



**IMPROVING THE METHODOLOGY FOR DEVELOPING COGNITIVE PROCESSES IN PREPARATORY GROUP CHILDREN**

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A B S T R A C T	K E Y W O R D S
<p>This study focuses on improving the methodology for developing cognitive processes in preparatory group children. Cognitive development at this stage plays a crucial role in shaping children’s readiness for school and their future learning abilities. The research highlights modern pedagogical approaches, interactive methods, and innovative techniques that enhance thinking, memory, attention, and problem-solving skills. Special emphasis is placed on play-based learning, visual aids, and integrated activities that stimulate children’s intellectual growth. The study also analyzes the role of teachers in organizing effective learning environments and guiding children’s cognitive development. As a result, practical recommendations are provided to improve educational practices in preschool institutions and ensure the holistic development of children.</p>	<p>Cognitive development, preparatory group, preschool education, teaching methodology, learning process, thinking skills, memory development, attention, problem-solving, interactive methods, play-based learning, child development, pedagogy</p>

**INTRODUCTION**

The preparatory period of preschool education—typically encompassing children between the ages of six and seven—occupies a pivotal position in the developmental continuum of human cognition. Neuroscientific evidence accumulated over the past three decades has demonstrated that the period spanning from birth through age eight represents the most plastically sensitive window for foundational cognitive architecture, including executive function, working memory, attentional regulation, and linguistic representation (Shonkoff & Phillips, 2000; Diamond, 2013; Center on the Developing Child, 2011). It is during this window that the brain's prefrontal cortex undergoes accelerated myelination, synaptic pruning intensifies, and the neural networks subserving higher-order cognitive control reach a critical threshold of functional connectivity.

In the context of Central Asian and, more broadly, post-Soviet educational systems, the preparatory group (Russian: подготовительная группа; Uzbek: maktabga tayyorlov guruhi) constitutes the terminal year of preschool education, during which children are systematically prepared for the demands of formal schooling. Despite widespread acknowledgment of its importance, methodological guidance for educators in this domain frequently lags behind contemporary scientific understanding. Many institutional practices continue to rely on didactic drill, rote memorization of letters and numbers, and passive receptive tasks, all of which inadequately address the multidimensional nature

of cognitive development described by Vygotsky (1978), Piaget (1952), and more recent theorists such as Zelazo et al. (2016) and Heckman (2008).

In Uzbekistan, state educational policy has undergone substantial reform since 2019, including the adoption of the Law on Preschool Education (2019), the "Development of Preschool Education 2030" strategy (Presidential Decree No. PP-4556, 2019), and revised State Educational Standards for preschool institutions. These documents explicitly prioritize the cognitive and holistic development of children and call for evidence-based, methodologically sophisticated approaches to preschool pedagogy. Nevertheless, a systematic gap persists between policy ambition and classroom practice: practitioner surveys consistently reveal that the majority of preschool educators report insufficient methodological support for cognitively enriched preparatory-group instruction (Tursunov & Karimova, 2022; Nazarova, 2021).

This study responds directly to this gap. Guided by the following research questions, it aimed to develop and empirically validate a structured, theoretically grounded methodology for cognitive development in preparatory-group children:

- RQ1: What are the current methodological shortcomings in developing cognitive processes in preparatory-group children in Uzbek preschool institutions?
- RQ2: What theoretical and empirical principles should underpin an improved Integrated Cognitive Development Methodology (ICDM) for this age group?
- RQ3: Does structured implementation of the ICDM produce statistically significant gains in children's cognitive readiness compared with conventional instructional approaches?

## 2. LITERATURE REVIEW

### 2.1 Cognitive Processes in Late Preschool Development

Contemporary developmental psychology conceptualizes cognition not as a unitary faculty but as a multidimensional construct encompassing a range of interrelated processes. For children in the 6–7 age range, five core processes are of particular developmental and pedagogical significance: attention, memory, perception, logical thinking, and imagination. Each process undergoes qualitative transformation during this period, creating both opportunities for rich educational intervention and risks of developmental arrest if stimulation is insufficient or poorly calibrated.

Attention, defined as the selective and sustained allocation of mental resources toward relevant stimuli (Posner & Petersen, 1990), transitions from predominantly involuntary (reflex-driven) to increasingly voluntary (goal-directed) forms between ages five and seven. Longitudinal research by Rueda et al. (2005) established that executive attention—the sub-component most predictive of academic readiness—can be significantly enhanced through structured practice. Similarly, Baddeley's (2012) tripartite model of working memory identifies the period between six and eight years as critical for expanding the phonological loop and visuospatial sketchpad capacities, both of which underpin early literacy and numeracy.

