

DEVELOPING PRIMARY SCHOOL STUDENTS' COGNITIVE ACTIVITY THROUGH INTELLIGENT TECHNOLOGIES: A METHODOLOGY BASED ON THE "EDUCATION" SUBJECT**Tursunova Marjona Rasul qizi***Email: Tursunova.marjona2000@gmail.com*

Abstract: *The article examines a methodology for developing cognitive activity among primary school students through the purposeful use of intelligent technologies in the teaching of the "Education" subject. The study focuses on the pedagogical conditions under which adaptive digital tasks, interactive question systems, feedback tools, and AI-supported learning resources can stimulate attention, curiosity, independent reasoning, problem solving, and reflection. The proposed methodology combines diagnosis, differentiated task selection, guided interaction, immediate feedback, and reflective consolidation. A set of indicators and a four-level assessment scale are developed for classroom monitoring. The article also presents an illustrative statistical model and simulated pre-test/post-test data solely to demonstrate how the methodology can be evaluated; these values are not reported as empirical results from a completed field experiment. The approach places teacher mediation, child safety, ethical use, and age appropriateness at the centre of technology integration. The findings suggest that intelligent technologies should be treated not as substitutes for the teacher but as instruments for creating richer cognitive situations and more individualized learning trajectories.*

Keywords: *primary education; cognitive activity; intelligent technologies; artificial intelligence; Education subject; adaptive learning; formative assessment; digital pedagogy.*

Аннотация: *В статье рассматривается методика развития познавательной активности учащихся начальных классов посредством целенаправленного применения интеллектуальных технологий при изучении предмета «Воспитание». Предлагается методический цикл, включающий диагностику, адаптивный подбор заданий, интерактивное взаимодействие, оперативную обратную связь и рефлексию. Определены показатели познавательной активности и четырехуровневая шкала ее оценки. Приведенные статистические данные имеют иллюстративный характер и предназначены для демонстрации процедуры оценки методики, а не для представления результатов реально проведенного эксперимента. Особое внимание уделено возрастной адекватности, роли учителя, безопасности и этике использования искусственного интеллекта.*

Ключевые слова: *начальное образование; познавательная активность; интеллектуальные технологии; искусственный интеллект; воспитание; адаптивное обучение; цифровая педагогика.*

Annotatsiya: *Maqolada boshlang'ich sinf o'quvchilarining «Tarbiya» fanini o'zlashtirish jarayonida intellektual texnologiyalardan maqsadli foydalanish orqali bilish faolligini rivojlantirish metodikasi yoritiladi. Metodika diagnostika, moslashtirilgan topshiriq, interaktiv*

muloqot, tezkor teskari aloqa va refleksiya iborat izchil siklga asoslanadi. Bilish faolligini baholash uchun mezonlar va to'rt darajali shkala ishlab chiqiladi. Keltirilgan statistik ko'rsatkichlar real tajriba natijasi emas, balki baholash mexanizmini namoyish etuvchi shartli-simulyatsion ma'lumotlardir. Metodikada o'qituvchining vositachilik roli, bolaning xavfsizligi, yoshga moslik va sun'iy intellektdan mas'uliyatli foydalanish tamoyillari ustuvor hisoblanadi.

Kalit so'zlar: *boshlang'ich ta'lim; bilish faolligi; intellektual texnologiyalar; sun'iy intellekt; tarbiya; adaptiv ta'lim; raqamli pedagogika.*

INTRODUCTION

The digital transformation of education is changing not only the tools used in classrooms but also the structure of learning activity. In primary school, this change is especially important because children are still developing attention, self-regulation, curiosity, language-mediated reasoning, and the ability to reflect on their own actions. Consequently, the educational value of intelligent technologies depends less on the mere presence of a digital device and more on the pedagogical design of the learning situation.

The relevance of the problem is reinforced by the growing attention of international organizations to responsible artificial intelligence and digital education. UNESCO's AI competency framework for teachers identifies human-centred thinking, AI ethics, AI foundations and applications, AI pedagogy, and professional learning as key dimensions of teacher competence [1]. The corresponding student framework emphasizes human-centred thinking, ethics, AI techniques and applications, and AI system design, with progression from understanding to application and creation [2]. OECD similarly argues that digital transformation should go beyond digitizing existing practices and should be accompanied by safeguards for effective and equitable use [3]. For children, UNICEF highlights safety, privacy, fairness, transparency, inclusion and developmental well-being as essential principles of child-centred AI [4].

