GEORGE BROWN PRESS
JOURNALS, BOOKS & PROCEEDINGS

GBP Proceedings Series

Article

2025 2nd International Conference on Business Economics, Education, Arts and Social Sciences (EASS 2025)

Wisdom "Nurturing" Childhood, Shaping the Future: Effectiveness and Insights of the Intelligent Child Care Model in Hangzhou Based on Implicit Interaction Theory

Kefan Shen [1,*], Yixuan Pan [1], Shaotong Huang [2], Chenmin Hong [1] and Yinglin Wu [1]

[1] Department of Preschool Education, Hangzhou Normal University, Hangzhou, Zhejiang, China
[2] Department of Ideological and Political Education, Hangzhou Normal University, Hangzhou, Zhejiang, China
* Correspondence: Kefan Shen, Department of Preschool Education, Hangzhou Normal University, Hangzhou, Zhejiang, China

Abstract: Accelerating the development of a childcare service system for infants and toddlers aged 0-3 years to meet the growing demand for diverse services is not only crucial for the implementation of macro population policies but also essential for addressing gaps in people's livelihoods and alleviating the challenges currently faced by infant and toddler childcare. In the era of rapid information technology development, information technology-enabled childcare models offer new opportunities. This study adopts a mixed research methodology to describe the current status of quality services within the smart childcare model in Hangzhou from three perspectives: model development, service perception, and service content. It also evaluates the effectiveness of this model. Finally, drawing on implicit interaction theory and current trends, the study summarizes and promotes key experiences and insights, offering valuable lessons for research in other regions.

Keywords: implicit interaction theory; intelligent child care; infants and toddlers; service model

Received: 21 February 2025
Revised: 25 February 2025
Accepted: 01 March 2025
Published: 02 March 2025

1. Introduction

Currently, the development of childcare services for infants and toddlers aged 0-3 in China remains weak, with structural imbalances, inconsistent service quality, and other challenges. Accelerating the construction of a comprehensive childcare service system is a crucial step in implementing the "young people with care" initiative proposed at the 19th National Congress of the Communist Party of China [1]. Zhejiang Province, as part of its effort to establish the flagship brand of "Zhejiang Has Good Education," is continuously enhancing the quality of childcare services. The 14th Five-Year Plan for Childcare Service Development in Zhejiang Province explicitly emphasizes the need to improve intelligent childcare services and foster new forms of intelligent childcare, setting an example for the national childcare system. As the capital of Zhejiang Province, Hangzhou plays a key role in grassroots social governance and public service delivery. Studying the effectiveness and experiences of Hangzhou's intelligent childcare model for infants and toddlers aged 0-3 aligns with current societal development trends and holds direct practical significance.

2. Background to the Study

2.1. Context: Digital Empowerment for Inclusive Childcare Services

In 2019, the State Council issued the first specific policy document on childcare services for infants and toddlers aged 0-3 since the founding of New China: The Guiding Opinions on Promoting the Development of Childcare Services for Infants and Toddlers Aged Under 3 Years. This marked the beginning of what has been called the "Year of Childcare." The National Development and Reform Commission (NDRC) has encouraged the development of digital, networked, and intelligent childcare services to enhance service quality and efficiency [2]. In 2021, the Decision of the Central Committee of the Communist Party of China and the State Council on Optimizing Reproductive Policies to Promote the Long-Term and Balanced Development of Population explicitly called for the "development of new business models in intelligent childcare" [3]. With the full liberalization of the two-child and three-child policies, childcare for infants and toddlers has become a focal point for the state, society, and parents. Intelligent childcare combines traditional childcare services with information technology, maximizing the integration and mobilization of resources to further enhance the efficiency and quality of existing services. This aligns with the national policy goal of ensuring that "children are properly cared for," and will contribute to achieving the broader objective of providing adequate childcare for young children. These policies have guided the direction of digitally-enabled childcare services and played a key role in promoting the development of childcare services in China.