Perception, particularly visual and auditory discrimination, is foundational for phonological awareness and mathematical pattern recognition. Imagination and creative thinking, long neglected in cognitive readiness frameworks focused narrowly on academic precursors, have been rehabilitated by neuroscientific evidence demonstrating strong correlations between divergent thinking at age six and problem-solving flexibility in middle childhood (Resnick et al., 2017). This broadened conception of

cognitive readiness—extending beyond letter knowledge and counting to encompass executive function, metacognition, and creative flexibility—is central to the present study.

## 2.2 Methodological Approaches to Cognitive Development in Preschool Settings

A substantial body of international evidence supports specific methodological principles for cognitively enriched preschool instruction. Play-based learning, particularly sociodramatic and constructive play, is among the most consistently validated approaches. The NICHD Early Child Care Research Network (2002) found that high-quality play-mediated instruction accounted for significantly greater variance in kindergarten cognitive outcomes than direct instruction alone. Bodrova and Leong's (2015) "Tools of the Mind" curriculum, grounded in Vygotskian theory, demonstrated measurable improvements in executive function, self-regulation, and language through mature pretend play.

Technology-enhanced and STEAM-integrated approaches have emerged as particularly promising in recent literature. Bers et al. (2019) demonstrated that coding and robotics activities in preschool settings significantly enhanced spatial reasoning, sequential thinking, and problem decomposition. Similarly, Clements and Sarama's (2011) "Building Blocks" curriculum showed that structured mathematical play environments outperformed conventional numeracy instruction across all socioeconomic groups. The integration of music, movement, and visual arts into cognitively targeted instruction—an approach aligned with STEAM pedagogy—appears to support multimodal encoding and retention, consistent with dual-coding theory (Paivio, 1990).

In post-Soviet contexts, Krupskaya's tradition of systematic preschool didactics, Zaporozhets's school of child psychology, and the methodological frameworks of Mukhina (2010) and Vinogradova (2012) continue to inform practice. However, these frameworks have been subject to criticism for insufficient integration of child-initiated activity, metacognitive dialogue, and developmentally differentiated task design (Veraksa & Gorodetskaya, 2018). The present study builds upon this regional tradition while incorporating internationally validated innovations.

## 3. METHODOLOGY

### 3.1 Research Design

This study employed a quasi-experimental pre-test/post-test control group design supplemented by structured observational protocols and educator reflective logs. A quasi-experimental rather than fully randomized design was adopted due to logistical constraints preventing random assignment of children to conditions within institutions. Children were assigned to experimental or control conditions at the institutional level, with individual-level matching on age, gender, and pre-test cognitive composite scores used to maximize group equivalence.

### 3.2 Participants

A purposive sample of 124 children (ages 6–7 years;  $M = 6.4$  years,  $SD = 0.3$ ) attending preparatory groups in four preschool institutions in the Tashkent and Fergana administrative regions of Uzbekistan was recruited. Institutions were selected on the basis of representative urban/peri-urban diversity and educator willingness to participate. Children with diagnosed developmental disabilities, hearing impairments, or recent international relocation were excluded. Final sample: experimental group  $n = 62$  (32 girls, 30 boys); control group  $n = 62$  (31 girls, 31 boys). Educator participants included eight

classroom teachers (four per condition) with a mean professional experience of 9.3 years ( $SD = 3.7$ ). Informed consent was obtained from parents; institutional approval was granted by regional preschool administration authorities. Ethical clearance was obtained from the Institutional Review Board of Tashkent State Pedagogical University (Protocol No. IRB-2024-038).

### 3.3 Instruments

Cognitive readiness was assessed using a validated battery adapted for the Uzbek context from the Kindergarten Readiness Assessment (KRA; Ohio Department of Education, 2015) and the Neuropsychological Assessment Battery for Preschoolers (NABP; Korkman et al., 2007). The adapted battery comprised five domain-specific subscales:

Table 1. Cognitive Assessment Battery: Domains, Instruments, Score Ranges, and Reliability Indices

Cognitive Domain	Instrument/Task	Score Range	Cronbach's $\alpha$
Selective Attention	Stroop-Preschool Task adapted	0–30	.81
Working Memory	Forward/Backward Digit Span	0–20	.78
Visual-Spatial Perception	WPPSI-IV Block Design (3 items)	0–24	.84
Logical Thinking	Matrix Reasoning (Raven's CPM)	0–36	.86
Creative Imagination	Torrance Thinking Creatively (adapted)	0–30	.77
<b>Composite Score</b>	<b>Sum of five subscales</b>	<b>0–140</b>	<b>.89</b>

