



INNOVATIVE APPROACHES TO DEVELOPING CONSTRUCTIVE AND  
TECHNICAL THINKING IN PROSPECTIVE TECHNOLOGY EDUCATION  
TEACHERS

Qodirov D

*Teacher at Nizami Tashkent State Pedagogical University of Uzbekistan*

**Abstract:** *This article examines the development of technical modeling and design competencies among prospective technology education teachers through the integration of metacognitive and creative thinking approaches. The study analyzes the effectiveness of educational interventions grounded in metacognitive and inventive thinking for fostering these competencies in undergraduate students specializing in technology education.*

**Keywords:** *technology education, technical modeling, design engineering, metacognitive intervention, inventive thinking, reflection, competence.*

The design and modeling processes carried out in the workshops of the course “Technological Education Practicum” closely resemble the real professional activities of skilled designers, technologists, machine operators, assemblers, and adjusters in industrial settings. Just as the creation of a new machine or mechanism in production follows certain stages, the creation of a technical model in educational workshops is organized in exactly the same sequence. These stages include:

- Formulating the technical objective (emergence of an idea for a new machine, mechanism, or model);
- Defining the requirements (determining the functional and constructive criteria for the technical objective);
- Developing and discussing design sketches;
- Designing the technological process and selecting the necessary materials and tools;
- Manufacturing and assembling parts, integrating components;
- Testing the model, adjusting and improving it if necessary.

Integrating these processes into the learning environment enables students to gain a deep understanding of both the theoretical and practical foundations of creating machines, mechanisms, and devices. Moreover, it fosters the development of design thinking, analytical skills for solving technical problems, and competencies necessary for finding practical engineering solutions.

The Technological Education Practicum also includes students’ familiarization with the structure of design departments within industrial enterprises. Learning about the work of the chief design office, general and specialized design bureaus, as well as draftsman-designers, enables students to understand the complex structure of production processes.

Typically, several design teams operate within an enterprise: some develop serially produced machines, while others create specialized machines by modifying existing assemblies.



Observing these processes broadens the professional outlook of prospective technology education teachers and enriches their specialized competencies.

Technical skills are a set of specialized knowledge, abilities, and practical competencies required to effectively perform specific work tasks. These skills can be taught, quantitatively expanded, and are considered a key factor in career advancement within technical fields.

Today, technical skills are developing rapidly and have become one of the most in-demand professional competencies in the global labor market. Technological progress, the digitalization of industry, and new production requirements are significantly broadening the landscape of technical skills.

In this context, the subject of technological education plays a crucial role. It introduces learners to labor processes, technical systems, production culture, and engineering thinking. Under current educational reforms, organizing technological education through an integrative model grounded in metacognitive and creative thinking has become an important scientific-practical direction.

The issue of developing competencies in technological education is recognized as an urgent scientific problem both internationally and within the education system of Uzbekistan. Uzbek scholars such as N. Muslimov [1], O. Tolipov [2], Sh. Safarov [3], O. Qosyinov [4], H. Qodirov [5], M. Qodirov [6], Sh. Muslimov [7], and N. Utayeva [8] have focused their research on the formation of practical activity skills, problem-based thinking, technical reasoning, and creativity competencies in technological education.

In the Russian education system, the development of technological thinking has been widely explored by researchers. A. V. Khutorskoy conceptualized the “competency-based approach” as a learning model oriented toward personal mastery and individualized development [9]. N. E. Erganova argued that constructive activity in technological education is a crucial condition for learners’ cognitive and metacognitive development [10]. V. S. Lednev interpreted the content of technological education as a “materialized form of human activity,” linking it directly to practical thinking. Similarly, the works of S. P. Ivanova and M. A. Krasnoshchekov highlight technical modeling as an effective tool for developing teachers’ creative reflection. According to these scholars, technological tasks should engage learners not merely in producing a finished product but in the processes of generating ideas and conducting analytical reasoning.

European scholars such as Flavell, Dennison, Dogan, Zadok, and Meijer view metacognitive activity as a fundamental cognitive mechanism in design and technological learning. In her research, Yazici Dogan demonstrated that metacognitive interventions in architecture and design education significantly enhance students’ creative motivation, self-assessment, and reflection skills [11]. Barak and Zadok propose structuring technological education based on a “problem-based design” approach. Their study emphasizes that students’ technical thinking develops through the problem-oriented analysis of practical tasks [12]. Meijer, in turn, shows that applying metacognitive strategies in digital modeling and engineering design courses strengthens learners’ reflective learning processes [13].

Analyses show that applying metacognitive approaches in the process of technical modeling enables learners not only to understand the essence of the practical activity being



performed, but also to monitor, evaluate, and redirect their own thinking processes. Metacognitive strategies—such as planning, monitoring, self-analysis, working on errors, and reflection—help students deeply analyze problem situations, select rational strategies, regulate the process, and evaluate outcomes when completing technical tasks. This, in turn, reinforces the practical foundation of the “learning technology through thinking” principle proposed in the study.

Integrating a metacognitive approach into the technical modeling process contributes to the development of the following pedagogical-psychological qualities in students:

- awareness and regulation of one’s own thinking mechanisms (metacognitive awareness);
- reflective analysis in shaping technical ideas;
- evidence-based decision-making;
- the ability to monitor the process and evaluate results;
- motivation oriented toward self-development.

In conclusion, these methodological approaches clearly demonstrate the necessity of introducing a practice-based reflective learning model into the system of preparing future technology education teachers. Indeed, the formation of competencies in technological education is not limited to creating a material product; it requires the development of students’ thinking culture, their critical approach to their own activities, the ability to make creative decisions, and the conscious regulation of cognitive processes. Therefore, an approach grounded in the integration of metacognitive and creative thinking should be recognized as not only a modern but also an essential methodological mechanism in the preparation of prospective technology education teachers.

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