A METHODOLOGICAL MODEL FOR DEVELOPING PRESCHOOL CHILDREN'S COGNITIVE AND CREATIVE ACTIVITIES THROUGH ARTIFICIAL INTELLIGENCE TOOLS

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doi:https://doi.org/10.5281/zenodo.22971009

Abstract: The rapid development of artificial intelligence (AI) is creating new possibilities for educational practice, including early childhood education. However, the pedagogical value of AI in preschool settings depends not simply on the availability of technological tools but on how these tools are integrated into developmentally appropriate learning activities. This article examines the methodological potential of AI tools for developing preschool children's cognitive and creative activities and proposes a pedagogical model for their purposeful integration into early childhood education. The study employs theoretical analysis, comparative analysis, synthesis, pedagogical modelling, and methodological design. Previous research on AI in early childhood education indicates that AI-related learning can be associated with cognitive development, creativity, collaborative inquiry, literacy, and other learning outcomes, while also revealing significant challenges related to teacher competence, age appropriateness, ethics, and educational design. Based on the reviewed literature, the article proposes a seven-stage methodological model: pedagogical goal setting, AI-tool selection, creation of a problem-based or creative situation, active child inquiry, production of a creative outcome, discussion and reflection, and pedagogical assessment. The model places the child and teacher rather than the technology at the centre of the educational process. AI is conceptualized as a mediating pedagogical resource that stimulates observation, questioning, comparison, imagination, problem solving, and creative expression. The article argues that effective AI integration in preschool education requires teacher mediation, active child participation, developmentally appropriate content, ethical safeguards, and systematic assessment. The proposed model provides a methodological framework for future empirical research and practical implementation in preschool educational organizations.
Keywords: artificial intelligence, early childhood education, preschool education, cognitive activity, creative activity, creativity, AI literacy, digital pedagogy, pedagogical model, teacher mediation.

1. Introduction

Artificial intelligence has moved from a predominantly technological domain into increasingly diverse areas of social and educational practice. Generative AI systems, intelligent educational applications, conversational agents, adaptive technologies, and AI-supported content-generation tools are creating new possibilities for designing learning environments. Although much of the current discussion focuses on higher education and school education, early childhood education is also becoming an emerging area of AI-related research.

The relevance of this issue is particularly evident because the preschool period represents an important stage in the development of children's cognitive, communicative, imaginative, and creative capacities. At this age, learning is closely connected with play, exploration, observation, communication, manipulation of objects, storytelling, experimentation, and interaction with adults and peers. Consequently, the introduction of AI into preschool education cannot simply reproduce technology-centred models developed for older learners.

The central pedagogical question is therefore not whether artificial intelligence can be introduced into preschool education, but under what pedagogical conditions AI can support children's development without replacing their active thinking, creativity, communication, and direct experience.

A scoping review by Su and Yang identified 17 studies concerning artificial intelligence in early childhood education and demonstrated that the field encompasses diverse applications and learning outcomes. The reviewed literature included research associated with computational thinking, creativity, collaborative inquiry, literacy, emotional development, and other areas of children's learning [1]. This finding indicates that AI-related educational activities may extend beyond teaching children about technology itself.

At the same time, the limited number and diversity of empirical studies indicate that conclusions about the developmental effects of AI in early childhood should be made cautiously. The presence of an AI tool does not automatically produce a desirable educational outcome. Rather, its educational value depends on the learning objective, the type of interaction, the pedagogical design, the teacher's role, and the child's level of participation.

Recent research has increasingly emphasized the importance of designing AI-supported learning around children's developmental needs. Yang, Li, and Lee proposed the Creative Project Approach, which integrates AI agents into early learning through a framework involving identification of learning needs, teacher-guided child-AI interaction, contextualized use of AI, consideration of automation and creativity, and evaluation of learning outcomes [2]. Such an approach provides an important conceptual basis for reconsidering AI not as an independent teacher but as a component of a broader pedagogical environment.

The international policy context also emphasizes caution. UNESCO's Guidance for Generative AI in Education and Research advocates a human-centred approach to AI in education and highlights issues including data privacy, ethical considerations, age appropriateness, and pedagogical validation [3]. These principles are particularly relevant to preschool education because young children require greater adult mediation and protection in digital environments.

The Uzbek educational context is also undergoing digital transformation. The national strategy for the development of artificial intelligence to 2030 identifies the development of knowledge and skills and the introduction of AI technologies into different spheres as important strategic directions [4]. At the same time, the Concept for the Development of the Preschool Education System until 2030 emphasizes the comprehensive development of preschool children [5].

