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Artificial Intelligence Empowers the Cultivation Path of Preschool Teachers' Core Digital Teaching Competence—A Case Study of Mianyang City

Manqin Zhou*, Weixi Du, Qiuping Wang,Qing Qu
School of Culture and Education,Tianfu College of Southwestern University of Finance and Economics,Mianyang, Sichuan Province, China
***Corresponding author, E-mail:zhoumanqin@tfswufe.edu.cn**

Abstract:
Against the background of educational digital transformation, the in-depth integration of artificial intelligence and preschool education has put forward new requirements for preschool teachers' digital teaching competence. Based on policy orientations such as the Guidelines for Kindergarten Education , the Guidelines for the Learning and Development of Children Aged 3-6, and the Sichuan Provincial "14th Five-Year Plan" Action Plan for the Development and Improvement of Preschool Education, this paper combines survey data from questionnaires of 120 preschool teachers, classroom observations of 30 lessons, and 15 groups of in-depth interviews in Mianyang City. It analyzes the current situation and dilemmas in cultivating preschool teachers' digital teaching competence in Mianyang, constructs a core digital teaching competence system of "foundation layer - application layer - development layer - guarantee layer", and proposes a four-dimensional cultivation path of "policy guidance - resource supply - practice empowerment - evaluation guarantee" adapted to Mianyang's regional characteristics. The research aims to solve the technical application problems of preschool teachers in Mianyang, promote the organic integration of AI technology and the essential nature of preschool education, and provide practical support for the high-quality digital development of preschool education in Northern Sichuan.

Keywords:
Artificial Intelligence; Preschool Teachers; Core Digital Teaching Competence

1.Introduction

In the wave of educational digital transformation, preschool education, as a fundamental part of the national education system, is undergoing a profound transformation from technical application to intelligent integration. The Guidelines for Kindergarten Education issued by the Ministry of Education clearly proposes to "make full use of educational resources in the natural environment and communities"[1], while the Sichuan Provincial "14th Five-Year Plan" Action Plan for the Development and Improvement of Preschool Education specifically puts forward "promoting the in-depth integration of information technology and preschool educa-

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tion and improving teachers' digital literacy"[4], providing clear policy guidance for the digital development of preschool education in Mianyang. From the perspective of practical evolution, the informatization of preschool education in Mianyang has moved from the embryonic stage of multimedia courseware application to the deepening stage of pilot AI technology application—innovative applications such as intelligent teaching assistants and VR/AR immersive teaching have been implemented in high-quality public kindergartens in urban areas. However, survey data shows that two-thirds of teachers clearly state that they "have difficulty proficiently using AI tools to design teaching activities", and half of the teachers "cannot interpret AI teaching data", with the common practical contradiction of "not knowing how to use, daring not to use, and not using well".

The significance of this research lies in bridging the gap between technology empowerment and teachers' competence in Mianyang. At the theoretical level, it integrates the core viewpoints of AI educational application and preschool teachers' professional development to clarify the composite dimensions of core digital teaching competence; at the practical level, it provides operable solutions for pain points such as insufficient resources in rural private kindergartens and limited time for teachers' technical learning in Mianyang. The research adopts the literature research method to sort out the achievements of preschool education digitalization, and combines survey data from kindergartens of different regions and types in Mianyang to extract common problems, ensuring that the research has both theoretical depth and regional pertinence.

2.Current Situation and Dilemmas of Cultivation

2.1. Teacher-Level Dilemmas

Dilemmas at the teacher level are concentrated in three aspects of competence deficiency and psychological anxiety. The difficulty in learning is reflected in the extremely fast iteration speed of AI technology—taking ChatGPT as an example, it only took 6 months to upgrade its functions from version 3.5 to 4.0. The survey shows that the average daily working time of the 120 surveyed teachers reaches 10.2 hours, and the fragmented time available for technical learning is only 0.8 hours, which makes more than half of the teachers shy away from complex technologies such as data analysis. Ethical shortcomings are also obvious: most teachers say they are not clear about the relevant norms for protecting children's data. A rural kindergarten once over-collected children's facial data and used it for kindergarten promotion, which clearly violates educational ethics. Emotional anxiety also plagues many teachers, who worry that AI tools will replace direct interaction between teachers and children. Practice shows that one month after the introduction of intelligent storytellers, the frequency of children taking the initiative to share life anecdotes with teachers dropped from 3.2 times a day to 1.8 times. This change has put teachers in a contradiction between technical convenience and emotional alienation.

2.2. Resource-Level Problems

Problems at the resource level are prominently manifested in insufficient adaptability and regional imbalance. On the one hand, interdisciplinary AI teaching resources are very scarce. According to the results of field surveys, among the existing AI resources, the language field is the most, followed by the art field, and the scientific inquiry field is the least. For example, when a kindergarten carries out STEM aerospace enlight-

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enment activities, it can usually only find about 3 suitable teaching resources. On the other hand, the imbalance in resource allocation between regions is significant: children in high-quality urban kindergartens can be equipped with more than one intelligent teaching device per person, while rural kindergartens often have ten children sharing one computer. In addition, rural private kindergartens also have difficulty accessing paid courses on some high-quality resource platforms, resulting in a prominent digital education gap.