2.2. Realistic Dilemma: The Path of Development of the Intelligent Childcare Model is not Yet Clear

Intelligent childcare is a new industry in the development of childcare services. The government has not yet issued a clear opinion on the development path of intelligent childcare services, and the research field has not yet formed a unified concept of the basic theory and connotation of intelligent childcare services. Institutions have not played a good role in demonstrating the driving effect of smart childcare services and have not formed a complete industrial ecology of smart childcare; parents and in-service teachers in childcare institutions do not have a deep and clear understanding of smart childcare services. Therefore, this study takes Hangzhou City, Zhejiang Province, as a sample city and guides other cities and municipalities to formulate smart childcare development strategies based on the experience of Hangzhou's smart childcare services in the formulation of government policies, the formation of parental cognition, the construction of models of childcare institutions, and the strength of social publicity, etc. to help the development of smart childcare according to the local conditions.

3. Theory and Modeling Foundations — Implicit Interaction Theory

Implicit interaction is a noteworthy frontier theory in the field of human-computer interaction in the rapidly developing informationization era. It partially overlaps with the concept of natural interaction but focuses more on the reasoning of specific interaction intentions implied by specific natural behaviors of the user and emphasizes that the device actively speculates the user's intention and actively provides services. Implicit interaction focuses on perception and reasoning, and the realization of implicit interaction also requires the support of multiple technologies.

3.1. Implicit Human

Implicit interaction between people is a complex and rich mode of communication that is widely found in everyday life. For example, we raise the volume of our voices when chatting with the elderly and lower it for children; waiters take the initiative to refill a guest's coffee; in quiet places such as libraries, we consciously lower our voices, soften our footsteps, or mute our cell phones, and clasping one's arms tightly may indicate fear or

resistance while opening one's arms expresses welcome. These non-verbal behaviors convey messages through eyes, expressions, body movements, etc., and can derive rich meanings when combined with specific situations (e.g., time, place, etc.).

3.2. Implicit Interaction between Humans and Machines

Human-computer implicit interaction is inspired by human-human implicit interaction and aims to mimic natural communication methods, reduce the user's operational burden, and enhance the experience. Its core is that the device can actively sense the user's goals and intentions and provide services without explicit commands. In smart product design, implicit interaction needs to follow the principle of emotionality, sensing user expressions and postures through sensors and deep learning technologies to create an emotional experience. At the same time, the product needs to have the ability of context perception, real-time perception of the environment, and user behavior prediction to provide accurate feedback, to realize the transformation from passive response to active interaction, and to build interactive reality with the user.

4. Research Methodology

4.1. General Idea of the Study

4.1.1. Object and Scope of the Study

In this study, the convenience sampling method was adopted to select a total of five smart childcare organizations in different areas of Hangzhou City, Zhejiang Province, and a total of 60 parents of infants and toddlers in different areas of Hangzhou City as the research subjects. The scope was ten municipal districts of Hangzhou.

4.1.2. Quantitative Research Methodology Selection

1) Research tools

Basic information questionnaire: designed by the project team itself, including region, gender, age, education, occupational status, and family background family children.

Smart Childcare Service Model Awareness Questionnaire: Self-designed, including three dimensions of knowledge, necessity, and development prospects of the smart childcare model in HCM City. The questionnaire adopts the Likert 5-level scoring method, from "very little understanding / very unnecessary / very optimistic" to "very understanding / very necessary / very optimistic" respectively 1 to 5 points, with a total score of 3 to 15 points, the higher the score, the higher the cognition. The higher the score, the higher the awareness.

Questionnaire on the service effectiveness of the smart childcare model: self-designed based on reference to domestic and international related literature [4-7]. An expert group consisting of two preschool education teachers with more than 10 years of teaching experience and the title of associate professor or above and one professor in the field of statistics were invited to test the reliability of the questionnaire content and the reasonableness of each entry. The questionnaire included 4 dimensions, including the degree of development, publicity, service efficiency, and service quality, with a total of 64 entries. Ten in-service teachers and administrators of a smart childcare center who met the inclusion criteria were selected for a pre-survey before the formal survey was conducted to finalize the official questionnaire.

