

Technical Creativity of Students as a Means of Improving Quality and the Process of Integrating their Professional Training

Turakulova Marjona Kiyom kizi, doctoral student, Bukhara Engineering and Technological Institute, Uzbekistan

Tukhtaeva Zebo Sharifovna, Associate Professor of the Bukhara Engineering Technological Institute, Uzbekistan,

Rakhmonov Kakhramon Sanokulovich, Associate Professor of the Bukhara Engineering Technological Institute, Uzbekistan,

Hasanova Zebo Davlatovna, Associate Professor of the Bukhara Engineering Technological Institute, Uzbekistan,

e-mail: qaxa8004@mail.ru

Abstract.

The article examines the studies of identifying the main components and principles of the implementation of the process of preparing students for technical creativity, the development, theoretical justification and experimental testing of the methodology for preparing students for technical creativity, the process and ways of developing the quantitative level and degree of students' creative thinking, the requirements for students' technical creativity, main pedagogically substantiated and interrelated features and properties that characterize it, the stages of stimulating the development of creative skills of future specialist engineers.

Keywords: creativity, technical creativity, student preparation, thinking, student preparation methodology, specialist engineer, creative activity, component, principle, experience.

Introduction.

According to our analysis of theory and practice, the system of lifelong education of Uzbekistan has diverse, but not fully utilized, opportunities for preparing students for technical creativity; in addition, the functional, substantive and procedural aspects of students' technical creativity and its have still not received theoretical and methodological development integrative influence on the process of their professional training. This determines the urgency of the problem, which we form as follows.

In conditions of modernization of Uzbek education, there is a need for restructuring and rethinking the tasks of preparing young people for technical creativity, and in this regard, the definition of new content, methods and the construction of an integrative process of ongoing preparation for technical creativity.

It is important to note that in the works of M.I. Aliev, M.G. Garunova, V.N. Mikhelkevich, V.M. Radomsky, J. Shimshek and others consider systems for preparing for technical creativity and integrated learning technologies for technical creativity methods. Thus, the study of the process of preparing young people for technical creativity is carried out from the standpoint of the social order of society in the educational system.

The initial positions of the development of the problem of preparing young people for creative activity are reflected in the works of Russian scientists, like G.T.A. Blonsky, A.C. Makarenko, V.A. Sukhomlinsky.

The significance of the inclusion of youth in technical creative activity for the harmonious development of the personality is evidenced by the works of teachers: P.R. Atutova, Yu.K. Babansky, Yu.K. Vasiliev, V.G. Razumovsky, M.N. Skatkina and other researchers.

The theory of the formation and development of personality traits necessary for the implementation of creative activity was developed by psychologists B.G. Ananyeva, D.B. Epiphany, T.V. Kudryavtsev, A.N. Leontiev, Y.A. Ponomarev, G.M. Jacobson and others.

The implementation of technical creative activity in the classroom was studied by P.II. Andrianova, L.I. Galkina, E.F. Seer, V.D. Putilin at all.

The relevance of the problem, its lack of development in the system of higher technical education, determined the choice of the topic of the article: "Technical creativity of students as a means of improving the quality and the process of integrating their professional training".

The aim of the study is to identify the main components and principles of the implementation of the process of preparing students for technical creativity and the development, theoretical justification and experimental testing of methods for preparing students for technical creativity.

Materials and methods.

The subject of the study is the process of preparing students for technical creativity, taking into account its influence on improving the quality of ongoing training.[1-6]

We have the hypothesis that, the effectiveness of the process of preparing students for technical creativity increases if:

- 1) the preparation process includes the following components: socially-targeted, substantive-targeted, procedural;
- 2) the implementation of each component and the training process as a whole is carried out in accordance with the principles of:
 - openness of the process of preparing students for technical creativity;
 - motivation of students to active creative activity;
 - enriching the experience of technical creativity;
 - a combination of significant technical creativity with production-oriented creative activity;
 - the principle of combining objectively new and subjectively new in technical creativity;
 - a combination of the possibilities of incorporating both ingrained and promising directions in the development of science and technology into technical creativity;
 - a combination of individual and collective creativity.

