International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

COPY RIGHT

ELSEVIER SSRN

IJIEMR Transactions, online available on 20 th June 2021.
Link: https://ijiemr.org/downloads/Volume-10/ISSUE-6
DOI: 10.48047/IJIEMR/V10/I06/21

Title: **PROBLEMS OF DEVELOPMENT OF RESEARCH COMPETENCE OF STUDENTS OF TECHNICAL UNIVERSITIES IN TEACHING MATHEMATICS**

Volume 10, Issue 06, Pages:103-111

Paper Authors: **Ergasheva Fatima Toyirovna**

USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per UGC Guidelines We Are Providing A Electronic Bar Code

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

PROBLEMS OF DEVELOPMENT OF RESEARCH COMPETENCE OF STUDENTS OF TECHNICAL UNIVERSITIES IN TEACHING MATHEMATICS

Ergasheva Fatima Toyirovna
Navoi State Pedagogical Institute, Uzbekistan

Abstract: This paper examines the problems of developing the research competence of students of technical universities in the process of teaching mathematics. The basic mechanisms of the formation of research activities and visual modeling of mathematical objects, processes and phenomena are investigated on the basis of variability, stage-by-stage and taking into account the peculiarities of the implementation of modern mathematical methods. A methodology and model of teaching mathematics has been developed, aimed at the formation and development of research activities of students of technical universities on the basis of visual modeling.

Keywords: research competence, visual modeling, learning process of mathematics, mathematical knowledge.

Introduction

On the threshold of scientific and technological progress, the development of robotics, the most advanced energy-saving, information and nano technologies, in many countries of the world there is an acute question of transferring engineering education to more modern teaching methods using all the achievements of modern mathematics, which have both fundamental and applied significance. Mathematics in technical universities is the methodological basis of natural science knowledge. Knowledge of mathematical methods at the present stage of development of the production process ceases to serve only the goals of general development and the acquisition of skills in elementary calculations, and the mathematical mindset becomes necessary for specialists in the main areas of scientific and practical activity.

Studying a mathematics course forms for students both a theoretical basis for mastering general professional and special disciplines, and practical skills that allow a future engineer to find rational solutions to problematic problems in an applied direction. In this regard, the requirements for the quality of knowledge and the level of training of technical bachelors in mathematics are increasing.

The need to improve the content of the mathematics course, to update the methods of teaching mathematics at the university is due to the transition to a multi-level system of higher professional education.

Literature review.

The problem of improving the methods of teaching mathematics at universities was studied from the standpoint of intensifying the educational process in higher educational institutions and optimizing mathematics education by A.A.Adannikov, V.V.Afanasyev, N.V.Ammosov, V.A.Dalinger, A.Zh.Zhafyarov, V.M.Monakhov, A.G.Mordkovich, A.Kh.Naziev, E.N.Trofimets, L.V.Shkerina, etc. educational institutions. The problems of mathematical education in technical universities are reflected in the works of many mathematicians and methodologists M.S.Ammosova, V.F.Butuzova, G.V.Dorofeeva, L.D.Kudryavtsev, S.M.Nikolsky, S.A.Rozanova, N.Kh.Rozova, M.A.Rodionova, E.I.Smirnova, G.M.Semenova, G.N.Yakovlev and other researchers.

In the formation of the content of mathematical education, the role of the external environment is played by future professional activity. Designing the general value-target hierarchy of education for the field of mathematical education of future engineers, priorities in teaching mathematics are determined. Analyzing the works of mathematicians B.D.Gnedenko,

A.N.Kolmogorov, L.D.Kudryavtsev, A.G.Postnikov, A.Renier, D.Poya, A.Poincaré, A.Ya.Khinchin and others, one can see in the unity of their opinion on the goal of teaching and educating students in the process of teaching mathematics [1-6].

The main goal of mathematics education is to foster a mathematical culture of thinking, which is a kind of fusion of the foundations of mathematical knowledge, logical thinking and mathematical intuition. However, this goal is not the only one.

Material and Methods.

Many researchers in the field of pedagogy also point to the need to reflect in the system of mathematical education of engineers as a general task of vocational training - the formation of research activities of students, the upbringing of "the habits of an independent search for something new, in faith in oneself and in the ability to concentrate thoughts for a long time on an exciting problem, on looking for ways to solve it" [7]. Thus, mathematical training at a technical university should be intensified in the direction of the formation of research activities of students. The level of formation of the professional competence of the future engineer largely depends on the quality of mathematical training.

