JDCS
디지털콘텐츠학회논문지
Journal of Digital Contents Society
Vol. 24, No. 1, pp. 177-193, Jan. 2023

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근거이론에 기초한 디지털 피트니스 서비스 경험에 관한 탐색적 연구

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Exploratory Study on Digital Fitness Service Experience Based on Grounded Theory

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[요 약]

본 연구는 근거 이론의 방법을 통해 스마트 피트니스 클럽의 디지털 피트니스 서비스에 대해 탐색적인 연구를 진행했다. 연구 목적은 영향 요소를 알아내 서비스 시스템을 개선하고 사용자 경험을 업그레이드 하는 것이다. 48명의 피트니스 클럽 사용자의 인터뷰 데이터를 바탕으로 코딩을 통해 '지속적인 가치 인식'을 핵심 변수로 하는 이론적 프레임워크를 생성했다. 이 프레임워크는 "저항 극복"에서 "새로운 경험 추구" 및 "연계 강화"로 이어지는 사용자의 서비스 경험 경로를 설명하고 서비스 주동성, 감각 자극 및 실시간 인터랙션이 서비스 경험에 미치는 주요 영향을 설명한다. 본 연구에 따르면 피트니스 서비스 분야에서 디지털 기술의 전복으로 인해 서비스의 체험과 서비스의 완전한 순환은 이미 모든 서비스 측과 디지털 기술 사이의 상호작용의 총체가 되었다. 스마트 피트니스 클럽의 주요 서비스 접촉 유형은 기술의 추진과 기술의 생성으로 바뀌고 있다.

[Abstract]

In this study, the research method of grounded theory is used to explore the digital fitness service of smart gym. The purpose is to improve the user experience by identifying the influencing factors of service experience. Based on the interview data of 48 gym users, the coding results generated a theoretical framework with "continuous value perception" as the core variable. This framework describes the service experience path from "overcoming resistance" to "seeking new experience" and then to "strengthening connection", and illustrates the important influences of service initiative, sensory stimulation and real-time interaction on service experience. Research shows that, in the field of digital fitness services, the complete cycle of service experience and service encounter has become the sum total of interactions between all service providers and digital technology. The main service contact types of smart gyms are turning to technology-facilitated and technology-generated.

색인어 : 디지털 피트니스 서비스, 스마트 피트니스 클럽, 사용자 경험, 토대이론

Keyword : Digital Fitness Services, Smart Gym, User Experience, Grounded Theory, Service Transformation

http://dx.doi.org/10.9728/dcs.2023.24.1.177

Received 05 November 2022; **Revised** 16 December 2022
Accepted 23 December 2022

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Ⅰ. Introduction

With the widespread use of digital technologies, “digital transformation” has become an important topic for global enterprises. Technologies such as artificial intelligence and big data analytics are becoming a natural part of the service experience. Digital devices are also starting to provide a new generation of user-centered services [1]. User experience design in services is thus gaining attention and contributing to the achievement of high levels of customer experience and brand value [2]. At the same time, in China, the emergence of COVID-19 has led to the services offered by gyms being considered as high-risk activities. During this period, gyms are required to record user access information and monitor users’ physiological data, or they must stop the service. This situation has accelerated the digital transformation of traditional fitness services.

As of December 2021, the market size of China’s fitness service industry reached 377.1 billion yuan, with approximately 75.13 million people paying for fitness services [3]. The broad market scale provides the foundation for the digital transformation of fitness services. Digital fitness services are gradually becoming a nascent demand in the market. However, most small and medium-sized businesses (SMBs) do not have sufficient experience in digital transformation [4]. Many gyms’ digital services are still heavily influenced by traditional business processes, and the service experience is yet to be explored. For researchers, digital transformation has now been studied by scholars in different fields, but little is currently known about the understanding of user experience in specific industries or service scenarios. For practitioners, it is crucial to evaluate user experience in the early stages of new product or service development [5]. Therefore, this study aims to conduct exploratory research on the experience of digital fitness services from the perspective of user experience in order to enrich our perspective on the phenomenon of digital transformation and to deepen our understanding of the user experience in digital services.

Our research is based on the behavioral data of smart gym users. The aim is to discover the key factors that influence the service experience from the user’s perspective. In the research process, we used field surveys and semi-structured interviews to collect primary data, and we conducted face-to-face or online interviews depending on the specific conditions and technical feasibility of the smart gym location. Grounded theory was used to code and analyze the data. The study analyzed the impact of current digital interventions on users’ exercise patterns and proposed a theoretical framework with “continuous value perception” as the core variable. The framework combines three time dimensions of user experience research—before, during, and after the use of the service, describes the user experience process from “overcoming resistance” to “seeking new experiences” to “strengthening connections”, and finally the key factors affecting service experience in each stage are clarified. The insights from this work on smart gym user behavior data can provide valuable theoretical and practical support for the work of relevant researchers and practitioners.

Ⅱ. Literature Review

Digital transformation is considered at a macro level as a profound change in society and industry caused by digital technologies [6]. Therefore, we review in this section the impact and research of digital technologies on service systems and fitness domains.

2-1 Research Related to Digital Technology Impact Service Systems

For service providers, previous studies have provided evidence of the positive impact of digital transformation on the business or organization. Internally, studies have focused on the improvement of digital technologies regarding business operational performance, such as automation, financial performance, and significant business improvements [7]-[9]. Externally, businesses or organizations are using digital technologies to enhance the service experience. Some industry studies provide specific data. Shen et al. found that omni-channel service strategies are adopted by whole retailers to enhance the customer experience [10]. Gunther et al. noted that data analytics are being widely used by internet companies in order to meet consumer demand and provide quality service [11]. As a whole, digital transformation is changing the ways in which the real economy operates. It has been suggested that new business models may emerge when all business sectors and functions are affected by digital transformation [12]. This transformation may be the creation of a new business model or the improvement of an existing business model [13]. The current study shows that digital transformation facilitates the iteration of business models and service experience enhancement in companies or organizations. On the consumer side, people are using digital technologies more extensively in their daily lives due to the convenience that they bring. The identity of consumers is changing as a result. Lucas et al. point out that digital technology empowers consumers to engage in value co-creation [14]. People are beginning to move away from being passive agents influenced by the service provider and are actively participating in service encounters [15]. Due to the

proliferation of digital devices, the channels and agents that deliver services are iterating and technology-led interactions are gradually increasing. There has been a profound change in the ways in which consumers interact in service encounters. Examples include smart convenience stores and virtual fitness assistants [16]-[17]. As a result, consumers are starting to take more and more responsibility for their interaction behavior and service experience. Furthermore, these changes have generated the emergence of a new type of consumer—the digital consumer. von Leipzig et al. showed that digital consumers are more confident and better informed about their needs, and they set higher expectations for services [18].

