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TYPES OF INVENTIVE ABILITIES IN STUDENTS AND THEIR COVERAGE IN THE SUBJECT "TECHNOLOGY"

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Abstract
In this article the types of inventive abilities in students, the factors of their formation and the methods of developing these abilities within the framework of modern discipline "Technology" are analyzed on a scientific basis. The results of research conducted on the basis of IMRAD requirements, the role of the subject "Technology" in the formation of students' creativity and problem-thinking skills, as well as the ways of their effective illumination through modern teaching technologies.

Keywords: Inventiveness, creativity, technology science, methodology, innovation, reader ability.

Introduction

Invention is one of the key factors of modern progress in today's rapidly changing world that innovative thinking and creative approach is becoming the key to success in every field. In particular, in the educational process, the identification and development of inventive abilities of students became an urgent issue. The school of the 21st century is required to become an environment that is not only educational, but also an environment that encourages thinking, finding solutions to problem situations and a new approach. In many scientific sources it is stated that inventiveness is the potential to process existing information, find non-standard solutions and implement new ideas. Therefore, the modern education system requires the student to be an active and creative person, not a passive learner. Inventive abilities are especially important in the process of the formation of technological thinking and mastering modern techniques. Unlocking and developing students' innovative potential in the Republic of Uzbekistan has reached the level of state policy. In education, progressive areas such as "STEAM", "creative labs", "robotics" and "startup projects" are being gradually introduced in education. However, practice shows that "inventiveness" in schools remains more of an extracurricular circle or only related to gifted children. But in fact, it is possible to identify and develop the inventive abilities in every student – the main thing is the correct methodology and integration into science.

The discipline "technology" provides the most favorable opportunities for students to unlock their inventive and creative potential, to develop their constructive and problem thinking. However, for these opportunities to be realized effectively, teachers, methodologists, and textbook authors must actively use modern approaches.

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In this article the types of inventive abilities in students, the factors of their formation and the methods of developing these abilities in the framework of modern discipline "Technology" are analyzed on a scientific basis. Existing problems and their solutions will also be studied on the basis of advanced foreign and national experience. The main purpose of the article is to identify the most effective ways to develop inventive abilities in the discipline of "Technology" and to develop practical recommendations.

METHODOLOGY

In this study, modern pedagogical diagnostic, empirical and experimental research methods were strictly used to determine the types of inventive abilities in students and to study on a scientific basis the level of their illumination in the subject "Technology": at the first stage, the exemplary science program "Technology" approved by the Ministry of Public Education of the Republic of Uzbekistan (2022 edition), curricula and educational and methodological complexes for grades 8-10 (Uzbekistan Ministry of Public Education, 2022; State Education Standard, 2023) and singled out the competencies of "inventiveness" and "creativity" as the main object of study; Later, at the theoretical-analytical stage, the methodologies of creative education of the world experience (Torrance Creative Thinking Test – TTCT; Altshuller's TRIZ technology, 5E approach, STEAM model) developed assessment criteria corresponding to schools in Uzbekistan and selected the following as the main diagnostic criteria: (1) cognitive creativity – the ability to develop new ideas and proposals, (2) development of effective solutions to problem situations, (3) practical design and constructive activities, (4) design and aesthetic innovative approach, (5) The level of access to modern technology. At the empirical stage, 372 students in grades 8-10 from Andijan, Fergana and Tashkent regions were randomly selected from 15 secondary schools to take a modified Torrance test (based on figurative and verbal tasks, mini-projects on creative problem tasks, "think and practice", "create a new subject", "design design"); the questionnaire detailed each student's involvement in inventive activities, indicators of creativity and participation in innovative tasks on the subject of "Technology" (completion of at least 3 projects or design works); In parallel, a semi-structured interview was conducted with the teachers of the subject "Technology" of each school, to clarify the level of use of inventive methods (project activities, problem learning, elements of TRIZ, STEAM laboratory work, design and technical creative classes); at the experimental stage, special creative tasks, design and technological projects were implemented for the "Technology" lessons in 3 schools of each region (the "experimental group", 98 students in total), on the basis of which the results of the students were monitored for three months: the quantity and quality of creative products, the practical results of new constructive ideas and technical projects and their compliance with the science program; as well as the subjective assessments of students and teachers were processed by statistical analysis (SPSS Statistics 27.0, Mann-Whitney U-test, correlation analysis), the distribution of inventive abilities by type, the influence of methodologies on the effectiveness and level of creativity in the "Technology" lessons; during the study, the results of the Torrance test, the results of project and problem assignments, student and teacher surveys, monitoring of applied creative work were chosen as the main source as diagnostic and evaluation criteria, as well as modern assessment tools based on foreign experiences (creative self-efficacy scale, assessment cards for STEAM-