A high degree of abstraction in the presentation of information about concepts and their properties in the process of teaching mathematics to students of technical universities determines the need for such an organization of teaching mathematics, when the ideas that arise in the thinking of students reflect the main and essential aspects of mathematical objects and laws, including through visual modeling mathematical knowledge.

The lack of unity of approaches to the interpretation of visual modeling in teaching, the weak reflection of the modeling method in teaching mathematics to students of technical universities, the lack of methods for presenting and presenting the achievements of modern mathematics in teaching in the formation of research activities of students prove the relevance of the chosen research topic, namely: "Formation of research activities of students technical universities in teaching mathematics based on visual modeling ".

Results.

The ascertaining stage of the experiment confirmed the need for systematic work of mathematics teachers aimed at the formation of students' research activities and made it possible to identify a number of contradictions:

- between a sufficiently high degree of abstraction of mathematical knowledge and the lack of mechanisms for the visual presentation of educational elements in teaching mathematics at a technical university on the basis of modeling;
- between the rather high developmental capabilities of visual modeling in teaching mathematics and the undeveloped specifics of its application in the process of forming the research activity of students of technical universities;
- between the high demands made by society for the professional and general cultural training of specialists at the university and the lack of mechanisms for ensuring the research experience of an individual in the context of the growth of professional and general cultural competencies of students of a technical university;

Any research has the following components:

- statement of the problem, preliminary analysis of the available information;
- conditions and methods for solving problems of this class;
- formulation of initial hypotheses;
- theoretical analysis of hypotheses;
- planning and organization of the experiment, analysis and generalization
- received facts;

verification of initial hypotheses and the final formulation of new facts and laws during research in production [8].

The listed components determine the sequence of any research, no matter in what area of knowledge it is carried out.

Empirical and theoretical studies should be supplemented with model studies based on the construction of a model - an analogue of the

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

object under study. So, according to V.N.Druzhinin [9], the modeling method differs from the theoretical method based on logical reasoning and from the empirical one, since modeling is used when it is impossible to conduct an experimental study, and the theoretical analysis is too cumbersome when studying the object under study.

Model studies are carried out when considering objects that are inaccessible to experimental study, or systems on which an experiment cannot be performed for moral reasons.

Model studies can also be carried out on the basis of the principle of convenience, for greater simplicity and cost-effectiveness of the study, and can also complement experimental and theoretical studies.

Studies can also be distinguished by their object. Here we can distinguish pedagogical, industrial, sociological, etc. research.

By the nature of their conduct, research can be divided into subjective and objective.

According to the method of obtaining knowledge, research can be divided into indicative, educational and scientific.

Orientational research is carried out unconsciously, with direct interaction with the surrounding reality. This type of research is usually carried out by children in infancy and preschool age.

Educational research is already a meaningful attempt to gain new knowledge. Moreover, knowledge is new only for the subject carrying out the research (this is also true for orientational research). Educational research is necessarily carried out under the supervision of a teacher, teacher.

Scientific research is carried out with the aim of obtaining objective knowledge that is meaningful not only for the subject of research, but also for others. To carry out this kind of research, special equipment and specialized laboratories can be involved, and a large number of people can be involved.

The formation of the experience of research activity occurs in the process of its implementation, characterized by a gradual transition from the reproductive level of mastering the activity to the creative level.

Table 1. Levels of formation of research activity.

Criterion			
Scientific information	The student has practical skills in working with reference literature in the field of scientific research methodology.	Possesses the skills of flexible perception of scientific texts, participation in discussions on methodology.	Mastering the general requirements for scientific research, the basics of planning, organizing the setting of the problem, analyzing the available information; conditions and methods for solving research problems.
Methodological	Formulates initial hypotheses, conducts theoretical analysis of hypotheses.	Verifies initial hypotheses and finally formulates new facts and laws when conducting research in production.	Development of predictive skills; the ability to put forward hypotheses, find alternative solutions to the problem.
Empirical	Observation, comparison, generalization, modeling	Planning and organization of the experiment, analysis and generalization of the obtained facts are carried out.	Finds the information you need, selects and analyzes information, draws conclusions.
Communicative	They are familiar with the requirements for the design of various research papers, know the rules and techniques of rhetoric, polemics, reflective listening.	Can conduct a dialogue, convince, inspire; change communication tactics, defend against manipulation and psychological tricks; owns the initiative in any kind of communication and situations, competent and laconic speech.	A high level of reflexive culture, allowing flexible and adequate response to changes in the communicative situation, a high level of professional erudition.

