Technology for Developing Intellectual Abilities of Older Preschool Children in Preschool Educational Organizations

Yusupova Dilafruz, Nazarova Dilnoza Eraliyevna, and Tashtemirova Nargizakhan Nematilla kizi

National Pedagogical University of Uzbekistan, Tashkent, Uzbekistan

Abstract. The senior preschool period (roughly ages five to seven) is decisive for the formation of intellectual abilities, yet practice in preschool educational organizations often lacks a systematic, technology-based approach to developing them. This paper proposes a pedagogical technology—a structured, reproducible system of goals, content, methods, and assessment—for developing the intellectual abilities of older preschool children. The technology integrates five developmental components (thinking, attention, memory, imagination, and speech) and organises the educational process into four interconnected blocks: target-diagnostic, content, procedural-technological, and result-evaluative. Its procedural core combines developmental play, theory-of-inventive-problem-solving (TRIZ) tasks, visual modelling, problem situations, project activity, and interactive digital and augmented-reality tools. An integrated index of intellectual development is defined to classify children into low, medium, and high levels and to measure progress. An illustrative formative experiment indicates that, under the proposed technology, the proportion of children at the high level rises substantially relative to a control group, while the share at the low level falls. The work offers preschool educators a coherent, measurable framework that aligns activity-based pedagogy with modern educational technology.

Keywords: Preschool Education · Intellectual Abilities · Pedagogical Technology · Developmental Play · Educational Technology · Cognitive Development

1 Introduction

Senior preschool age is a sensitive period for cognitive growth: it is when visual-effective and visual-figurative thinking mature toward the first forms of verbal-logical reasoning, when voluntary attention and memory begin to take shape, and when imagination and coherent speech expand rapidly. The quality of pedagogical support during these years has lasting consequences for a child's readiness for school and for lifelong learning. In the activity-based tradition of preschool pedagogy, play is the leading activity through which these abilities develop, and the educator's task is to organise developmental activity within the child's zone of

 Online ISSN: 2348–3326 DOI: 10.21276/MATRIX.2026.9.1.4

proximal development so that today's assisted achievement becomes tomorrow's independent capability.

Despite broad agreement on these principles, everyday practice in many preschool educational organizations still relies on fragmented exercises rather than a coherent, reproducible system. What is missing is a *technology*: an ordered sequence of diagnosable goals, structured content, deliberately chosen methods, and criterion-based assessment that any practitioner can implement and evaluate. This paper develops such a technology for the intellectual development of older preschoolers. Its contribution is threefold: a four-block structural model of the technology; an integrated index that makes intellectual development measurable and classifiable into levels; and an account of how contemporary educational technology—including interactive and augmented-reality tools—can be embedded in the procedural core alongside classical developmental methods.

2 Related Work

Theoretical foundations for the technology rest on the activity and cultural-historical traditions of developmental psychology. Vygotsky's concept of the zone of proximal development frames learning as cooperation that precedes and shapes development; Piaget's account of pre-operational and emerging concrete-operational thought characterises the cognitive transitions of this age; and Elkonin's and Leontiev's analyses of play as the leading activity explain why developmental games are the natural vehicle of preschool learning. Building on these foundations, problem-based and inventive approaches—notably the adaptation of the theory of inventive problem solving (TRIZ) for young children—show how open-ended tasks cultivate flexible, divergent thinking.

A complementary strand concerns the role of modern educational technology. Augmented-reality and interactive media have been examined as tools that can increase engagement and support experiential learning, while also raising design and sustainability challenges that educators must manage [5]. On the assessment side, methods from data science are increasingly relevant to education: discriminative feature-selection techniques help identify which indicators most strongly characterise a developmental profile from multidimensional observation data [3]; machine-learning model analysis demonstrates reliable categorisation of cases into ordered classes, a task directly analogous to classifying children into developmental levels [1]; and data-driven predictive monitoring illustrates how progress can be tracked and anticipated over time [4]. Finally, artificial-intelligence models that reason under uncertainty offer a principled way to handle the inevitable imprecision of behavioural assessment [2]. The present technology integrates these pedagogical and technological strands into a single implementable system.

Online ISSN: 2348–3326 DOI: 10.21276/MATRIX.2026.9.1.4

3 The Proposed Pedagogical Technology

3.1 Structure and Components

The technology is organised as four interconnected blocks linked by a feedback loop, shown in Fig. 1. The *target-diagnostic block* fixes the developmental goal and establishes each child's baseline through initial diagnosis. The *content block* specifies the five developmental components—thinking, attention, memory, imagination, and speech. The *procedural-technological block* delivers the content through developmental play, TRIZ tasks, visual modelling, problem situations, project activity, and interactive or augmented-reality tools, using individual, subgroup, and frontal forms of organisation. The *result-evaluative block* applies criteria and levels, diagnoses outcomes, and feeds corrective information back into the process.