For the service offering itself, digital technology has first changed the "human" element of the service. First, it is obvious that technology enhances the capabilities of employees [19]. In another case, technology replaces employees, and technology-led service encounters no longer require the presence of employees [20]. It has also been argued that employees and consumers are taking on new roles, rather than being at the heart of traditional services [21]. Schumann et al. suggest that there is no longer a clear boundary between consumer and employee roles due to the impact of technology [22]. In addition to this, the new features of digital technologies have also impacted the service experience. Scholars such as Lanzolla noted that products and services have the opportunity to achieve new features, higher reliability, and higher utilization due to the excellent connectivity, interactivity, and data computing capabilities of digital technologies [23]. These changes create new challenges for the evaluation of service experiences, which Stephanidis suggests are related to the means and object of interaction. It expands from explicit to implicit interactions and escalates from one-to-one to many-to-many interactions [24]. At the same time, in addition to "human-to-object" interactions, "object-to-object" interactions are also included [25]. The study of the behavior and experience of these interactions is usually focused on usability and user experience, two important concepts in the field of human–computer interaction. They are considered to be the key determinants of any product, system, or service for human use [26]. Currently, user experience research is widely disseminated and accepted, and the concept of usability is gradually regarded as a subset of user experience [27]. According to ISO standards, user experience aims to study "a person's perceptions and responses resulting from the use and/or anticipated use of a product, system, or service", including all users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors, and accomplishments before, during, and after using the product or service [28]. Compared to usability research that focuses on user perceptions and user performance, user experience research provides a more inclusive perspective. It focuses on the user's emotions or feelings during the interaction behavior and the intangible value that comes from the interaction behavior.

2-2 Research Related to the Impact of Digital Technology on the Fitness Field

The rapid adoption of digital technology in the fitness sector offers the possibility of digital interventions and personalized support for gym-goers. In the application space, data tracking features such as pedometers, heart rate monitors, and oxygen saturation tests are being added to mobile and digital devices with IoT modules. An example is the mobile application WeRun, which allows users to see the number of steps that they take each day to exercise. In the research arena, several studies have shown the impact of digital technology on fitness behavior. Brickwood et al. evaluated the use of wearable devices in digital interventions. Wearable devices were found to lead to significant increases in daily steps, physical activity, and overall energy expenditure [29]. Katelyn Esmonde explored the relationship between data collection technology and runners' intrinsic experiences based on the experiences of 10 young female runners using self-tracking devices [30]. Jeroen Stragier conducted a study of 717 runners regarding online fitness community use, and the results showed that the use of online fitness communities facilitated long-term progress in training [31]. These studies focused on investigating the use of specific digital technologies, while only a limited number of studies used an exploratory approach to examine user behavior in the fitness domain. For example, Uttara Ananthakrishnan et al. used data from Safegraph, Google Places, and other websites to compare the digital resilience of gyms and dental centers [32]. Meera Radhakrishnan et al. used data on users' visits to gyms to explore people's motivation to exercise, gym participation patterns, and reasons for dropping out of gyms in order to help gym-goers to adhere to their workouts over time [33].

In summary, research has been conducted in a number of areas to explore the impact of digital transformation driven by digital technologies that have changed the service experience and placed new demands on the evaluation of the experience. The important value of user experience in service evaluation is now receiving attention from industry and academia, and the role of digital interventions in the fitness field is beginning to be recognized by gym-goers. However, research on the user experience of digital fitness services is still in the exploratory stage. Most of the relevant studies focus on users' use of a particular digital technology or digital device, while few studies have been conducted on the comprehensive experience of digital fitness services. The most important factors affecting the service

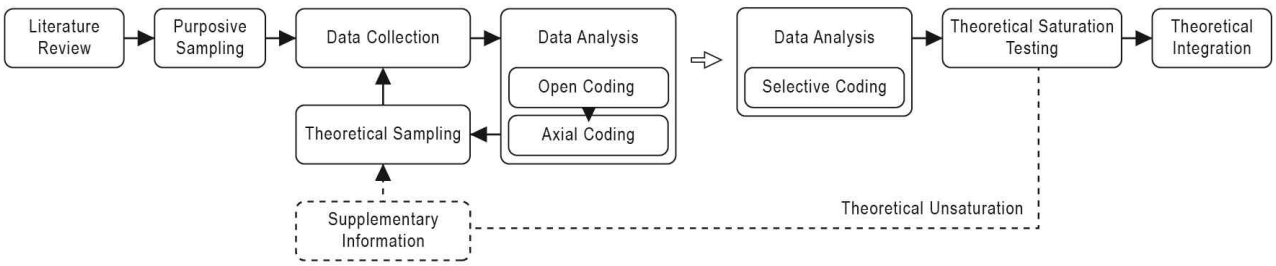

그림 1. 리서치 프로세스
Fig. 1. Research process

experience in digital fitness scenarios have not been fully described. In terms of research methods, prior studies have mostly used usability testing to evaluate the service experience, collecting data and validating theoretical frameworks or hypotheses through structured methods. Two of the most commonly used methods are user testing and expert reviews. Users' emotions, feelings, and expectations are rarely explored. Moreover, user behavior is constantly changing according to different specific scenarios [34]. Therefore, we believe that research methods that presuppose a theoretical framework or hypothesis may not be fully applicable to this study. Given the purpose of the work, we conducted an exploratory qualitative study to ensure the validity of the data obtained for studying the phenomenon in a specific scenario. The results obtained may serve as a useful addition to the existing quantitative studies. In contrast to previous studies, this study combined all temporal dimensions of user experience research to collect and code user behavior data in order to form a theoretical framework that can describe user experience pathways. This study focuses on the key factors affecting the service experience in digital fitness services and discovers the actual gap between the service experience and users' expectations, so as to provide substantial theoretical support and suggestions for the optimization of smart gyms and their digital fitness services.

Ⅲ. Methodology

3-1 Research Context

In China, places that provide digital fitness equipment and digital fitness services are called "smart gyms". According to the design of Alibaba Group's "Koubei Smart Gym", before entering the gym, users can apply for membership, view class schedules, and book classes in the mobile application. Once the user enters the gym, the identity of the member will be automatically recognized, and the type of exercise, exercise data, and exercise trajectory of the user in the venue will be tracked and analyzed in real time to form a personalized fitness program and visual exercise analysis for the user. The smart gym is also equipped with smart showers, smart closets, and other related digital equipment. Smart gyms generally include four main areas: an aerobic training area (set up with treadmills, mountain climbers, and exercise bikes, etc.), a strength training area, a multi-functional gymnastics hall (for group classes), and an activity area for private instruction or stretching. Among them, the stationary fitness equipment is generally equipped with IoT modules and monitors. The multifunctional gymnastics hall and some areas have electronic screens for image and data display. There is also music playing on a loop throughout the gym. In addition, because of the influence of COVID-19, many smart gyms have also started to carry out online fitness services through mobile applications.

