



The Influence Mechanism of AI Learning on Early Childhood Teachers: A Perspective of Social Technical System Theory

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Abstract

With the deep integration of AI technology in the field of education, AI learning for preschool teachers has become a key link in promoting the digital transformation of preschool education. By reviewing relevant literature, this paper systematically constructs an analytical framework for the influencing factors of preschool teachers' AI learning based on the four core dimensions of the socio-technical system theory-individual perception, technology acceptance, structural relationship, and task goal. The research finds that at the individual perception level, achievement motivation, professional identity, and technological self-efficacy are the core internal driving forces, at the technology acceptance level, perceived usefulness and perceived ease of use affect teachers' acceptance of AI, at the structural relationship level, support from kindergartens, collaboration among colleagues, and policy guidance constitute multi-level environmental factors, at the task goal level, the interweaving of professional development needs and teaching practice requirements drives AI learning. Based on this, this study puts forward corresponding policy suggestions to provide theoretical support and practical guidance for promoting preschool teachers' AI learning and improving the quality of preschool education.

Keywords

Preschool teachers; AI learning; Influencing mechanism; Social-Technical system theory

1. Research Background

With the rapid advancement of AI, profound transformations have occurred in the field of education. Early childhood education, as the cornerstone of education, the professional development of teachers is relevant to the quality of preschool education. The national policy actively promotes the transformation of educational informatization. The "Outline for the Construction of a Powerful Education Nation (2024-2035)" proposes to pioneer new courses through digitalization and facilitate educational transformation assisted by AI. The "Teacher AI Competency Framework" released by UNESCO reveals that AI education has entered the stage of "ecological reconstruction". In this context, exploring the influence mechanism of AI learning for early childhood teachers is of great significance for implementing national strategies and enhancing the quality of preschool education.

However, the existing studies mostly pay attention to the technical efficacy of AI, while ignoring the dynamic adaptation process of teachers. The research on the influencing factors of AI learning for preschool teachers is insufficient. Based on the socio-technical system theory, this study explores the multi-dimensional factors that affect preschool teachers' AI learning, providing theoretical support for training policies and practices.

2. Research Review

In the era of Education Informatization 2.0, the innovative integration of artificial intelligence and preschool education constitutes a significant future development trend. Alongside the rapid advancement of artificial intelligence, technologies like deep learning and image recognition have been adopted in the domain of early childhood education, mainly manifested in four forms: intelligent systems for early childhood education, multiple intelligence assessment, educational robots, and simulation games. Facing these circumstances, preschool teachers present diverse characteristics and discrepant patterns in their learning of artificial intelligence. Some teachers actively explore the integration of technology. For instance, the team of Hangzhou Kangqiao Kindergarten has innovated teaching by leveraging tools such as DeepSeek and Doubao. While others demonstrate resistance. This disparity reflects the complexity of the influencing factors on teachers' technology learning, and there is an urgent need to establish a systematic theoretical framework for analysis (Hu, Wang, & Li, 2025).

The socio-technical system theory offers an appropriate perspective for comprehending this complex phenomenon. This theory originated from the research on the production system of British coal mines conducted by Trist and Bamforth in the 1950s, emphasizing the mutual dependence and co-evolution of technical systems and social systems. In the context of educational informatization, the socio-technical system theory considers the technological learning of preschool teachers as the outcome of the interaction among multiple factors such as individual perception, technology acceptance, task goals, and structural relationships. In combination with the above theory, this study will further expound on the influencing factors of preschool teachers' AI learning by integrating some existing scales or models (Sun, Zhang, & Li, 2024).

3. Mechanism Model of Impact

Based on the socio-technical systems theory, this study analyzes the influencing mechanism of AI learning for preschool teachers, as depicted in Figure 1. It encompasses psychological factors such as achievement motivation in individual perception, perceived usefulness and ease of use in technology acceptance, multi-level environmental support within structural relationships, and the demands of professional development and teaching practice under task goals, uncovering their complex correlations and paths of action.

