INNOVATIVE STEAMS PRACTICES IN EARLY CHILDHOOD EDUCATION: DEVELOPING LOGICAL THINKING AND SOCIAL INTERACTIONS

Gauhar Djanpeisova
Head of the Department of Preschool Education, Branch of
Herzen State Pedagogical University, Tashkent, PhD, Professor

Keywords: STEAMS practices; preschool education; logical thinking; social interaction; innovative technology; integration; early childhood pedagogy.

Abstract: This article investigates innovative STEAMS (Science–Technology–Engineering–Arts–Mathematics–Social) practices designed to foster logical thinking and social interaction in preschool children. Emphasis is placed on the integrated nature of STEAMS–blending science, technology, engineering, the arts, mathematics and social–communicative experience–in shaping core competencies. The study elaborates on pedagogical conditions and methods that underpin the effective implementation of a STEAMS–based approach in early childhood settings.

Introduction. In contemporary educational discourses, the principle of variability is closely aligned with the ideals of democratization, humanization and individualization of preschool education. The operationalization of this principle entails creating learning environments in which each child has the opportunity to unlock his or her cognitive and personal potential via a variety of educational programmes, methodologies and pedagogical technologies.

In this context, the adoption of STEAMS practices–which unite the disciplines of science, technology, engineering, arts, mathematics and socio – communicative development—gains particular importance. Such an integrative approach not only cultivates logical–mathematical thinking in preschool children but also nurtures skills of collaboration, dialogue and collective problem – solving. Through the integration of both traditional and innovative technologies within a variable educational space, optimal conditions are formed for children to develop analysis, classification, comparison and generalization skills, as well as capacity for social interaction.

Particular attention is granted to the transition from the STEAM approach (Science, Technology, Engineering, Arts, Mathematics) to STEAMS–where the "S" explicitly denotes social–communicative competence. Examples of such practices include the establishment of STEAMS–laboratories in preschool institutions; use of interactive digital resources and educational applications; and design of games and tasks that support the grasping of elementary scientific concepts (cf. Linder & Eckhoff, 2020; Edutopia, 2025).

Case Study: Methodological Design of the STEAMS Project "World of Shapes"

This section details a methodological development of a STEAMS project implemented with children aged 5–6 in preschool educational organisations in Tashkent.

1. **Project Objective:**

To form elementary mathematical representations and develop logical–spatial thinking through hands–on modelling of geometric shapes among preschoolers.

2. Project Tasks:

- To acquaint children with basic geometric forms (circle, square, triangle, rectangle, oval);
- To teach classification of shapes by colour, size and form;
- To foster the ability to compose complete images from individual geometric elements;

- To develop cooperative working skills (role distribution, joint problem–solving);
- To cultivate aesthetic taste and imagination via artistic–creative activity.

3. Directions of Project Implementation (STEAMS Components):

Science: Exploring the World through Observation and Experimentation

At the foundation of the Science component lies children's innate curiosity – their drive to explore, observe, and understand the physical world. The aim is to develop early scientific reasoning, grounded in sensory exploration, classification, and hypothesis formation. According to the constructivist model (Piaget, 1970; Bruner, 1986), knowledge is actively constructed by the child through interaction with real objects.

Activity example: "Shapes Around Us"

In this observational game, the educator presents familiar objects – a plate, a book, a ball, a window — encouraging children to identify their geometric analogs (circle, square, rectangle, oval). This simple yet powerful exercise builds cognitive bridges between abstract geometric concepts and concrete sensory experience.

Follow–up questions ("What shape are the clock's hands?" "Which object looks like a rectangle?") help to develop analytical perception, spatial awareness, and language precision.

Expected outcomes: formation of early logical–mathematical reasoning, expansion of active vocabulary, improved visual discrimination, and the ability to generalize attributes.

Experimental task: "The Magic Mirror of Symmetry"

Each child receives half an image (e.g., half of a butterfly or leaf) and uses a mirror to complete it. Through this playful experiment, children discover the concept of symmetry, learn to anticipate missing parts, and comprehend balance and proportion.

Cognitive outcomes: development of visual analysis, concentration, and reflective thinking; stimulation of curiosity toward experimental discovery – an essential aspect of scientific inquiry.

Technology: Digital Tools for Cognitive and Creative Engagement

The Technology dimension of STEAMS introduces children to interactive, digital learning environments that foster exploration, design thinking, and data representation skills. In alignment with UNESCO's "ICT Competency Framework for Teachers" (2022), early technological literacy should enhance – not replace –sensory experience and social interaction.

Example: "GeoBoard: The World of Geometry"

Children use tablet–based applications (e.g., GeoBoard, Shape Builder) to create and manipulate geometric figures. The teacher scaffolds the process by posing open – ended questions ("How can we make this figure larger?" "What happens if we rotate it?"). This strengthens analytical and synthetic thinking, spatial reasoning, and algorithmic sequencing.