2) Survey data collection

After creating an electronic questionnaire on the Questionnaire Star platform, this study was distributed to parents of infants and toddlers aged 0-3 years old since August 16, 2024, which lasted for 5 days, and 60 questionnaires were collected. To ensure the reliability of the quality of the responses, the questions set in the questionnaire were mandatory, and the responses that took less than 2 minutes to complete the questionnaire were excluded. In addition, according to the time point and IP address of the questionnaire and the actual questionnaire, the researcher eliminated the large influx of anomalous answers

in the same area within a short period and the obvious regularity of the answers. Finally, 51 valid questionnaires were obtained, with a recovery efficiency rate of 85%, and the specific basic information is summarized in the following Table 1:

Table 1. Basic Information Statistics.

Projects	Options	Frequency	Percent
Age	Age 20 and under	7	13.5%
	Ages 21 to 25	5	9.6%
	Ages 26 to 30	14	26.9%
	31 to 35	16	30.8%
	36 to 40	2	3.8%
	Age 40 and older	7	13.5%
Occupations	Publishing, audio-visual production, communications, and communications services	4	7.7%
	State functionaries	4	7.7%
	Finance and Insurance	3	5.8%
	Production personnel in agriculture, forestry, animal husbandry, fishing and water resources	3	5.8%
	Wholesale and retail workers	2	3.8%
	Employees of enterprises and public institutions or managers of enterprises and public institutions	12	23.1%
	Persons employed in business or service industries	9	17.3%
	Health care and social work services	1	1.9%
	Retired or not currently employed	1	1.9%
	Manufacturing workers	1	1.9%
	Accommodation and catering	2	3.8%
	Freelancers	9	17.3%
Education	Undergraduate degree	24	46.2%
	Junior high school and below	2	3.8%
	Junior college	5	9.6%
	High school/secondary school	7	13.5%
	Graduate students and above	13	25.0%
Monthly household income	10,001-15,000 yuan	11	21.2%
	15,001-20,000 yuan	11	21.2%
	20,000 to 25,000 yuan	5	9.6%
	More than 25,000 yuan	6	11.5%
	5000-10,000 yuan	15	28.8%
	Less than 5000 yuan	3	5.8%
Family place of residence	Binjiang District	2	3.8%
	Fuyang District	5	9.6%
	Gongshu District	8	15.4%
	Linan District	1	1.9%
	Linping District	2	3.8%
	Qiantang District	8	15.4%
	Shangcheng District	2	3.8%
	West LAKES	8	15.4%
	Xiaoshan District	11	21.2%
	Yuhang District	4	7.7%
Family type	Single parent family	1	1.9%
	Intergenerational families (children + maternal grandparents)	1	1.9%

Nuclear family (children + parents)	31	59.6%
Main family (children + parents + maternal grandparents)	18	34.6%

3) Questionnaire data analysis

After analyzing the 51 questionnaires recovered, it is possible to get a clearer picture of the level of knowledge of parents of infants and toddlers about smart childcare services, the current status of Mandarin learning and digital learning in terms of their awareness of the development prospects, and the need for development.

In terms of the degree of understanding, the following chart shows the proportion of parents and practitioners in HCM City who know about smart childcare, including 12 who know it very well, 21 who know it relatively well, 16 who don't know it very well, and 2 who have never heard of it. A total of 87.71% of parents believe that the publicity effect is generally effective and above, indicating that the effectiveness of publicizing smart childcare services in HCM City is very good.

On balance, parents are positive about the development prospects of smart childcare services, especially in terms of enhancing service efficiency, personalized services, resource allocation, family communication, and cooperation, as well as industry standardization and professionalization.