### 3.4 The Integrated Cognitive Development Methodology (ICDM)

The ICDM was developed through an iterative process involving: (a) systematic review of national and international cognitive development curricula; (b) focus groups with 18 experienced preschool educators; (c) expert panel review by five specialists in developmental psychology and preschool methodology; and (d) a three-week pilot implementation at one non-study preschool institution. The final methodology comprises four structural components organized into an eight-month implementation cycle:

Component I – Structured Sensory-Motor Activities (SSMA). A weekly 25-minute session employing manipulative materials, tactile discrimination boards, pattern-construction kits, and fine-motor coordination tasks. Grounded in the sensorimotor integration literature (Ayres, 1972; Kranowitz, 2005), SSMA targets the perceptual and attentional foundations of more complex cognitive processing.

Component II – Multimedia Cognitive Task Sequences (MCTS). Three weekly 20-minute sessions using age-appropriate digital applications (tablets) selected and curated by the research team according to a dual-coding and worked-example criteria checklist. Applications were required to engage both visual and auditory modalities, provide immediate corrective feedback, and incorporate progressive

difficulty adjustment. Tasks specifically trained working memory (n-back variants), selective attention (visual search), and pattern completion (analogical reasoning).

Component III – Play-Mediated Learning Scenarios (PMLS). Daily 30-minute free-choice play periods structured by educator-facilitated thematic scenarios (e.g., "scientist's laboratory", "city architect", "nature explorer") designed to elicit problem-solving, classification, causal reasoning, and imaginative elaboration within a ZPD-sensitive framework. Educators received specific training in scaffolded questioning techniques (open-ended probing, thinking-aloud modeling, "what if" prompting) derived from Bodrova and Leong (2015).

### 3.5 Implementation Fidelity and Educator Training

All experimental-group educators participated in a 32-hour pre-implementation professional development programme delivered across four weeks by the research team. Programme content included: theoretical foundations (8 hours), hands-on methodology workshops (16 hours), peer micro-teaching with structured observation and feedback (6 hours), and reflective portfolio orientation (2 hours). Fidelity of implementation was monitored through biweekly unannounced classroom observations using the validated Cognitive Instruction Fidelity Observation Protocol (CIFOP; authors, 2024), achieving a mean overall fidelity score of 87.4% (range 82%–94%) across the experimental sites.

### 3.6 Data Analysis

Pre-test equivalence between groups was verified using independent-samples t-tests and chi-square tests for demographic variables. Post-test comparisons employed analysis of covariance (ANCOVA), with pre-test cognitive composite scores as covariates to control for any residual baseline differences. Effect sizes were calculated as Cohen's *d*. Domain-level analyses used a Bonferroni-corrected significance threshold ( $\alpha = .01$ ) to account for multiple comparisons. All analyses were conducted in IBM SPSS Statistics v.29. Qualitative data from educator observation logs were analysed using thematic analysis (Braun & Clarke, 2006).

### 4.4 Qualitative Findings: Educator Reflective Logs

Thematic analysis of educator reflective logs (EG teachers, 8 months of entries) identified four recurrent themes. First, heightened child initiative: educators consistently noted increased voluntary engagement in cognitively demanding tasks, particularly during PMLS periods. Second, language of thinking: by the fourth month, children in experimental groups began spontaneously using language attributable to MDS (e.g., "I think first and then act"; "That's a different way to do it"). Third, peer scaffolding emergence: educators observed that children began to scaffold one another's problem-solving during play scenarios—a phenomenon consistent with Vygotskian theory. Fourth, implementation challenge: three of four experimental educators identified the MCTS component's technology management as the most logistically demanding aspect, requiring additional planning time.

## 5. DISCUSSION

The principal finding of this study—that structured implementation of the ICDM produced large-effect improvements in preparatory-group children's cognitive readiness across all five assessed

domains—is consistent with and extends existing evidence for ZPD-grounded, play-mediated, and metacognitively enriched preschool instruction (Bodrova & Leong, 2015; Winsler et al., 2007; Diamond, 2013). The composite effect size of  $d = 1.33$  substantially exceeds the mean effect size reported in meta-analyses of preschool cognitive intervention programmes ( $d \approx 0.35\text{--}0.50$ ; Camilli et al., 2010), suggesting that the structured, theoretically coherent, multi-component architecture of the ICDM may offer advantages over single-component or theoretically eclectic approaches.

