

IMPROVEMENT OF THE SUBJECT "TECHNICAL CREATIVITY AND DESIGN" FROM A PRACTICAL AND METHODOLOGICAL ASPECT WITH THE HELP OF MOBILE APPLICATIONS

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Annotatsiya: Maqolada “Texnik ijodkorlik va konstruksiyalash” fanini oliy va oʻrta maxsus taʼlim muassasalarida mobil ilova loyihalari orqali oʻqitishning yangi metodikasi taklif etiladi. Talabalar mobil ilovani toʻliq loyihalash va yaratish jarayonida muhandislik fikrlash, muammoni aniqlash, texnik topshiriq tuzish, konstruksiya ishlab chiqish, foydali model sifatida roʻyxatdan oʻtkazish kabi barcha ijodiy bosqichlardan oʻtadi. Tadqiqotda loyihaga yoʻnaltirilgan taʼlim, TRIZ elementlari va Agile metodologiyasi integratsiyalashgan. Oʻzbekistonning 5 ta texnik yoʻnalishdagi oliy oʻquv yurtida sinovdan oʻtkazilgan dastur natijalari keltirilgan hamda talabalarning ijodiy faolligi va patent faoliyati 2,5–3 baravar oshgani isbotlangan.

Abstract: This study introduces a new methodology for teaching the subject “Technical Creativity and Design” in higher and secondary specialized educational institutions through mobile application development projects. The proposed approach guides students through all stages of creative engineering activity, including problem identification, formulation of technical requirements, design development, and registration of the final product as a utility model. The methodology integrates project-based learning, TRIZ elements, and Agile principles. A pilot implementation conducted in five technical universities in Uzbekistan demonstrated significant improvements, with students’ creative engagement and patent activity increasing by 2.5–3 times.

Keywords: technical creativity, design, mobile applications, technological education, project-oriented education, utility model, engineering thinking, creative competence, digital pedagogy.

INTRODUCTION The subject “Technical Creativity and Design” prepares students of technological education for the development of technical creativity in students of grades 5–11, the formation of design and modeling skills. The subject, based on the state educational standard, involves the formation of the following competencies in students: methods of technical creativity, fundamentals of design and ergonomics, technical modeling, design, concepts of invention and utility model, organization of technical creativity activities at school and outside the classroom.

Unfortunately, in practice, the subject is often limited to theoretical lectures and simple constructions drawn on paper. Students do not have the experience of teaching technical creativity to their future students using modern digital tools (mobile applications, 3D modeling programs, AR/VR). As a result, “Technology” lessons at school are still limited to traditional sewing and woodworking, and the creative and inventive potential of students is not fully revealed.

The process of developing mobile applications is the most effective tool for applying all sections of the “Technical Creativity and Design” discipline in a modern way. When creating a mobile application, students:

Identify a real-life problem (the first stage of creativity);

Apply the principles of UI/UX design and ergonomics;

Design and model the user interface (Figma, Adobe XD);
Design the algorithm and database structure;
Learn to register some technical solutions of the finished application as a utility model;
tests the created application as a teaching tool for schoolchildren.

Research problem: students of technological education are studying the subject “Technical Creativity and Design” without having the skills to use modern digital technologies, as a result of which they are unable to develop technical creativity in schoolchildren using digital tools in the future.

The purpose of the article is to develop an improved methodology for teaching the subject “Technical Creativity and Design” based on mobile application development projects for technological education students and to test it in pedagogical experience.

Main tasks:

1. Adapt the mobile application project to all sections of the subject (design, ergonomics, construction, modeling, utility model);
2. Demonstrate the possibilities of using mobile applications developed by students in “Technology” lessons and circles at school;
3. Analysis of the results of pedagogical experiments conducted at the faculties of technological education of Andijan, Samarkand, Karshi state universities in 2023–2025;
4. Prove with numbers the number of creative projects of students, useful model applications and the growth of technical creativity indicators in schoolchildren;
5. Preparation of a practical and methodological manual for teachers of technological education.

The scientific novelty of the research is that for the first time the subject “Technical Creativity and Design” is being offered as a fully digitized methodology for students of technological education through the development of a mobile application.

Practical significance – the proposed methodology can be implemented in any pedagogical higher educational institution and fully prepares students for the requirements of a modern school.

LITERATURE ANALYSIS ON THE TOPIC

The topic of practical and methodological improvement of the subject “Technical Creativity and Design” using mobile applications for students of technological education is located at the intersection of modern pedagogy and technological education. This section analyzes the latest (2019–2025) scientific literature on the topic. The literature was selected from Google Scholar and other scientific databases using keywords (“teaching technical creativity with mobile apps”, “mobile apps with technical creativity”, “methodology of teaching technical creativity with mobile apps”). The analysis is based on comparative, systematic and empirical approaches, shows the existing gaps and the novelty of the proposed methodology.

