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IMPROVING THE METHODOLOGY OF DEVELOPING FUTURE ENGINEERS' TECHNICAL THINKING SKILLS

[1]Yarlakabov Umirzoq Mamatkulovich

[1]Associate Professor, Doctor of Philosophy in Pedagogy, Department of Professional Education, Jizzak State Pedagogical Institute, Uzbekistan.

Abstract

This article provides ideas and feedback on the development of skills of future engineers in technical thinking, knowledge of technical language, self-activation, mobility, creative thinking, modern didactic tools and effective use of electronic information resources. Scientific analysis on the formation of professional competencies such as invention, design, technology, technological thinking, troubleshooting, detection and elimination, technical diagnostics, repair and adjustment have also been disclosed.

Keywords: ingenuity, design, technology, technological thinking, troubleshooting, mobility, creative thinking, technical thinking, knowledge of technical language.

INTRODUCTION

Problems of formation of specialists' independent thinking skills in "Lifelong learning" educational programs are relevant in the theory and practice of pedagogy in the world. In accordance with the UNESCO Convention on Technical and Vocational Education, the professional thinking and creativity of students through the creation and implementation of innovative technologies of educational services in accordance with the requirements of the labor market in the context of globalization and the development of creative skills are very important.

In international pedagogical practice, technical multimedia programs aimed at the formation and development of important professional and personal qualities play an important role in the preparation of students in the field of technology for professional activities. In this point, in today's context of the Fourth Industrial Revolution, as a result of frequent changes in the requirements for the quality of training of future vocational education teachers, their professional independence and technical thinking skills are important. Their professional motivation, diagnostics and ingenuity, technological mapping and management, visual modeling (Visual Simulation), self-activation, mobility, positive "I-concept", search and processing of technical information and the effective use of modern didactic tools and electronic information resources in the process of shaping reflexive abilities contribute to the development of integrative technical knowledge and skills.

Literature review

In higher education institutions, the student should receive such a basic professional knowledge that the knowledge will allow him to master the ever-expanding horizons of his future profession with the relative ease. Any professional activity has its own content and can be determined by the laws of organization and implementation of the activity. Before identifying the aspects of the activities of a

future vocational education teacher that are the objects of research that differ from the activities of specialists in other fields, we will consider the main components of the activity.

"Activity is a specific form of people's socio-historical life, which is the purposeful transformation of human natural and social existence. Any activity performed by the subject includes the goal, the engine, the process of change and its outcome. In carrying out the activity, the subject itself significantly changes and develops "[17; 3-p].

An interesting and unique structure of activity(in many respects) was developed by V.S.Lednev and it was called "invariant" [21]. The founders of this theory are V.V.Davidov, A.N.Leontev and others [17,22,23].

V.S.Lednev proposed to consider two major components of human activity, namely invariant and morphological. Invariant constituents are "non-real components of a particular type of activity that represent any type of specific activity." "Morphological forms of human activity are real and relatively independent forms of activity in social life" [21]. According to his concept, the appearance of invariant activity represents the internal plan of an action, and the types of morphological activity represent the external plan.

Analysis of the work of V.A.Slastenin [30], V.A.Kan-Kalik [19], I.Ya.Lerner [23] and others, the development of both pedagogical and special professional thinking, the characteristics of the intellectual process in students, taking into account the many factors of the educational process, helps to use forms and methods that allow students to develop more effectively in teaching and is a necessary condition for his professional training - he concluded.

By studying the structure of technical thinking skills M.G.Ageeva [12], T.V.Kudryatsev [20], Yu.Z.Gilbukh [16], V.N. Maksimova [25] E.S. Chugunova [32], I.S. Yakimanskaya [33], M.V. Mukhina [27] and others did research.

Research Methodology

Technical thinking is a set of intellectual processes and their results that provide solutions to the problems of professional and technical activities (design, technological, arising in the repair and maintenance of equipment and others) [24].

Technical thinking is the process of solving technical problems, just like any other thinking. It is the characteristics of the technical material that determine the specificity of the activity, the method of performing operations with this material in many respects. This leads to the development of certain aspects of thinking, as well as a certain structuring of its components [24].