Despite these developments, an important methodological problem remains insufficiently addressed: how can AI tools be incorporated into preschool educational activities in a way that simultaneously stimulates cognitive activity and creativity while preserving the child's agency and the teacher's pedagogical responsibility?

This article addresses this problem by developing a methodological model for integrating AI tools into preschool learning activities.

The purpose of the study is to theoretically substantiate and develop a methodological model for using AI tools to support preschool children's cognitive and creative activities.

The objectives are to:

1. analyze current approaches to AI use in early childhood education;
2. identify pedagogically significant conditions for AI-supported preschool learning;
3. distinguish cognitive and creative dimensions of children's activity;
4. develop a methodological sequence for integrating AI into preschool activities;
5. formulate principles for the responsible and developmentally appropriate use of AI.

2. Literature Review

2.1. Artificial Intelligence in Early Childhood Education

Research on AI in early childhood education is still developing. Su and Yang's scoping review demonstrated that research in this field has included educational robotics, AI-related learning, intelligent systems, and other technologies. Importantly, the review identified connections between AI-supported learning and several developmental domains, including creativity, collaborative inquiry, literacy, and computational thinking [1].

This body of research suggests that AI should not be conceptualized exclusively as an object of technological education. Instead, it can function as a pedagogical resource within broader developmental activities.

However, this distinction is essential. Teaching children about AI and using AI to support children's learning are not identical educational practices. In the first case, the learning objective may involve understanding concepts associated with artificial intelligence. In the second, AI may serve as a tool for generating questions, visual material, scenarios, stories, or interactive learning experiences.

For preschool education, the second approach requires particularly careful pedagogical mediation.

2.2. AI and Children's Creativity

Creativity in early childhood is expressed through children's ability to generate ideas, transform existing representations, imagine alternatives, construct narratives, experiment with materials, and produce novel combinations.

AI technologies may provide children with additional stimuli for such activities. For example, an AI-generated image can become the starting point for a storytelling task, a problem-solving activity, a drawing exercise, or a discussion about alternative possibilities.

Nevertheless, the creative value of an AI-generated product should not be confused with the creativity of the child. If an AI system produces a complete story and the child merely listens to it, the technological output should not be interpreted as evidence of children's creative development. In contrast, if the AI-generated stimulus encourages children to modify the story, invent alternative characters, propose different endings, or create their own visual representation, the technology becomes part of a child-centred creative process.

This distinction is central to the methodological model proposed in this article.

2.3. The Teacher as a Mediator

The role of the teacher becomes more important rather than less important when AI tools are introduced into preschool education.

Research on AI literacy in early childhood education has emphasized the challenges associated with appropriate pedagogical implementation and the need for greater understanding of AI among educators [6]. Research on teachers' perceptions of AI educational tools has similarly highlighted the importance of teachers' knowledge, attitudes, and acceptance in the successful integration of AI into learning environments [7].

Therefore, the preschool teacher should not be reduced to an operator of digital tools. The teacher is responsible for:

- identifying the educational objective;
- selecting an appropriate AI-supported activity;
- determining the level of technological involvement;
- ensuring age appropriateness;
- monitoring the child's interaction with technology;
- encouraging independent thinking;
- questioning and discussion;
- evaluating learning outcomes;
- protecting children's privacy and safety.

In this framework, AI does not replace the teacher. Instead, the teacher determines how and why AI is used.

3. Methodology

The study is theoretical and methodological in nature. It does not report experimental results because no controlled intervention or empirical dataset was generated for the purposes of this article.

The research methodology combines:

- theoretical analysis of scientific literature;
- comparative analysis of existing AI-in-education approaches;
- synthesis of pedagogical principles;
- analysis of international guidance;
- pedagogical modelling;
- methodological design.

The analytical process consisted of four stages.

First, research on AI in early childhood education was examined to identify major areas of application and developmental outcomes.

Second, studies addressing AI literacy and teacher competence were considered to determine the role of pedagogical mediation.

Third, international recommendations concerning ethical, age-appropriate, and human-centred AI use were analyzed.

Fourth, the findings were synthesized into a methodological model specifically designed for preschool cognitive and creative activities.

The model is not presented as an experimentally validated intervention. Rather, it represents a theoretically grounded framework that can subsequently be tested through empirical research.

4. Results

The central result of the study is the development of a seven-stage methodological model:

Pedagogical Goal → AI Tool Selection → Problem-Based/Creative Situation → Active Child Inquiry → Creative Product → Discussion and Reflection → Pedagogical Assessment

The model is based on a fundamental principle: technology must be subordinated to the pedagogical objective rather than the pedagogical objective being subordinated to technology.