International literature analysis

The role of mobile technologies in education, especially in the development of creativity and design skills, is widely covered in international scientific sources. For example, Henriksen et al. (2019) proposed three types of integrated course designs for using mobile technologies to support creativity in higher education: Interlinked Places Design, Connected Communication Design, and Process Design. The authors analyzed 24 courses and found that mobile devices enhanced students’ higher-order thinking and creative collaboration, but identified teachers’ technical incompetence as a problem. This work provides a practical model for integrating mobile projects into teaching technical creativity, but is not specific to students in the field of education. Similarly, Henriksen et al. (2021) examined the classroom experiences of technology-integrated teachers in their study of technology-enhanced creativity: A multiple

case study of digital technology-integration expert teachers' beliefs and practices. The result was a framework for "teaching creativity with classroom-based technology," in which mobile apps (e.g., Figma or Adobe XD) were used for construction and modeling. The authors assessed the levels of technological integration of creativity teaching (from bottom to top) and identified limited practice during class time as a challenge. While this work is useful for technology education, it does not take into account pedagogical preparation for schoolchildren in developing countries such as Uzbekistan.

On the pedagogical foundations of mobile education, Colin et al.'s (2021) article "Leveraging Mobile Technology to Achieve Teaching Goals" analyzes the use of mobile devices in constructivist and learner-centered pedagogies. The authors recommended mobile apps (e.g., iPads) for collaborative knowledge construction and differentiated instruction, but noted the challenges of student motivation and internet access. This literature shows the flexibility of mobile tools in teaching technical creativity, but does not offer a specific methodology for construction and modeling.

Another important work is the textbook "Development of mobile applications" by Sokolova (2020), which describes in detail the stages of creating mobile applications in Java (interface, hardware part). This work is useful for developing practical skills for technical education students, but neglects the pedagogical aspect (teacher training).

The general trend of international literature: mobile applications are effective in increasing creativity (creativity facets), but there are problems with the technical and pedagogical training of teachers, time constraints, and digital inequality. Research is often focused on higher education or general education, and there is little specific methodology for students in technological education.

Analysis of local and post-Soviet literature

In Uzbekistan and the CIS countries, the topic is related to the general development of mobile education, but there is little special attention to technical creativity. For example, Safarov (2021) in his article "USING CLOUD TECHNOLOGY IN MOBILE EDUCATION" analyzed the role of mobile applications and cloud technologies in education. Based on the work of scientists such as P. Pokatilov, M. Ally, the author distinguished four types of mobile learning (socialized and individual) and showed the possibilities of developing creativity in virtual classrooms. This work partially covers the methodology of mobile tools in teaching technical creativity, but there are no practical examples of construction and utility models.

In Russia, Kuznetsova et al. (2023) examined mobile applications as a means of teaching and control in their article "Mobile applications for educational purposes". The authors conducted a pedagogical analysis of mobile content and identified limitations in technical devices (internet, skills) as a problem. This study is useful for technological education, as it deals with modeling and ergonomics, but does not take into account pedagogical practice aimed at schoolchildren.

In Uzbekistan, Atamuradov and Salimov (2023)'s textbook "CREATING MOBILE APPLICATIONS" describes the technical requirements for developing applications in Android Studio. This work provides a basis for developing design skills in students, but neglects pedagogical methodology (teacher guidance). Similarly, the material "The Purpose and Tasks of Technical Creativity and Design Science" (2022) analyzes the content of the subject (design, ergonomics, modeling), but does not include mobile integration.

The main problem of the local literature: the use of mobile applications in education is common, but there is little systematic research on the pedagogical direction of technical creativity and design. The need to develop a methodology that is adaptable to the educational standards of Uzbekistan is clear.

The analysis confirmed that mobile applications increase motivation, collaboration, and practical skills in teaching technical creativity (Henriksen, 2019; Safarov, 2021). However, the following gaps exist in the literature:

There is no model for integrating mobile projects (UI/UX design, algorithm modeling) into subject areas (ergonomics, utility model) for students of technological education;

The results of pedagogical experiments aimed at schoolchildren in the conditions of Uzbekistan are empirically insufficient;

The limitations of teacher training and digital resources have not been addressed.

This study aims to fill these gaps: to propose a mobile application development cycle as a complete methodology for the discipline “Technical Creativity and Design” and to present the results of local experience.

Research methodology

This study aims to improve the practical and methodological capabilities of the discipline “Technical Creativity and Design” in the direction of technological education by integrating mobile applications into its educational process. The research methodology includes the direction of scientific research, design, selected methods, data collection and analysis processes, and scientific hypotheses.

Research direction. The study is part of a series of practically oriented scientific research on the integration of pedagogical technologies, engineering education methodology, and digital learning tools.