3-2 Research Process

We used a procedural grounded theory research approach to build the theory [35]. Grounded theory is a set of qualitative research methods summarized by American scholars Barney Glaser and Anselm Strauss in the 1960s. Grounded theory allows researchers to collect primary data from literature, texts, interviews, questionnaires, and other sources. Afterwards, through sentence-by-sentence analysis and systematic induction of the primary data, a theory is eventually abstracted on the basis of empirical facts to address the serious disconnect between theoretical and empirical research that is prevalent in social science research [36]. Compared to deducing theoretical propositions from existing research, grounded theory focuses more on the reality of respondents' experiences. There are fewer studies on digital service experiences in specific scenarios, especially fitness service scenarios, and the relevant research hypotheses or theoretical frameworks have not been widely explored. Therefore, this feature of grounded theory provides a bottom-up approach to theory building for our study. Moreover, due to the deep integration between the digital, physical, and social domains, for service experience evaluation work,

researchers are required to develop a deep understanding of the real thoughts and behaviors of users in specific service scenarios. Grounded theory is a method for qualitative research and theory development based on the systematic collection and analysis of primary data [37]. This method can help us to extensively explore the deeper connections among user behavior data. For these reasons, we adopted grounded theory as our research method. The bottom-up theory construction helps to generate a descriptive theoretical framework to allow us to understand the user experience in digital fitness services.

The specific research process is shown in Figure 1. After recruiting the sample, we collected data as primary sources through semi-structured interviews. Data analysis of the primary data was completed through three steps: open coding, axial coding, and selective coding. The data were collected and analyzed in a continuous comparison. When no new concepts were found during the data analysis, the theory could be considered to have reached saturation. Otherwise, sampling was continued in order to supplement the data until theoretical saturation was reached. Eventually, our coding scheme passed the theoretical saturation test, and a theoretical framework was developed from it.

3-3 Data Collection

표 1. 스마트 피트니스 클럽 6개의 디지털 기능 정보
Table 1. Digital functional information of six smart gyms

Digital Functions	BJ		CD		SZ	
	BJ-A	BJ-B	CD-C	CD-D	SZ-E	SZ-F
Identification (fingerprint, vein or facial recognition)	●	●	●	●	●	●
Mobile payment (membership processing, vending)	●	●	●	●	●	●
24h unmanned	○	○	●	●	○	●
Wearable devices (bracelets, watches or arm bands)	●	●	●	●	●	●
IoT fitness equipment (treadmill, exercise bike, etc.)	●	●	●	●	●	●
Gamification training content	●	●	●	●	●	●
Online services (via mobile apps / social media accounts)	●	○	●	●	○	●
Intelligent bathing, intelligent storage (NFT)	●	●	●	●	●	●
Online fitness services (live or video classes)	○	●	●	○	○	●

In order to reduce the variation among the study cases, we selected six smart gyms in China that applied similar digital technologies through fieldwork, which were located in three cities in the northern, southern, and southeastern regions of China. The six smart gyms had different branding and visual identity systems, but they were all chains and were representative. As shown in Table 1, they offered similar digital services, such as automatic identification, mobile payment, wearable devices, and IoT fitness equipment. We adjusted the questions that might be covered in the follow-up interviews so that some of the service differences between the cases would not affect the results of the study.

After identifying the case gyms, we recruited two investigators in each city in which the gyms were located, who were graduate students with social research experience at local universities.

표 2. 스마트 피트니스 클럽의 주요 서비스 단계와 사용자의 운동 모드
Table 2. The main service stages of the smart gym and the workout modes of users

Workout Patterns	Main Service Stages				
	Before Service		In Service		After Service
	Reservation	Plan	Workout	Records	Analysis
Trainer-Guided	Online	From trainers	Trainer-assisted	Device records	Device eneration
	Face-to-face	From trainers	Trainer-assisted	Trainer records	Trainer analysis
Self-Directed	None	From devices	Device-assisted	Device records	Device eneration
	None	Self-developed	Self-directed	None/ Self-recorded	None/Self-analysis
Online Fitness	Online	From trainers	Online trainer-assisted	None/ Self-recorded	None/Self-analysis

They served as hosts and recorders during the interviews and participated in the subsequent data review. During the interviews, the hosts were responsible for organizing the interviews and ensuring the respondents' willingness to express themselves. The recorders, on the other hand, were required to organize and submit the content of the interviews transcribed by the speech recognition software. At the end of the experiment, the investigators were paid in cash. We eventually formed a six-person survey team and implemented at least weekly online surveyor meetings to ensure that the surveyors had the knowledge and research skills needed to perform their duties. Data collection began in February 2022 and was completed in August 2022. Investigators conducted face-to-face interviews with respondents

near the gym. The length of time ranged from 5 to 20 min. During the control period resulting from COVID-19, interviews were conducted by online video conference. The length ranged from 10 to 30 min. Interviewees were reassured that their personal identities would not be disclosed. Interviewees were given a membership to a video site at the end of the interview.

Respondent sampling and recruitment were conducted simultaneously by three survey teams. To recruit respondents that fit the service scenario, we first conducted a small population-based purposive sampling procedure. Respondents were required to have visited a smart gym no more than 1 month prior to the study; to be willing to share their behavioral data and thoughts; and to agree to have the interview recorded. In the data from the first interview, we summarized the main service aspects of the smart gym and the users' workout patterns, as shown in Table 2. It was found that respondents had different interaction behaviors and service experiences at different service stages. To support the development of the theory, we conducted a second recruitment step based on the theoretical sampling of users who visited the smart gym more than three times per month and used it for more than one month. The second sampling step focused on ensuring that respondents had a full-time experience of the digital fitness service. Moreover, data collection from users with frequent participation in digital fitness services was used to improve the detail and veracity of data in retrospective reports and to reduce the potential for general description and reporting bias. The number of recruits was determined by the principle of theoretical saturation. Theoretical saturation was reached in this study at the completion of the data analysis of 48 respondents. Subsequently, we continued to recruit 10 respondents and conducted interviews and data collection for a follow-up theoretical saturation test. The respondents consisted of 25 males and 23 females with a mean age of 28.23 years. The age distribution in the sample was under 20 years (8.33%), 22–30 years (54.17%), 31–40 years (33.33%), and over 40 years (4.17%).