Figure 1 and Figure 2 shows the degree of development of the service model of smart childcare organizations. From the figure, we can see that the degree of development of smart childcare services through the home and family interaction platform to provide parents with regular feedback on the situation of infants and toddlers is the highest, accounting for about 54.18% of the total number of people, followed by the establishment of online nursery procedures through the Internet platform, accounting for about 42.76% of the total number of people. It can be seen that the development of online processing and information feedback platforms for smart childcare services has been developed to a greater extent and recognized by parents; at the same time, the online childcare procedure processing platforms provided by smart childcare institutions save parents' time and energy and break the limitations of time and space.

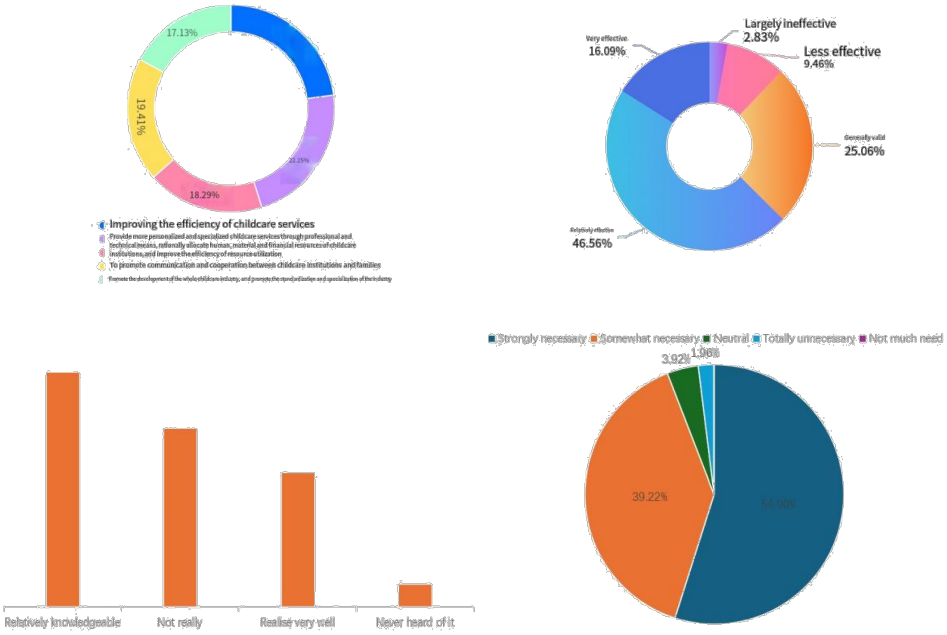

Figure 1. Intelligent Childcare Services Awareness Map.

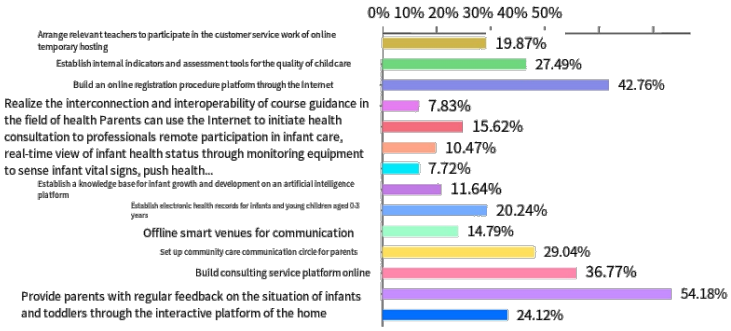

Figure 2. Extent of development of smart child care models.

4.1.3. Qualitative Research Methods

1) Interview outline design

In September-October 2022, on the basis of the preliminary research, this study targeted the two core issues of "the current situation of smart childcare model services" and the corresponding "smart service experience" to design the interview outline.

2) Interview data

The data for this study were mainly derived from one-on-one semi-structured interview data, and 10 parents of infants and toddlers (covering different regions, genders, ages, etc.) and 18 staff members of childcare institutions/gardens (including different regions, genders, years of experience, etc.) were selected and interviewed according to the principle of relational sampling. Nvivo12 plus qualitative analysis software was selected as the content analysis tool for coding and analysis. During the data analysis process, there was an ongoing circular interaction between the interview data, existing literature, and the researcher's experience. Themes and indigenous concepts that surfaced from the interview data itself formed open codes, and themes that were similar in the open codes were categorized into spindle codes. Finally, the main axis codes were compared, analyzed, and summarized with the concepts in the existing literature to form selective codes from four aspects. The final coding results are shown in the Table 2 below.