Technical thinking, like any other type of thinking, is done using certain thinking operations (comparison, contrast, synthesis, classification, etc.). Its peculiarity is only that the operations of thinking listed above in technical activity are carried out with technical materials. The term "technical thinking" has recently appeared in the psychological and pedagogical literature and is often understood intuitively by the authors. Many researchers [26] believe that the production of technical thinking is a process of reflection of technical processes and objects, their structure and principles of operation in the human mind, as well as the passage of thought processes in the field of technical images. There are also attempts to limit the content of the concept of "technical thinking" and to introduce a new concept of "technological thinking". The ability to think technologically means "the ability to consciously direct their activities in any production environment, in different newly created conditions, the ability to clearly imagine a whole set of events in the process of detail preparation, their sequence in different possible variants; to compare, evaluate and select the most appropriate of these options "[15].

There may be a need to include both of these concepts and to differentiate their content, but we believe that this is not the case in our study.

Since technical thinking is carried out in the process of solving any problem in the field of technology (inventive, design, technological, etc.) [31], the solution to the problem of its specificity is approached from the point of view of analyzing the characteristics of technical problems. An attempt was made to describe and explain all possible types of technical issues from it. This, in turn, made it possible to articulate the requirements for technical thinking.

In particular, V.V. Chebishev divided all technical issues into 2 types:

- diagnostic (from the possible set of signs that arise as a result of certain reasons, it is established that the signs correspond to this set);

- predictive (establishment of possible consequences in the selection of measures from which it is necessary to select the optimal one for this set of conditions from several possible solutions).

According to the author, it is expedient to divide technical issues into two groups: creative (constructive and technical issues, issues related to design and rationalization of technology); non-creative (planning and organizing activities, regulating work processes) [31].

This means that technical issues may include very complex, but not very creative, issues (such as the use of diagrams and operations on images).

In our opinion, technical thinking can be considered as a type of practical thinking (as opposed to theoretical thinking) because it belongs to the types of professional activity, and it is characterized by the following features: the need to solve various problems based on professional activity; high uncertainty of the initial situation; high demands on the level of observation of private details, which are an indicator of hidden complex processes; high level of variability of possible solutions; it is not at all necessary to know in advance the whole solution in solving practical problems, since the implementation of the first stage allows to determine the problem of the next stage; a high level of ability to move quickly from thinking to practical work and vice versa, because thinking is embedded in practical activity and the decision-making process, which takes place in a very short time, is directly examined.

The formation of technical thinking skills is a complex process and is slow and depends on a person's general intelligence, practical skills, abilities and other factors. Therefore, the study of the content and structure of technical thinking requires a systematic approach. Therefore, we envisioned the process of technical thinking that will be formed in future vocational education teachers in the areas of vocational education in higher education institutions as a whole, with a number of interconnected organizers, a system of stable interactions and equal unity.

An analysis of modern technical problems and comparing them with 20-30 years ago shows that if previously it was enough to use natural language enriched with technical terms to describe and solve these problems, today in most modern technical problems drawings, diagrams, diagrams are free it is necessary to master a special language called technical language in order to understand. Technical language serves as a kind of connecting link between theory and practice. The peculiarity of any technical scheme is that certain concepts in it are "coded" using one or another symbol. To determine what is depicted in a diagram, it is necessary to know well the conditional symbols and functions of some of its parts.

Thus, mastering the language of technique is essential because the feature of technical objects is that they have descriptions so that experts can visualize and use the desired object according to such descriptions. Technical issues are also very often given in the form of conditional symbols. It is necessary to "re-encode" the information given in such a specific form. Therefore, mastering technical language is a necessary component of technical thinking skills.

One of the components of technical thinking skills is agility. Agility is the ability to observe or direct the flow of work quickly, in a timely manner, problem solving and other skills.

With the rapid development of science, engineering and technology today, research - operational activity is becoming one of the main types of professional activity of the future teacher of vocational education.

The research-operational activity of a future vocational education teacher is interactive in its structure and includes the following complex types of work: technical diagnostics - technical diagnostics as a determination of the technical condition of machines and mechanisms; repair - repair and troubleshooting; adjustment - working condition, adjustment, correction (Fig. 1).

