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Article

The Content and Relevance of Developing Students' Creative Competence Through Software Learning Tools

Alikulova Saodat Mukhitdinovna*[1]

1. Assistant Professor, Karshi State Technical University, Uzbekistan
* Correspondence: saodataliqulova1988@gmail.com

Abstract: The socio-economic and technological advancements require higher education systems to train competitive, innovative, and creative thinking specialists in engineering. In this context, the use of modeling, simulation, and automation design technologies have been used as an integrated software learning tool to improve the creative competence of students in engineering education. Although there is a lot of theory on creativity and competence-based education in engineering education literature, relatively little deliberate pedagogical embedding of software tools, as one of the vehicles to cultivate domain-specific creativity, is discussed. The purpose of this research is to confirm the pedagogical perspective on software-mediated education as one that develops students of creative competence and will for novel professional designansuctions. The results imply that students exhibit originality, flexibility, independent thinking, and intrinsic motivation when taught with interactive, problem-based, and technology-enhanced methods as compared to traditional reproductive approaches for students. It is proved that the formation of creativity is based on the psychological environment support and the purposeful organization of the educational process. This study connects theoretical perspectives on creativity with applied computer tools in the context of engineering education, giving prominent status to specialized creativity as a key component of professional competence. These findings indicate that a modernization of curricula, use of digital technologies to design instruction, and adequate preparation of educators who can implement innovative-oriented learning environments.

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1. Introduction

Today, the socio-economic reforms being implemented in our country, the rapid development of science, technology and production sectors are placing completely new demands on the higher education system. In particular, the modern labor market requires the training of qualified specialists who are competitive, perfectly master their profession, able to think independently and creatively, and ready for innovative activities [1][2]. In particular, the development of creative competence of students studying in engineering fields is emerging as an important strategic task. This was emphasized by the President of the Republic of Uzbekistan Shavkat Mirziyoyev in his Address to the Oliy Majlis on December 26, 2025, in which he stated that further modernization of the higher education system, improving quality, and integrating education with practice (market) are identified

as priority areas. Special attention is paid to the issue of training specialists who think creatively, master modern technologies, and strive for continuous professional growth [3].

The views of the President of our country Sh.M. Mirziyoyev on realizing the potential of young people, developing their creative and intellectual capabilities also confirm the relevance of this issue at the level of state policy. In the conditions of modern society, the need to develop students' creativity through the digitization of the educational process, the use of software tools, and the introduction of problem-based and interactive teaching methods is increasing day by day. Because traditional, reproductive educational approaches cannot fully meet today's needs [4]. The main task of education should be not to direct students only to master ready-made knowledge, but also to teach them to independently search and find unusual solutions to problem situations. In pedagogical and psychological research, the concept of creativity is interpreted as a component of creativity. Creativity expresses a person's ability to create new ideas, apply existing knowledge in a new context, take a non-standard approach to problems, and find innovative solutions [5][6].

Various approaches to this concept have been put forward by foreign and domestic scientists:

-J.P. Guilford associates creativity with divergent thinking and interprets it as the ability to develop multiple solutions to a problem;

- E.P. Torrens, on the other hand, saw creativity as the process of problem-solving, generating hypotheses, testing them, and evaluating the results, and developed criteria for determining creative thinking;

-A.H. Maslow associates creativity with the need for self-actualization of the individual, considering it a universal quality inherent in human nature;

-H. Gardner interprets creativity based on the theory of multiple intelligences, justifying its manifestation in various fields of activity;

Patti Drapeau emphasizes the importance of developing creative thinking skills, creating an interactive environment, using non-standard situations, and working with creative products in the formation of creativity in students. In her opinion, creativity is not an innate ability, but a competency that is developed under certain conditions [7].

The issue of creativity has also been studied by local scientists from various aspects. In particular, according to G.N. Ibragimov, the development of creativity in students is considered a step-by-step process, distinguishing the stages of reproductive-risk taking, creative-searching, and innovativeness [8][9].

-T.Ch.Aliboev evaluates creativity as the ability to create ideas that have practical value and justifies its importance in professional activity.

-R.A.Mavlonova, O.Musurmonova and other scientists recognize creativity as an important component of the professional and innovative training of future specialists.