The main points of the study are as follows:

- 1) identifying the main components of the process of preparing students for technical creativity and determining the relationship between them (social-targeted, procedural, substantive-targeted components);
- 2) the definition and meaningful disclosure of the principles for the implementation of the components of the process of preparing students for technical creativity;
- 3) development of a methodology for preparing students for technical creativity, the basis of which is a set of activities representing a cycle of development and creation of a technical object.

The theoretical significance of the study is;

- in clarifying the signs of the concept of “technical creativity of students”, taking into account the characteristics of the process of professional training of students in a vocational educational institution;

- in identifying a set of principles for constructing the process of preparing students for technical creativity and establishing their co-ordination, taking into account the components of this process.

It is difficult to find the field of a person’s inventive activity, where his mind manifests itself as vividly as in the ability to notice, unexpectedly identify, in an original and competitive way, and persistently solve the vital tasks of science and technology, including production. In the present period of time, the laws of technical creativity that have not been fully disclosed constitute one of the most complex problems of science. Productive components of the manifestation of the mind in inventive and scientific-technical discoveries are especially difficult to access. Particularly significant for creative activity and invention, attentiveness, ingenuity, patience, insight and resourcefulness in solving complex problems deserve attention from the various, namely, psychological and pedagogical sciences.

Continuous creative development expands the possibilities of human activity, transforms the world around us, creates something new in technology and in its continuous improvement. This requires a focused formation of education and the restructuring of the scientific and technical activities of specialists. At the same time, it is supposed to overcome such socio-didactic paradoxes as

- The priority of ineffective, but easily implemented developments;
- reduction of time and material resources allowed in the planning, design and manufacture of products;
- reducing the price of errors made at all stages of the creation of new labor products.

Training a future specialist in the new conditions requires the intensification of the scientific and technical activities of teachers, specialists, managers, scientists and the pedagogical system as a whole.

Specialists should strive to ensure that this system is organic and holistic. Here, organic means not only structural substantive components, but also the goals and objectives of preparing students for scientific and creative activities.

Of course, for us, the most important direction of the pedagogical process is the preparation of students for scientific and technical activity, and the increase in their creative activity. For this we need teachers who have a philosophy of technical creativity and a methodology for the development of creative activity.

Given the great urgency of the problem of teachers' advanced training and retraining of teachers in the fundamentals of scientific and technical creativity, in our study we will consider creativity as a branch of science, as an educational discipline, its structure, its philosophical foundations, and methods for enhancing a person’s creative activity.

This phenomenon reflects the highest level of intellectual development of modern society. The achievements of science, technology, art and culture largely depend on people who know and use the theory and methods of creativity and, in particular, scientific and technical creativity.

The solution to the problem of the development of technical inventive activity is associated with the methodological and theoretical understanding of the controversial situation characteristic of human interaction with a complicated technical environment. On the one hand, <http://annalsofrscb.ro>

it is necessary to master and increase national wealth, expressed in its subject-material form, on the other hand, to ensure the development of man as a carrier of public knowledge, enrich his subjective and personal world.

In the prognostic plan, it is important to determine whether a person will become a dependent on more and more advanced machines or, on the contrary, scientific and technological progress will be accompanied by the affirmation and elevation of a person, the further development of his intellect. In conditions when new perfect machines, mechanisms and automatic machines brought to life by the student's scientific and technical readiness are capable, in the absence of proper opposition, to make a person a "detail" of a complex technical system and to displace an unskilled worker from production, such social moral factors, such as: professional qualifications, competence, skill, specialist skill in dealing with the means of production. All this, however, is impossible without technical inventive activity. One of the most important tasks of scientific and technological progress is also to protect young people from the technocratic approach, the danger of the spread of which is increasing due to the increasing saturation of the technosphere.