Outcomes: development of visual–spatial coordination, problem–solving strategies, and technological fluency – key elements of digital competence in early childhood.

Workshop: "Mathematics on Screen"

Using educational platforms such as Montessori Numbers or Khan Kids, children complete gamified tasks: counting, ordering, classifying objects, or matching numerals. Through feedback and self – correction, they experience the logic of computational systems.

Expected results: consolidation of number sense, improvement of sustained attention, persistence, and intrinsic motivation for learning mathematics through technology–mediated play.

Engineering: Building and Designing to Learn

The Engineering element encourages children to apply problem–solving, experimentation, and design principles in tangible contexts. It transforms abstract reasoning into hands – on construction, testing, and reflection, forming the basis of engineering thinking (Yakman & Lee, 2012).

Project: "City of the Future"

Children collaborate to design and construct a model city using LEGO or wooden blocks, including streets, houses, bridges, and parks. The educator sets parameters ("The city must have a school, a park, and a bridge") and facilitates discussions on stability, symmetry, and proportion. Learning value: children internalize principles of spatial organization, measurement, and interdependence of structural elements.

Outcomes: growth of spatial imagination, creative flexibility, group planning, and architectural awareness.

Project: "Bridge Across the River"

Children use various materials to construct a bridge over a "river" (blue paper). Through guided inquiry – "Why does the bridge stay upright?" "How can we make it stronger?" – they test hypotheses and observe cause – effect relations.

Cognitive outcomes: comprehension of stability, weight distribution, and balance; emergence of early engineering logic; confidence in tackling real – world problems.

Arts: Creativity, Expression, and Aesthetic Thinking

The Arts component of STEAMS transcends decorative activity; it acts as a cognitive and emotional bridge between imagination and logic. According to Vygotsky's theory of imagination (1930), artistic creation stimulates symbolic thinking and conceptual understanding.

Activity: "Houses on Our Street"

Using pre–cut shapes (triangles, squares, rectangles), children create compositions of houses and assemble a collective "street." The educator guides them to notice proportion, symmetry, and composition balance.

Learning outcomes: development of artistic vision, understanding of geometric structure in artistic contexts, and cultivation of aesthetic taste. This activity enhances fine motor coordination, spatial composition, and emotional expressiveness, forming the foundation for visual literacy.

Creative task: "Geometric Ornament"

Children design symmetrical patterns using coloured geometric shapes, then discuss: "What makes this pattern beautiful?"

Outcomes: conceptual understanding of symmetry and rhythm, appreciation for harmony and order, and increased attention to detail. Through art, children internalize mathematical patterns emotionally – learning that beauty and logic coexist in creative problem–solving.

Mathematics: Logical Patterns and Quantitative Reasoning

The mathematics strand provides the cognitive structure underpinning all STEAMS domains. It develops logical operations (comparison, seriation, classification) and quantitative reasoning in the context of play.

Game: "Count and Place"

Children receive numbered cards and collect the corresponding number of shapes. The collective verification process supports peer learning and numerical dialogue.

Outcomes: strengthened understanding of one–to–one correspondence, quantity conservation, and mental arithmetic.

Game: "Find the Pair"

Children identify and group shapes by shared attributes – colour, size, or form – thereby internalizing early classification systems. Developmental results: formation of set theory foundations, visual memory, and cognitive flexibility – essential for logical operations.

Game: "What's Missing?"

By reconstructing patterns (e.g., square–circle–square–circle), children infer missing elements and create new sequences.

1377

Cognitive outcome: ability to predict, infer, and generalize – hallmarks of mathematical reasoning. These playful structures lay groundwork for algebraic thinking and pattern recognition at later stages (Davydov, 2000).

Social (Social Competence): Collaboration and Communication

The Social dimension transforms individual learning into collective intellectual and emotional experience. It develops empathy, negotiation skills, and a sense of shared responsibility – aligning with the OECD "Learning Compass 2030" framework, which defines collaboration as a core future competence.

Project Game: "Building Together"

Children work in groups to design a "school of the future" or a "dream park." They negotiate, assign roles (designer, builder, decorator), and co–create.

Learning process: children practice leadership rotation, emotional regulation, and collective goal setting.

Outcomes: ability to argue constructively, respect peers' perspectives, and experience cooperative success.

Collaborative Art Project: "Geometric Picture"

Groups use geometric shapes to create a collective collage ("Our City," "The Seasons"), then present and explain their work. Educational outcomes: development of group planning, task division, self – expression through teamwork, and public presentation skills.

Socially integrated activities reinforce dialogical communication, enhance emotional intelligence, and prepare children for collaborative learning environments in primary school.

Integrated Outcomes of STEAMS Pedagogy

Through these interdisciplinary practices, children:

- acquire logical and creative thinking abilities;
- internalize scientific and engineering reasoning;
- develop digital and technological fluency;
- experience aesthetic and emotional growth;
- and master communication and teamwork.

