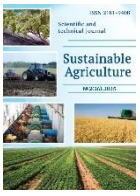
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Developing Technical Thinking of Students in the Process of Preparation for Professional Activity

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a r t i c l e i n f o

Keywords:
Technical thinking, engineering, specialization, psychological and pedagogical theory, model, intellectual quality, skill, qualification, activity, research methods, assimilation, problem situation.

a b s t r a c t

The article analyzes the scientific ideas of technical thinking and determines its role and importance in the professional activity of the engineer, analyzes the state of the problem of developing students' technical thinking in psychological and pedagogical theory and practice in higher education, specializes in the development of technical thinking generalization and systematization in accordance with the quality characteristics, as well as the development of technical thinking of engineering students and the development of a mechanism for its implementation.

1. INTRODUCTION

The ever-evolving technical complexity of the means of production in the world places great demands on the professional intellectual qualities of the engineer and his creative abilities. Being able to think technically is an important professional quality of engineering thinking. The development of this type of thinking skills and the future success of the engineer is largely determined by the quality of the educational process at the stage of vocational training in higher education.

In particular, the educational systems of the leading research centers of developed countries, such as P. Debrai-Retzen "Talented Student Teacher Model" (France), US "Merit" (USA), are working effectively in this direction. Therefore, the integrated use of non-standard forms, methods and tools for the development of technical thinking plays an important role in the preparation of technical students for professional activities

In the world practice, the scale of research conducted on the basis of innovative-integrative and differential approaches to strengthen the technical thinking skills of students, increase their intellectual potential, skills in working with information is growing. In particular, the development of students' technical thinking is a priority in the training of future engineers as qualified specialists in line with international trends. Therefore, in the process of preparing future engineers for professional activities in technical higher education institutions, opportunities to study the methods of professional development of the individual, in particular, to develop a professionally important way of thinking for future engineers are becoming increasingly important. In particular, the development of technical thinking of technical engineers on the basis of modern approaches to the professional training of future engineers in technical education is an important factor in raising the quality of higher education to a new level.

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The Action Strategy for the further development of the Republic of Uzbekistan includes "further improvement of continuing education, continuing the policy of training highly qualified personnel in line with modern needs of the labor market" and "improving the quality and efficiency of higher education institutions based on the introduction of international standards for education and training quality" [1, 39] functions are defined. Important tasks in the implementation of these tasks include, among other things, the description of the training of future engineers, increasing access to modular and programmed learning technologies in the e-learning environment and improving the process of training qualified specialists based on natural sciences.

The problem of developing people who have mastered their profession in every field has always been a priority of the educational process, which is traditional for both foreign and domestic science. The essence of the problem is that on the one hand, attention is paid to the requirements for a person who has mastered the profession, and on the other hand, to the individuality of the subject in this activity:

1. Political and socio-economic changes taking place in the modern stage of development of society, the legitimate growth of scientific and technological progress, the provision of production in all areas with technical and technological equipment in accordance with the rapidly developing period, set new requirements for higher education. This situation reflects the changes in the social order, placing high demands on the national economy and, accordingly, the labor of engineers.

2. The increase in the number of studies in the field of personal psychology, the problem of self-determination, the choice of life and career, and so on. focused.

When we think about professional activity, we need to define three concepts: profession, direction or specialization and qualification. A profession is a type of activity (occupation) that is conditioned by the distribution of labor in society, which is a socially justified source of material well-being [2, 285].

Qualification is the degree and level of professional training an employee needs to perform a specific job, including the availability of knowledge, skills and competencies. Qualification is characterized by specific knowledge, skills and competencies to perform professional tasks and is defined by professionally important qualities. ocational training should be based on science-based assumptions defined in the professiogram, such as occupation and professional skills. Their content and structure depends on the objectives of the study of the profession, its specificity and the theoretical basis of the research.

The methodological basis of our research is:

- the requirements for the personality of the engineer arise from the analysis of the functional aspects of his activities;

- the description of the engineering activity is created taking into account the proposal of the conditional content model of professional activity [3,4]. The psychological structure of the activity distinguishes three levels of generalization: a clear view and conditions of activity; types of professional functions and tasks; professional efforts [4, 49-50];

- perceptions of the professional activity and invariant components of any specialist can be expressed in the form of specialization. These components include technological, organizational, design, research and pedagogical activities [4, Z05].

U.I. Inoyatov scientifically substantiated the theoretical and organizational methodological bases of quality control and management of education in vocational education institutions [5,327].

