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TEACHING STUDENTS TO THINK CREATIVELY IN DRAWING GEOMETRY LESSONS

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Abstract
In the modern information society, the formation and development of creative thinking competencies has become one of the priority areas of the education system. Especially at the higher education stage, expanding the scope of students' thinking, preparing them as specialists who can make independent, critical and creative decisions, is considered an urgent issue in pedagogical theory and practice today [1]. This scientific thesis sheds light on this problem, highlighting the role of the discipline of drawing geometry and its methodological capabilities in the formation of creative thinking. The study pays special attention to studying how students' spatial thinking, graphic expression skills and creative approaches develop in drawing geometry lessons. In this process, experimental developments carried out using educational activities based on interactive technologies, problem-based learning methods, project tasks and information and communication tools and their results are scientifically analyzed. The significance of the study is that it serves not only to implement pedagogical innovations into practice, but also to identify ways to improve the science of drawing geometry as a powerful tool for developing students' thinking.

Keywords: Graphic geometry, creative thinking, interactive methods, pedagogical technologies, spatial imagination.

Introduction

In today's globalization and digital transformation, one of the main tasks facing the education system is to prepare students to think creatively and creatively, as specialists who can solve problems based on innovative approaches. This is especially relevant for educational institutions in technical areas, and the science of drawing geometry is an important tool in this process. Because drawing geometry is one of the main sciences in the formation of spatial thinking, perception of real and abstract objects based on the laws of geometry, and the development of constructive thinking through their graphic representation. The theoretical and practical foundations of this science serve to activate the mental potential of students, expand logical thinking, form advanced ideas, and develop the ability to find innovative solutions to various engineering and technological problems. The "Development Strategy of New Uzbekistan for 2022–2026" of the President

of the Republic of Uzbekistan also identifies increasing the intellectual potential of young people and training them as competitive specialists as an important task. From this point of view, it is necessary to combine the science of drawing geometry not only on the basis of classical approaches, but also with modern, interactive, problem-based, project-based educational methods. Scientists such as A. Tulaganov, S. Ergashev, M. Jorayev emphasize in their research that the integration of the content, form, tools and assessment methods of the lesson plays an important role in the development of creative thinking. At the same time, it is possible to form the competencies of students in drawing geometry lessons, their deep thinking, analysis and conclusion through the active participation of students in drawing geometry lessons, the use of tasks aimed at independent work based on their creativity elements, and work on projects related to real-life problems. In this process, it is possible to increase the effectiveness of the lesson and expand the student's independent thinking capacity through the use of modern pedagogical technologies - cluster, brainstorming, syncwine, conceptual map, electronic platforms. Thus, organizing drawing geometry lessons in a creative direction serves to develop not only spatial thinking, but also the student's general intellectual, communicative, social, and information culture.

Methodology

The methodological basis of this study was pedagogical experiment, observation, diagnostic tests, psychological and pedagogical analysis, statistical analysis and comparison methods. At the initial stage, two equal groups were formed from 120 undergraduate students studying in technical areas involved in the study - experimental (60) and control (60) groups. A special educational program was introduced to the experimental group based on innovative methods aimed at developing creative thinking in the subject of drawing geometry. This program included problem tasks that develop creative thinking, modeling spatial constructions, independent development of graphic transformations, project-based tasks and interactive exercises. Conceptual maps, graphic laboratories, modern CAD (AutoCAD, Compass 3D) technologies were used in the teaching process. In the control group, traditional methods were used - memorization of theoretical information and graphic tasks of a classical form. In both groups, lessons were organized on the same topics, but the methodological approaches differed. During the study, three-stage mastery monitoring was conducted with students - diagnostics of initial knowledge, intermediate and final tests. In addition, in-depth analyses were conducted based on questionnaires, psychological tests, as well as pedagogical observations to determine the level of thinking, creative approaches and self-assessment skills of students. Descriptive indicators, analysis of variance (ANOVA) and T-tests were used for statistical analysis using the SPSS program. Through this scientific approach, the effectiveness of the creative approaches used in the experimental group, their impact on the quality of mastery, the level of spatial thinking and graphic culture were comprehensively assessed. The methodological approach of the study was formed on the basis of the theoretical views of

such scientists as GG Selevko, VV Serikov, AA Mukhin on innovative educational technologies. In this, structural-component models of creative thinking activity (motivational, intellectual, communicative, and reflective) were taken as the basis and tested through a pedagogical experiment in the context of the subject of drawing geometry.