Despite the fact that the research activity is separated into a separate block, it does not exist in isolation from other areas of engineering activity, but organically merges with them. An important point in the process of the formation of students' research activities is the correspondence of the training content to the set goal.

Analysis of works devoted to the problem of the development of higher education allows us to highlight the basic principles of building a new system of vocational education:

The principle of continuity. The new model of education allows the student to continue education at all stages of life, taking into account the possibilities, needs of the individual, as well as in connection with the situation on the labor market. In addition, the continuity of education solves the problem of retraining, advanced training, since it allows you to get the necessary professional training in a fairly short time, thereby acquiring special importance in a market economy [7, 10, 11, 12].

The principle of humanization. This principle implements the idea of general, non-highly specialized limitations. According to this principle, the dominant influence of the educational function over professional training is highlighted in the structure of the content of education, taking into account the fact that "a comprehensively developed personality is a person who is able to apply creative abilities in his professional activity" [12, 13].

The principle of fundamentality. Fundamentality is understood as the optimal combination of the philosophical, ideological and methodological aspects of studying the subject, which should be presented on a scientific basis. The implementation of this principle makes it possible for a specialist to adapt in a wide field of activity in the context of rapid innovation processes, since it ensures the mastery of a variety of activities, forming a new innovative style of thinking.

The principle of flexibility and openness, which is the most characteristic feature of a discretely stepped system of higher education.

After successful completion of each level of education, the student has the right to make a choice of further education or professional activity. Thus, he constructs his individual educational trajectory, based on his own abilities and material capabilities. In addition, the society's need for specialists of various qualifications and levels of education is being realized.

The principle of independence. The current level of development of society requires from its members the most justified independence in the process of solving professional problems. The rigidly regulated learning process in the traditional higher education system did not form the skills of independence. The student did not have to think about building his own educational route, about the totality of the knowledge and skills that he would like to receive and which would best suit his inclinations and needs. All these issues were solved by the system for him.

Projecting the general value-target hierarchy of education on the field of mathematical education of future engineers, we will highlight the priorities in teaching mathematics for future engineers. Let us define the principles and criteria for selecting the content of the mathematical training of students of technical universities, aimed at the formation of the student's research activities. For this, it is necessary to determine the criterion on the basis of which it is possible to judge the achievement of the set goals. This criterion can be the ability to mathematical modeling. The application of the modeling method in the formation of professional competence of a future engineer performs the following functions:

- contributes to the development of students' outlook;
- introduces the methodology of scientific research and methods of cognition;
- develops motivation and interest in mastering natural - scientific and vocational knowledge;
- develops cognitive activity and replenishes professional knowledge;
- fosters management activities;
- develop creativity, engineering thinking;
- develops heuristic thinking activity;
- promotes self-education, self-improvement;
- develops a predictive approach;
- the ability to put forward hypotheses, find an alternative solution to the problem.

All these abilities and qualities acquired when using the method of functional and mathematical modeling are necessary in solving professional problems and problems in any engineering activity.

This allows, on the one hand, to consider functional-mathematical modeling as an integral component of engineering thinking, and on the other hand, it opens up the prospect of the process of its formation in the system of training the professional competence of a future engineer.

Taking into account the above requirements, we will define the role, place and tasks of mathematical modeling in the educational process of an engineering

university. Initially, let us turn to deciphering the essence of the concepts themselves, model and mathematical modeling.

The methodological basis for the integration of knowledge in the process of teaching mathematics to students of technical universities in the formation of research activities is visual modeling.

Visibility was originally considered in didactics as a teaching principle, according to which teaching is based on specific images directly reproduced by students. In connection with the creation of the teaching theory, visual aids (object or phenomenon, image, model, scheme) were developed. As a result of the systematization of teaching methods in didactics, an explanatory and illustrative teaching method was formed, where visual and verbal teaching methods were applied simultaneously. With the development of didactics and its links with developmental and educational psychology, learning from associative theories of conscious memorization moved to developing learning theories based on the activity approach. In this regard, it is necessary to rethink and update the methodological system of teaching mathematics and its components: goals, content, methods, forms and means of integration, as well as the formation of the student's personality experience in mathematical research.