Within this context, the "Education" subject provides a particularly suitable environment for cognitive-activity development because many of its topics require students to explain motives, distinguish appropriate and inappropriate behaviour, solve everyday moral situations, compare alternatives, and justify personal decisions. Intelligent technologies can enrich such activities when they are embedded in a teacher-guided methodology rather than used as autonomous substitutes for instruction.

The object of the research is the process of developing primary school students' cognitive activity in the "Education" subject. The subject is the pedagogical conditions, methods and tools for using intelligent technologies to stimulate cognitive engagement. The aim is to develop a practical methodology that integrates intelligent technologies with age-appropriate pedagogical strategies. The objectives are to: (1) clarify the structure of cognitive activity in primary education; (2) identify pedagogically meaningful functions of intelligent technologies; (3) develop a methodological cycle for lessons; (4) propose indicators and an assessment scale; and (5) demonstrate a statistical evaluation procedure.

LITERATURE REVIEW

The literature and policy discussion on AI in education increasingly moves from a technology-centred view toward a human-centred pedagogical model. UNESCO's teacher framework describes AI pedagogy as a distinct competency area and stresses the importance of critical assessment, student-centred learning and pedagogical innovation [1]. The student framework similarly positions learners as responsible users and co-creators rather than passive recipients of AI-generated content [2].

OECD's analysis distinguishes digital transition from digital transformation. The former may simply transfer existing practices to digital platforms, while the latter changes learning processes and the wider educational ecosystem [3]. This distinction is important for primary education: an interactive quiz is not automatically pedagogically innovative if it only replaces a paper worksheet. Its value increases when it provides meaningful choice, timely feedback, differentiated difficulty or opportunities for explanation.

UNICEF's child-centred approach adds an important developmental dimension. Intelligent systems used with children should protect privacy, reduce discrimination, support inclusion and promote children's best interests [4]. These principles are particularly relevant in primary school because younger learners may not fully understand how digital systems collect, process or reproduce information.

The methodological gap addressed in this article concerns the connection between intelligent technology and the specific cognitive mechanisms of the "Education" subject. Rather than treating AI as a separate topic, the proposed model uses it as a pedagogical mediator for problem situations, dialogue, adaptive practice, feedback and reflection.

RESEARCH METHODOLOGY

The study uses a methodological design combining pedagogical modelling, comparative analysis, criterion-based assessment and descriptive statistics. The proposed model is organized as a five-stage cycle: diagnosis → personalization → interactive cognitive task → feedback → reflection. The central methodological assumption is that technology should increase the quality of the cognitive task, not reduce the learner's responsibility for thinking.

For classroom monitoring, five indicators are proposed: sustained attention (A), curiosity and questioning (C), independent reasoning (I), problem-solving (P), and reflection (R). Each indicator is scored from 1 to 4. The integrated Cognitive Activity Index (CAI) can be calculated as: $CAI = (A + C + I + P + R) / 5$. The resulting score can be interpreted as: 1.00–1.75 low; 1.76–2.50 emerging; 2.51–3.25 sufficient; 3.26–4.00 high.

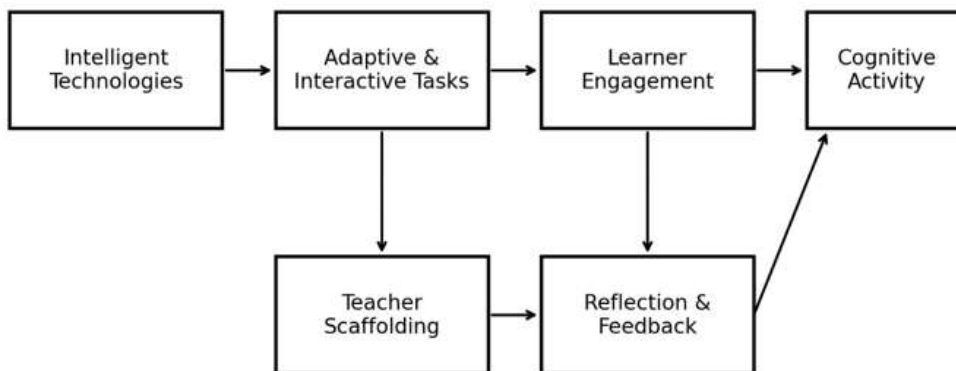
The article does not claim that the numerical examples below were obtained from a real classroom experiment. They are illustrative simulated values constructed to show how the proposed indicators and statistical procedures may be used after real data are collected. In an empirical version of the article, these values must be replaced by observations from the author's sample.

