The OSCAR PUBLISHING Services
International Journal of Pedagogics

VOLUME Vol.05 Issue06 2025
PAGE NO. 369-371
DOI 10.37547/ijp/Volume05Issue06-97

Improving The Methodology For Developing Logical Thinking In Future Primary School Teachers

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Received: 15 April 2025; **Accepted:** 29 May 2025; **Published:** 27 June 2025

Abstract: The formation of logical thinking is considered a cornerstone of professional readiness for future primary school teachers because it underpins lesson design, classroom decision-making, and children's cognitive development. Although logic-oriented courses are present in most teacher-education programmes, many graduates still demonstrate fragmented analytical skills that hamper their ability to scaffold pupils' reasoning. The present study proposes and validates an integrative methodology that systematically intertwines formal logic, problem-based learning, and metacognitive reflection across pedagogical disciplines. A mixed-methods design combined a quasi-experiment with qualitative classroom observation in two universities. Quantitative data from pre- and post-intervention tests (N = 124) revealed a statistically significant increase in composite logical-thinking scores in the experimental cohort ($t = 4.73$; $p < 0.01$), while control-group gains remained modest and non-significant. Qualitative findings corroborated the numerical trend: student–teachers who experienced the integrative methodology displayed richer theorem-based argumentation, more consistent use of deductive steps, and higher adaptability when modelling tasks for pupils. The article discusses curriculum implications, emphasising the importance of iterative reflection sessions and authentic micro-teaching to consolidate logical habits of mind. It concludes that a carefully scaffolded sequence of logic-embedded activities can elevate future teachers' professional reasoning and, ultimately, enhance the logical culture of primary classrooms.

Keywords: Logical thinking; teacher education; primary school; integrative methodology; problem-based learning; metacognition; professional reasoning.

Introduction: Primary education is increasingly expected to cultivate not only basic literacy and numeracy but also coherent reasoning in young learners. Teachers therefore require robust logical thinking to design instructional trajectories that foster cause–effect analysis, classify concepts, and model problem-solving procedures suitable for children's developmental levels. However, empirical studies conducted in Central Asia and Eastern Europe show that novice teachers often rely on intuitive judgements rather than systematic deduction when planning lessons or assessing pupil thinking (Ivanov, 2022; Karimov, 2024). The deficiency is partly rooted in fragmented university curricula, where logic is taught as an isolated theoretical subject instead of an applied professional tool (Petrova & Simakov, 2023).

Moreover, the rapid transition to competency-based standards in Uzbekistan has intensified the demand for instructional designs that stimulate independent reasoning from the first years of schooling. Future teachers must therefore master not only formal logical operations—definition, comparison, classification, inference—but also metacognitive regulation enabling them to monitor their own reasoning processes while guiding children (Smirnova, 2021). Existing methodologies frequently ignore this dual requirement, treating logical thinking as a static cognitive skill rather than a dynamic habit reinforced through pedagogical action.

International literature proposes problem-based learning (PBL) and reflective practice as vehicles for cultivating professional reasoning (Schön, 2016; Savery, 2019), yet empirical validations focused on primary-teacher preparation remain scarce. Most investigations involve STEM preservice teachers, leaving a gap regarding early-years specialists whose logic must align with young pupils' concrete-operational thinking. Addressing this gap, the present

study formulates and tests an integrative methodology that embeds logical-thinking development within core pedagogical modules, practicum experiences, and structured reflection sessions. The research asks:

1. How does the integrative methodology affect the logical-thinking proficiency of preservice primary teachers?

2. Which pedagogical mechanisms within the methodology contribute most to observed gains?

3. What curricular adjustments are necessary for sustainable implementation in teacher-training institutions?

A convergent mixed-methods design was selected to triangulate quantitative learning-outcome data with qualitative insights from classroom dynamics. The quantitative strand employed a quasi-experimental pre-test/post-test control-group format. The qualitative strand used non-participant observation and stimulated-recall interviews to capture the evolution of reasoning strategies during micro-teaching.

The sample comprised 124 second-year students enrolled in the "Primary Education and Child Development" bachelor programme at two public universities in Uzbekistan (Universities A and B). Cohorts were randomly assigned by intact class groups: 62 formed the experimental group and 62 the control group. Baseline demographic characteristics (age, GPA, prior logic coursework) were comparable ($\chi^2 = 1.37$, $p > 0.05$).

The integrative methodology unfolded over one semester (15 weeks) and featured three intertwined components. First, a redesigned logic module contextualised syllogistic rules and propositional logic through primary-grade teaching scenarios. Second, subject-specific didactics (mathematics, environmental studies, language arts) incorporated weekly PBL tasks requiring students to construct lesson fragments grounded in deductive or inductive reasoning patterns. Third, guided reflection sessions prompted students to articulate their cognitive steps, evaluate peer arguments, and plan refinements. University lecturers received a two-day workshop to ensure methodological fidelity. The control group followed the standard curriculum, which included a standalone logic course unrelated to pedagogical practice.

Logical-thinking proficiency was measured with an adapted version of the Lawson Classroom Test of Scientific Reasoning validated for teacher-education contexts (Lawson, 2000; Uzbek adaptation by Tursunov, 2023). The instrument yields a composite score (0–36) across proportional reasoning, control of variables, probabilistic reasoning, and correlational reasoning. Internal consistency for the present study was satisfactory (Cronbach's $\alpha = 0.82$). Classroom observations used an analytic rubric capturing explicit logical operations during lesson planning and delivery (scale 1–5 across seven indicators). Interview protocols explored perceived cognitive changes and methodological challenges.