Table 2. Interview Level 3 Coding Chart.

Conceptual node	Core node (Level 2 indicator)	Tree nodes (Level 3 indicators)
Degree of pattern awareness	Not much understanding	Not quite aware of the specific difference between wisdom and regular childcare
Service satisfaction	Bad reviews	Not used, and not good review
	Not very satisfied	Concerns about facial recognition security
	General	Resource sharing services are not used much
	More satisfied	Dingding WeChat communication is more convenient
	Very satisfied	Home-school resource sharing service is good
Service demand	Learning progress	Would love more feedback on your child's learning progress
	Daily life	Expect detailed daily reports
	Eating habits	Want to adjust your child's diet more scientifically
Service usage	Intelligent monitoring	Can know the child's attendance in and out of the house

	App query	You can see the video of children in the garden through the mobile APP
	There is no smart childcare equipment	There is no such equipment in the park. It has not been used
	It is updated every year.	It is more scientific, convenient, and intuitive
	Related technology application and platform construction of institutions	Non-sensory attendance (facial recognition, non-contact temperature measurement, etc.)
		Smart wearable linkage real-time image capture (such as capturing and pushing to caregivers and parents when the abnormal body temperature of infants is detected from the smart bracelet)
		Indoor and outdoor sensor environmental monitoring data are displayed in real time and data sharing is realized among nurseries, parents and regulatory agencies
Service suggestions		Establish an intelligent evaluation system for individual social interaction, interests, and hobbies, and thus provide personalized care services for different individuals
	Infant behavior prediction and safety guarantee	Smart parenting should be getting better and better, and hopefully safer
	Records of infant and child health data	Record, analyze and warn infants and young children's health data such as diet, sleep, medication, toilet use, frequency and quantity
	Analyze the rationality of the physical layout and curriculum setting of the park	Future smart childcare also includes higher-level intelligent service projects: based on the data of infants' activity duration, frequency, and visits, the rationality of the physical layout of the park and curriculum Settings is analyzed

4.2. Research Credibility

4.2.1. Qualitative Research Reliability

In this study, the alpha reliability coefficient method was chosen to evaluate the internal reliability of the interview results, aiming to examine the internal consistency of the interview method and content. In general, alpha values are positively correlated with reliability. The reliability test was conducted based on the degree of consistency of the coding results of the six coders, which resulted in an overall reliability coefficient of 0. 746 > 0.7, indicating that the overall reliability of this study was very high. Based on rigorous literature, this study systematically explored the service effectiveness of the smart childcare service model and provided theoretical justification for the key elements in the interviews. The interview subjects were also widely selected. In summary, the executive interviews in this study have good validity.

4.2.2. Quantifying Research Credibility

In this study, the intrinsic reliability of the questionnaire was examined through Cronbach's Alaph coefficient, which aims to examine the internal consistency of the content between the questions. In general, the larger the reliability coefficient, the higher the reliability of the questionnaire. Through the test, the internal consistency coefficient of the whole questionnaire is 0.844 > 0.7, which indicates that the internal consistency of the

questionnaire is good. The KMO value of the formal scale was 0.704 obtained by using factor analysis, and Bartlett's spherical test results reached a significant level ($p < 0.001$), and the results of exploratory factor analysis showed that the number of factors and the distribution of question items were in line with the research design and the factor loading coefficients of all the measurement items were greater than 0.5, which can be considered as good validity.

5. Experience of Hangzhou's Smart Childcare Service Model

5.1. Technology Applications

A core experience of the smart childcare service model in HCM City is the combination of technology application and personalized service. According to the theory of implicit interaction, smart childcare services can perceive changes in children's expressions and postures through technological means, such as sensors and deep learning, and provide emotionally rich interactive experiences accordingly. The application of such technology not only improves the efficiency of childcare but also enhances parents' peace of mind about their children's safety and health. Teachers' interviews mentioned that the smart childcare service makes the work more focused and transparent, and parents are more assured of the management and teaching of the campus.