Table 1. Proposed indicators of primary students' cognitive activity

Indicator	Operational description	Possible evidence	Score
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Attention	Maintains focus on the cognitive task and follows instructions	Time-on-task; completion continuity	1–4
Curiosity	Asks questions, explores alternatives and seeks explanations	Number/quality of questions	1–4
Independence	Attempts to solve a task before requesting direct assistance	Independent attempts; strategy choice	1–4
Problem-solving	Identifies a situation, considers options and justifies a response	Solution reasoning quality;	1–4
Reflection	Explains what was learned and how a decision was reached	Exit reflection; self-explanation	1–4

The methodology distinguishes four technology functions: adaptive task selection, interactive dialogue, formative feedback, and learning-resource generation. The teacher remains responsible for selecting age-appropriate content, checking generated material, and ensuring that the technology supports rather than replaces student reasoning.



Methodological cycle: diagnose → personalize → interact → reflect → adjust

Figure 1. Conceptual model of cognitive-activity development through intelligent technologies.

ANALYSIS AND RESULTS

The proposed methodology is implemented through a lesson sequence in which each technological element has a clearly defined cognitive purpose. At the beginning of a lesson, a short diagnostic question or visual situation identifies the learner's initial understanding. The intelligent component can then provide differentiated prompts, while the teacher decides which prompt is educationally appropriate. During the main activity, students work with moral or social situations relevant to the "Education" curriculum. Instead of asking the system to provide a ready answer, students are encouraged to compare alternatives, explain consequences and formulate their own conclusion.

A practical example is the topic "Respect and responsibility". Students can be shown a short scenario involving a classroom conflict. An intelligent learning tool may present two or

three alternative responses at different levels of complexity. The student chooses an option and is then asked to explain why it is appropriate. The teacher uses the explanation—not merely the selected option—to assess cognitive activity.

Table 2 presents a sample lesson architecture.

Stage	Teacher action	Student cognitive action	Technology role
1. Diagnosis	Presents a short problem situation	Recalls, predicts, asks questions	Adaptive diagnostic item
2. Personalization	Selects an appropriate difficulty level	Chooses a pathway and strategy	Adaptive task recommendation
3. Cognitive task	Facilitates discussion and comparison	Explains, compares, justifies	Interactive prompts/simulation
4. Feedback	Checks reasoning and corrects misconceptions	Revises an answer	Immediate formative feedback
5. Reflection	Asks students to explain learning	Self-evaluates and summarizes	Reflection prompt

For quantitative evaluation, the teacher may calculate the mean score for each indicator before and after a defined instructional period. If real paired observations are available, a paired-samples t-test can be used when its assumptions are satisfied; otherwise, a non-parametric alternative such as the Wilcoxon signed-rank test can be considered. Effect size should also be reported because statistical significance alone does not describe the practical magnitude of change.

Indicator	Baseline mean*	Post-intervention mean*	Illustrative change
Attention	2.7	3.5	+0.8
Curiosity	2.8	3.6	+0.8
Independence	2.5	3.3	+0.8
Problem-solving	2.6	3.4	+0.8
Reflection	2.4	3.2	+0.8
CAI	2.6	3.4	+0.80

*Illustrative simulated values only; they are not empirical results from the author's completed experiment.