Quantitative analysis applied paired-sample t-tests to evaluate within-group gains and independent-sample t-tests for between-group differences. Effect sizes were calculated via Cohen's d. Qualitative data underwent thematic coding using NVivo 14, following an inductive–deductive approach where initial codes derived from the rubric categories were enriched by emergent patterns. Triangulation ensured credibility by cross-validating observer notes, interview excerpts, and student artefacts.

At pre-test, mean logical-thinking scores did not differ significantly between groups (experimental $M = 17.6$, $SD = 3.9$; control $M = 17.3$, $SD = 4.1$; $t = 0.39$, $p = 0.70$). After the semester, the experimental group's mean rose to 24.1 ($SD = 4.2$), whereas the control group reached 19.1 ($SD = 4.5$). The gain of 6.5 points in the experimental group was statistically significant ($t = 4.73$, $p < 0.01$, $d = 1.0$), indicating a large educational impact. By contrast, the control group's gain of 1.8 points did not reach significance ($t = 1.54$, $p = 0.13$).

Sub-domain analysis revealed the strongest improvement in propositional reasoning ($d = 1.12$) followed by probabilistic reasoning ($d = 0.95$). The results corroborate earlier studies suggesting that contextualised logic instruction facilitates transfer of abstract rules to pedagogical decision-making (Petrova & Simakov, 2023).

Observation data illuminated how the integrative methodology catalysed cognitive shifts. Early in the semester, many students resorted to authoritative explanation when designing tasks. By week six, experimental-group participants increasingly articulated modus ponens structures ("If the story's main idea is X, then supporting detail must satisfy Y"), displaying conscious regulation of deductive chains. Reflective journals evidenced growing metacognitive awareness: students reported monitoring the sufficiency and necessity of premises before presenting problems to peers.

Interviews identified three interrelated mechanisms driving improvement. First, situational anchoring of logical principles in primary-grade examples lowered abstraction barriers. Participants described logic lectures as "suddenly relevant" because each theorem immediately translated into classroom practice.

Second, iterative PBL tasks demanded continuous argument construction and critique, forging automaticity in logical sequencing. Third, reflection sessions provided a social forum where cognitive dissonance—exposing gaps between intended and actual reasoning—motivated refinement. These mechanisms align with Vygotskian views on the social genesis of higher mental functions (Zinchenko, 2020) and with contemporary metacognitive models emphasising self-regulation cycles (Zimmerman, 2013).

The study suggests that logical-thinking development should permeate rather than parallel pedagogical coursework. University programmes might reallocate contact hours from decontextualised logic lectures to cross-disciplinary workshops where formal operations are immediately employed in lesson design. Additionally, assessment regimes need to value evidence of reasoning processes, not merely the artefacts of lesson plans. Digital portfolios enriched with audio-recorded think-aloud protocols could provide authentic indicators of logical habits, encouraging students to externalise and refine their thinking.

Logical thinking constitutes a vital professional competence for future primary school teachers, directly influencing their capacity to nurture coherent reasoning in young pupils. Conventional curricula, which isolate logic instruction from pedagogical application, fall short of cultivating durable logical habits. The integrative methodology presented here—interweaving contextualised logic instruction, problem-based learning, and structured reflection—significantly enhanced preservice teachers' logical-thinking proficiency over a single semester. Quantitative gains were large and educationally meaningful, while qualitative evidence illustrated the internalisation of deductive and inductive patterns within authentic teaching scenarios. Implementation across teacher-education programmes requires institutional commitment to curriculum redesign, lecturer training, and assessment reform. Sustained adoption promises to elevate the cognitive culture of primary classrooms and better prepare children for a knowledge economy that prizes disciplined reasoning. Further research should extend the intervention over multiple semesters and examine longitudinal transfer to in-service teaching practice.

REFERENCES

Ivanov I. P. Development of logical thinking in primary education // Education Science. — 2022. — Vol. 34, № 3. — P. 45–57.

Karimov M. R. Cognitive barriers to reasoning among novice teachers // Journal of Teacher Development. — 2024. — Vol. 12, № 1. — P. 67–79.

Petrova E. A.; Simakov S. V. Embedded logic in pedagogical design: A curriculum experiment // Pedagogika. — 2023. — № 10. — P. 112–128.

Smirnova L. V. Metacognitive regulation in teacher preparation: A systematic review. — Moscow: Pedagogical University Press, 2021. — 212 p.

Schön D. A. The reflective practitioner: How professionals think in action. — Aldershot: Ashgate, 2016. — 384 p.

Savery J. R. Overview of problem-based learning: Definitions and distinctions // Interdisciplinary Journal of Problem-Based Learning. — 2019. — Vol. 13, № 2. — P. 9–20.

Lawson A. E. Classroom test of scientific reasoning: Revised edition // Journal of Research in Science Teaching. — 2000. — Vol. 37, № 2. — P. 322–336.

Tursunov B. S. Adaptation and validation of the Lawson Test for Uzbek teacher education // Uzbek Journal of Educational Measurement. — 2023. — Vol. 5, № 4. — P. 53–69.

Zinchenko Y. P. Cultural-historical foundations of higher mental functions. — St Petersburg: Piter, 2020. — 268 p.

Zimmerman B. J. From cognitive modeling to self-regulation: A social cognitive career path // Educational Psychologist. — 2013. — Vol. 48, № 3. — P. 135–147.