For a deep and conscious assimilation of mathematical knowledge, the visual-model teaching method acts as a connecting link among other teaching methods: problem, project, research, abstract-deductive and inductive methods of cognition. Visual modeling has a special place in teaching mathematics. Many mathematical theories have a high degree of abstraction, which leads to the presentation of information in sign-symbolic form.

Visual modeling as a teaching technique is present in all methods of explanation, as a component of understanding and figurative representation of mathematical knowledge. This explains his choice as an integrating factor in teaching mathematics, aimed at the formation and development of research activities of students of technical universities in the process of teaching mathematics. Confirmation of the relevance and feasibility of using the method of visual modeling is the creation by mathematicians of the 17th-18th centuries $\varepsilon-\delta$ language for substantiating limiting processes. “Such visual modeling created the opportunity, among other things, to rise to a new, socially significant level of understanding and explaining the essence of the foundations of differential and integral calculus” [8, p. 209]. The construction of the process of teaching future engineers, aimed at the formation of research activities of students, was carried out by us on the basis of the concept of visual-model teaching developed by E.I. Smirnov [6] and his students.

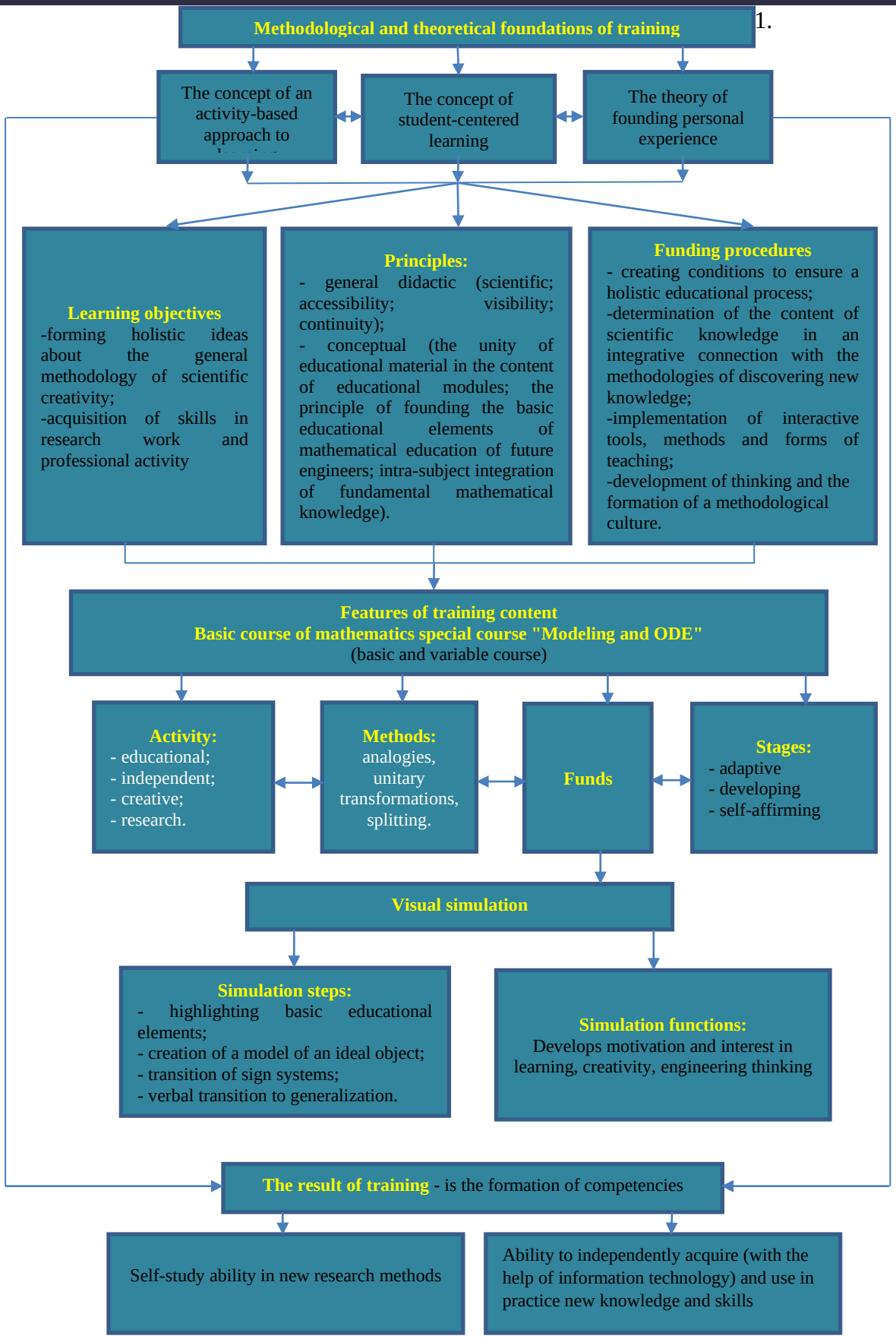
Preference is given to the "visual" model as a reliance on stable associations, simple geometric shapes, psychological laws of perception and neurophysiological mechanisms of memory [14].