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integrated lessons, creative ratings with a TRIZ-approach) were used; Based on the results of the collected data, individual and group results for each type of inventive ability (cognitive, practical, problem, design and digital innovation) were clearly classified and a reasonable scientific analysis was carried out on the mechanisms of coverage and development in the discipline "Technology".

RESULTS

The results of the conducted scientific and practical research, based on specific figures and facts, include a comprehensive analysis of the level of inventive abilities of students, their types and the effectiveness of coverage in the subject "Technology": firstly, on the basis of a modified Torrance test of creative thinking, high creativity (total TTCT score of 130 and higher) was studied in the cross-section of schools the average creativity (TTCT score 100–129) accounted for 21.2% of students, 54.6% of students with low creativity (99 and below) – 24.2% of readers; In terms of types of inventive skills, "cognitive creativity" (analytical and ideological thinking) was strong in 39.8% of students, "applied and technical inventiveness" (design, design and development of technological solutions) was clearly manifested in 27.4%, "problem thinking and innovative activity" 22.9%, "aesthetic and design creativity" - 9.9% of students; In the gender section, design and aesthetics prevailed among girls, and design and problem thinking prevailed among boys (results $p<0.01$, Mann-Whitney U-test). Empirical data show that the creative efficiency of students who participated in project-based lessons in the subject "Technology" was 2.3 times higher than that of participants in traditional lessons: 71.2% of students in project and problem tasks created an innovative product (new design, mini-project, technological mock-up, creative program) related to inventiveness, while in the group of traditional "definition and test-based" lessons this indicator was only 31.4%; in experimental schools (98 students), during monitoring of the effectiveness of creative projects (3-month follow-up), an average of 2.4 creative products (a 3D modeled mock-up, a small device based on Arduino or other microcontrollers, a modern design project, a digital innovation platform or an ecological product) were created from each student, and the results were statistically significantly correlated with the student's TTCT score, project result and subjective assessment (Spearman $r = 0.63$; $p<0.001$); In the "Technology" lessons, project-based classes in the cross-section of methods for the development of inventions showed an efficiency of 82.3%, 76.9% efficiency on the basis of problem situations, 74.2% with the introduction of TRIZ technology elements, STEAM-integrated lessons showed 69.7% efficiency, and traditional laboratory work showed only 38.5% efficiency; In the analysis of teacher interviews, it was found that the most important factor for the development of inventiveness was the sufficient organization of project activities in the classroom (according to 95% of the teacher), individual approach to problem tasks and determination of the trajectory of personal development for each student (84%); creativity was found to be significantly higher in schools with modern approaches to "Technology" lessons than in schools with traditional curricula (average difference in TTCT scores was 27.3 points, $p<0.01$); in the process of analysis, it was observed that students' interest in technology and motivation to work on the project basis increased, at the same time the maximum efficiency was achieved in schools that introduced innovative tools - 3D printer, Arduino, laser cutting, robotics

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elements and digital design programs (the share of students with a TTCT score of 135+ in these schools was 29.5%, and in traditional schools it did not exceed 12.7%); The highest results of inventiveness were manifested through the creative lab and small innovative startup competitions organized on the basis of the project, where the inventive skills were strengthened by 87.4% of the pupils who participated in such training sessions, and each creative product was tested by teachers and independent experts on a 10-point scale; In conclusion, it is concluded that students' inventive abilities are formed not only through theoretical knowledge, but also through practical projects, technological creativity, development of effective solutions to problem situations and direct work with modern innovative tools, as well as as the increase in the number and quality of inventive-oriented tasks in each curricula of the discipline "Technology", the overall indicator of creativity and the ability of students to start a startup in the future, the level of involvement in innovative projects increases significantly; The results of the present scientific and statistical research confirm on a scientific and statistical basis the decisive role of the discipline "Technology" in the development of inventive abilities, the effectiveness of innovative approaches and the actual growth of students' creative potential due to the results of practical results.

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