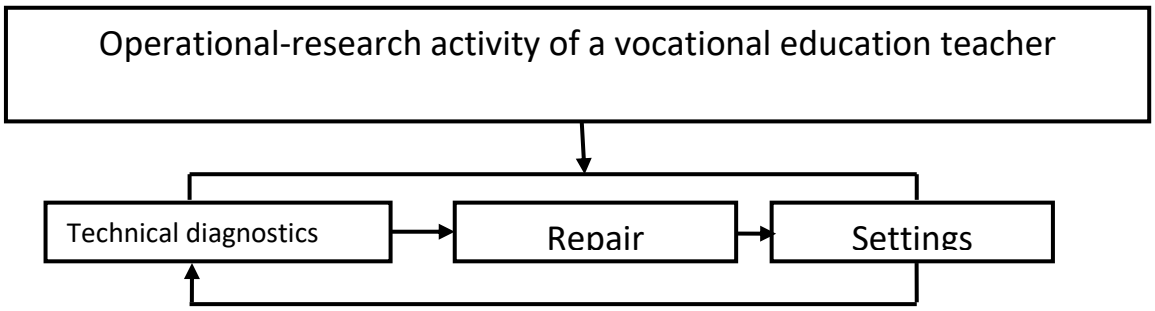

Figure 1. *Operational-research activity of a vocational education teacher*

The troubleshooting process includes the three components listed above. In the first stage the fault is detected (technical diagnosis), in the second stage the fault is eliminated (repair), in the third stage the inspection and correction (adjustment) is carried out. In case of any deviation from the work of the machine (machine), the sequence of three-component research-operational algorithm is repeated until the required parameters of the equipment are adjusted to the norm. Thus, the important factors influencing the formation of technical thinking in the training of specialists in these professions include various types of creative and constructive activities throughout the educational process. Thus, from the moment of fault detection, the search, which includes the commissioning of the equipment, as a final stage of operational activity, creates a scheme of interconnected and sequential actions. From what has been said, it seems that there must also be a reflexive component in the structure of technical thinking.

Reflexive component - (Latin reflexo - looking back) the process of thinking, self-observation, self-awareness of their actions and their rules, self-awareness of internal psychological acts and situations by the subject. Figure 1.2.2 shows that the process of technical thinking begins with motivation and ends with reflection.

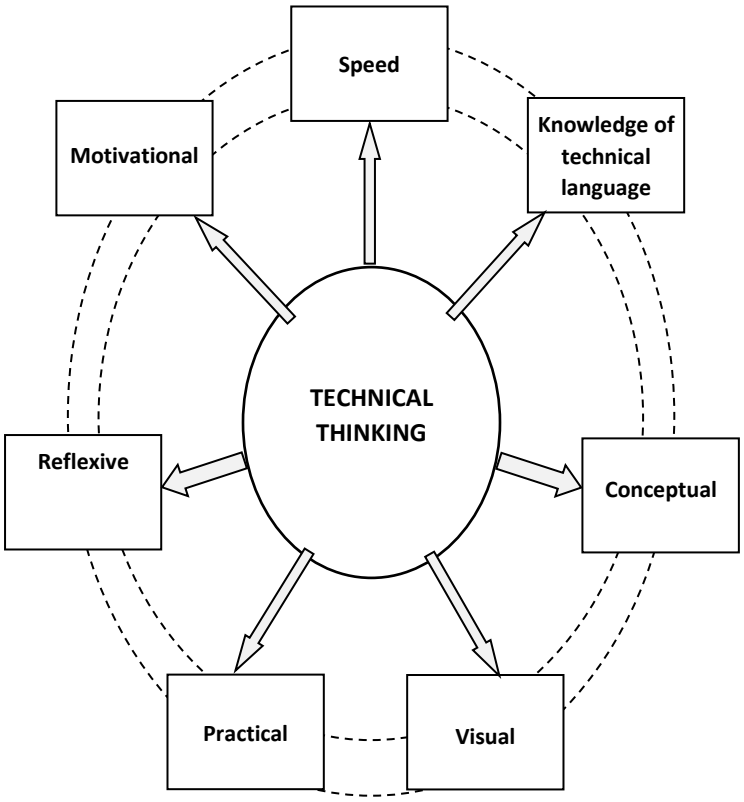

Figure 2. *The Components of the integrative structure of a vocational education teacher's vocational thinking skills*

According to A.M. Novikov, reflection, on the basis of previously accumulated experience, allows to create its own new, previously non-existent feature, qualities [28]. This, in our view, is the basis for distinguishing the reflexive component of technical thinking skills. Our experience shows that the effectiveness of the formation and development of technical thinking of future teachers of vocational education is realized in the process of technical creativity of the student, his creative and constructive activity.