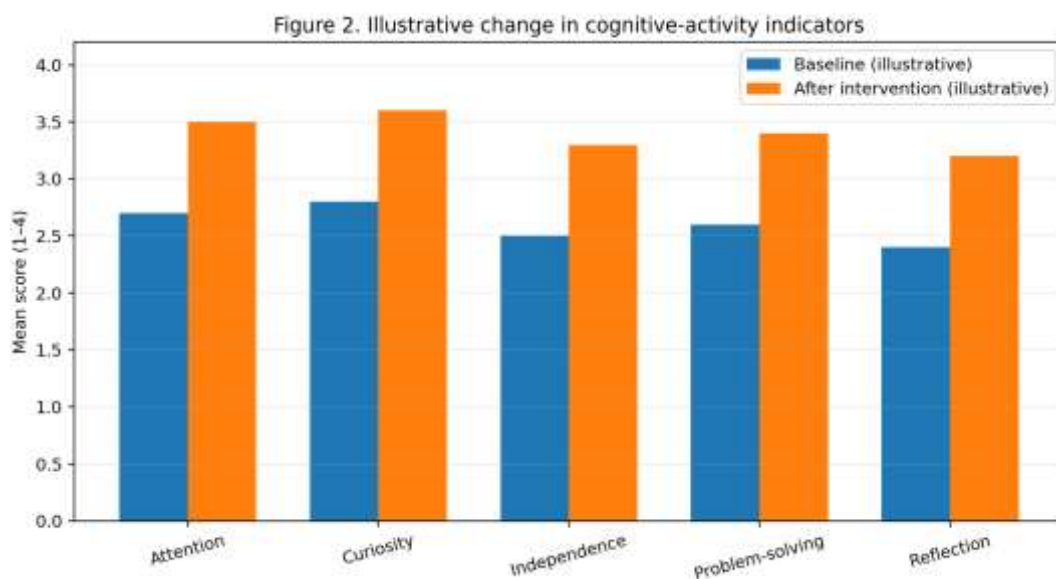


Figure 2. Illustrative pre-test/post-test pattern for the proposed indicators (simulated data, not field results).

The illustrative pattern shows how a teacher could visualize changes in cognitive activity. The largest methodological value of such a chart is not the numerical size itself but the possibility of identifying which dimensions require additional pedagogical support. For example, if independence remains lower than attention, the teacher may reduce the amount of direct prompting and introduce more open-ended tasks.

A second useful indicator is the distribution of students across cognitive-activity levels. Table 3 and Figure 3 show a simulated example of how the distribution might be reported.

Cognitive-activity level	Baseline (%)*	After intervention (%)*
Low	32	12
Medium	48	43
High	20	45

*Illustrative simulated distribution for demonstrating the reporting format; not an observed sample.