Stating the value of the existing research in this area for constructing a general theory of the development of technical inventive activity, it is necessary, however, to note that, basically, they were devoted to the development of its individual aspects and problems, but the scientific and pedagogical comprehensive support of this process was not carried out and was not based on new trends in professional pedagogy (integration of professions, the relationship of general and vocational education, the intensification of the learning process, cooperation between schools, universities and enterprises). This situation holds back the development of the theory of development of technical invention and the possibility of its implementation in vocational, technical and labor training of students.[7-13]

So, theoretical analysis allowed us to simultaneously reveal that technical invention as a field of scientific knowledge has not been practically studied. And although the research focus of engineering and pedagogical work has always been given great importance, the engineer's scientific cultures are small, fragmented, and do not reflect the systemic vision of this problem. Until now, in the scientific and pedagogical literature there is no holistic concept of the formation of the technical inventive activity of a future specialist, the essence of the phenomenon under study, which would express its specific properties in modern processes of updating society and the university, would not determine the possibility of interaction between subjects of education in a continuous educational process University, aimed at the formation of students of this integrative quality.

Meanwhile, the study of the level of technical invention of students studying in a university has shown that the current system of training future specialists does not contribute to the development of professional motivation, which serves as an incentive for creative action, the search for new ways to solve professional, technical and engineering problems.

Thus, there is an objectively established contradiction between the all-round need of society for specialists with a high level of technical inventive activity and the actual state of solving this issue both in theory and in practice of higher education.

The formation of the fundamentals of technical invention of a future specialist should be carried out in the context of a holistic pedagogical process of the university from the standpoint of personality-activity and system-axiological approaches to determining the goals, content and technology of their formation.

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The methodological basis of the study is: the provisions of materialist dialectics on the enduring value of understanding the essence of human activity, participation in which transforms the personality, exalts its needs; ideas on the comprehensive harmonious development of the personality, its professional development; on labor and social production, on the connection of theory with practice; on the combination of training with productive labor; on the integration of science, technology and production.

In the research process, the following theoretical and empirical methods were used: analysis of psychological and pedagogical literature, theoretical modeling, analysis and synthesis, ascent from abstract to concrete, comparison, generalization, idealization, extrapolation, interviewing, questioning, analysis of products of technical inventive activity of specialists, university graduates, as well as a detailed pedagogical experiment in universities and industrial enterprises.

The scientific novelty of the research is that a pedagogical concept for the development of technical inventive activity of students has been developed, providing for the interaction of its substantive and professionally-active parties, taking into account their focus on improving the quality of engineering training, education and development of students, the formation of their creative skills and engineering thinking, providing professional development of mobile specialists.

Providing the creative abilities of university students, it is possible to identify trends in the development of technical invention of students in a university under conditions of accelerating scientific and technical progress on the basis of the laws of the process of teaching the basics of technical invention; to develop principles for its construction and conditions for their implementation; to identify the possibilities of enhancing the creative orientation of engineering and technical tasks on the basis of a personal-activity approach to learning; to develop an optimal system of didactic tools that take into account the professional interests of students (creative tasks, algorithms for students to solve them, a system of independent work, methods for assessing results, forms of work organization).

The significance of the study lies in the mass introduction of the developed system of teaching the basics of technical invention in the process of educational and practical training and in extracurricular activities at the university, which increases the level of qualification, stimulates the formation of a professional orientation of the personality, creates the prerequisites for a creative attitude of future engineers to their activities, reduces the time for inclusion in technical invention in production and increases their share in innovation and invention, provides the conditions for continuing professional education.

Technical invention of university students is an objective process in the technical, general engineering and vocational training of students, possessing integrative qualities of inter-scientific interaction (social, economic, scientific, technical, professional, psychological, pedagogical, physiological), the main source of development of technical invention is scientific and technical progress as a synthesis of science, technology and production.

As a pedagogical category, technical invention reveals the fundamental essence of the interdependence of personality formation, the conditions for the development of scientific and technological progress, and engineering training. It reflects the essential properties, relationships and relationships between them and transforms them in the educational, cognitive and research - creative process at the university. The pedagogical theory of the development of technical

invention includes a characteristic of the process of technical invention, its multicomponent structure and the totality of conditions for the effective functioning of this process.

Results and discussion.

Thus, the theoretical search for effective methods for the formation of creative skills of a future specialist engineer during his training involves solving the following problems:

1. To analyze the literature on the problems of the formation of creative skills.
2. To determine the content structure of the creative skills of the future engineer.
3. Theoretically substantiate the need for the use of new methods of forming the creative skills of a future engineer.