As can be seen from Table 1, the process of solving a technical problem - from the idea to the creation of the finished product, then covers the design of technical documentation, that is, all the components of technical thinking that we have identified.

Table 1. *Algorithm for solving technical problems and decision-making in the process of creative and constructive activity*

Stages of solving technical problems	**Result**
1. Formation of alternatives to technical issues and project topics	Putting a technical issue and deciding on a future project topic
2. Search for the principle of operation of the future technical device	Deciding on a leading technical idea for a future device
3. Analysis of possible alternative models of technical device	Deciding on the ideal model of the future technical device
4. Design of technical equipment	Deciding on the shape of the future technical device
5. Building and tesingt a working model	Deciding on model quality, making changes, rationalization
6. Creating and testing an experimental sample	Deciding on the degree of suitability of the experimental model to the ideal model
7. Execution of technical documentation, economic calculations	Deciding on the appropriateness of introducing the device into production

The analysis of research on the formation of technical thinking, which we discussed earlier, allowed to determine the degree of formation of this type of thinking, the qualities that can be diagnosed in the learning process, which is important to increase the manageability of the process of forming a professionally important type of thinking. The following are the qualities:

- integrative: technical thinking is carried out using images, concepts, and actions that are closely intertwined and interconnected. In solving real technical problems, the ability of a future teacher of vocational education to look at the object of thought from all angles is very important. The teacher must be able to anticipate the design, technological, economic and other aspects of the decision, its consequences;

- creative character: technical thinking should be practiced in situations characterized by a high degree of uncertainty. This, in turn, requires the teacher to have the following creative skills: finding and posing problems; support for a wide variety of ideas; non-standard response to standard motors, speed - the need to solve many production - technical problems in a limited period of time and the solution of "unplanned" problems that arise during the operation, etc.

Very important didactic methods aimed at the formation of creative skills are the solution of inventive problems, the analysis of rationalization proposals and the acquisition of advanced production experience.

In order to develop creative technical thinking, it is especially important to involve students with creative potential in different aspects of

research work. The development of students' thinking is most effective not only in the teaching process, but also in extracurricular activities with them in clubs and technical creativity sections [14].

The following main areas of formation of technical thinking skills of future vocational education teachers are identified: a set of methods for diagnosing technical thinking skills should be developed and implemented, which will allow to determine the individual level characteristics of the student; Small groups of future vocational teachers will be formed on the principle of "idea generator - support laboratory", taking into account the characteristics of the formation of technical thinking skills; heuristic problems have been introduced into various forms of the educational process, which allows to develop the motivation to study the technical direction of the resources of methods of solving non-standard production situations of professional activity. Therefore, at the formative stage, in accordance with the proposed hypothesis, based on the test results, groups of students were offered design assignments on the principle of solving educational problems and creating small creative teams.

The students in the small groups of 5-6 people we formed worked on the “Idea Generator - Support Lab” scheme. In this option, it was possible to set and solve heuristic problems of varying levels of complexity. The idea of the solution was identified by the "Idea Generator", and members of the "Support Laboratory" group provided assistance in searching for information, calculations, modeling, documentation and easier problem solving. Educational motivation, educational resource and interdisciplinary learning issues are necessary for the formation of technical thinking skills in future vocational education teachers. Such a set of issues includes issues related to selection and recall, comparison and generalization, interpretation and verification. In the formation of technical thinking skills in general disciplines (engineering graphics, electrical engineering and electronics, metrology, standardization and certification, resistance of materials, theory of machines and mechanisms, machine parts, materials science, etc.), future vocational teachers have the main cognitive resources. In order to activate students' thinking activities, it is necessary to motivate them to solve technical problems. For this purpose, taking into account the interests and abilities of students, explanatory drawings, graphics, visual pictures from everyday life were widely used in the academic disciplines, creating problematic situations.

It should be noted that the educational resources of the base enterprise play an important role in the formation of technical thinking skills in future teachers of vocational education. Student training and internships were organized at enterprises. For example, in order to comply with the rules of safety and training of the enterprise DAEWOO SERVIS, located in Jizzakh, students were offered any problematic situations of a technical nature or less familiar issues. In order to study the conditions of non-standard production, a roundtable discussion was held with employers and was organized in the form of a professional interview and safety instructions. Internship supervisors and production masters (masters) focused the students on the complexities of production equipment, interesting technical solutions. Many students participated in exhibitions of scientific and technical creativity and professional skills competitions. Gains experience in communication with a professional interlocutor on technical topics, creates a certain terminology and technological reserve, the general area of professional communication determines the motivation for students to study and understand the technical level in production. Upon completion of the formative phase, we analyzed the diploma projects of college students of the last three years, as well as the feedback and reviews of supervisors.