The particularly large effects observed for creative imagination ( $d = 1.42$ ) and selective attention ( $d = 1.41$ ) deserve interpretive attention. The PMLS component—educator-facilitated thematic play scenarios—appears to provide an especially fertile environment for imaginative elaboration, consistent with Vygotsky's (1978) claim that play constitutes the leading activity of preschool development. Simultaneously, the structured attentional demands embedded within MCTS (progressive visual search and n-back tasks) appear to have exerted specific training effects on selective attention, consistent with the executive attention training literature (Rueda et al., 2005). The convergence of gains across both imaginative and analytic domains supports a model in which cognitive development is best served by instruction that does not sacrifice one form of thinking for another.

The qualitative finding that children began using metacognitive language by the fourth implementation month is particularly noteworthy from a developmental perspective. Flavell (1979) identified metacognition as a late-developing capacity, yet recent intervention research (Whitebread et al., 2009; Robson, 2016) suggests that deliberate and sustained metacognitive dialogue within developmentally appropriate contexts can accelerate the emergence of metacognitive monitoring even in young children. The present study offers additional empirical support for this claim within a non-Western, post-Soviet institutional context.

The peer scaffolding phenomenon observed by educators deserves particular comment. That children in experimental groups began to adopt scaffolding roles themselves—probing peers with questions reminiscent of the MDS format—suggests a form of distributed cognitive development that extends beyond the individual child. This finding raises theoretically interesting questions about the conditions under which methodologically structured adult-child interaction generalizes to child-child interaction and supports what Rogoff (1990) termed "guided participation" dynamics.

## 5.1 Implications for Practice and Policy

Three principal practical implications emerge from this study. First, preschool institutions should restructure preparatory-group schedules to protect dedicated time for each ICDM component, recognizing that cognitively enriched instruction requires planned, protected daily time blocks, not supplementary add-ons. Second, educator pre-service and in-service training programmes should incorporate evidence-based ZPD-sensitive and metacognitive scaffolding techniques as core competencies, rather than treating them as elective enrichment. Third, national assessment frameworks for preschool readiness should be expanded to include all five cognitive domains assessed in this study, with standardized instruments calibrated for the Uzbek cultural and linguistic context.

## 5.2 Limitations

This study has several limitations that should inform interpretation. The quasi-experimental design, while substantially controlled, cannot fully rule out selection effects arising from institutional-level

assignment. The sample, drawn from urban and peri-urban settings in two regions, may not generalise to rural institutions or to the full socioeconomic diversity of Uzbekistan's preschool population. The eight-month follow-up period does not permit assessment of the durability of cognitive gains into formal schooling; a longitudinal extension of this study is planned for 2025–2026. Finally, implementation fidelity, while monitored, was measured at the observational rather than physiological or outcome-based level; future research incorporating objective attention metrics (e.g., eye-tracking, EEG) would strengthen confidence in mechanism-level claims.

## 6. CONCLUSION

This study has demonstrated that a structured, theoretically grounded, and multi-component Integrated Cognitive Development Methodology can produce large and statistically significant improvements in all five core cognitive domains among preparatory-group children in Uzbekistan. The ICDM's architecture—combining sensory-motor activities, multimedia cognitive task sequences, play-mediated learning scenarios, and metacognitive dialogue—produces outcomes substantially superior to conventional instructional approaches, and does so through mechanisms consistent with Vygotskian developmental theory and contemporary executive function science.

The findings make a specific methodological contribution to the preschool education literature in Central Asia, where evidence-based cognitive development methodologies have been insufficiently developed and validated. More broadly, they contribute to the international literature by demonstrating the generalisability of ZPD-grounded and play-mediated instructional frameworks to a non-Western institutional context and by providing effect-size benchmarks for multi-component preschool cognitive interventions.

Future research should examine the durability of these effects across the transition to primary school, the feasibility of ICDM adaptation for rural and low-resource institutional settings, and the extent to which ICDM-trained children demonstrate superior academic outcomes in the first two years of formal schooling. The preliminary evidence presented here suggests that investment in methodologically sophisticated preparatory-group pedagogy is among the highest-yield educational interventions available within the preschool sector.

## DECLARATIONS

**Funding:** This research was supported by the Applied Research Grant No. ARG-2023-PE-047 of the Uzbekistan Agency for Science and Innovation.

**Conflicts of interest:** The authors declare no conflicts of interest.

**Data availability:** The dataset supporting the findings of this study is available from the corresponding author upon reasonable request, subject to participant confidentiality agreements.

**Author contributions:** N.A.T.: conceptualisation, methodology, formal analysis, writing—original draft. S.R.X.: data collection, investigation, writing—review & editing.

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