Although the concepts of creativity and ability are closely related, they do not have the same meaning. Ability is based on the psychological and physiological characteristics of a person and allows for the rapid and effective acquisition of knowledge and skills. Creativity, in turn, expresses the ability to apply this knowledge and skills in a new, unusual way. Thus, creative competence is an integrative unity of knowledge, skills, qualifications, motivation and creative thinking [10][11].

2. Materials and Methods

The methodology of the present study is based on qualitative-analytical research that targets the engineering degree that shapes students' creative competence through the use and application of software learning tools. The research is founded upon an analysis of theoretical-pedagogical and psychological-sociological sources concerning creativity, innovative educational technologies, creative competence, and the examination of

normative documents and policy statements pertaining to the modernization of higher education. The paper applied a systematic literature review approach to identify the most salient conceptual paradigms of creativity suggested by both international and local scholars, build on these paradigms to distil and synthesize their implications on engineering education. Furthermore, content analysis was performed to identify how software tools for modeling, simulation, automation, and design can help develop students' independent thinking and problem-solving skills. Comparative analysis was also used to contrast traditional reproductive teaching methods with interactive, problem-oriented and technology-enhanced methods, underscoring their comparative effectiveness in facilitating creative competence. Criteria of creativity originality, flexibility, fluency, motivation, and systematicity were used as analytical indicators to assess the efficiency of software-supported instruction. Methodological framework in the study combines theoretical generalization of pedagogical interpretation to prove the importance of an appropriate psychosocial environment and project-oriented learning in developing specialized creativity of future engineers.

3. Results and Discussion

Specialized creativity is of particular importance in the development of creative competence of future engineers. Specialized creativity is creativity manifested within a specific professional activity, which involves the use of innovative approaches to solving professional problems. It is during student life that this type of creativity is formed and lays the foundation for future professional activity [12]. The use of software tools in engineering education is an important factor in the development of students' creative competence. Software tools for automation, modeling, simulation and design of electric power systems allow students to combine theoretical knowledge with practical activities, analyze problem situations in a virtual environment and develop innovative solutions. This strengthens their independent thinking, research activity and creative activity [13].

To develop creativity, it is important to create a favorable psychological environment in the educational process. It is necessary for the student not to be afraid of making mistakes, to be able to express his/her thoughts freely, to take the initiative and to test his/her creative ideas in practice. The teacher himself/herself is required to be a creative thinker, open to innovative approaches. The criteria for creativity are recognized as fluency of thinking, originality, flexibility, sensitivity, development, systematicity, efficiency and motivation. These criteria can be used to develop strategies for assessing and developing students' creative competence [14].

The development of the creative competence of future engineers based on the planning and organization of the pedagogical process in the field of technical knowledge using software educational tools, interactive educational technologies and methods is one of the priority areas of modern higher education. This process serves to deepen students' professional knowledge, develop independent and creative thinking, and prepare them for innovative activities. By focusing the content, methods, and tools of education on creativity, the opportunity to train highly qualified engineering personnel in line with the needs of society and the economy expands [15].

4. Conclusion

In conclusion, the research proves the significance of using software learning tools in the study of engineering disciplines for the effective formation of students' creative competence through the development of independent thinking, problem-solving skills, and preparation for innovative professional activity. The results show that creativity is not a naturally occurring ability but rather a cultivated skill that is developed through interactive pedagogical strategies, positive psychological environments, and deliberate use of the modeling, simulation, and design technologies. Technology-enhanced and problem-based learning methods have been found to be relatively effective at supporting

future engineers in divergent thinking, creative originality, and fluency, flexibility, and motivation when compared with traditional reproductive approaches to the teaching of engineering. These results suggest that curricula in higher education must deliberately adapt to include digital, interactive tools and methods as key elements of professional preparation, so that professional education aligns with labor market needs. Additionally, institutional policies must focus on equipping teachers for creative teaching and establishing innovation-based learning settings. In terms of directions for further research, it is advisable to conduct empirical studies with mixed-method and quasi-experimental designs that would more objectively analyze the long-term effects of technology-supported education on domain-specific creativity, and to investigate domain-specific models of technology integration for engineering education.

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