For example, supervisors of graduate work analyze, summarize, defend, determine the ability of students to independently formulate and solve a creative problem, the ability to make a solution independently, in their own views, in the process of its implementation. In our opinion, the most effective way to transform theoretical knowledge and skills is

through practice (2-3 courses). Each type of internship allowed for the correction of students ’production activities and professional behavior, helped to form technical thinking skills, and addressed production issues in non-standard ways.

The analysis of production practices showed that the analysis and innovation of production processes in enterprises builds students' technical thinking skills that motivate them to production activities. In the fourth year, they know how to categorize successful work experience, demonstrate the strengthening of their professional skills, solve creative, non-standard problems, compare, analyze based on reflection and self-control, and realize the relationship between goals, means and results of their actions.

The formation of technical thinking skills of future teachers of vocational education in higher education institutions is carried out in the process of studying general and special disciplines, a dynamic and variable form of organizing goal-oriented activities and communication of teachers and students, including methods and tools.

Improving the training is done in the following three sequential and interrelated stages: preparation for the training, conducting it, and self-analysis. In the process of preparing for a lesson, it is necessary to define and formulate the purpose of learning, to define the essence of the subject of the lesson, because the purpose of the lesson is a clear model of knowledge, skills and abilities that must be formed in students. Determining the educational purpose of a training session poses a number of challenges. Therefore, in the training sessions, we tried to arouse the following feelings in the students: admiration, pride, respect, responsibility, duty, and so on.

The developmental goal of the training is realized in the following two areas: 1) memory development, technical thinking, literate speech techniques, cognitive interests and others. These are manifested at the level of formation of knowledge, skills and abilities; 2) developing a sense of self-realization in the community.

The formation of technical thinking skills in students can be done through a variety of methods and techniques, including problem-based learning, programmed learning using card-assignments (tests), various independent work in the form of diagrams and tables. When preparing for a training session, it is necessary to select only the basic, basic material that represents the essence of the science being studied for in-depth processing in the training session. Secondary, introductory materials should be given to students in an abbreviated form or outside of class for independent processing. It is advisable to explain the information of practical and production nature (rules of use of equipment, methods of work, etc.) during the laboratory, practical training and introductory training.

By defining the purpose and content of each subsequent lesson, we determine the sequence of describing its content, i.e., the structure and content of each constructive element of the lesson.

Students actively think that a piston made of aluminum alloy produces lighter and less inertial forces, but a large crack is provided in the piston sleeve joint. The formation of students' technical thinking in the classroom is related to specialization, so we use them in a systematic way to solve problems. For example, in the study of "General structure of the car engine" the following exercises can be asked: to determine the degree of compression in the engine cylinder. In this exercise, students must first determine the working and full volume of the cylinder, and then the degree of compression. Students complete this task in the final part of the lesson, the following options can be suggested as homework: why a car engine of the same working volume (approximately V=1,5 l) produced in 2001 "Nexia" produced in 2012 "Nexia" -2 ”is about 0.5 times smaller than the engine? What technical parameters does the ratio of piston diameter to its length affect? Which internal combustion engines are long-range and which are short-range? Which definition depends on

the size of the combustion chamber and the entire volume of the cylinder? In the process of addressing these issues, students independently conduct academic research and then substantiate or validate the issues they have raised in the previous session.

Analysis and results

Jizzakh Polytechnic Institute, Bukhara Institute of Engineering and Technology and Samarkand State Institute of Architecture and Construction named after Mirzo Ulugbek were selected as the venues for the research project. It was found that the teaching of general sciences (resistance of materials, theory of machines and mechanisms, machine parts, automotive structure and thermal engineering) in the chosen direction is traditionally carried out according to the following scheme: lecture as a leading form, then practical and laboratory practical training, then projects, practice and finally the final control. The analysis of the rating scores of students in these subjects (based on the records) showed that general professional subjects are difficult to master for most students. With this in mind, the main goal of the experimental work was to find ways to effectively develop technical thinking skills in future teachers of vocational education.