The fundamental research of K.T. Olimov studied the theoretical and practical aspects of the creation of textbooks for vocational education. In this fundamental research, the concept of creating a new generation of educational and methodological literature for the process of teacher training in vocational education is scientifically based and scientific and methodological recommendations for improving the quality of the educational process are given [6,286]. Practitioner O.A. Abdukuddusov studied the problem of an integrated approach to the process of training teachers of vocational education [7,157].

Pedagogical scientist NA Muslimov studied the scientific and methodological bases of the formation of pedagogical qualities in the future teacher of vocational education, the formation of a new generation of specialists, the upbringing of a harmoniously developed person with a spiritually mature, independent outlook, creative thinking, devotion to universal and national values. special attention [8,325].

These analyzes allowed us to draw the following conclusions about the main types of activities in which the engineer participates: design, rationalization, project implementation, implementation, operator, document management, control, organization, research, analysis, consulting and training, communication, to give stimulus (motivation). If we give a list of the functions of the engineer in technical maintenance in production, it can be divided into three main types of activities of the engineer [9, 67]:

1. Engineering services in production:
- engineering development of management solutions;
- location of the production process in space;
- organization of labor and other groups;
- implementation of product quality control;
- control the performance of the device.

2. Future activities of engineers:
- development, organization and implementation of product quality and cost increase;
- technical preparation of the organization for the production and presentation of new types of products.

3. Research activities should ensure:
- Solve issues of general importance;
- strategic diagnosis of production development;
- Strategic diagnosis of future products.

Actions develop on the basis of knowledge. The result of their development is the skills and competencies of the students. In general, the way to develop intellectual abilities (or techniques of mental activity) is as follows: mastering the content of the method - its independent application in the process of exercises on different materials - transfer the method to other situations, ie using mastered methods to solve new problems (in other types of tasks).

The speed of technical thinking is manifested in applying their knowledge in a variety of contexts and solving specific problems in a limited amount of time. It is therefore a delicate adaptation of operating mechanisms to operating conditions. Improving the speed of operational mechanisms is the closest stage to skill development [10,787-794].

As a way to develop the speed of technical thinking at all stages of training were close to real conditions:

- uncertainty of the situation (tasks with incomplete or redundant information; tasks with partially incorrect information; tasks with different solutions and selection of the most optimal; multi-level tasks if the implementation of the first stage allows to determine the tasks of the next stage) develops relative observation;

- to solve technical problems that require a quick transition from thought to action in order to find a solution to them over time.

To develop the speed of technical thinking, V.A. Molyako [11,66] suggests the use of the following methods in the learning process: time-limiting method, sudden blocking method, high-speed sketching method, new options method, lack of information method, information-enriched method, situational drama method, and so on.

2. METHODS.

The following were selected as the main research methods:

1. Bennett test - a standardized test to assess the level of development of technical thinking - to assess the ability to read drawings, to understand the drawings of technical devices, to solve simple physical and technical problems [8,325].

2. Wild questionnaire - used to assess the propensity of students in various professional activities - art, technology, working with people, physical labor, development and consumption of material products [12,26]. As additional assignments, students were given reflection assignments: Indicate no more than two areas of activity that are most appropriate for you.

3. Specially designed questionnaire for students.

4. Specially designed questionnaire for teachers.

The questions in the questionnaire provided for some teachers and students are similar in meaning and differ in expression. When using questionnaires and tests, the field of diagnostic parameters has to be limited to reliable and validated diagnostic materials. The use of non-standard self-accounting methods allows the engineer to cover a wide range of personal characteristics. Using the method of self-accountability, it was decided to determine the perceptions of students about personal thinking, the method and dynamics of its development.

In the development of technical thinking, it is advisable to focus primarily on the activation of the student's cognitive processes - intuition, perception, memory, attention and thinking, and the effective use of advanced teaching methods.

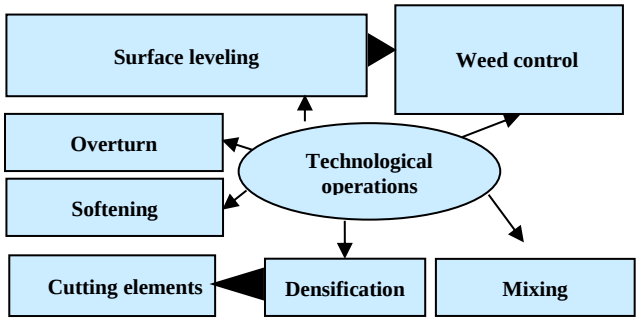
The use of the "Pictogram" method in this process allows the student to develop technical thinking.