The patterns of holistic perception and operation of mathematical objects made it possible to highlight the content for the development of methodological knowledge and research skills. Operating with mathematical objects is primarily a sign-symbolic activity to transform the system of symbolic means. Signed is a simulation that uses as models sign transformations of some kind: diagrams, graphs, drawings, formulas, character sets, etc.

The most important type of sign modeling is mathematical modeling, in which the study of an object is carried out by means of a model formulated in the language of mathematics and using certain mathematical methods. According to the majority of researchers, by mathematical modeling we mean the display in mathematical form (in the form of equations, inequalities, systems, graphs) of the basic laws of the process or object under study. As a result of the theoretical analysis of psychological and pedagogical research in the field of mathematical education, a model of teaching mathematics to students of a technical profile, aimed at the formation of the student's research activity, was built (Scheme 1).

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

1.



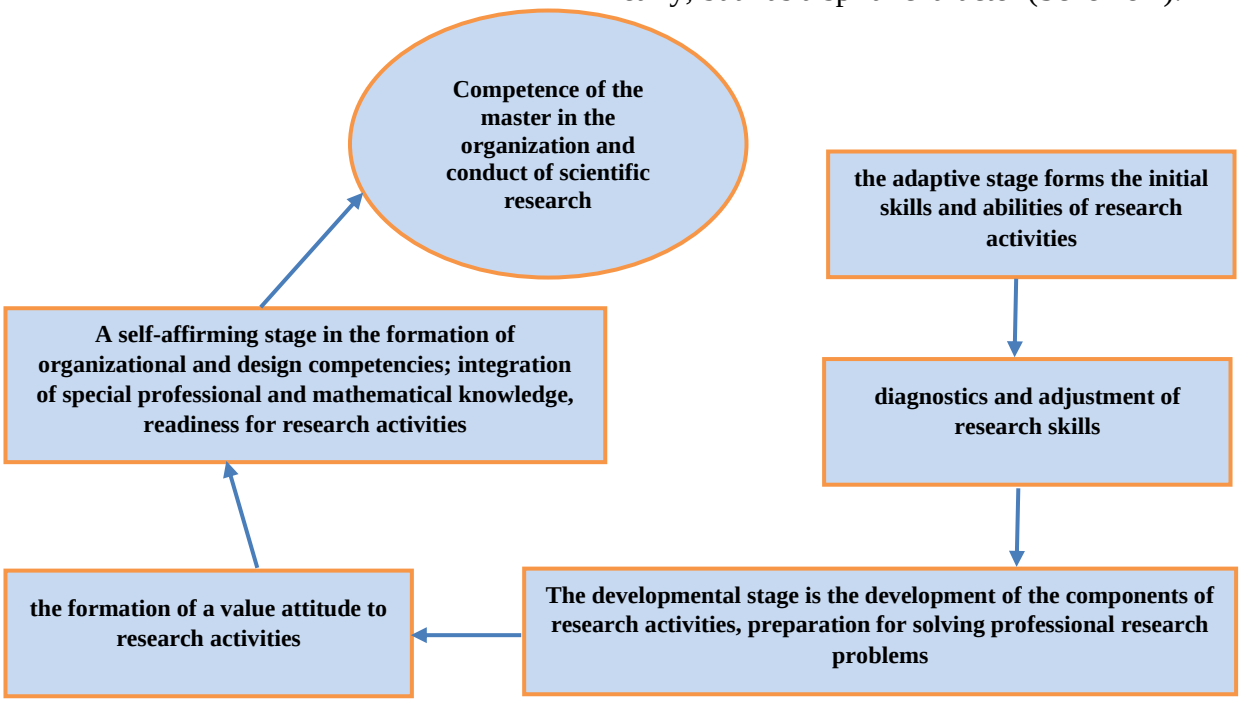
International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

Model of teaching mathematics to students of technical universities, aimed at the formation of research activities.