3-4 Interview Guide

The interviews were conducted according to the developed interview guide, which is shown in Table 3. The guide was designed to accommodate the purpose of the study and to ensure consistency in the direction of the study across the different survey groups. If the interviewees had any confusion about the questions, the host would clarify them. In grounded theory research, data collection and analysis were iterative. Therefore, without compromising the direction of the study, the hosts were allowed to refine the interview questions based on new concepts that emerged during the data collection process, thus guiding the interviewees to better express their ideas. After completing the interviews, the transcribed and collated interview data were summarized by the transcribers of each group in the form of electronic transcripts, which served as the source material for data analysis.

표 3. 인터뷰 가이드
Table 3. Interview guide

Interview	Sub-Questions
Basic Questions	What are your thoughts on smart gyms or digital fitness services?
	Why choose a smart gym for your workout?
	What makes you insist on visiting a smart gym?
	How do you do your workouts? Why?
	Do you do online fitness?
	To what extent do you use digital technology to intervene in workout?
	Have you ever used a wearable device for workout?
	Have you ever used a fitness equipment with an IoT module?
	Has your gym launched a mobile app yet? Are you using it?
	Are digital fitness services having an impact on your workouts?
	What other digital devices or digital services have you used?
Before Service	What was your initial impression of a smart gym or digital fitness service? Why?
	Did you have any ideas before the service?
In Service	Did you find any particular experience or disturbance after the service started?
After Service	What other services have you used with after working out? Why?
Follow-up on Emergent concepts	Can you describe in detail the event you are proposing?
Wrapping up	Do you have any thoughts to add about digital fitness services?
	Do you have something you want to ask me?

Ⅳ. Data Analysis

The process of data analysis involved sequentially open coding, axial coding, and selective coding. Rigor and reliability were considered in the data analysis process. The first author led the data analysis of the original data and developed coding schemes at each stage of data coding. Line-by-line coding was performed during data analysis to avoid selective use of data. Four investigators co-reviewed the coding scheme at each stage. For the purpose of reducing researcher bias and avoiding the appearance of incomplete theories, codes emerging from one

transcript were checked against other transcripts to compare similarities and to confirm whether a more plausible abstracted description was available. A code was retained only if it was jointly confirmed by multiple investigators. After the joint review, the first author led a discussion of the coding comments and emerging concepts by the investigative team until a consensus was reached on the coding results. After completing the coding of the data, we tested the coding scheme for theoretical saturation.

4-1 Open Coding and Axial Coding

The same concept has different names in multiple versions of rooting theory. We adopted LaRossa's naming of the individual concepts in the coding session [38]. Open coding is the first stage of data analysis and aims to build a concept–indicator model. Indicators consist of a word or a series of words, phrases, or sentences in the data. A concept consists of a label or name associated with one or more indicators [39]. In this stage, after line-by-line coding, we obtained 37 indicators and their corresponding 6 concepts.

Axial coding is the second stage of data analysis, which requires intensive analysis of categories (i.e., variables) in order to explicitly examine the relationships between variables [40]. In this phase, six concepts are abstracted into three variables. We describe the service experience path of the user in relation to the division of service stages in user experience research, i.e., before, during, and after the service. The variables are (1) overcoming resistance, (2) seeking new experiences, and (3) strengthening connections. The coding scheme is shown in Table 4. Due to the excessive amount of data from the original interviews, only the coding scheme after axial coding is listed.

표 4. 토대이론 코딩 분석 개요
Table 4. Overview of grounded theory coding analysis

Open Coding	Ref No.	Files (ppl)	PR (%)	Axial Coding	Selective Coding
First time use (equipment or services)	a1	33	69%	A1 Technical readiness	A Overcoming resistance
Negative emotions (tension,anxiety,frustration,etc.)	a2	21	44%		
Learn in advance	a3	18	38%		
Completed independently (equipment and servicelearning)	a4	17	35%		
Time and effort spent	a5	15	31%		
Protecting private data	a6	31	65%	A2 Trusted relationship	
Good social image	a7	25	52%		
Trusted information sources	a8	15	31%		
Data visualization	b1	39	81%	B1 Perceptible services	B Seekingnew experiences
Real-time data tracking	b2	30	63%		
Non-interference interaction	b3	25	52%		
Data analysis function	b4	25	52%		
Workout supervision	b5	22	46%		
User care (holiday wishes, workout summaries, diet recommendations, etc.)	b6	11	23%		
Movement correction	b7	8	17%		
Information push (video, text)	b8	4	8%		
Fun experience	b9	27	56%	B2 Sensory stimulation	
Competition mechanism	b10	23	48%		
Atmosphere creation	b11	21	44%		
Real-time feedback	b12	19	40%		
Incentive mechanism	b13	15	31%		
Virtual characters	b14	7	15%		
Animation simulation	b15	6	13%		
Comments and communication	c1	31	65%	C1 Online socializatio n	C Strengthening connections
Mobile applications	c2	30	63%		
Quality content and production	c3	26	54%		
Number of users	c4	22	46%		
Social support (gainingattention, recognition, and influence)	c5	17	35%		
Short video media platform	c6	16	33%		
Data sharing	c7	13	27%		
Live streaming	c8	35	73%	C2 Online fitness	
Not susceptible to interference (COVID-19, weather, time, etc.)	c9	29	60%		
More participants	c10	25	52%		
Community awareness	c11	21	44%		
Trainer quality	c12	20	42%		
Real-time comments	c13	16	33%		
Non-verbal information	c14	11	23%		

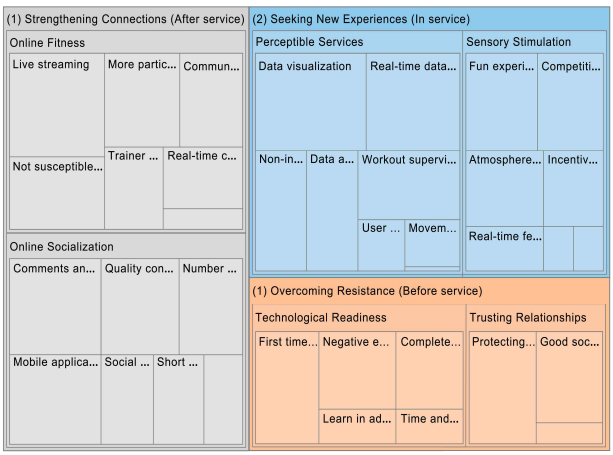

그림 2. 직사각형 트리 다이어그램: 코드화된 참조 수에 따른 노드 비교

Fig. 2. Rectangular tree diagram: nodes compared according to the number of coded references

4-2 Selective Coding

Selective coding can be defined as the search for a "story line" [35]. Since each variable tells only part of the story, it is necessary at this stage to identify a core variable that can link all the variables to form an explanatory theoretical framework. In this study, we sorted out the interconnections among the three variables generated in the axial coding and identified "continuous value perception" as the core variable.