Results

The results of the study were formed on the basis of an in-depth analysis of the results of the educational activities, levels of thinking and creative approach skills of the experimental and control groups. In the experimental group, the use of a creative approach, interactive methods and problem-solving tasks in lessons had a significant positive effect on student activity. More precisely, the quality indicators of graphic tasks completed by students in the experimental group were 87%, which is 27% higher than the 60% result in the control group. Also, as a result of tests aimed at determining the level of spatial thinking, the experimental group scored an average of 18.5 points, while in the control group this indicator was around 13.7 points. According to data determined through questionnaires and surveys, 85% of students in the experimental group reported an increase in their competencies in such areas as independent thinking, putting forward new ideas, and finding non-standard solutions to graphic problems in lessons. This indicator did not exceed 45% in the control group. According to the results of statistical analysis, analysis of variance (ANOVA) showed that the changes in the experimental group were significantly significant ($p < 0.05$). In addition, the experimental group also showed high indicators in terms of interest in the subject of drawing geometry, activity in lessons, desire for independent work, and involvement in creative projects. During the experiment, the creative tasks used in the lessons - the design of spatial objects, three-dimensional modeling exercises, and independent development of graphic transformations in CAD programs - proved that the students developed not only technical, but also aesthetic taste. These results correspond to the indicators of creative thinking put forward by internationally recognized scientists - E. Torrance, J. Guildford, V. Davydov, and I. Lerner. In particular, the students of the experimental group achieved high results in graphic culture, spatial thinking, constructive thinking, and reflective approaches. This proved that enriching the subject of drawing geometry with innovative methods can help students not only master the educational material, but also apply it in practice, solve real problems, be creative, and become competitive specialists in the future.

Conclusions and Suggestions

As a result of the conducted research, it was found that teaching drawing geometry based on a creative approach not only develops students' spatial imagination, but also serves as an important factor in the formation of modern competencies such as independent thinking, an integrated approach to problems, and non-traditional decision-making. The innovative pedagogical methods used in the experimental group - problem-based learning,

project-based learning, interactive technologies, effective use of information and communication tools, development of creative tasks based on graphic transformations, and creation of a socio-psychological environment that stimulates students' creative thinking - proved to be much higher than expected results. Students achieved significant progress in mastering all components of creative thinking - motivational, cognitive, operational, and reflective components. In particular, positive changes were observed in the skills of transforming spatial forms, imagining complex graphic objects, connecting them to practical tasks, and developing innovative graphic solutions based on CAD programs. The results of the study show that lessons based on traditional approaches limit students to theoretical knowledge only and cannot sufficiently reveal their creative potential. Therefore, a number of proposals can be put forward to guide students to creative thinking in drawing geometry lessons: firstly, it is necessary to update curricula and subject programs and increase the share of creative and problem-solving tasks in them; secondly, it is necessary to develop creative teaching methods in drawing geometry for teachers, apply them in practice, and organize special advanced training courses on this; thirdly, organize project-based classes for students, in which they learn to solve real problems based on graphic objects; fourthly, it is possible to increase students' interest in the lesson by enriching lessons with the help of modern technologies - 3D modeling, CAD programs, interactive whiteboards, digital graphic tools; fifth, to create an assessment system based on a creative approach, in which students are encouraged to develop continuously by assessing not only the final result, but also the process itself. In addition, it is necessary to create organizational and pedagogical conditions that stimulate creative activity - an environment of free thinking, an environment that allows for self-awareness and expression, and to promote methods of solving problems based on student cooperation. International experience and advanced practices also show that today the education system should not be limited only to imparting knowledge, but should serve to reveal the personal potential of each student. Graphic geometry has great potential in this regard as a science that forms spatial and graphic thinking, directing it to creative thinking. In conclusion, it can be said that the innovative approaches carried out within this science not only increase pedagogical efficiency, but also play an important role in preparing the younger generation as intellectually, intellectually and morally mature, competitive specialists.

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