5.1.1. Parents' Awareness of the Use of Technology in Smart Childcare Services

Make childcare more efficient and be able to monitor your child's safety and health in real-time. Helps our teachers manage their classes better and maintain closer contact with parents. Parent interviews also show that young parents value the intelligence and convenience of smart childcare and want to know their children's situation in real-time through smart childcare services.

5.1.2. Parents' Current Access to Smart Childcare Services

The application of relevant technologies enables childcare services to be more personalized to meet the needs of different children. Feedback from parents shows that by integrating advanced information technology, the smart childcare service not only enhances the transparency and interactivity of the childcare service but also improves the quality and efficiency of the service, making it a very novel model. Therefore, when HCM City promotes the smart childcare service model, it should pay attention to the actual needs of parents and teachers, constantly optimize the application of technology, and ensure the personalization and precision of the service.

5.2. Increased Communication and Transparency between Schools and Families

Another important experience of the smart childcare service model in HCM City is the innovation in home-school communication and transparency enhancement. While implicit interaction theory emphasizes the active provision of services by devices, the smart childcare service realizes real-time communication between home and school through apps and other platforms, enhancing the transparency of childcare services. In the teacher interviews, teachers believed that the smart childcare service helped them manage their classes better and maintain closer contact with parents.

5.2.1. The Role of Smart Childcare Services and the Difference between them and Ordinary Childcare Services

Intelligent child care, called wisdom, certainly provides more data-based intelligent support, so that the work is more targeted and more transparent. Parents are more assured of the campus management and teaching and so on, greatly reducing the difficulty of communication between home and school. Intelligent childcare services enable parents to understand their children's situation more conveniently, improving the transparency and

efficiency of childcare. The convenience of this communication method is also recognized by parents.

5.2.2. Home-School Communication and Transparency in Smart Childcare Services

In the smart childcare service model, Hangzhou should continue to utilize information technology to strengthen communication between home and school, increase the transparency of the service, and enhance parents' trust. In this way, the smart childcare service not only enhances parents' satisfaction but also promotes parents' participation in their children's education process, forming a favorable atmosphere for home-school co-education.

5.3. Information Security and Privacy Protection

The third key lesson from the smart childcare service model in Hangzhou is the importance of information security and privacy protection. Implicit interaction theory mentions that devices need to actively sense the user's goals and intentions, which is reflected in the smart childcare service by collecting and analyzing children's data. However, concerns about information leakage were expressed in both teacher and parent interviews. Teachers wanted better data protection measures, and parents also expressed concerns about information security. The content of the form shows that parents are concerned about the security of smart childcare services. This suggests that we must pay attention to data security when promoting smart childcare services. HCM City needs to strengthen data protection measures in the smart childcare service model to ensure that parents' and teachers' concerns are addressed, thereby promoting the healthy development of the smart childcare service model. By establishing a strict data management and protection mechanism, the trust of parents and teachers in the smart childcare service can be enhanced, providing a safer environment for children to grow up in. Because of this, HCM City must put data security at the center of the promotion of smart childcare services and take effective measures to strengthen data protection to eliminate the concerns of parents and teachers. This includes establishing strict data management and protection mechanisms, ensuring encrypted storage and secure transmission of data, implementing access control, and conducting regular security assessments and vulnerability fixes.

Through these efforts, HCM City will not only be able to increase the trust of parents and teachers in smart childcare services but also provide a safer and more reliable environment for children to grow up in.