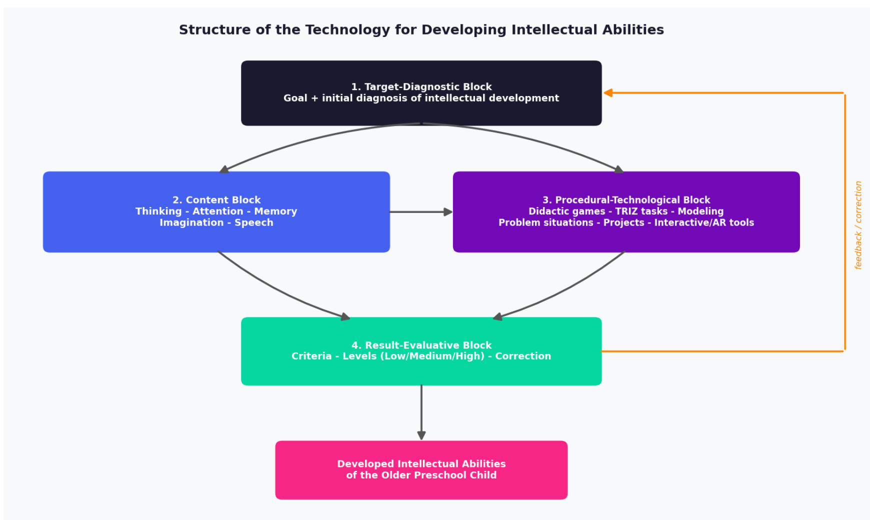

Fig. 1: Four-block structure of the proposed technology, with a feedback loop for ongoing correction

3.2 Diagnostic Criteria and the Integrated Development Index

Intellectual development is assessed across the five components. Let $s_i \in [0, s_{\max}]$ denote a child's score on component $i \in \{T, A, M, I, S\}$ (thinking, attention, memory, imagination, speech), obtained from standardised developmental tasks. Each score is normalised to $[0, 1]$, and an *integrated intellectual development index* (IDI) is defined as a weighted mean:

$$\mathrm{IDI} = \sum_i w_i \frac{s_i}{s_{\max}}, \qquad \sum_i w_i = 1,\ w_i \geq 0, \tag{1}$$

Online ISSN: 2348–3326 DOI: 10.21276/MATRIX.2026.9.1.4

where the weights w_i reflect the relative emphasis placed on each component (equal weights, $w_i = 0.2$, are used by default). The index maps each child to one of three developmental levels:

$$\text{Level} = \begin{cases} \text{Low}, & \text{IDI} < 0.40, \\ \text{Medium}, & 0.40 \leq \text{IDI} < 0.70, \\ \text{High}, & \text{IDI} \geq 0.70. \end{cases} \tag{2}$$

Progress over an intervention period is measured by the gain $\Delta\text{IDI} = \text{IDI}_{\text{post}} - \text{IDI}_{\text{pre}}$. Table 1 summarises the criteria and their behavioural indicators.

Table 1: Diagnostic criteria for the integrated intellectual development index

Component	**Observable indicators**
Thinking	Classification, seriation, analogy, simple logical inference
Attention	Concentration, stability, and voluntary switching on tasks
Memory	Voluntary recall of figures, words, and sequences
Imagination	Originality and elaboration in construction and storytelling
Speech	Vocabulary, coherence, and reasoning expressed verbally

3.3 Implementation

The technology is implemented over a structured cycle. After initial diagnosis, children engage in regular developmental sessions that progress from concrete manipulation toward symbolic modelling and verbal reasoning, with tasks calibrated to each child's zone of proximal development. Interactive and augmented-reality activities are introduced sparingly and purposefully—to visualise relationships, support construction tasks, and sustain motivation—rather than as a substitute for hands-on play. Continuous observation feeds the result-evaluative block, which triggers individualised correction where needed.

4 Results and Discussion

To illustrate the expected effect, a formative experiment compares an experimental group taught with the proposed technology against a control group following the standard programme. Figure 2 and Table 2 report the distribution of developmental levels before and after the intervention; the figures are illustrative and intended to demonstrate the evaluation method rather than to report fieldwork.