The renewal of society, and even more so its radical change, is a controversial, complex and lengthy process associated with the search for new ways, means of implementing transformations in all spheres of human life. All this necessitates the creative participation of all members of society in this process, since insufficient creative activity, lack of effective incentives for its development and implementation are the main factors that impede the implementation of new ideas, ideas, new goals and orientations.

The processes of democratization and humanization of society create an opportunity to choose the ways of life of its members, favorable conditions for the creativity of the development of each individual.

That is why in the conditions of the spiritual revival of society, the activities of educational institutions, from kindergarten to university, require specific changes that are caused by the need to form a socially active, creative personality, which is possible only if favorable conditions are created for the comprehensive development of each person's potential capabilities and his / her self-realization in the learning process.

The pace of scientific and technological progress has set the modern system of vocational and secondary specialized education the task of educating a creatively acting, intellectually and practically developed personality, capable of creative solution of ordinary tasks.

The implementation of these tasks requires the system of vocational education to organize such training, which would not only guarantee the acquisition of skills to adapt in an effective space, but also encourage their transformation and modernization relative to the needs of the individual and self-realization in a wide field of activities.

Meanwhile, the question of the possibility of learning creativity in vocational education is still uncertain. The concept of "creative skills", its structure, criteria and indicators of formation remain uncertain. Creative skills, which are indicated in the State Education Standard of the Russian Federation as the desired component, are not yet the task of education. And at the same time, a high level of the grading system is called "creative", which means that a systematic creative activity of the student and teacher should be organized with indications of its specific landmarks, attraction of relevant skills, demonstration of creative technologies, a system for studying the dynamics of qualitative changes, etc. d.

The quantitative level and a high degree of mastery of creative thinking indicate a person's ability to adapt, self-development and innovation. Creative skills are realized creative abilities of a person, the identification of which is a new product; they are the highest in the hierarchy of skills, provide human vitality, allow the creative potential of the individual to be realized, reveal themselves in the form of corresponding abilities. Each skill includes elements of

creativity. Some of them are determined ontogenetically and remain leading for the individual for life.[14-20]

The basis of success in the situation of solving the creative tasks of a future specialist engineer is a highly developed ability to carry out certain manipulations with concepts, images, ideas, where the main component of the psychological mechanism of human behavior is the high development of the person's internal plan of action. Accordingly, the creative skills of a future specialist in engineering are an integral quality of the latter's personality, which determines the ability to be creative and develop in the process of professional training and further professional activity. The creativity of an engineering specialist is manifested through the ability to create a creative atmosphere, see technical problems, find new original and productive ways to solve them, creatively using various objects. You can draw initial conclusions:

- 1) to date, among educators and psychologists there is no agreed, unanimous opinion on the structure of creative skills;
- 2) an important component of creative skills is the ability of a person to divergent thinking;
- 3) the decisive role is played by motivation (especially internal);
- 4) creative achievements are impossible without the assimilation by a person of general and specific knowledge related to creativity;
- 5) an important role is played by the positive emotional state of a person, faith in their abilities.

The following main components of the creative skills of future specialist engineers can be distinguished:

- 1) intellectual and logical skills: to analyze, synthesize, perform mental operations of comparison, highlight the main, the main, describe phenomena, processes, systematization, classification, abstraction, concretization, generalization;
- 2) intellectual-heuristic skills: the formation of hypotheses, the generation of original ideas, fantasizing, associative thinking, independent judgments, the ability to transfer knowledge and skills to new situations, see contradictions, problems;
- 3) communicative and creative skills: to defend one's point of view, convince others in the process of creative discussion, mastering the experience of other people, quickly mastering rational methods and techniques of creative activity, cooperation, productive communication, successful resolution of conflict situations during collective creative activity.

The most important qualities of a specialist engineer that contribute to successful creative activity are also identified:

- ability to non-standard solution of the problem;
- search-problem style of thinking;
- originality in all areas of its activity;
- creative imagination, developed imagination;
- specific personal qualities (courage, risk appetite, ingenuity, determination, optimism, enthusiasm, perseverance, confidence, quick wit, intuitive feeling of new, original, etc.).