4-3 Theoretical Saturation Test

During the grounded theory study, theoretical saturation was considered to be reached when the source material simply repeatedly displayed existing concepts. To verify theoretical saturation, as well as the reliability and validity of the study, two additional investigators who were not involved in the coding review were invited to code the 10 transcripts used for the theoretical saturation test. The results showed that no new concepts emerged during the coding process. Twenty-nine indicators of general agreement emerged between the obtained coding results and the previous coding scheme, with a coding consistency of 0.78%. Therefore, we consider that the current coding scheme has high reliability. To further ensure the confirmability of the coding scheme, we sought confirmation from the interviewees. Through online meetings, we randomly invited the eight respondents who had participated in the interviews to review the coding scheme and invited additional comments to confirm that their ideas were reflected in the coding scheme. In most cases, the final coding results that were retained came from all of the above participants. Therefore, we considered that the coding results reached theoretical saturation and no further additions were needed. In Figure 2, the rectangular tree diagram is the visualization result of the coding scheme. The rectangles represent the nodes in the hierarchy, and the hierarchical relationships between parent and child nodes are expressed by the mutual nesting of the rectangles. The chart shows the frequency of agreement between the three selective coding results in the original data. The relative degree of agreement among the results is represented by the relative area of the rectangular regions.

V. Results and Discussion

This section will first describe the impact of digital interventions on users' workout patterns, and then discuss the theoretical framework according to the three service stages and clarify the factors in each service stage that have a significant impact on the service experience: (1) overcoming resistance—technological readiness and trusting relationships; (2) seeking new experiences—service perceptibility and sensory stimulation; and (3) strengthening connections—online socialization and online fitness.

5-1 Workout Patterns and Digital Interventions

29 chose trainer-guided, of which 22 used digital interventions. Moreover, 19 chose self-directed, of which 13 used digital interventions. An approximate 73% of respondents in the offline fitness scene used digital services. In addition, 21 people performed online fitness activities.

We collected respondents' reasons and responses regarding their choice of workout pattern, as shown in Figure 3 and 4. Digital interventions are now widely accepted in trainer-guided workout patterns. Here, 22 of them used digital technologies. These technologies were focused on "session booking" and "recording" sessions to "gain easier communication skills" (77%) and "facilitate data analysis" (68%). The data show that digital technology has shifted some of the service tasks from trainers to technology, but the workout and workout analysis sessions are still trainer-driven. Trainers "can provide a more tailored workout program" (86%), which is the main reason that respondents continued to choose trainers over digital technology for assistance in their workouts. This phenomenon supports the interpretation that trainers still play an important role in technology-driven fitness services and that the value of the services unique to trainers prevents them from being replaced by digital technology, at least in the short term. In addition, the other main reasons are

"stronger training supervision" (71%), "trainers are committed to training results" (57%), and "used to traditional methods and don't want to change" (43%). It can be said that in addition to the customized services provided by trainers, service commitment and strict training supervision were found to be the most valuable services that respondents believed that trainers could provide. The results partially support and extend the findings of existing studies on the value of trainers [33].

Of the self-directed workouts, 13 had digital interventions during the workout. "Workout data visualization" (87%), "automated data logging" (67%), and "more fun experience" (40%) were the main reasons that they adopted digital services. Respondents who chose not to use digital services explained that they "trust their workout plan more" (83%). In addition, respondents felt that "using digital devices while exercising is distracting" (67%), while others cited "not wanting to spend money on wearable devices" (33%). User adoption of digital services is a gradual process, with higher data availability and a fun service experience demonstrating appeal to respondents who work out through self-directed means.

In addition to offline workouts, 21 respondents reported that they had recently also been working out online. The main reasons cited by respondents were "online workouts are free from distractions such as COVID-19" (86%), "better access to trainers" (52%), and lower cost of ownership (43%). Other respondents indicated that they did not work out online because "the physical fitness environment provided a more focused experience" (67%) and "the intensity of the online workout was impersonal" (37%). Relatively speaking, the physical service scene continues to provide a stronger experience and memory for users [41]. However, for users who cannot work out in a gym, online fitness provides them with a new service scenario. Users can complete their workout programs at a lower cost and have access to more professional trainers through online channels.

5-2 Theoretical Framework

A theoretical framework with "continuous value perception" as the core variable was developed in the study, as shown in Figure 5 . This process has a direct impact on the adoption of the service. When the user's service experience meets or exceeds the perceived value, the user tends to stay with the service. Conversely, this may lead to intermittent withdrawal or even abandonment of the service experience. Perceived value in this context refers to the user's subjective perception of the multiple forms of value that the service has. Moreover, the criteria for assessing this value are diverse and often change with context, time, and place.

그림 3. 디지털 개입을 선택하는 이유 (>10%)
Fig. 3. Reasons for choosing digital interventions (>10%)

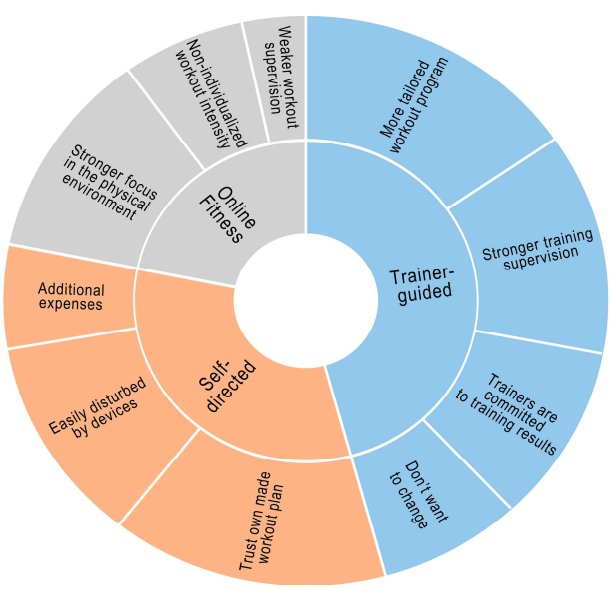

그림 4. 디지털 개입을 선택하지 않는 이유 (>10%)
Fig. 4. Reasons for not choosing digital interventions (>10%)

Before the service, users need to overcome the resistance of "technical readiness" and measure the service provider's service image in terms of security and reliability to establish a "trust relationship". Afterwards, users experience the new service content through "perceived services" and different forms of "sensory stimulation". After the service, the online service dominates the connections between users and between users and the service. Mobile apps extend the service lifecycle of digital fitness services and promote long-term usage by integrating the ability for users to "socialize online" and "work out online" with other users.

