraries should employ diverse and careful processing methods

in practice, timely inspect and correct calculation results, and improve data calculation accuracy in their work.

5. Conclusion and Outlook

Monitoring systems centered on quantified self technology have gradually been integrated into medical systems in some countries. The *Horizon Report (Higher Education Edition)* has listed quantified self, learning measurement, and other technologies as key development technologies for higher education for several consecutive years. Domestic research on quantified self themes has rapidly expanded from the medical field to the education field, with research articles gradually emerging in libraries and digital reading aspects. Integrating quantified self technology into library services to seek new development and establish service and management models based on quantified self technology will enable libraries to explore users' digital footprints, establish book recommendation directories, and develop potential and stable users. Issues such as information security, liability attribution, and startup costs faced by libraries in applying quantified self technology require establishing trust relationships between libraries and users and relying on legal improvements. Expanding quantified self application scope still has unresolved problems. Broader field applications require deeper user demand research.

It can be anticipated that future quantified tools will be as lightweight as fitness bracelets, capable of monitoring and recording personal reading time and accurately tracking daily reading habits and preferences. Quantified tools will submit data to one or more library consortia, through which libraries can obtain user reading habits and preferences and identify potential users that align with their resource layout. Based on understanding different user needs, libraries can gain insight into different users' visit frequencies and conduct searches according to their reading habits before they arrive. This will not only enhance user experience but also improve reference service efficiency. Resource allocation for individual libraries and even national libraries can become more rational, significantly reducing reading resource waste.

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Author Contributions

Wang Chaochen: Responsible for literature investigation, paper writing, and partial revision.

Xu Yuequan: Designed research framework, provided writing guidance and partial revision.

English Title: Application of Quantified Self Technology in the Library

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Abstract: [Purpose/significance] This paper studies the practical significance and development model of quantified self technology in library application, enabling libraries to provide users with technical environments for self-quantification, improving users' personal cognition levels, and expanding library service management models. [Method/process] Through investigating the application status of quantified self technology in various fields domestically and internationally, this paper clarifies the application significance of quantified self technology in the library field. Based on distinguishing the similarities and differences between quantified self and traditional library service concepts, it establishes a library service management system based on quantified self technology and identifies user quantified self data that can be used in library scenarios and fields for library application data. [Result/conclusion] The paper proposes a service management model for quantified self technology in libraries and key technologies for quantifying user behavioral data. Libraries can establish quantified self application systems by tracking users' digital footprints

and establishing optimal reading directories. The application of quantified self in libraries still faces issues such as data control rights acquisition, data portability, user information security, and liability for negative impacts, which require establishing trust relationships and relying on legal improvements to resolve.

Keywords: quantified self; library; big data; information sharing

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

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