2.3. Cultivation-Level Constraints

The cultivation level faces dual constraints of a single model and weak teaching staff. The current cultivation model is still dominated by theoretical teaching. In the preschool education informatization courses offered by local universities in Mianyang, there are few practical courses involving AI tool operation, and the content does not cover key skills such as VR teaching and data analysis. The composite competence of training teachers is also obviously insufficient: nearly half of the trainers have a background in computer science, and they do not understand the characteristic of young children's short attention span, making it difficult to design targeted courses based on this rule; the remaining industry experts lack the ability to solve technical problems—they often cannot provide effective guidance on practical operational difficulties such as abnormal data export from the preschool education cloud system, which greatly reduces the cultivation effect.

3.Composition System of Core Digital Teaching Competence

3.1. Foundation Layer: Core Literacy for AI Application

Foundation layer competence includes AI cognition, tool application, and data screening literacy. Teachers need to clarify the application boundaries and ethical norms of AI in preschool education—for example, the duration of virtual games should be controlled within 15 minutes, and AI evaluation cannot replace emotional judgment. A high-quality public kindergarten in an urban area once judged children's abilities only by the language scores of educational APPs, ignoring their expression potential in role-playing. Such problems need to be avoided through training. Teachers should also proficiently operate tools commonly used in Mianyang's kindergartens, such as Seewo Whiteboard, VR equipment, teaching APPs, and Canva. Training should be combined with local scenarios—for example, when guiding VR operations, methods to guide children to describe exhibits in Mianyang Aerospace Science and Technology Museum should be taught simultaneously. In addition, teachers need to screen resources in accordance with the Guidelines for the Learning and Development of Children Aged 3-6, avoid primary school-oriented software, verify the accuracy of local resources such as Mianyang folk children's songs, and select slow follow-up APPs for children with language delays. Teachers with this competence have significantly higher resource utilization rates.

3.2. Application Layer: Digital Teaching Design and Implementation

Application-level competencies focus on digital teaching design and implementation, with the core lying in the in-depth integration of AI resources and the five major domains of preschool education to achieve the systematicness of teaching design and the flexibility of implementation. For example, when conducting teaching with the theme of "Mianyang Science and Technology City", teachers can use AI to generate aerospace micro-videos to break down the structure of rockets, assisting in the dissemination of knowledge in the

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science domain; combine intelligent painting software to guide children in creating future rockets, supporting the cultivation of creativity in the art domain; and use virtual games to design rocket part counting tasks, fulfilling the goal of number cognition in the mathematics domain, thus forming an interdisciplinary teaching closed loop. In the process of human-machine collaborative teaching, teachers must adhere to the principle of "technology as support and teachers as leaders"; for instance, when carrying out the theme activity of "Understanding Mianyang Rice Noodles", they first use AI animations to show the rice noodle production process to activate children's life experiences, then organize children to make ingredients with clay while providing step-by-step guidance to those with weaker hands-on abilities, and finally guide children to share their creative ideas or conduct secondary optimization based on the work scores from the intelligent system. During the implementation phase, teachers also need to dynamically pay attention to children's reactions—if some children experience dizziness or fear when a kindergarten carries out a VR aerospace observation activity, teachers should immediately stop the VR experience, switch to physical aerospace model assembly, and alleviate children's anxiety through anthropomorphic language, which truly reflects the child-centered educational philosophy.

3.3. Development Layer: Data Analysis and Teaching Innovation

The core of development-level competencies is data analysis and teaching innovation, which requires teachers to break through the role limitation of being merely technology tool users and possess comprehensive abilities in data interpretation and teaching innovation. In terms of data analysis, teachers need to establish a two-dimensional analytical logic combining quantitative data and qualitative observation; for example, if the preschool education cloud system shows that a child has low participation in construction games , they should not directly conclude that the child is "unsociable" but instead further identify through daily observation that the child has social barriers—wanting to join peers'activities but not knowing how to initiate communication. On this basis, teachers design a group rocket construction task, assign the child the basic role of handing parts, and gradually guide the child to participate in social interactions to avoid analysis deviations caused by over-reliance on data alone. In teaching innovation practice, teachers can rely on AI technology to enrich teaching forms: they can use virtual simulation centers to simulate children's conflict scenarios and provide a platform for practicing mediation skills, and by inputting children's characteristics□such as being 5 years old, having an interest in Mianyang Rice Noodles, and having language development delay into generative AI, they can create personalized dialogue games to help children improve their language expression abilities.