Stage 1. Pedagogical Goal Setting

The teacher begins by identifying what developmental outcome is expected.

For example, the objective may be:

- developing observation;
- comparing objects;
- identifying similarities and differences;
- encouraging questioning;
- developing narrative skills;
- stimulating imagination;
- generating alternative solutions;
- creating an original product.

The objective should be formulated independently of the AI tool.

This prevents the common methodological error of beginning a lesson with the question, "What can this AI tool do?" Instead, the process begins with the question, "What developmental task do the children need to accomplish?"

Stage 2. Selection of an AI Tool

Only after defining the pedagogical objective does the teacher select an appropriate AI-supported tool.

For example, a visual AI tool may be used to generate unusual images for observation and storytelling. A conversational AI system may support the teacher in preparing questions or scenarios. A generative system may provide alternative story situations.

The child does not necessarily need direct access to the AI system. In many preschool contexts, teacher-mediated use is more developmentally appropriate.

Stage 3. Creation of a Problem-Based or Creative Situation

The AI-generated material becomes a stimulus for inquiry.

For example, the teacher may present an unusual image of a forest containing imaginary objects and ask:

"Why might these objects be in the forest?"

"What could happen next?"

"How could we change this picture?"

"What would you add?"

Such questions transform a digital stimulus into a cognitive and creative situation.

Stage 4. Active Child Inquiry

At this stage, the child becomes the central participant.

Children observe, ask questions, compare alternatives, predict possible outcomes, explain their ideas, negotiate with peers, and propose solutions.

The teacher's role is to facilitate rather than provide immediate answers.

This stage is crucial because the educational value of AI depends largely on whether the child is intellectually active.

Stage 5. Creation of a Creative Product

Children transform their ideas into an observable product.

The product may be:

- a drawing;
- a story;
- a model;
- a collage;
- a role-play scenario;
- a verbal description;
- a group project;
- an alternative ending to a story.

The AI-generated content serves as a stimulus rather than the final product.

Stage 6. Discussion and Reflection

Children explain what they created and why.

The teacher may ask:

“What was your idea?”

“Why did you choose this solution?”

“What else could we do?”

“What would happen if we changed this part?”

This stage strengthens communication and metacognitive elements of learning.

Stage 7. Pedagogical Assessment

Assessment focuses on the child's activity rather than the technological quality of the final product.

The teacher may observe:

Cognitive indicators:

- observation;
- questioning;
- comparison;
- classification;
- prediction;
- problem recognition;
- solution seeking.

Creative indicators:

- number of ideas;
- variety of ideas;
- originality of solutions;
- imagination;
- transformation of existing ideas;
- production of creative outcomes.

Communicative indicators:

- explanation of ideas;
- participation in discussion;
- listening to peers;
- verbal expression.

This approach allows assessment to remain developmentally oriented.

5. Discussion

The proposed model reflects a shift from technology-centred learning to child-centred AI-supported learning.

A technology-centred model may follow the sequence:

AI tool → generated content → child receives information.

The proposed pedagogical model follows a different sequence:

developmental objective → pedagogical situation → AI-supported stimulus → child inquiry → creative activity → reflection**.**

The difference is substantial. In the first model, the technological system determines the learning experience. In the second, the teacher determines the educational purpose and uses technology selectively.

This distinction is particularly important in preschool education because children's development depends on direct interaction with people, objects, environments, and peers. AI should therefore complement rather than replace play, communication, experimentation, physical activity, storytelling, and hands-on exploration.

The Creative Project Approach proposed by Yang, Li, and Lee similarly emphasizes the identification of children's learning needs, teacher-guided interaction, contextualized AI use, consideration of creativity and automation, and evaluation of outcomes [2]. The present model extends this logic by placing greater emphasis on the sequence through which AI-supported stimuli are transformed into children's own cognitive and creative products.

5.1. Cognitive Development

AI-supported activities can create situations in which children need to observe, compare, classify, predict, and explain.

For example, a teacher may present several AI-generated representations of the same object and ask children to identify similarities and differences. The educational value lies not in the images themselves but in the reasoning process stimulated by them.

Similarly, an AI-generated scenario can create a problem requiring children to propose solutions.

Thus, AI may function as a **stimulus for cognitive activity** rather than a source of ready-made knowledge.

5.2. Creative Development

Creativity requires opportunities to produce alternatives.

An AI-supported preschool activity can therefore be structured around questions such as:

“What else could it be?”

“How could we change it?”

“What would happen in another situation?”

"Can you invent a different ending?"