1) Overcoming Resistance: Technical Readiness and Trusting Relationships

The use of digital devices was a commonly reported source of resistance, with 69% of respondents indicating that they were "using a digital fitness device for the first time" (a1) and 44% of the respondents "felt negative emotions" while using it (a2). Respondents said, "To avoid embarrassment, I don't want to try a device I haven't used or am not familiar with its functions" (HZ-F-43); "When there are a lot of people around, for example, when using smart lockers and bathing equipment, mishaps can make me feel embarrassed." (BJ-B-11). Some studies have suggested that users will tend not to use products or services that are difficult to use [42]. The research data partially support this view, but because technology-related usability or ease of use issues were not highlighted in the coding results, we believe that the data are more similar to the technology-readiness-related view that technology induces emotional discomfort, which directly or indirectly influences users' beliefs and behaviors toward technology [43]. Examples include "nervousness" (BJ-A-05; CD-C-18; HZ-F-48) and "anxiety" (CD-D-25; SZ-E-34). Studies have shown that inadequate technology preparation disrupts users' emotional experience and negatively affects their technology use. The data support the TPB model [44]. "Perceived behavioral control (PBC)" influences the user's intention to use. Therefore, service proactivity is emphasized and service providers need to actively provide clear service guidance and training to reduce user anxiety and increase user confidence in device use [45]. In addition, the study identified changes in users' needs for achieving technology readiness. The data showed that users preferred to achieve technology readiness prior to service use, rather than in tandem with the service experience. For example, "I need to be responsible for my workout and knowing the features of each device in advance is a prerequisite for obtaining exercise results… Occupying the device to learn about the features while working out can cause distress to others" (BJ-B-08). "I look up the information in advance so I know how to use the equipment… My workout time is limited and I need more efficient services as well as personalized settings that better fit me. Why should I spend money on this if I won't use the digital services or only use the basic features?" (CD-D-29). In this regard, we believe that the early establishment of technology readiness has a positive impact on the service experience. It allows users to achieve higher performance and offers the ability to meet their own personalized goals. The finding expands the requirement for service proactivity. Service providers need to provide service support to ensure that service guidance and training is available to users before the service begins.

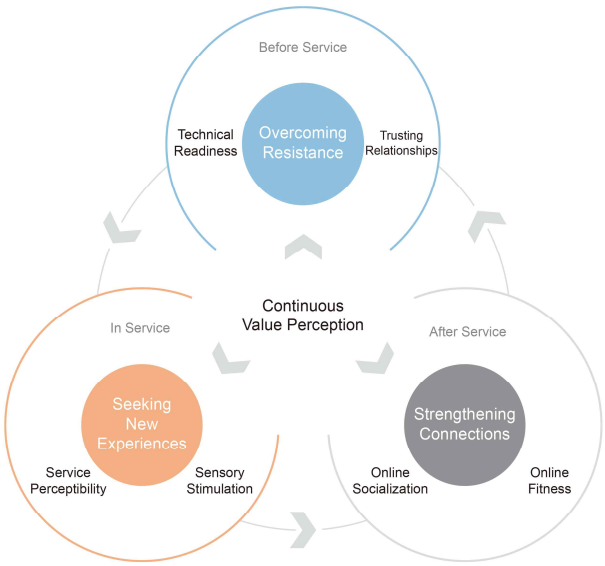

그림 5. 스마트 피트니스 클럽 사용자를 위한 디지털 피트니스 서비스 경험 프레임워크

Fig. 5. A framework of digital fitness service experience for smart gym users

Related to this, the data show that nearly 31% of users want to be "independent" (a5) when preparing for technology use. A typical report states, "I am used to using my phone to get information online and often a short video can solve my proble m… Sometimes it is helpful to ask other gym goers or staff, but I don't want people to know I don't know how to use a certain piece of equipment" (CD-D-30). It can be said that "convenience" (CD-C-21; HZ-F-47) and "privacy" (HZ-F-39; SZ-E-37) became important reasons for users to choose this mode. This also shows the increasingly diverse and personalized service needs of users. This provides a new opportunity for digital fitness services. Service providers can expand their service channels and provide service support to users for technology readiness through convenient and non-face-to-face service contact. At the same time, we believe that establishing a multi-channel connection with users prior to using the service will help them to engage more extensively in subsequent digital services.

The study found that concerns about data privacy contribute to user insecurity, with 65% of respondents saying that service providers need to "protect private data" (a6). Respondents said, "I suspect that my data may be being misused by the service provider" (BJ-A-03; HZ-F-39); "I have concerns when registering accounts, tying devices, and entering facial data" (BJ-B-14; BJ-B-09; HZ-F-45). In addition, in the survey data, the study identified users' perceptions of different data and noteworthy differences among them. The data showed that respondents generally cared

more about basic personal information, while users expressed less concern about the data generated by their personal exercise behavior. Respondents said, “My biggest concern is that my personal information will be leaked or misused, especially when apps and wearable devices involve filling in my personal information” (CD-D-26); “Information such as name, age, ID number, phone number and home address should be (SZ-E-33); “It is justifiable for apps or wearable devices to collect data generated by our workouts, such as heart rate, step count, and other data. This is because, after all, we need to resort to the relevant functions provided by digital devices” (CD-C-17). Therefore, the protection of data privacy and analysis of exercise data may both be necessary. Service providers need to ensure the security of data privacy to establish a trust relationship with users. At the same time, service providers can analyze users’ workout data to enhance the user experience in order to form new service opportunities [46]. The study also revealed the impact of information reliability on service experience. For example, “I now remain cautiously skeptical of workout knowledge from multiple sources because I have been injured by taking advice from others that was limited to his personal experience” (BJ-A-05); “I tend to spend a lot of time querying and summarizing this workout knowledge. Now I can get it directly from the information pushed by the app or device, but hopefully it is effective” (BJ-A-01). Users expect the information that they receive from digital fitness services to be trustworthy. The data suggest that a reliable source of information means a rapid reduction in user skepticism and in the time cost of gaining workout knowledge. Our findings are similar to those of Hansen et al., indicating that trust and perceived risk influence users’ decisions [47]. Before the service, service providers need to improve users’ intention to use and their expectations of the service experience by establishing a safe and reliable image of the service (a7).