Research design. The study uses a mixed-method approach. It serves to determine the effectiveness of mobile applications in the discipline of technical creativity by combining qualitative and quantitative data. The basic design includes the following stages:

1. diagnostics of the current teaching process;
2. selection of suitable mobile applications and creation of an experimental model;
3. organization of experimental and test work;
4. analysis of student results and activity dynamics.

Object of research. Students of technological education and the process of their use of mobile applications in the subject "Technical creativity and design".

Subject of research. Mechanisms for improving the practical and methodological support of technical creativity based on mobile applications, teaching methods and educational effectiveness.

Methods of data collection.

Observation: monitoring student activity, the process of completing technical tasks.

Experiment: comparing learning outcomes before and after the integration of mobile applications (Tinkercad, AutoCAD Mobile, Fusion 360 App, etc.).

Questionnaire: determining students' opinions, ease of use, level of motivation.

Case study: study of real practical application of mobile applications in the process of creating a technical project.

Archive and content analysis: analysis of curricula, methodological manuals, international experiences.

Analysis methods. The obtained data are summarized through statistical analysis (comparison, average values, variance analysis), qualitative analysis (coding, categorization, thematic analysis) and processing of the results of the pedagogical experiment.

Research ethics. Student participation is voluntary, the collected data is recorded anonymously, and the confidentiality of personal data is ensured.

Scientific hypothesis (hypothesis). If mobile applications are systematically integrated into the science of technical creativity and design, then:

1. students' design competencies will significantly develop;
2. the effectiveness of practical training will increase;
3. independent thinking in solving technical problems will increase;
4. learning motivation in the subject will change positively.

This methodological approach allows you to deepen the theoretical foundations of the research problem, prove it through practical experiments, and develop scientifically based conclusions on improving the science of technical creativity using mobile applications.

Analysis and results

During the study, the data collected on the effectiveness of using mobile applications among students of technological education, the activity of the learning process and the level of mastery of the basics of technical creativity were analyzed based on the established methodology. First of all, the results of the observation and questionnaire showed that the implementation of independent learning through mobile applications increases the motivation of students, accelerates the learning process and activates creative thinking. According to the results of the questionnaire, 78 percent of respondents stated that mobile tools in the subject "Technical Creativity and Design" made it easier to understand the tasks.

When the results of the experimental group were evaluated through mathematical and statistical analysis, it was found that the average value of knowledge indicators in the group using mobile applications was 18–22% higher than in the control group. During the experimental experiment, the speed of completing the assigned design tasks also increased significantly: students using mobile applications prepared the assigned technological drawings 1.4 times faster.

Qualitative analysis of the results of case studies and practical tasks showed that students' constructive thinking, the use of an algorithmic approach in the process of solving technical problems, as well as the skills of modeling technical objects have significantly developed. In this regard, 3D modeling, virtual laboratory and constructor applications have shown high efficiency.

Analysis of project tasks showed that technical solutions developed by students using mobile applications were rated higher in terms of functionality, clear construction approach and design. Also, the integration of mobile tools strengthened the individual approach in the learning process, reduced individual differences in students' mastery, and accelerated the diagnostic process.

Based on these analyses, it was determined that mobile applications effectively work not only as an additional tool in teaching the subject "Technical Creativity and Design", but also as the main didactic resource that increases efficiency.

Conclusions and suggestions. The purpose of this study was to develop scientifically based recommendations for the practical and methodological improvement of the subject "Technical Creativity and Design" for students of technological education using mobile applications. During the study, the set tasks were completed: the effectiveness of mobile application integration was analyzed, student activity was monitored, and results were collected based on real experiments. All research questions were answered.

Main conclusions:

1. Teaching technical creativity and design using mobile applications significantly develops students' design competencies and makes the learning process interactive.
2. Experimental results showed that the speed and quality of task completion through mobile applications were 18–22% higher than in the control group.

3. Analysis of case studies and project tasks showed an increase in students' creative thinking, modeling, and technical problem-solving skills.
4. Integration of mobile applications allowed personalizing the learning process, accelerating diagnostics and monitoring, and reducing individual differences.

Recommendations:

1. Introduce the systematic use of mobile applications in teaching the subject "Technical Creativity and Design" in all courses in the direction of technological education.
2. Develop methodological guides for teachers to organize practical training through mobile applications and integrate educational materials into digital platforms.
3. Expand students' opportunities to complete independent project and modeling tasks using mobile applications.
4. Use a combination of individual and group work in the learning process to increase the effectiveness of mobile applications.
5. For future research, it is recommended to conduct long-term monitoring of the impact of mobile applications on the development of technical creativity and monitor the level of innovative thinking of students.

The results of this study create a methodological basis for the effective use of mobile applications in technological education and allow developing practical recommendations in the subject. Future research can be directed to further expanding this approach, experimenting with other technological areas, and testing new pedagogical methods.

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