Pictogram - (used by LV Zankov). The student must memorize the exact word on the topic through the image in the picture. In doing so, he must invent a connection between the word and the image, which will then help him recall that figure. In the process of forming an associative connection between a picture and a word, the student chooses such meaningful connections that, in his opinion, these pictures will be useful for remembering the word. Therefore, the nature of thinking activity through this method allows the development of thinking.

The content of the method: the student remembers the parts of a particular technique (of course on a new topic) and draws an independent picture - a scheme. This drawn picture or diagram should help you remember the word-figure later. A separate letter is not recommended. For example, consider "Technological operations, processes and tillage systems." With this method, after understanding the topic, the student will be able to use the method of "FOUR STEPS", which allows you to apply it in practice. The "four-step" method is a four-step method of the process of acquiring practical skills [14, 3344-3348].

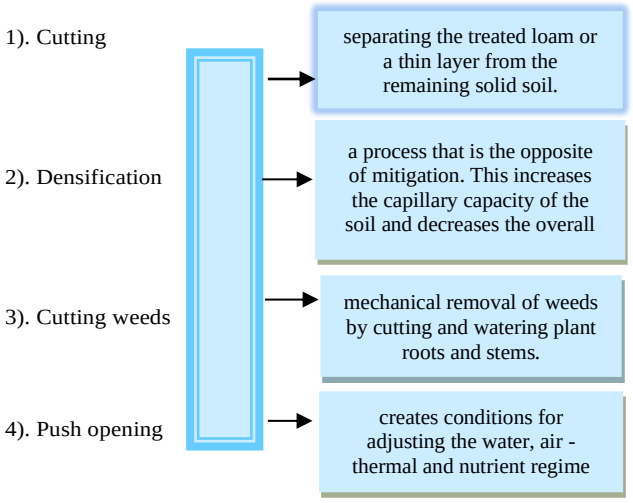
This method helps learners to quickly and perfectly master the same repetitive knowledge and skills. When the “four-step” method is used, learners are introduced to as simple operations as possible, then repeat it and practice until they have mastered it perfectly.

1. Explains to the student the stage of the simple thinking process in the "Explanation" stage.



1. In the “Explain what to do” phase, students demonstrate in practice how to complete the task, understanding the main idea of the topic.

2. "It is called by its name"



3. In the third stage, the student repeats the work movements. They express their opinion on the actions they are taking and correct their mistakes (Table 1).

Table 1.

Create a blitz game to find the "hidden" operations of the stages of technological processes using the table below [15,100].

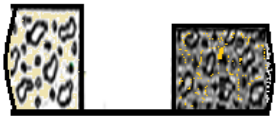
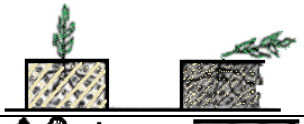
	Step 1	Step 2	Step 3
Basic processing	Milling 3	Plowing 1	Deep softening without turning the blade 2
Surface treatment	mixing the soil with cultivators, harrows, rollers, harrows, mowers 2	compacting the soil with cultivators, harrows, rollers, harrows, mowers, weeding 3	loosening the soil with cultivators, harrows, rollers, harrows, mowers 1
Special processing	softening at great depths 2	plantation and tier processing 1	soil milling 3

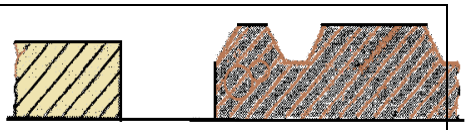
4. In the "exercise" stage, students master the work and perform it independently.

It is advisable to further strengthen the knowledge and skills of students on a particular topic during practical training. At the same time, it is necessary to use active methods that encourage students to think more to develop technical thinking (Table 2).

Table 2.

Combine the parts

1	overthrow	A	
2	mixing	B	
3	soften	C	
4	condensation	D	

5	weeding; digging ditches, forming ridges and ditches.	E			
answer	1-	2 -	3-	4-	5-

Assignments that allow students to think technically (analysis, synthesis, comparison, generalization) are important for actively processing the acquired knowledge. They provide an opportunity for the active phase to follow the relatively passive phase of technical knowledge acquisition. Completion of practical tasks or work independently and presentation of results allow to effectively develop technical thinking. In this case, we recommended the use of a number of practical tasks, such as "Find the similarity of technical objects", "Assistance", "T-Scheme" [14, 3344-3348].

3. RESULTS AND DISCUSSION.

The acquisition or attainment of a profession by a person is an integral continuous process from the time of choosing a profession to the time when an individual becomes a professional. Based on the logic of this assertion, the main part of the study participants: from the beginning of the career (first stage of higher education), making their own career choice, on the verge of becoming a professional and facing various difficulties in obtaining a profession (graduate of higher education) stage) students.