Despite this, the list of the most important characteristics of the creative skills of a specialist engineer is not sustainable. An analysis of the psychological and pedagogical literature leads to the conclusion that the level of creative activity of a specialist engineer is determined, as a rule, depending on a particular direction of his professional activity.

It should further be noted that in order to determine the level of preparation of the teacher's activities in the formation of the creative skills of the future engineer, it is necessary to consider the various areas of his professional and his approach to determining the subsystems of the educational system of creative activity.

1. Motivational and creative activity and personality orientation. The interest of the individual, a sense of satisfaction from their activities, a desire to achieve new heights and success, initiative and the desire to be a leader, the desire for self-education, self-knowledge and self-education.

2. Intellectual and logical properties of personality. The ability to analytic and synthetic activities, to perform mental comparisons, to highlight the main, systematization and classification, induction and deduction, explanation, abstraction, concretization and generalization.

3. Intellectual-heuristic abilities of the individual. Basic intellectual operations: hypothesizing, generating original ideas, fantasizing, associative thinking, independent judgments, the ability to transfer knowledge and skills to new situations.

4. Worldview abilities of the personality, contributing to success in educational and creative activities. Worldview elements that determine the direction of the researcher's work: personal confidence in the social sense of creative activity for scientific, technical and social progress, methodological foundation of scientific achievements.

5. Moral qualities of the personality, affecting the success of creative activity. Honesty, as an integrative moral quality, including truthfulness, integrity, fidelity to the obligations undertaken, subjective confidence in the correctness of one's position, sincerity in front of oneself and other people.

6. The ability of the individual to self-government in the process of creative activity. Purposefulness, the ability to plan, the ability to self-realization of a person, the ability to self-control, the ability of a person to objectively evaluate their capabilities, individual characteristics and achievements.

7. Communicative qualities of personality. The ability to master the best practices of others, quickly learn new rational methods and techniques of creative activity, the ability to collaborate.

8. Aesthetic qualities of the personality. The ability to be guided in creative activities by the principles of harmony, beauty, symmetry, integrity.

9. Individual personality traits. The pace and style of activity depends on the temperament of the individual; performance as the ability to perform creative tasks for a long time.

In these subsystems, teachers can be at different creative levels:

1. Reproductive provides that the teacher, working on the basis of the developed techniques, recommendations, experience, selects those that are most appropriate for the specific conditions of his work, the individual psychological characteristics of students.

2. The innovative one provides that the teacher, based on an analysis of his experience, the specific conditions of his pedagogical activity, makes adjustments to his work, improves, and modernizes it.

3. Design involves such activities of the teacher, in which, based on his experience, knowledge of the psychological and pedagogical characteristics of the student team, using

existing techniques, the teacher designs his own version of the solution to the pedagogical problem.

4. Innovation provides for the solution of a pedagogical problem on a fundamentally new basis, it is distinguished by novelty, originality, and high performance.

Thus, a creatively-oriented teacher is a person who is characterized by a high level of creative skills (creative personality traits and additionally formed motives, personal qualities, abilities for successful creative activity), an appropriate level of knowledge of the subject, acquired psychological and pedagogical knowledge, abilities and skills which, under favorable conditions for the teacher's pedagogical creativity, provide him with effective pedagogical activity to develop the potential creative potential of students.

With all the diversity of the problems of forming a future specialist engineer as a creative person, preparing him for creative professional activity, the aspect of the formation of creative skills of engineering students in engineering schools is not sufficiently studied in the theoretical, methodological and methodological plans. At the same time, in the system of professional training of a future specialist engineer, at the initial stages of his involvement in technical self-realization, there is an especially great need to deepen the theoretical and practical preparation for creative professional activity, namely, there is an urgent need for techniques that improve the training of future engineers as creative personalities.

That is why a further perspective of this direction is the development of a methodology for the formation of creative skills of future specialist engineers in the process of their professional training in the study of the cycle of technical disciplines.

Based on the analysis of the basic content of various training courses, we can conclude that the subject area of the cycle of technical disciplines is most optimal for the formation of creative skills of a specialist engineer.