Such open-ended questions prevent the activity from having a single predetermined answer.

The teacher should also avoid evaluating children's creative products primarily according to technical or aesthetic perfection. The developmental focus should remain on the child's ideas, reasoning, experimentation, and originality.

5.3. Ethical and Developmental Considerations

The use of AI with young children requires particular attention to ethical safeguards.

UNESCO emphasizes human-centred AI, privacy protection, age appropriateness, and ethical validation in educational applications [3]. These principles are especially significant in preschool contexts.

Consequently:

1. children should not be required to disclose unnecessary personal information to AI systems;
2. teachers should carefully evaluate AI-generated content before presenting it;
3. AI content should be developmentally appropriate;
4. direct AI interaction should be mediated according to children's age and educational needs;
5. AI should not replace human interaction;
6. teachers should remain responsible for pedagogical decisions.

AI-generated content can also contain factual inaccuracies, inappropriate representations, cultural bias, or unsuitable visual material. Therefore, teacher review is an essential methodological condition.

6. Practical Application

The proposed model can be applied to different preschool learning domains.

Example 1: Nature Exploration

Objective: develop observation and classification.

The teacher presents several AI-generated images of animals living in different environments.

Children identify:

- which animals belong together;
- where they live;
- what characteristics they share;
- what would happen if an animal were placed in another environment.

The AI-generated images serve as stimuli for observation and reasoning.

Example 2: Storytelling

Objective: develop imagination and narrative competence.

The teacher presents an AI-generated unusual character and asks children to create a story around it.

Children determine:

- the character's name;
- where it lives;
- what problem it encounters;
- who helps it;
- how the story ends.

The AI produces the initial stimulus, while the children construct the narrative.

Example 3: Creative Design

Objective: develop divergent thinking.
The teacher presents an unusual AI-generated house.
Children are asked:
"How would you change this house?"
"What could be added?"
"Who could live there?"
"How could you make it more useful?"
Children then draw their own versions.
Here, the AI image functions as a starting point for transformation rather than a finished creative product.

7. Implications for Preschool Teachers

Successful implementation requires the development of teachers' AI literacy.
Teacher AI literacy should include at least five dimensions:

1. technical literacy — understanding basic AI functionality;
2. pedagogical literacy — understanding when AI can support learning;
3. critical literacy — recognizing errors and limitations in AI-generated content;
4. ethical literacy — understanding privacy, safety, bias, and age-appropriate use;
5. creative literacy — designing activities in which AI stimulates rather than replaces children's creativity.

This means that professional development programmes for preschool teachers should not focus exclusively on teaching them how to operate AI applications. They should also develop the ability to design meaningful learning situations around those applications.

8. Limitations and Future Research

The present article has several limitations.
First, the proposed model has not yet been validated through a controlled empirical experiment. Therefore, claims concerning its effectiveness should be tested rather than assumed.
Second, AI technologies develop rapidly, meaning that specific tools may change faster than methodological principles.
Third, different preschool settings have different levels of technological access, teacher preparedness, and institutional support.
Future research should therefore examine the model experimentally using appropriate preschool-age samples and developmentally suitable assessment instruments.

Future studies may compare:

- conventional learning activities;
- AI-supported teacher-mediated activities;
- different levels of AI involvement.

Longitudinal studies may also investigate whether repeated exposure to AI-supported creative activities affects children's cognitive flexibility, narrative ability, problem solving, and creative expression.

9. Conclusion

Artificial intelligence creates new opportunities for designing stimulating learning environments in early childhood education, but its pedagogical value cannot be reduced to technological novelty. The decisive factor is the educational design within which the technology is used.

This article proposed a seven-stage methodological model consisting of pedagogical goal setting, AI-tool selection, creation of a problem-based or creative situation, active child inquiry, production of a creative outcome, discussion and reflection, and pedagogical assessment.

The central principle of the model is that AI should stimulate children's thinking rather than replace it. The child remains the active subject of learning, while the teacher remains the primary pedagogical mediator.

The model also establishes a conceptual distinction between AI-generated content and children's creativity. A technologically sophisticated product does not by itself demonstrate creative development. Creative development is better represented by the child's capacity to generate ideas, transform information, propose alternatives, solve problems, communicate reasoning, and produce personally meaningful outcomes.

Accordingly, responsible AI integration in preschool education requires the combination of technological possibilities with developmental psychology, pedagogical design, teacher competence, ethical safeguards, and child-centred learning.

The proposed framework provides a theoretical and methodological foundation for future empirical research aimed at determining the effectiveness of AI-supported approaches to developing preschool children's cognitive and creative activities.

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