STEAMS thus becomes a holistic pedagogical system, harmonizing cognitive, emotional, and social development, and preparing preschoolers for the intellectual demands of the 21st century.

Discussion and Conclusion

Thus, the variability of the educational process in Uzbekistan's preschool institutions constitutes a complex phenomenon, encompassing content, organisational, methodological and assessment components – whose interrelation ensures high – quality development of children and the formation of logical thinking. Practice evidences that the use of diverse programmes and technologies – from traditional didactic methods to cutting – edge digital solutions and the STEAMS approach–supports the formation of basic intellectual competences in preschoolers. In particular, the integration of a learner – centred, competence–based and activity –oriented approach with innovative learning formats ensures the development not only of logical but also of critical and creative thinking.

We may conclude that the variability of the educational process in early childhood education organisations in Uzbekistan is not a marginal element but rather a system – forming factor, ensuring the sustainable development of the preschool education system. Its successful implementation serves as a foundation for preparing children for school, embedding in them skills of autonomous thinking, adaptability and readiness for learning in a rapidly changing world.

References:

1. Постановление Президента Республики Узбекистан от 08.05.2019 г. № ПП–4312 «Об утверждении Концепции развития системы дошкольного образования Республики Узбекистан до 2030 года» [Электронный ресурс]. – Режим доступа: https://lex.uz/ru/docs/4327240 (дата обращения: 22.10.2025).

2. Амонашвили, Ш. А. Личностно–гуманная педагогика. – М.: Амрита–Русь, 2018. – 288 с.

3. Асмолов, А. Г. Психология личности: культурно–историческое понимание развития человека. – М.: Смысл, 2001. – 416 с.

4. Виготский, Л. С. Мышление и речь. – М.: Лабиринт, 2000. – 352 с.

5. Давыдов, В. В. Теория развивающего обучения. – М.: Институт развития школьного образования, 2000. – 544 с.

6. Джанпеисова, Г. Э. Формирование и развитие математического мышления как фактор эффективной подготовки детей к обучению в школе // Pedagogika. – 2017. – № 2. – С. 84–90.

7. Джанпеисова, Г. Э. Стратегии и перспективы развития дошкольного образования в Узбекистане // Молодой ученый. – 2017. – № 51 (185). – С. 272–274.

8. Зимняя, И. А. Ключевые компетенции — новая парадигма результата образования. – М.: Исследовательский центр проблем качества подготовки специалистов, 2004. – 40 с.

9. Подласый, И. П. Педагогика: Новый курс: учебник для вузов. – М.: Владос, 2019. – 576 с.

10. Хуторской, А. В. Ключевые компетенции и образовательные стандарты. – М.: Академия, 2003. — 96 с.

11. Callahan, A. A Guide to Preschool STEAM Activities [Электронный ресурс] // Edutopia. – 2025. – Режим доступа: https://www.edutopia.org/article/introducing–steam–activities–preschool/ (дата обращения: 22.10.2025).

12. Linder, S. M.; Eckhoff, A. Breaking Down STEAM for Young Children [Электронный ресурс] // NAEYC. – 2020. – Режим доступа: https://www.naeyc.org/resources/pubs/tyc/feb2020/breaking–down–steam (дата обращения: 22.10.2025).

13. Preschool STEAM: Transform Learning with Play–Based STEAM [Электронный ресурс]. – Режим доступа: https://preschoolsteam.com/ (дата обращения: 22.10.2025).

14. MyBrightWheel Blog: Fun STEAM Activities for Preschoolers [Электронный ресурс]. – 2025. – Режим доступа: https://mybrightwheel.com/blog/steam–activities–for–preschoolers (дата обращения: 22.10.2025).

15. National Association for the Education of Young Children (NAEYC). STEM and STEAM in Early Learning: Research Review. – Washington D.C.: NAEYC Press, 2022. – 68 p.

16. Yakman, G.; Lee, H. Exploring the Theoretical Framework of STEAM Education // Journal of the Korean Association for Science Education. – 2012. – Vol. 32, No. 2. – P. 569–578.

17. Lippard, C.; Lange, E.; Rohde, T. Integrated STEM Approaches in Early Childhood: Evidence and Practice // Early Childhood Education Journal. – 2021. – Vol. 49. – P. 867–881.

18. Breiner, J. M.; Johnson, C. C.; Hakeem, M.; Koehler, C. M. What Is STEM? A Discussion About Conceptions of STEM in Education and Partnerships // School Science and Mathematics. – 2012. – Vol. 112, No. 1. – P. 3–11.

19. Quigley, C. F.; Herro, D. An Examination of STEAM Teaching Practices in Elementary Classrooms // Journal of Science Education and Technology. – 2016. – Vol. 25, No. 3. – P. 410–426.

20. Sousa, D. A.; Pilecki, T. R. From STEM to STEAM: Using Brain –Compatible Strategies to Integrate the Arts. – Thousand Oaks: Corwin Press, 2018. – 240 p.