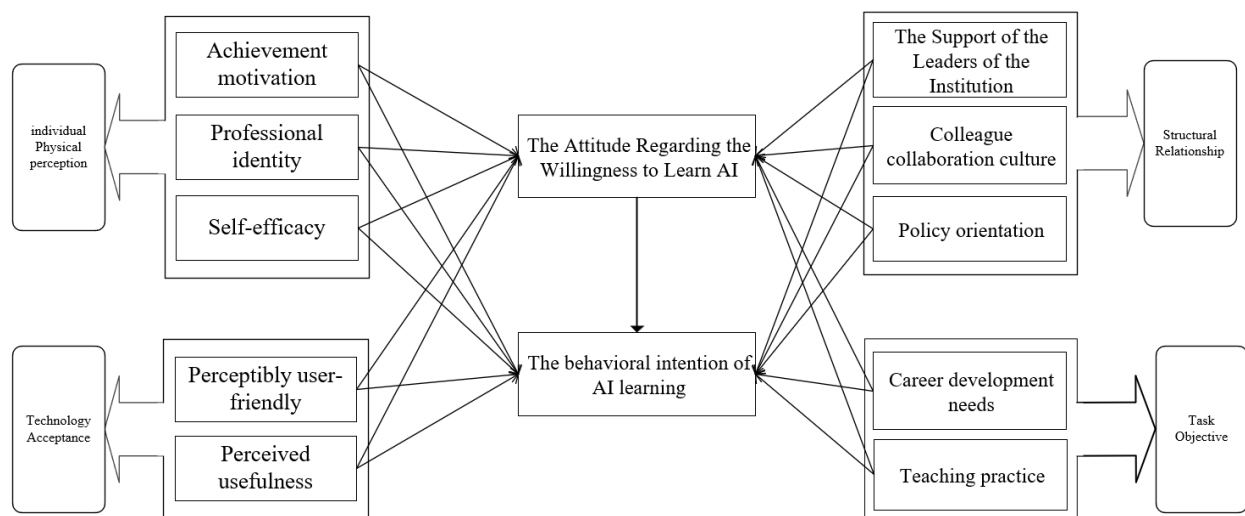


Figure 1. Model of the Mechanism of AI Learning Impact on Preschool Teachers.

3.1 Individual Perception

The individual perception focuses on the intrinsic motivational system of early childhood teachers' learning of AI. This study mainly pays attention to the psychological and social behaviors of early childhood teachers, including three psychological factors: achievement motivation, professional identity, and technological self-efficacy. Achievement motivation is the core driver, stemming from professional dedication and accountability for child development,

which motivates teachers to perceive AI as a strategic tool for enhancing pedagogical quality and personalized service delivery. Professional identity that significantly shapes learning intentionality through positive occupational cognition and role internalization. Technological self-efficacy, defined as domain-specific confidence in AI application, which exerts greater predictive validity on Technology Acceptance Model (TAM) adoption outcomes than general computer literacy, directly mediates behavioral implementation. Empirical evidence establishes these factors' interdependent operations, with professional identity moderating motivation-to-action pathways and self-efficacy bridging institutional support to classroom practices (Holden & Rada, 2011). Teachers of early childhood education with high self-efficacy have faith in their capabilities. When confronted with difficulties and challenges during the process of learning AI, they tend to actively seek solutions instead of giving up readily. Conversely, those with low self-efficacy might experience anxiety and resistance due to doubts about their own technical abilities, thereby impeding their progress in learning AI (Almulla, 2024).

3.2 Technology Acceptance

When exploring how early childhood teachers can embrace and effectively apply artificial intelligence technology, Davis's Technology Acceptance Model (TAM) provides us with a potent analytical framework. This model focuses on two core factors: perceived usefulness and perceived ease of use. Specifically, perceived usefulness measures the judgment of teachers on whether AI technology can enhance teaching efficacy, while perceived ease of use reflects the subjective assessment of teachers regarding the effort required for learning and applying AI technology. The specific demands of early childhood education, such as individualized teaching and gamified learning, combined with the characteristics of AI technology, jointly shape the perception of teachers on the usefulness of AI technology (Lim, 2023). For instance, AI-driven learning analytics tools can assist early childhood educators in identifying the advantages and disadvantages of each child, thereby enabling them to adjust teaching strategies and implement individualized teaching. When teachers are aware that AI can observe and evaluate children's development more effectively, provide personalized resources, and improve teaching interactions, they will be more inclined to incorporate it into their teaching practices. Simultaneously, the perception of ease of use is of vital importance to the AI learning behavior of early childhood educators. Excessively complex AI systems may give rise to resistance due to overly high cognitive demands. In contrast, those AI tools with simple interfaces, user-oriented designs, and strong support frameworks can lower barriers and enhance their willingness to learn.