The purpose of the empirical part of the study was to study the dynamics of the level of development of technical thinking in students in the educational process and the perceptions of teachers and students about the key moments in the development of technical thinking in future engineers [10, 787-794].

Ashkent State Agrarian University, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, National Research University, Karshi Engineering and Economics Institutes in the field of agriculture were selected as the place of the empirical part of the study: 5111007 - Vocational Education (Agricultural Mechanization). It was also decided to collect and analyze the opinions of the second subject (teachers) on the same issues, so that the information obtained is not one-sided, ie not obtained from only one subject (students) of the educational process.

In the research process, they participated in the role of the "reference" group. The purpose of this activity was to know the content of the concept of "technical thinking", the level of development of this type of thinking in students, their views on the dynamics of professional thinking in the study of technical sciences, because teachers have a deep knowledge of their profession, ie general, technical and technological.

Thus, the study participants were divided into four groups: Because empirical research has a descriptive and expressive character, and given the complexity and multifaceted nature of the problem being studied, we identified key areas of research..

First, we were interested in students 'attitudes toward technical thinking as an important professional expression:

- understanding of the term "technical thinking";
- be able to independently assess the level of development of technical thinking;
- to understand or how to understand the process of development of technical thinking in higher engineering education.

Second, we were interested in teachers 'views on technical thinking as an important professional view:

- the subjective content of the concept of technical thinking;
- assess the level of development of technical thinking in students' mastery of various stages of technical sciences;
-determine effective methods of psychological and pedagogical impact on the development of technical thinking in future engineers.

Third, it was important to determine the level of development of technical thinking in students of different levels and to study the dynamics of this level in different directions and to identify the causes of this dynamics. Such reasons include the following factors:

- the impact of the level of mastery of subjects that activate technical thinking;
- the impact of students' propensity for various activities;
- factors such as the impact of the level of awareness of students' propensity to work with technology were analyzed.

All this was necessary for students to know in order to create a system for the development of technical thinking during the period of technical higher education. A total of 1387 people participated in the empirical research, including: 1314 students, 332 of whom were girls and 982 were boys. teachers - 73 people, 14 of them women and 59 men (their work experience in a few months to 42 years).

The study consisted of two consecutive, logically conditioned steps.

The first phase of the study was aimed at studying the dynamics of the development of technical thinking during the period of study of students in technical higher education. Thus, the first stage of empirical research - a descriptive description - was obtained.

The organization and conduct of the second phase of the study is as follows:

- comparison of the level of technical thinking of students who participated for the first time in the first and second stages of the study (check the results obtained in the first stage);
-comparing the level of technical thinking of students who repeatedly participated in the first and second phases of the study (longitudinal analysis). If the results of the repeat diagnosis are higher than the results of the initial diagnosis, then a conclusion can be drawn about the developmental effect of the training; if an insignificant increase in results is observed, this test material testifies to the effect of learning.

Quantitative data on respondents as a result of the analysis of student responses are presented in Table 3. The easiest question for students was the importance of technical thinking for future professional activities, and the most difficult question was about the nature of this type of thinking in the process of obtaining engineering education and ways to develop it [10, 787-794].

We begin our analysis of the results by defining the concept of "technical thinking". Although this question was answered by a deficient percentage of respondents, it was given .198 definitions. Among them, we did not expect to find an absolutely correct explanation of the meaning of this concept.

Qualitative analysis of the responses showed that the definitions could be divided into 2 groups: "acceptable" reflecting specific aspects of this complex concept and "very broad" aspects that corresponded not only to this type of thinking but to many other things. It should be noted that students began their definitions with the word "skill" or "ability," but then continued with "doing something ..." or "solving similar tasks," meaning that they were "thinking" (problem solving). process) and "intellect" (the ability to solve certain problems).

The combination of all the "acceptable" definitions made it possible to obtain the following descriptions of technical reasoning [10, 787-794]:

- technical thinking includes visual images (some students call this image abstract, some call it explicit) the separate parts of the mechanism and their spatial movements allow us to determine the cause-and-effect relationships and the principle of operation of the components of the mechanism; refers to the ability to read drawings and see projections ("understanding drawings, formulas, and calculations as text"), i.e., to create mental models of physical processes;
- these actions are aimed at solving technical and engineering problems in the operation and maintenance of equipment: troubleshooting and repair of equipment, the ability to design technical equipment itself, that is, to find new solutions that provide maximum profit and minimum loss;
- this thinking is necessary, on the one hand, to quickly understand, analyze and generalize a large amount of technical information (a condition for understanding the technical sciences), on the other hand,

to adapt technical knowledge in practice;

- for the development of this type of thinking, children must first play with the constructor, and then study the exact and technical sciences (physics, theoretical foundations of electrical engineering, electrical machines, etc.); but, of course, the knowledge gained in the learning process must be put into practice;

- this thinking "has an algorithmic description, that is, it takes into account all possible options for the development of the situation (just like a computer)";

- if this type of thinking is sufficiently developed, it becomes a skill: defines technical ("mathematical, analytical") thinking and special technical observation; provides a direction to understand any process in the technical sciences as a technical process.