2) Seeking New Experiences: Service Perceptibility and Sensory Stimulation

The study revealed the importance of service perceivability. The data show that 81% of respondents adopted data visualization services. In addition, respondents stated “I can clearly perceive the completion of my exercise program through the exercise data automatically recorded by the app and the results of data analysis, even if it was recorded weeks ago… Changing data is motivating me to make progress” (CD-C-19); “Have received workout reminders or holiday wishes from the app” (BJ-A-06; CD-D-28; CD-D-31); “Using any fitness equipment is hassle-free because the device’s screen shows the correct posture for use. I don’t have to worry about using it incorrectly anymore. Also, this definitely reduces the risk of exercise injuries” (BJ-B-10; BJ-B-14). In traditional fitness services, the analysis of exercise data was invisible and largely monopolized by trainers or fitness professionals. Now, it can be achieved with digital technology and communicated to users through virtual agents, apps, or other new, perceptible user interfaces, and has a motivating effect on users’ workouts. The data show that these perceptible services expand the boundaries and enhance the service experience. Examples of such services include data analysis, workout monitoring, and user care. Our findings support Secomandi et al.’s view that intangible service content needs to be perceived by users [48]. Building on this, it was found that the ways in which users interact with these tangible interfaces is influenced by movement behavior. For example, “I want to watch videos or listen to music while using a treadmill or hiking machine… While performing a strength training, I will ignore any request that requires me to stop to operate, even if it is a phone call” (BJ-B-12). “I noticed that when I was running on the treadmill, it was difficult to go through the touch screen to change the content in the interface… Especially during the sprint phase, it was very bad to endure a boring program that could not be changed” (CD-D-25). It is crucial to examine the user’s interaction with the technology in the context of use [34]. Studies have shown that interactions that do not match movement behavior may cause user agitation and disrupt concentration, which in turn affects the user’s experience of the service and use of the technology. Our findings may facilitate the development of more humane interaction strategies. During workouts, for service content that needs to be perceived by the user, the interaction style needs to match the user’s movement behavior and be incorporated into the service experience in a non-intrusive manner (b3).

Many respondents sought a leisure experience through gamified training mechanics. It was observed that such gamification mechanisms guide users to intensify their workouts in specific ways through digital technology, interfaces, or trainers’ design of gamified content. The data revealed that a “fun experience” (56%) and “competitive mechanics” (48%) were the main features. First, the study found that the real-time progress feedback provided by the technology facilitated users’ ability to maintain focus on their workout behaviors. “During strength training, sometimes I wanted to finish early, but with each set completed, the device would encourage me to finish the rest of the workout… The device could notify me once per kilometer while running, and when I wanted to stop, a thought would occur to me, ‘Wait until I’ll stop when I hear the next notification!’ This often allows me to keep going for an extra kilometer” (SZ-E-36). In addition, the digital system rewards users when they persist in their workouts for a certain amount of time, or when they accomplish specific goals. For example, “When completing a

workout, I can earn achievements and light up icons in the app, and I can see other people's achievements through my friends' rankings. I need to stick to the training program to maintain my ranking in the leaderboard" (BJ-B-11). The study data also showed the impact of ambiance creation (b11) on the service experience. For example, "When I use the kinetic bike, the scenery and background music in the big screen changes with the distance I ride. The constantly updated scenery and music seemed to make me ride longer… The mood was good and the time passed faster" (BJ-A-07); "The avatar representing myself could pass others as if I were running outdoors, I knew where I was running and at where to stop… I no longer have to determine my running progress by looking at the numbers from time to time" (HZ-F-48). The study demonstrated the impact of sensory stimulation (B2) on the service experience. The results are generally consistent with related studies that suggest that sensory stimulation becomes an important tool to enhance the service experience [49]. At the same time, our data provide evidence for additional studies from the fitness service domain. Gamified training mechanisms that provide feedback on progress in auditory or visual form enhance users' self-efficacy in workout behaviors [50].Reward mechanisms also provide a strong incentive for users and serve as an important motivator to promote long-term engagement in fitness activities. In addition, specific fitness scenarios provide audiovisual realism and authenticity through ambience creation, and users gain varying degrees of aesthetic pleasure and focus as a result. The anthropomorphic images and avatars reduce the cognitive load of workout data and enhance the emotional engagement of users during exercise [51].

Some respondents also cited negative experiences with gamified training. Respondents stated, "I may only work out a few hours a week, and the gamification requires many people to participate together and may also involve grouping, so I'm not sure I can do well with the appropriate tasks" (SZ-E-37); "Working out with excellent or very professional fitness people to do workout activities makes me very stressed" (BJ-A-03). The data support the TAM model in that self-efficacy can be used as an external factor to the TAM model to influence receptive attitudes and behavioral intentions [52]. Therefore, we suggest that when users have low levels of workout and high levels of perceived competitive pressure, this can negatively affect their service encounter. The data also suggest that users' service experience may be affected due to the gamified training being too difficult or too easy, with fixed and unchanging game content. For example, "I haven't used the game feature on my device in a long time and am very bummed because I am currently facing challenging tasks that I simply cannot complete in the short term." (CD-C-22); "I've experienced all the game content and have nothing new to offer… The amount of exercise does not meet my exercise needs and is of little value to me" (BJ-B-13). In view of this, balancing the relationship between the difficulty of game mechanics and users' ability becomes a service challenge to be solved. Moreover, service providers may need to ensure periodic updates of service content to ensure the appeal of gamified training mechanics. In addition, studies have found the value of gamified training in specific scenarios: "I often choose to participate with friends rather than participating in gamified training organized by a coach alone" (CD-C-21); "If the focus is only on the fun of exercise without setting specific training goals, I will have more ideas for participation… The relaxed atmosphere increases opportunities for communication. People can encourage each other and also make friends" (CD-C-23). It can be argued that gamified training mechanics exhibit a more favorable impact on users' social and emotional connections when they participate with peers and for leisure purposes. With this in mind, service providers can seize the opportunity to deliver services in this manner to meet the needs of many users for a recreational experience.