3.3 Structural Relationship

The AI learning of preschool teachers is empowered and influenced by the multi-level environment, ranging from the kindergarten to society. In accordance with the ecosystem theory, individual development is nested within multiple layers of the environment. Among them, the support from kindergarten leadership and the culture of colleague collaboration are the key micro-factors. As the technical decision-makers and managers, the kindergarten leadership has a considerable influence on their attitudes and behaviors. They not only need to offer resource guarantees, such as hardware facilities, software procurement, and training funds, but also create an atmosphere that encourages innovative attempts (Huang & Teo, 2019). The interaction and collaboration among teachers constitute a social support network. An open and collaborative colleague culture is conducive to knowledge exchange and reduces the risks and costs of learning. Policy orientation, as a meso-level factor, provides direction and impetus for preschool teachers' learning of AI, influences the decision-making regarding technology introduction in kindergartens, and also shapes teachers' perception and attitude towards AI technology (Liu, Song, & Huang, 2021). For example, the policy documents on the integration of artificial intelligence and education issued by national and local education departments provide the policy basis and guidance direction for the application of AI technology in the field of early childhood education. These policies can direct kindergartens to incorporate AI technology into their development plans and encourage teachers to conduct related teaching practices and research.

3.4 Task Objectives

The integration of AI in early childhood education embodies educational informatization trends while reconceptualizing teachers' professional competencies. Under initiatives like "AI + Education," technological proficiency has become integral to professional development, incentivizing participation in pilot programs and research. This alignment between institutional expectations and practical demands fosters proactive AI literacy acquisition, as teachers

navigate systemic pressures to harmonize technical mastery with evolving educational paradigms. Concurrently, AI introduces novel instructional challenges, necessitating adaptive pedagogical strategies to reconcile technological capabilities with developmental appropriateness in early learning contexts (An & Ma, 2023). Some kindergartens have begun to experiment with artificial intelligence tools. This requires teachers to be proficient in operating these tools and to integrate them flexibly into the curriculum to enhance children's engagement and creativity. Selecting age-appropriate tools and designing activities that align with development goals are essential. For instance, the practical needs of using AI to support art creation and language skill development have driven continuous innovation in teaching methods, encouraging teachers to constantly improve their technical skills through classroom practice. This approach promotes "learning by doing", combining the acquisition of AI skills with teaching to address real teaching challenges while maintaining the relevance of teaching in technology-enhanced early childhood education.

4. Suggestions and Prospects

This research embarks from four dimensions—individual perception, technology acceptance, structural relationship, and task objective—to explore the influencing factors of AI learning for preschool teachers. The study discovers that AI learning for preschool teachers is a complex systematic project, which is jointly influenced by multiple factors.

4.1 Stimulate Achievement, Identity and Efficacy Recognition

From the individual perception perspective, achievement motivation, professional identity, and self-efficacy are the crucial factors affecting the internal impetus for preschool teachers' AI learning. To improve the learning effectiveness, it is feasible to publicize outstanding cases, set up reward mechanisms to stimulate achievement motivation, conduct professional spirit education activities to intensify professional identity, offer stratified training and technical assistance to enhance self-efficacy, and assist teachers in proactively integrating AI into teaching.

4.2 Highlighting Value and Optimizing Design

This study employs the Technology Acceptance Model (TAM) to analyze how perceived usefulness and ease of use influence preschool teachers' adoption of artificial intelligence. First, through outcome sharing sessions, the significant development of young children in cognitive and social aspects with the assistance of AI, as well as its advantages in personalized and gamified teaching, should be demonstrated to enhance teachers' awareness of AI's potential to improve teaching effectiveness. Secondly, at the technical level, software developers and educational technology departments should closely collaborate to optimize the design of AI tools. Timely addressing teachers' questions and concerns can reduce the difficulty and psychological burden of using AI, thereby increasing their willingness to learn and apply AI technology.

4.3 Leadership, Collaboration, and Policy Promotion

From the perspective of structural relationships, micro-level support from the leadership of kindergartens and collaboration among colleagues, as well as meso-level policy guidance, can all empower preschool teachers in their learning of AI. To promote teachers' AI learning, a multi-level collaborative support system needs to be established. Kindergarten leaders should increase resource investment and build innovative platforms, education departments should set up reward funds to honor kindergartens and teachers who apply AI, using policy incentives to promote the popularization and in-depth application of AI in early childhood education.

4.4 Integration of Professional Development and Practices

In terms of task goals, the interweaving of professional development demands and teaching practice requirements drives teachers to acquire AI technology. To assist teachers in addressing the challenges of AI, a support system should be established from two dimensions. At the professional development level, the education department and kindergartens should incorporate AI capabilities into the assessment criteria and set up training, research topics, and pilot projects. In teaching practice, kindergartens should be equipped with AI devices, organize discussions on course design, encourage the development of characteristic courses, and establish feedback mechanisms to facilitate the integration of AI and early childhood education and enhance teachers' capabilities and teaching quality.

In conclusion, the learning of AI by preschool teachers is influenced by multiple intertwined factors. Therefore,

targeted suggestions are put forward to promote the deep integration of technology and teaching practice, and help preschool teachers adapt to the intelligent transformation of education.

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