The opinions of the second subject-teachers were also collected and analyzed, so that the information received was not one-sided, that is to write, not received from only one of the subjects of the educational process (students). Because teachers are professionals in this activity (deep general, technical and technological knowledge). It is very important to know their opinions about the content of the concept of "technical thinking", the dynamics of professionally important types of thinking in the study of technical sciences, as they have knowledge about the degree of formation of this or that type of thinking in students.

The main tasks of the first stage of the experimental work are: 1) to determine the initial level of formation of technical thinking skills in future teachers of vocational education; 2) to determine the impact of technical thinking skills formed on future vocational education teachers on the acquisition of technical knowledge.

A total of 465 people participated in the study, of which 78 were girls and 347 were boys. The teachers are 40 people, 15 of them are women and 25 are men, with work experience ranging from one to 35 years.

The following were selected as the main research methods:

1. Bennett test - a standardized test to assess the level of formation of technical thinking skills (reading drawings, understanding the schematics of technical devices, assessment of skills in solving simple technical problems) [29].

2. Specially designed questionnaire for students (Appendix 1).

3. Specially designed questionnaire for teachers (Appendix 2).

The Bennett test was used to determine the initial level of technical thinking skills in future vocational education teachers [29].

This test is designed to assess a person's technical thinking skills, in particular, the ability to read drawings, diagrams, technical devices and their disassembly, to solve simple technical problems. Students participating in the experiment were presented with 70 pictures. Some examples of them are given in 11 appendices.

The Bennett test distinguishes the following three levels of technical thinking ability formation: very low, low, medium, high, very high.

The results obtained from the Bennett test are given in Table 2 below.

Table 2 *The Levels of initial technical thinking skills formed in future vocational education teachers*

The level of formation of technical thinking skills	The number of students in the field of automotive engineering is 110 people (senior students)	The number of students in the theory of machines and mechanisms is 115 (3rd courses)
Very low	18	21
Low	37	40
Medium	30	34
High	18	16
Very high	7	4

As can be seen from this figure, 55 out of 110 students (59%) in the field of "Automotive Structure" and 61 out of 115 students (54%) in the subject "Theory of Machines and Mechanisms" have below average technical thinking skills.

The analysis of the results of the work of future teachers of vocational education on solving technical problems was carried out by them in the process of solving standard technical problems in the general disciplines "Theory of Machines and Mechanisms" and "Automobile Construction".

The main tasks of the third stage of experimental work are:

1) development of a methodology for the introduction of the developed system of teaching and diagnostic tasks in the educational process;

2) to test the system of teaching-diagnostic tasks aimed at the formation of technical thinking skills in future teachers of vocational education.

Experimental work on the introduction of a system of teaching and diagnostic tasks in the educational process in general subjects, aimed at the formation of technical thinking skills in future teachers of vocational education, was conducted in 2015-2017.

In 2015, the experimental work was attended by 3rd and 4th year students of vocational education in the field of "Ground transportation systems and their operation." The results are shown in Table 3.

Table 3 *The results of the analysis of the initial level of formation of technical thinking in students in the experimental and control groups*

The degree to which technical thinking is formed	**Control group (Vehicle structure 100 students)**	**Experimental group (Car structure 105 students)**	**Control group (Theory of Machines and Mechanisms 100)**	**Experimental group (Theory of Machines and Mechanisms 110 students)**
Very low	20 (20%)	20 (19,14%)	18 (18%)	20 (18,1 %)
Low	38 (38%)	39 (37,13%)	42 (42%)	38 (34,5%)
Medium	26 (26%)	28 (26,7%)	26 (26%)	30 (27,5%)
High	10 (10%)	12 (11,4%)	10 (10%)	14 (12,2%)
Very high	6 (6%)	6 (5,7%)	4 (4%)	8 (7,6%)

The diagram constructed according to the table shows that the low level of formation of technical thinking skills in students in control and experimental groups is almost the same (Figure 3.2.1).