The illustrative pattern is characteristic of well-designed formative interventions: the experimental group shows a marked migration from the low to the high level and a substantially larger index gain than the control group. Two mechanisms plausibly account for this. First, organising activity within the zone of

Online ISSN: 2348–3326 DOI: 10.21276/MATRIX.2026.9.1.4

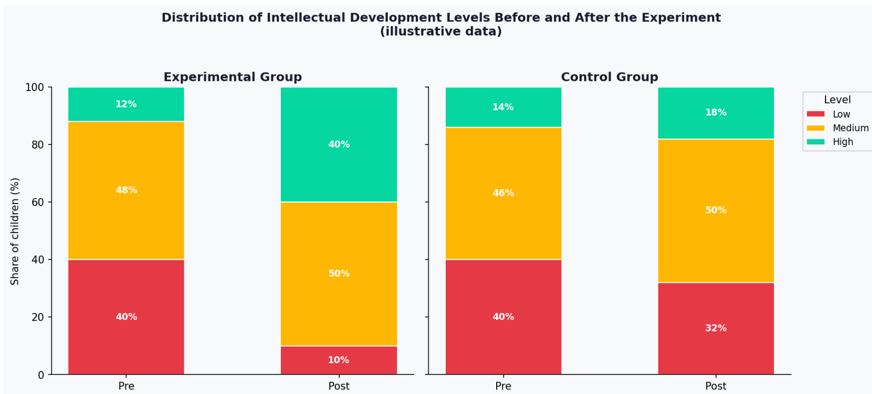

Fig. 2: Distribution of intellectual development levels before and after the intervention (illustrative)

Table 2: Level distribution and mean index, pre- and post-intervention (illustrative)

Group	**Low (%)**	**Medium (%)**	**High (%)**	**Mean IDI**	**ΔIDI**
Experimental – pre	40	48	12	0.46	—
Experimental – post	10	50	40	0.71	+0.25
Control – pre	40	46	14	0.47	—
Control – post	32	50	18	0.53	+0.06

Online ISSN: 2348–3326 DOI: 10.21276/MATRIX.2026.9.1.4

proximal development, and sequencing it from manipulation to modelling to verbalisation, scaffolds the very transitions that define senior-preschool cognition. Second, embedding inventive and problem-based tasks cultivates flexible thinking that generalises across the five components rather than training each in isolation. The measurable index makes these gains visible and supports timely correction; modelling the underlying assessment as an ordered-classification problem, as in related data-analytic work [1, 3], offers a route to more objective and partly automated level assignment in future deployments.

5 Conclusion

This paper presented a pedagogical technology for developing the intellectual abilities of older preschool children, comprising a four-block structural model, an integrated and level-classifiable development index, and a procedural core that unites classical developmental methods with contemporary educational technology. The framework makes intellectual development both systematically teachable and measurable, and an illustrative experiment suggests it can shift substantially more children to higher developmental levels than standard practice. Future work includes large-scale empirical validation across preschool educational organizations, refinement of the index weights from observational data, and careful study of how augmented-reality and AI-assisted assessment can be integrated without displacing the hands-on, play-based activity that remains central to early childhood development.

References

1. Baig, T., Buhari, A., Ather, D., Babu, G.P., Puttaswamy, A., Gupta, A.: Ml based model analysis for regional fruit and crop categorization in central asia. In: 2026 5th International Conference on Innovative Practices in Technology and Management (ICIPTM). pp. 1–6. IEEE (2026)
2. Hussein, T.M., Rakhmatilla, T., Ather, D., Khan, R.L., Sarkar, T., Rakhra, M.: A neutrosophic-ai model for spatiotemporal analysis of land parcel transactions. International Journal of Neutrosophic Science (IJNS) **27**(1) (2026)
3. Kumari, N., Ather, D., Buhari, A., Agarwal, V., Verma, A.: A multi-objective hybridized metaheuristic optimization technique for discriminative feature selection from high-dimensional data. In: 2026 5th International Conference on Innovative Practices in Technology and Management (ICIPTM). pp. 1–8. IEEE (2026)
4. Saxena, U., Singh, G., Chaudhary, N., Ather, D., Kler, R., Dubey, R.: Iot-driven predictive maintenance in industrial systems using deep neural networks. In: 2025 International Conference on Intelligent & Innovative Practices in Engineering & Management (IIPEM). pp. 1–6. IEEE (2025)
5. Trivedi, S., Jain, V., Balusamy, B., Pani, S.K., Ather, D.: Augmented reality and sustainability: Goals and challenges (2025)

Online ISSN: 2348–3326 DOI: 10.21276/MATRIX.2026.9.1.4