Formation is the pedagogical management of the individual formation of the human person. The process of forming a student's personality as a subject of creative social relations and productive creative activity is in essence a pedagogical management of the development of a person's potential creative abilities, the formation of such creative qualities that ensure success in creative activity, the individual formation of the student's personality as socially active.

The following are the steps to stimulate the development of creative skills of future specialist engineers:

- 1) motivational - at this stage, students form a positive motivation to perform creative actions;
- 2) activity - at this stage, students have the knowledge and skills in creative activity, personal qualities;
- 3) effective - at this stage, students develop skills in using previously acquired knowledge to solve problems in a specific given situation.

Below (Figure 1.) are indicated the stages of stimulating the development of creative abilities of future specialist engineers.

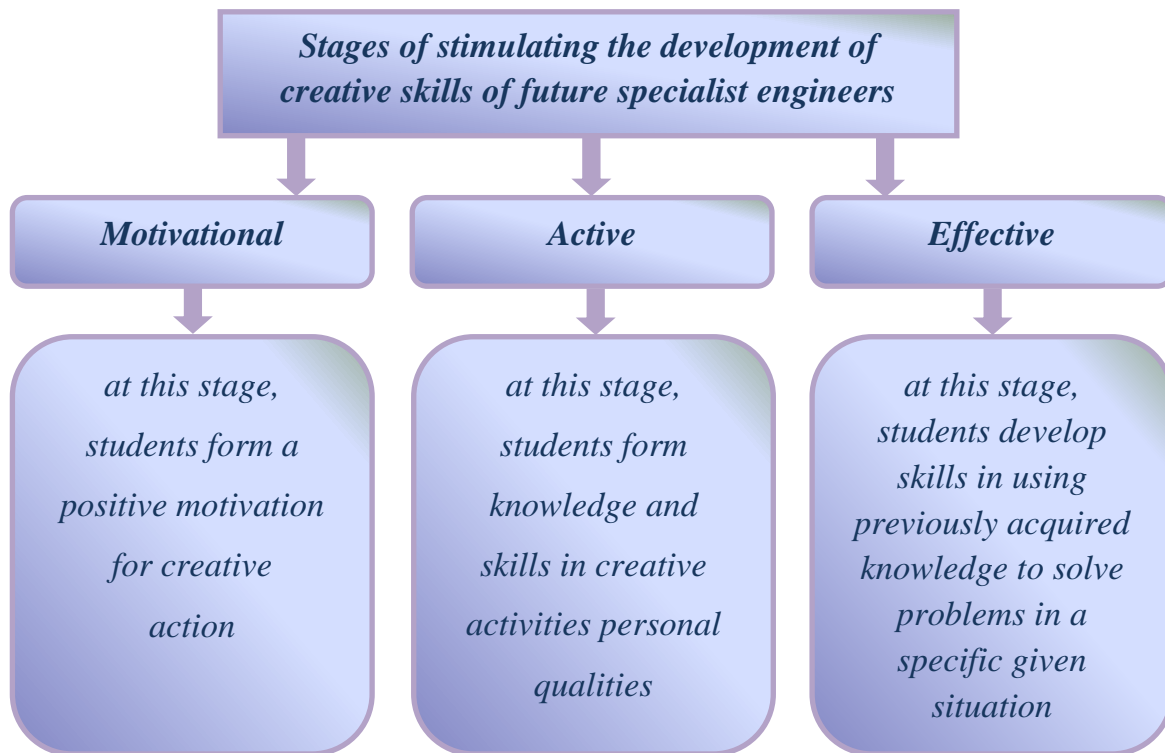


Figure 1. Stages of stimulating the development of creative abilities of specialist engineers.

The formation of the student's creative personality in the educational process should be considered as a process of facilitation (stimulation), that is, as the creation of conditions for facilitating, facilitating, stimulating, activating the development of students' creative abilities.

Experimental work confirmed the validity of the developed methodology, its compliance with the conditions for the implementation in practice of preparing students for technical creativity.

The expediency of building training on the basis of interdisciplinary connections and the process of its implementation through the subordination of various methods, means, types of activities, individual forms of work with students in classroom and extracurricular times is confirmed.[21-29]

The effectiveness of the process of preparing students for technical creativity using the established methods — creative technical tasks and creative technical tasks (with their modifications), as well as the possibility of content preparing students for technical creativity has been confirmed.