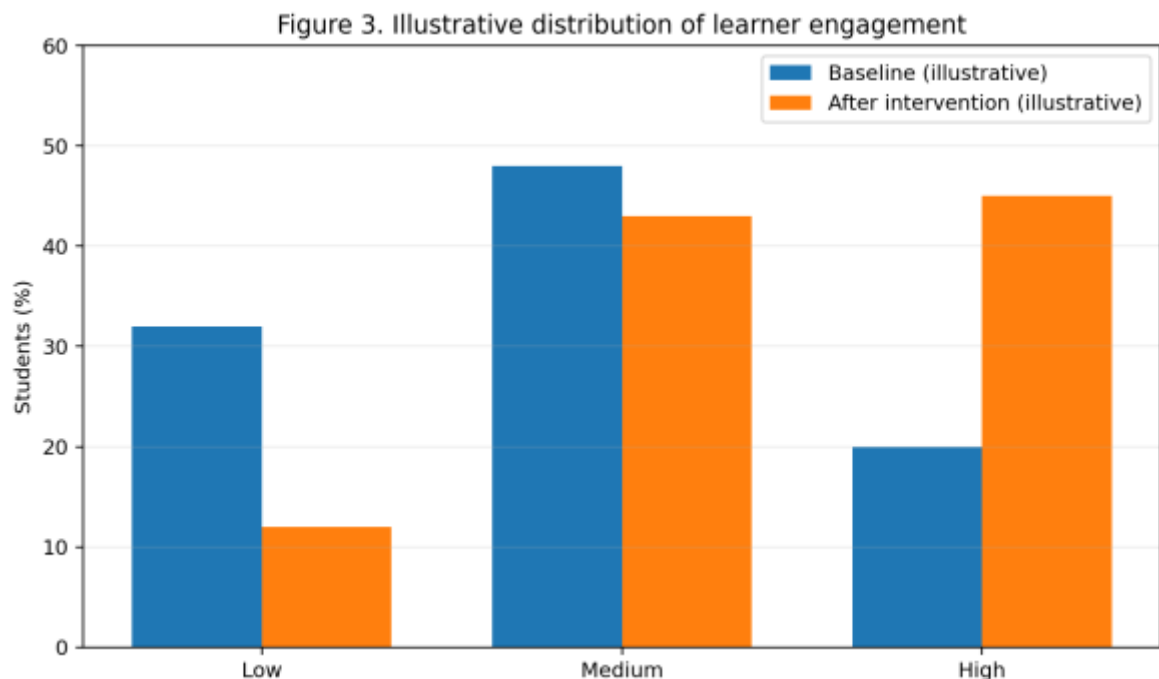


Figure 3. Illustrative distribution of cognitive-activity levels before and after the methodology (simulated data).

Table 4. Recommended intelligent-technology tools and their pedagogical functions

Technology category	Primary function	Cognitive activity supported	Teacher control
Adaptive quiz system	Adjusts difficulty and task sequence	Attention, independence	High
AI-supported dialogue/prompting	Generates guiding questions	Curiosity, reasoning	High
Interactive scenario/simulation	Represents social and moral situations	Problem-solving, decision-making	High

Automated formative feedback	Provides immediate response cues	Self-correction, reflection	Medium–high
Multimedia generation tools	Creates age-appropriate visual prompts	Attention, imagination, explanation	High

The methodology also requires explicit safeguards. Students should not be encouraged to enter personal, family or identifying information into open AI systems. Generated explanations must be checked by the teacher, particularly when the topic involves values, social behaviour or sensitive situations. The system should not be treated as an unquestionable authority. Instead, students should be taught to ask: What is the evidence? Does the explanation make sense? Can another answer also be justified? This approach connects AI use with critical thinking rather than passive acceptance.

DISCUSSION

The proposed methodology has three pedagogical advantages. First, it supports differentiation: students can receive tasks with different levels of complexity while remaining within the same lesson objective. Second, it increases the speed of formative feedback, allowing misconceptions to be addressed before they become stable learning difficulties. Third, it creates additional opportunities for dialogue and reflection, which are central to the “Education” subject.

At the same time, technology does not automatically increase cognitive activity. Excessive automation may reduce productive struggle, encourage guessing, or shift attention from reasoning to obtaining a quick answer. Therefore, the methodological principle should be formulated as “technology for thinking, not technology instead of thinking.” This is consistent with UNESCO’s human-centred approach and with OECD’s emphasis on effective, equitable and safeguarded digital transformation [1–3].

The main limitation of the present article is methodological: without a verified field dataset, numerical results cannot be interpreted as evidence of effectiveness. The simulated tables and figures are therefore included as a transparent model of how an empirical study can be reported. A future study should include a clearly defined sample, intervention duration, control/comparison group where appropriate, pre-test/post-test instruments, inter-rater procedures, and statistical significance and effect-size estimates.

CONCLUSION AND RECOMMENDATIONS

The development of cognitive activity in primary school requires more than the introduction of digital devices. Intelligent technologies become pedagogically meaningful when they are integrated into a structured cycle of diagnosis, personalization, cognitive challenge, feedback and reflection. For the “Education” subject, this approach is particularly useful because many learning outcomes involve reasoning about situations, values, choices and consequences.

The proposed methodology recommends: (1) defining a cognitive objective before selecting a technology; (2) using adaptive tools to differentiate tasks rather than to provide ready-made answers; (3) requiring students to explain and justify their choices; (4) combining

automated feedback with teacher judgement; (5) using the five-indicator Cognitive Activity Index for classroom monitoring; (6) teaching children to question and verify AI-generated content; and (7) applying child-centred principles of safety, privacy, fairness and inclusion.

In practical terms, intelligent technology should function as a methodological amplifier of the teacher's work. Its contribution is greatest when it creates more opportunities for children to observe, ask, compare, reason, solve and reflect. The next stage of research should test the proposed model on a real primary-school sample and replace the illustrative statistics in this article with verified empirical data.

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