5.4. Innovative Pathways to Personalized Service

Implicit interaction emphasizes interaction by sensing the user's behavior and environment without explicit action, which can greatly enhance the user's experience and reduce their cognitive burden. By analyzing the growth data of infants and toddlers, the smart childcare service system develops personalized education programs to meet the needs of infants at different stages of their development, thus promoting the full development of their potential. This customized service not only contributes to the overall development of the child but also allows parents to feel more intimate and professional care. In addition, the system can recommend activities and learning resources suitable for children according to their interests and preferences through implicit interaction, so that children can learn while having fun and grow while learning. With the accelerated development of globalization, more and more families are facing the problem of cross-border childcare. By integrating multiple languages and technical support, the Intelligent Childcare System provides convenient and efficient childcare services for families in different countries and regions. Both parents and children can enjoy high-quality childcare services across language and geographical barriers. In short, the smart childcare service system not only provides more scientific and personalized growth support for infants and toddlers

through the application of implicit interactive technology but also brings parents a convenient and efficient childcare experience. In the context of globalization, this service model can transcend the boundaries of language, culture, and geography, providing high-quality childcare services to more families and helping every child's healthy growth and all-round development. In the future, with the continuous progress of technology and the expansion of application scenarios, smart childcare services are expected to realize innovation and breakthroughs in more fields, injecting new vitality into the global childcare business.

6. Conclusion

In the context of the evolution of inclusive childcare, there has been a notable enhancement in the popularity, promotion, and acceptance of childcare across various sectors of the community, thereby fostering a favorable societal climate. This development is particularly noteworthy given the pivotal role of science and technology in driving innovation in the field of childcare, with a concomitant focus on the early development of infants and toddlers. The advent of intelligent childcare services has facilitated more frequent selection due to their provision of a convenient communication platform through the Internet, big data, and artificial intelligence. These services have also adopted a more comprehensive safety system and developed personalized services for infants and toddlers. The current landscape features a range of smart childcare models, which have demonstrated effectiveness and innovation in their promotional strategies. These models facilitate effective communication between parents and the community, optimize resource allocation, and offer superior options for infant and toddler development. However, the development of a more effective and convenient model of childcare service remains an important area for future research.

References

1. H. Liang, et al., "Equity in maternal-and infant-care services in China: A trend analysis based on residence and area (2000-2014)," *Int. J. Health Plann. Manage.*, vol. 32, no. 3, pp. 372-383, 2017, doi: 10.1002/hpm.2438.
2. A. Prathyanga, P. Shyaminda, P. Chamikara, S. Lakshan, S. Thelijjagoda, and D. Kasthurirathna, "Intelligent Daycare: Enhancing Child Safety with IoT and Machine Learning Innovations," *2024 9th International Conference on Communication and Electronics Systems (ICCES)*, Coimbatore, India, 2024, pp. 530-538, doi: 10.1109/ICCES63552.2024.10859472.
3. S. Wang, X. Zhu, F. Bu, and G. Zhang, G., "The responsibility and action of corporations for the development of 0-3 years old children's childcare services in China," *Labor Hist.*, vol. 65, no. 6, pp. 835-853, 2024, doi: 10.1080/0023656X.2024.2338494.
4. C. Liu, M. N. A. Rahman, X. Wang, and Y. Mao, "Parental demands for childcare services of infants and toddlers in China under the three-child policy," *Child Care Pract.*, vol. 2022, pp. 1-25, Sep. 2022, doi: 10.1080/13575279.2022.2109596.
5. H. Zhao, P. Zhao, and Y. Wang, "Attitude of nursing students towards Internet-based nursing service for the aged," *Int. J. Nurs. Sci.*, vol. 9, no. 1, pp. 114–119, 2022, doi: 10.1016/j.ijnss.2021.12.013.
6. F. Tian, Z. Peng, Y. Mi, et al., "Development and validation of a rating scale for barriers to and facilitators of nurses' participation intentions in 'Internet + Nursing Service'," *BMC Nurs.*, vol. 23, p. 559, 2024, doi: 10.1186/s12912-024-02215-1.
7. J. Chen, K. Li, K. Li, et al., "Dynamic planning of bicycle stations in dockless public bicycle-sharing system using gated graph neural network," *ACM Trans. Intell. Syst. Technol.*, vol. 12, no. 2, pp. 1–22, 2021, doi: 10.1145/3446342.