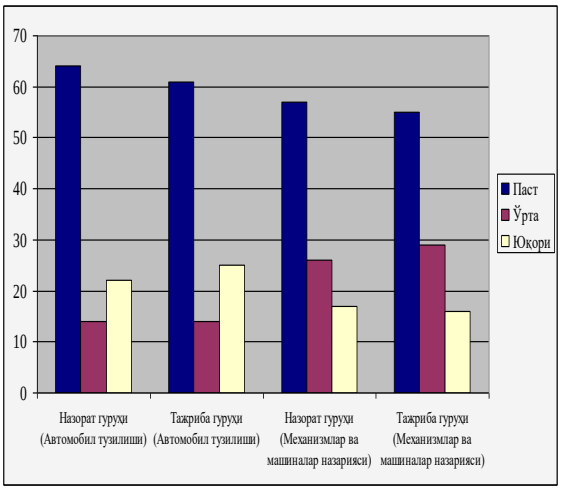

Figure 3.2.1. *Dynamics of the initial level of formation of technical thinking in students in experimental and control groups*

The criterion χ^2 (xi square) was used for statistical processing of the obtained data [18]

$$\chi^2 = \frac{1}{NM}\sum_{k=1}^{m}\frac{(MP_k - NV_k)^2}{P_k + V_k} \quad (1)$$

Here: χ^2 - results of observations; P_k is the frequency of pre-experimental observations; V_k is the frequency of post-experimental observations; m is the number of degrees; N is the number of students in the control group; M is the number of students in the experimental group.

Processing of statistical data on the results of both disciplines showed that the difference between the experimental and control groups was almost insignificant, that is,the " χ^2 square criterion" was 7.25 for the theory of machines and mechanisms and 8.75 for the science of automotive engineering. smaller than its 9.49 value in the table (achievable with a probability of 0.005).

In the experimental work in 2017, students were trained on the basis of specially developed assignments for 8 semesters on the subject "Automotive Structure" and 4 semesters on the subject "Theory of Mechanisms and Machines". The results obtained by combining low and very low values for low and high and very high values for high values are given in Table 3.2.4 and.

GENERAL CONCLUSIONS

In the process of theoretical and empirical research, the following conclusions and recommendations were drawn in accordance with its goals and objectives:

1. Research and analysis of sources, research on the preparation of future teachers of vocational education for professional activities have shown that the issue of formation of technical thinking skills in them is not sufficiently studied as a pedagogical problem.

2. Technical thinking is formed in the process of performing intellectual operations (analysis, synthesis, comparison, generalization, etc.), but their course has a special direction, depending on the purpose and the problem to be solved in theoretical and practical, based on the presence of reproductive and productive and visual forms.

3. Based on a systematic approach, technical thinking skills have an integrative structure consisting of seven components (motivational, conceptual, figurative, practical, agility, technical language, reflexive), the content and interrelationships of each component are identified and technological knowledge is generated. the content of motivational, figurative, agility, and reflexive components was improved through synthesis based on the principles of reflection.

4. Invariant teaching methods such as "speed sketching", "information failure" and "time constraints" and their application in the teaching of general subjects, which are effective in the formation of technical thinking skills in future vocational education teachers, have been developed.

5. The content of each component reflected in the model of formation of technical thinking skills, including components such as purpose, content, process and outcome-assessment in the context of modernization of higher education institutions. Qualification requirements for future teachers of vocational education are considered as a social order, in which the purpose, components, pedagogical conditions, stages, criteria for assessing the readiness,

levels of the process of formation of technical thinking skills are scientifically and methodologically substantiated.

6. In order to improve the methodology of formation of technical thinking skills of future teachers of vocational education created on the basis of non-standard technical issues aimed at developing technological and creative abilities and visualization of the Bennett test.

7. Based on the analysis of the results of experimental work aimed at improving the methods of formation of technical thinking skills of future teachers of vocational education, it was determined that the use of a special system of tasks for the formation of technical thinking skills is effective. High level of thinking formation increased by 14.5%, medium level by 11%, as well as high level in the field of "Automotive Structure" by 8%, medium level by 16%; an increase in the level of formation of technical thinking skills was found to improve the quality of technical knowledge acquisition (average score increased from 3.6 to 3.9 in the experimental group and almost unchanged in the control group). The obtained results confirm the effectiveness of the experimental work. This indicates that the experimental work was set up correctly, as well as that the research was done correctly.

Based on the results of the research, the following methodological recommendations have been developed for the formation of technical thinking skills in future teachers of vocational education in higher education institutions:

- The organization of training sessions in the process of preparing teachers of vocational education for professional activities, using invariant teaching methods in general vocational subjects;

- The creation of the basis of the system "Teacher-Apprentice" for the formation of technical thinking skills in students in the teaching of general subjects in the field of vocational education in higher education institutions.

- Development and implementation of educational and methodological literature, manuals and e-learning resources for the formation of technical thinking skills in teachers of vocational education.

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