3) Strengthening the Connection: Online Socialization and Online Fitness

The data show that respondents continue to use online services for fitness support after the service. In particular, 63% of respondents choose to use mobile apps (63%), followed by short video media platforms (33%) and others (4%). Of these, 65% of respondents are happy to communicate online, 27% are keen to share their fitness achievements, and 13% of users spend online. It can be said that an interactive experience across multiple channels is becoming part of the service experience [53]. The data also show that online communication and the sharing of fitness results became the main uses of mobile apps. For example, "there are many fitness professionals who share detailed planning of their day through edited videos, and I can share my experience by joining the group he created" (HZ-F-44); "the app keeps my workout habits and I will periodically post some of my exercise logs… I set up everyone to see what I share and comment on it. I have gained a lot of attention and recognition from my fans and I enjoy witnessing others' progress" (HZ-F-40). Research data provide evidence for the motivational effect of online services on users' exercise behavior [31]. Social features under technology support connect users with other fitness users online, and community communication and comment texts provide feedback from others, including encouragement and recognition of exercise achievements. Service providers need to work toward a higher level of information sharing, which makes it possible for users to

receive broader social support. In addition, the study found that the use of mobile apps by Chinese smart gym users does not show a significant correlation with the gym that they visit, with only 19% of respondents currently using apps launched at their particular gym. “The number of users” (46%) is considered the most important factor for app selection by the respondents. Respondent HZ-F-39 stated, “I use the most popular fitness app, which maintains the most users, so I see more content shared by users every day, and the information I share is seen by more people.” For non-utilitarian apps, studies have suggested the impact of elements such as emotion, achievement, and enjoyment on user adoption [54]. Our study provides evidence from the fitness services domain on the impact of social norms on the user adoption of apps. In light of this, app promotion may be difficult for gym launches when there are a small number of users or when the launch is late. The question of how service providers can increase the user adoption of their own branded apps needs to be further investigated.

Regarding the online fitness scene, the study found that users prefer to train and interact via live streaming, and that the video format is starting to lose its appeal. For example, 73% of respondents talked about the live mode when discussing online fitness (c8). Respondents stated that “live interactions are more engaging, we can directly observe the trainer’s reaction to comments… I would feel lonely working out via video and I would have no one to respond to my messages right away” (BJ-B-16); “I can workout with more people when live, and I can meet more exercisers who are similar to my age and workout level… We can share our feelings and encourage each other through real-time comments” (CD-D-32). These data demonstrate the importance of a real-time interactive experience in the online fitness scene. Through live video streaming, users can additionally “observe the trainer’s expressions and movements” (CD-D-27) and other non-verbal information, and generate a deeper understanding and interaction in the ongoing interaction. Through “joint training and topic exploration” (BJ-A-02; BJ-B-14), multiple participants can psychologically perceive each other’s presence and receive mutual support. Research data support the impact of interactivity on social presence [55]. Interactivity between users and other users and trainers influences users’ perceptions of social presence. The real-time interactive experience provided by the live mode made it easier for users to connect with other users and trainers. By communicating and training with users who share the same goals, users’ sense of community is enhanced (c11). Real-time comments from other users and real-time encouragement from trainers (c13) strengthen users’ extrinsic motivation to perform workouts.

In addition to technical support, the study found that the service experience in the online fitness scenario is driven by the trainer. For example, 42% of respondents reported choosing services based on the quality of the trainer (c12). A typical report states, “Unprofessional online coaching is more likely to lead to injury. Sometimes trainers ignore the requirements of heart rate to be maintained, duration, and rest between sets when working out, and simply emphasize the standardization of movements” (CD-D-31); “I can work out online for days for an attractive and professional trainer” (BJ-B-16); “Professionalism is the basic requirement… needs to be interesting and can achieve more vivid communication with us” (CD-C-20). The data show that the overall quality of trainers influences users’ service adoption. Meanwhile, the performance of trainers likewise has an important influence on the service experience in online fitness scenarios. Therefore, trainers must develop appropriate skills, such as “expressive skills” (BJ-B-10; CD-C-20) and a “quick response” (HZ-F-42), to address the matching problem between traditional business skills and the developed role requirements [45]. In addition, our data support the phenomenon that users of online fitness services inevitably assume a higher risk of injury compared to face-to-face coaching [56]. This requires trainers to pay more attention to the instructional process in order to provide safer and more appropriate workout programs to improve the user’s service experience.

Ⅵ. Conclusions and Limitations

This study on smart gyms facilitates the expansion of application scenarios for user experience research and expands our understanding of the digital service experience. We analyzed the impact of current digital interventions in smart gyms on users' workout patterns. Froehle et al. categorized service contacts into five types: technology-free, technology-assisted, technology-facilitated, technology-mediated, and technology-generated [20]. Our study shows that the main types of service contact in smart gyms are shifting from technology-free to technology-facilitated and technology-generated. Subsequently, a theoretical framework of data generation describes the pathway of user experience in digital fitness services and elucidates the impact of elements such as service proactivity, sensory stimulation, service perceptibility, and real-time interaction on user service experience. The findings further explore the connections and gaps between empirical data and theoretical findings from existing studies in specific industry services. As a secondary source, it helps to enhance the understanding and sensitivity of subsequent researchers to the theories in the field.

In terms of practical, the study provides suggestions for

improving digital fitness services. Service guidance and training need to be set up in advance rather than concurrently with users' service use; intangible service content needs to be perceived by users and integrated into the service experience in a non-intrusive interactive manner; gamified training mechanisms have been shown to improve user engagement and service experience in the fitness domain as well. Highly realistic atmosphere creation and sensory stimulation can be used to reduce the cognitive load of users and enhance their concentration and emotional engagement in fitness activities. At the same time, coordinating the balance between the challenge difficulty of the game mechanics and the user's ability to work out, as well as maintaining the appeal of the gamified training content, becomes an urgent service challenge to be addressed; finally, Online fitness scenarios should be designed around real-time interactive experiences and trainers' service performance. These insights above are helpful in optimizing the design of digital fitness services in practice to respond to evolving user expectations.

The study shows that in the fitness services space, due to the disruption of digital technology, the complete cycle of the service experience and service encounter no longer exists in the fitness process alone; it has become the sum of all interactions between all service parties and digital technologies before, during, and after the service. However, even within this scope, there are limitations to our study. For example, we obtained less data on user behavior for smart showers or smart body measurements in the primary sources. Based on the theoretical saturation principle, this study involved a limited number of respondents. Although our study passed the theoretical saturation test, our results may also be applicable only to the more developed regions of China due to the regional limitations of the study sample. In addition, due to COVID-19, a portion of the data were collected through online meetings and could not be collected in the field. In response, we used theoretical sampling to minimize the effect of respondents' selective memory on the raw data. Digital service transformation in specific industries such as gyms, especially for SMBs, will become an inevitable trend in the service market's development, but there is still a paucity of relevant service experience research. The theory developed from the data needs further validation studies. Future research may require larger and systematic sampling to validate and refine a comprehensive theoretical framework.

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