3.4. Guarantee Layer: Ethical Control and Emotional Connection

Guarantee layer competence is prominently reflected in the dual adherence to ethical control and emotional connection. Teachers should take the initiative to prevent various ethical risks in AI applications. In terms of data privacy protection, written consent from parents must be obtained before collecting sensitive information such as children's facial data, and screen time should be strictly controlled within one hour a day. Faced with algorithmic biases—such as the system's biased judgment on the participation of introverted children—teachers need to manually adjust evaluation standards for correction. In addition, the risk of data use has been significantly reduced by formulating AI teaching ethical norms. Emotional connection competence requires teachers to strengthen teacher-child interaction in the application of technology. For example, after using an

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intelligent storyteller to play Mianyang folk stories, guide children to discuss Mianyang snacks in the stories and share their feelings; after exploring the aerospace city with VR, organize a sharing session "The Rocket I Want to Design". Teachers convey care through eye contact and timely responses, adhering to the bottom line that technology serves the essence of education.

4.Construction of Cultivation Path

4.1. Policy Guidance

Policy guidance takes balance as the core goal. In accordance with the Sichuan Provincial "14th Five-Year Plan" Action Plan for the Development and Improvement of Preschool Education, Mianyang City needs to focus on promoting the digital development of rural private kindergartens, narrowing the urban-rural gap through resource inclination—such as coordinating the allocation of basic intelligent equipment like interactive whiteboards, building a regional preschool education resource sharing platform, and promoting the flow of high-quality urban digital teaching resources to rural areas. Combined with the Implementation Rules for the Evaluation of Kindergarten Care and Education Quality[5], local authorities should formulate evaluation standards for preschool teachers' core digital teaching competence, incorporating ethical control and emotional connection into core indicators. It should not only pay attention to teachers' technical operation level but also value their ability to adjust teaching according to children's reactions. At the same time, an incentive mechanism should be established to stimulate teachers' initiative to improve digital literacy.

4.2. Resource Supply

Resource supply needs to create an interdisciplinary and scenario-based support system. The adaptive teaching resource library can be co-developed by local preschool education institutions, Science and Technology City enterprises, and high-quality urban public kindergartens in Mianyang. Institutions provide preschool education theoretical support, enterprises are responsible for developing VR teaching scenarios integrating local elements such as Mianyang Science and Technology City and Li Bai's Former Residence in Jiangyou, and public kindergartens optimize suggestions based on teaching practice feedback. The resource library should fully cover the five major fields of preschool education, develop characteristic content such as Fujiang River ecological observation, and establish a regular update mechanism to meet children's interests. In terms of training teachers, it is necessary to form a composite team with both preschool education professionalism and technical capabilities, promote two-way communication between preschool education experts and technical personnel, and improve the pertinence of training and guidance.

4.3. Practice Empowerment

Practice empowerment can be promoted through "three classrooms + multi-subject" collaboration. Each kindergarten sets up an AI teaching practice corner, equipped with basic intelligent equipment, and regularly carries out teaching seminars and practical reflection activities. Deepen the integration of "three classrooms": university classrooms focus on AI cognition and ethics teaching, virtual simulation centers provide simulated training of child interaction scenarios, and cooperative kindergartens provide real teaching practice platforms for teachers, forming a "theory - simulation - practice" cultivation chain. Implement a hierarchical cultivation

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strategy: new teachers focus on training in basic tool operation and data protection norms; backbone teachers focus on improving resource development and teaching innovation capabilities; add low-cost AI tool application courses for rural private kindergarten teachers to enhance training practicality.

4.4. Evaluation Guarantee

Evaluation guarantee should establish a "technology + humanities" diversified system, forming a collaborative evaluation mechanism involving AI systems, teachers, children, and parents. AI systems quantify teaching process data, teachers examine the effectiveness of technical application through teaching reflection, children feedback activity interests in intuitive ways, and parents focus on the impact of technical use on children's health. Evaluation dimensions should balance technical application and humanistic care. In addition to assessing tool operation capabilities, it should also pay attention to the quality of teacher-child emotional interaction and the compliance of data use, ensuring that technical application always serves children's development and avoiding formalistic application.

5.Conclusions

Based on survey data from kindergartens of various types and regions in Mianyang, this research clarifies that preschool teachers' core digital teaching competence is a composite system consisting of technical application, teaching design, data analysis, ethical control, and emotional connection. Its cultivation needs to solve practical dilemmas such as high learning pressure on Mianyang teachers, unbalanced resource allocation, and a single cultivation model. The proposed four-dimensional cultivation path is based on Mianyang's policies and practices, using AI to improve teaching efficiency while adhering to the essence of preschool education that prioritizes emotions, avoiding the risk of technical alienation.In the future, relying on the advantages of Mianyang Science and Technology City, we can explore the development of an AI-based teacher competence diagnosis system, which automatically identifies teachers' competence shortcomings through technical tests and case analysis. At the same time, promote the formulation of ethical norms for AI application in preschool education in Mianyang, clearly defining the boundaries of data collection. It is expected that based on this research, it will help the in-depth integration of AI technology and preschool education in Mianyang, realizing the unity of technology empowerment and the original intention of education.

Author Contributions

Conceptualization: Manqin Zhou; Methodology: Manqin Zhou; Formal analysis: Weixi Du; Writing—original draft:Qiuping Wang; Writing—review & editing: Qing Qu,; Funding acquisition:Manqin Zhou

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