The analysis shows that two errors are hidden in these definitions: it is a specific feature of any thinking that is shown without explanations related to the “technical” attribute, or the type of thinking applied to a particular situation is understood. for example, “mind technique” and more precisely “thinking like a machine”, i.e. technical thinking refers to the technology of implementing any thinking.

The existence of such options for understanding the term “technical thinking” once again proves the urgency of psychological-pedagogical education and the development of psychological competence of future professionals (Table 3).

Table 3

The number of students who consider technical thinking to be an important professional quality for their professional activity (percentage of respondents who answered this question)

Faculties	Course				General
	1	2	3	4	
	97,4	97	97,4	-	97,3
Agricultural mechanization	91,8	96,4	95,8	100	96
Hydromelioration	95,3	100	95,6	97,7	97,2
Mechanization of hydromelioration works	83	73,6	75	80	77,9
Land resource management	82,3	8,5	2,4	4,5	76,9

The analysis of Table 3 shows that students of pure engineering faculties fully believe in the importance of technical thinking for their professional activities Students of Mechanization of Irrigation and Agricultural Electrification do not know how important this type of thinking is for future specialization. The answers of the students of the faculty of Agricultural Electrification are especially important: from the 2 nd year onwards, the number of respondents who answered “yes” to this question has been decreasing.

The reasons and assumptions of these arguments are different: they are underdeveloped technical thinking as a professional ability, primary professional relations, especially the teaching of technical sciences in these faculties, shortcomings in the development of professional consciousness during the study period. It should be noted that the study of self-assessment of technical thinking is the most important regulator of adequate performance appraisal. Low and high self-esteem does not ensure personal growth and self-improvement.

4. CONCLUSION.

It is known that the main task of higher education is to develop the knowledge, skills and abilities of the future engineer, during which the important qualities of his professional activity will develop spontaneously.

According to the results of our research, the development of technical thinking in students occurs in the educational process, but the dynamics of this process is characterized by its instability [10, 787-794].

Thus, in the broadest sense, the goal of "development of technical thinking" should be stated in the state regulations, firstly, regulating the training of engineers, secondly, the management of the educational institution and its teachers of all disciplines, understanding that technical thinking becomes more active in the learning process. If the institution plans to implement this goal, the implementation of this goal at the level of the institution of higher education may be considered informal. Providers of the process of developing technical thinking All participants of this project must be active participants in the project.

While each teacher understands this responsibility, he or she should use his or her teaching tools to ensure the development of technical thinking based on ideas about the science possibilities taught for each lesson and the structure of technical thinking (i.e., developing specific goals).

The teacher should have a clear idea of the following during each lesson:

- what technical and technological knowledge should be developed during the training, and which of these knowledge should be implemented at the level of understanding and which at the level of images;

- which of these knowledge (concepts or images) can be developed in the classroom?

- what qualities of thinking (speed, creativity, integration and reflexivity) should be improved during the training; A clear understanding of the goal allows teachers to achieve their goals and plan with an understanding of their means.

By providing the conditions for the development of reflexivity of technical thinking and helping all participants to be active in the process of professional development, students should know the clear purpose of developing technical thinking in each lesson.

The development of technical thinking is the process by which a person becomes a professional. Therefore, it is necessary to analyze the content of education in accordance with this development dynamics in a specific specialty. The result of this analysis is the disclosure of the logical internal aspects of each specific component of the process of developing technical thinking: theoretical teaching sciences, teaching practice and educational design. At the same time, the processes under consideration should ensure strict alignment of the components, indicating their convenient distribution over the years of training and ensuring continuity using a system of interdisciplinary connections.

“In the system under consideration, practice is far ahead of theory. This was manifested in the absence of theoretical foundations in the existing set of disciplines for each period. The absence of a theory is characterized by a negative impact on the practical situation ”[13; 53].

Analysis of the curriculum for the training of engineers at the National Research University "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers" provided the development of thinking.

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