European International Journal of Pedagogics (ISSN: 2751-OOOX)

Received: 30 March 2026 | Accepted: 26 April 2026 | Published: 18 May 2026

DOI: 10.55640/eijp-06-05-21

RESEARCH ARTICLE

Methodological Approaches To Developing Technical Thinking Competence In Future Teachers

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VOLUME: Vol.06 Issue05 2026

PAGE: 94-96

Abstract

This article analyzes methodological approaches to developing technical thinking competence in future teachers. The study substantiates competence-based, activity-oriented, systemic, constructivist, integrative, and reflective approaches as a theoretical basis for designing effective teacher education programmes focused on technical reasoning.

KEYWORDS

Methodological approaches, technical thinking competence, future teachers, competence-based education, systems approach, constructivism, activity approach, integrative learning, reflection, teacher education.

INTRODUCTION

The development of technical thinking competence in future teachers requires a solid methodological foundation. Without such a foundation, teaching methods may remain fragmented and episodic. Methodology defines how the competence is understood, which components are prioritised, how learning tasks are selected, and how results are assessed.

Technical thinking competence is multidimensional. It includes knowledge of technical concepts, the ability to analyse systems, practical skills of modelling and design, creative problem solving, communication of technical ideas, and reflection on decisions. Therefore, one methodological approach is insufficient. An effective model should integrate several complementary approaches.

The relevance of this topic is linked with the increasing demand for teachers capable of working in technology-rich and innovation-oriented learning environments. Future teachers should be prepared not only to use digital and technical tools but also to guide learners in understanding technological processes and solving real problems.

The purpose of the article is to identify and substantiate methodological approaches to developing technical thinking competence in future teachers. The objectives are to define the theoretical meaning of each approach, explain its didactic function, and integrate the approaches into a coherent developmental framework.

Literature Review And Methods

Competence-based education provides the first methodological foundation. Raven's work emphasises that competence includes not only knowledge but also motivation, values, and the ability to act effectively in specific contexts [1, 45-48]. Applied to technical thinking, this means that students should demonstrate performance in solving technical and pedagogical tasks.

The activity approach is also essential. Dewey argued that education should be grounded in experience, inquiry, and practical action [2, 78-81]. Technical thinking develops when

learners manipulate objects, investigate processes, create models, and reflect on outcomes.

The systems approach enables the analysis of technical objects and pedagogical processes as interconnected structures. Senge's systems thinking perspective highlights the importance of seeing relationships rather than isolated elements [3, 68-70]. This is crucial for technical reasoning, because every technical object functions through the interaction of parts.

Constructivist pedagogy states that learners build understanding through active engagement with tasks and social interaction. Vygotsky's theory of mediated learning supports the importance of collaboration and guidance [4, 86-89]. In technical education, this implies scaffolded problem solving and collective design work.

The article was prepared within a theoretical and methodological research design. The study applied system analysis, comparative pedagogical analysis, conceptual modelling, synthesis of international literature, and pedagogical generalisation. System analysis made it possible to consider technical thinking competence as an integral formation that includes cognitive, operational, creative, communicative, and reflective components. Comparative analysis was used to examine the didactic potential of innovative methods in contrast with predominantly reproductive teaching formats. Conceptual modelling enabled the development of a methodological sequence that can be implemented in teacher education programmes.

Results And Discussion

The analysis identified six methodological approaches that should form the basis of technical thinking competence development. The competence-based approach determines the expected outcome. It requires the formulation of clear indicators: ability to analyse technical objects, model processes, solve problems, justify design decisions, and reflect on results.

The activity-oriented approach determines the organisation of learning. Students should not only listen to explanations but also perform operations: observe, compare, measure, design, test, and improve. This approach transforms technical thinking from theoretical awareness into practical competence.

The systems approach determines the content logic. Technical objects should be presented as systems with structure, function, input, output, feedback, and constraints. Such presentation develops the ability to understand causal and functional relations.

Component	Didactic focus	Expected outcome
Competence-based approach	Defines expected learning outcomes and indicators	Measurable competence development
Activity-oriented approach	Organises learning through practical operations	Operational technical skills
Systems approach	Explains technical objects through relations and functions	Systemic and causal reasoning
Reflective approach	Requires analysis of decisions and improvements	Self-assessment and professional growth

The constructivist approach determines the learning environment. Students construct knowledge through inquiry, collaboration, and problem solving. The teacher functions as a facilitator who creates situations, supports reasoning, and guides reflection.

The integrative approach connects technical thinking with mathematics, science, digital technologies, design, and pedagogy. It prevents fragmentation of knowledge and supports interdisciplinary understanding. The reflective approach ensures that students analyse not only what they did but why they did it, how effective it was, and how it can be improved.

Conclusion

The study concludes that technical thinking competence should be developed through an integrated methodological framework. Competence-based, activity-oriented, systems, constructivist, integrative, and reflective approaches complement each other and together create a strong basis for teacher education.

A methodological framework of this kind allows higher

education institutions to design curricula, tasks, assessment tools, and digital learning environments that consistently develop technical reasoning. Future research should focus on empirical validation of the proposed framework and the creation of diagnostic instruments for measuring competence levels.

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