The developed level methodology of pedagogical guidance for students acquiring experience in technical creativity ensures the construction of the educational process on the basis of a combination of creative tasks taking into account the capabilities of academic disciplines and each student; allows you to establish the connection of knowledge and skills in general subjects, special disciplines and industrial practice and provides the conditions for the formation of students' creative activity in technical creativity.

In the experiment, the following directions were established and tested for the implementation of the second block component of the content of preparing students for technical creativity, which provide a positive effect: the inclusion of additional supporting and auxiliary

tasks; the introduction of independent topics in basic academic disciplines; building knowledge on a cross-subject basis; special course development.

The developed set of objective and subjective criteria and performance indicators provides the possibility of ongoing monitoring and final assessment of the effective impact of student participation in all forms of technical creativity on the quality of their professional training.

The reality of the implementation of technical creativity of students in the process of their professional training is confirmed.

Conclusion.

The stated goal of the study reflects the social order for education to prepare students for technical creativity. Achieving this goal involves reaching the didactic level of development of the research problem, allows to overcome a number of contradictions: between the level already achieved and the changing requirements for the content and nature of creative training; between the universality of the goal and the limited capabilities of those tools that are available in the framework of private methods.

Consideration of the preparation of students for technical creativity as a didactic task allowed:

- consider the preparation of students for technical creativity as a stage and an integral part of introducing students to technical creativity in the system of their professional training;
- carry out the development of the content of this training, which reflects the totality of activities, firstly, the cycle of development and creation of a technical object, and secondly, the knowledge and skills associated with this process necessary for the implementation of technical creativity;
- identify and test in practice the training methods that ensure the effectiveness of the implementation of its content, only if they reflect the specifics of technical creativity as a special type of social creative activity;
- provide for a sequence of creative technical tasks and tasks of various difficulty levels (corresponding to the levels of pedagogical guidance of students 'technical creativity) that enrich the individual experience of students' creative activity;
- to prepare students for technical creativity in accordance with the developed theoretical model, which reveals the most significant links between the goals of preparation, its content, process and results;
- to determine the totality of objective and subjective criteria corresponding to the main directions of enriching the experience of technical creativity and assimilation of knowledge and skills envisaged by the content of training.

Taking into account the peculiarities of the process of preparing students for technical creativity, we have identified the following components of this process - socially-targeted, substantively-targeted, and procedural. The implementation of each component of the process of preparing students for technical creativity was carried out taking into account the following principles:

- openness of the process of preparing students for technical creativity; students motivation for active creative activity;
- enriching the experience of technical creativity;

- a combination of significant technical creativity with production-oriented creative activity;
- a combination of objectively new and subjectively new in technical creativity;
- a combination of the possibilities of incorporating both ingrained and promising directions in the development of science and technology into technical creativity;
- a combination of individual and collective creativity.

Thus, when analyzing the process of preparing students for technical creativity, its theoretical justification and experimental verification, we proved that the preparation is based on the developed content, subordination and purposeful use of various means, methods, organizational forms, types of activities (and their individual manifestations) in the unity of classes in the classroom and extracurricular time. We have identified the requirements for the technical creativity of students, characterizing its basic pedagogically sound and interrelated features and properties, enshrined in the following meaningful and objective principles:

- a) a combination of objectively new and subjectively new in technical creativity;
- b) a combination of the possibilities of incorporating both ingrained and promising areas of development of science and technology into technical creativity;
- c) a combination of individual and collective creativity of students. These goal-oriented principles are concretized in substantiated directions of enriching individual experience of technical creativity, as well as in criteria and performance indicators of preparing students for technical creativity.

The obtained results of the theoretical and experimental stages of the study allow us to conclude that we have achieved our goal, solved problems in general, and confirmed the hypothesis of our study.

The study does not exhaust all the problems of the development of technical creativity. Promising areas of research into the technical creativity of young people include the implementation of the principle of continuity in preparing students for technical creativity in the system "school - technical school - university"; the intensification of the activities of technical creativity circles in the direction of innovation and invention; current trends in the management of technical creativity.

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