The development of thinking and the formation of a methodological culture occurs in the process of organizing search, research activities and largely depends on the student's ability to adequately define the purpose of the study, select the necessary tools, identify the implementation mechanism, and correctly interpret the information received.

The implementation of interactive forms, means and methods of teaching mathematics occurs through the use of project techniques (web quest technology). A web quest is a type of informational, problem-oriented tasks of individual or group training aimed at the formation and development of skills of independent activity, search and research activities of students in the process of mastering, research, processing and presentation of educational material using the capabilities of the Internet.

In this regard, the process of the formation of research activity is not considered linearly, but has a spiral character (Scheme 2).



Scheme 2. **Spiral of funding for the formation of research activities.**

The formation and development of research activities of students of technical universities on the basis of visual modeling allows the integration of mathematical and methodological knowledge by means of mathematical modeling. Mastering the mathematical activity of students is based on a visual representation of objects, processes and phenomena in teaching mathematics, the use of special methods of presenting knowledge (the method of analogy, unitary transformations and splitting) in teaching mathematics to students of technical universities.

Discussion. The methodology of teaching mathematics to students of technical universities, aimed at the formation and development of research activities of students, is implemented on the basis of the integration of mathematical and methodological knowledge, by means of visual modeling in the course of solving professionally oriented research problems. When presenting various sections of the theory of differential equations (especially at engineering faculties), the problem of choosing

the most optimal and effective method for presenting this material always arises. Over the past 100 years (and maybe more) not a single sufficiently constructive analytical method of research and method of presenting this material has been proposed.

More and more attention is paid to various numerical algorithms for studying these problems. Only 50 years after the real introduction into scientific practice of the vector-matrix method of writing a system of differential equations in the 90s of the 20th century in the works of Yu.A. Konyaev [15, 16, 17]. A number of new constructive analytical research methods were developed (without pretending to be universal) in the qualitative theory of differential equations, including stability issues, as well as in the theory of regular perturbations. Namely, two new algorithms (the method of unitary transformations and the method of splitting) were investigated and implemented as methods of analysis and teaching (together with the method of justified analogy). This made it possible, on their basis, to create new effective methods of presenting the relevant sections of mathematics, which was confirmed when they were taught at the Faculty of Engineering.

Conclusion.

Having made a conclusion, let us single out three stages in the formation of students' research activities:

1. The adaptive stage lays down the initial research skills and forms the components of students' research activities:

- scientific and informational: in mastering the practical skills of working with reference and scientific literature;
- methodological: in proposing a hypothesis and carrying out a theoretical analysis of the problem;
- the empirical component is aimed at developing research skills to compare, generalize, model based on observation;
- communicative: provides knowledge of the rules and techniques of rhetoric, polemics and reflective listening.

2. The developmental stage prepares students for solving professional research problems through mastering special mathematical research methods (analogy, splitting, unitary transformations), diagnostics of operating research skills and their correction are carried out. The development of the components of research activity takes place in enriching the experience of perceiving scientific texts, participating in discussions on putting forward initial hypotheses, planning and organizing an experiment, analyzing and generalizing the obtained facts, and formulating new facts and laws. A value attitude towards research activity is being formed.

3. The self-affirming stage is characterized by maturity, integration of special, professional knowledge and mathematical knowledge, readiness for research activities. The components of research activity are expressed in the ability to organize the formulation of a problem, to independently search for methods for solving research problems, to possess predictive skills to put forward hypotheses and find alternative solutions to the problem. The student has a high level of reflective culture and professional erudition.

References

1. Ammosova, M.S. Professional orientation of teaching mathematics to students of mining faculties of universities as a means of forming their mathematical competence: dissertation of the candidate of pedagogical sciences 13.00.02. -Krasnoyarsk, 2009.
2. Gorstko, A.B. Get to know mathematical modeling. - M .: Knowledge, 1991 .—160 p.
3. Dalinger, V.A. Improving the process of teaching mathematics based on the purposeful implementation of intra-subject connections. - Omsk: IPKRO, 1993. 323 p.
4. Kudryavtsev, L. D. Thoughts on modern mathematics and its study. -Moscow: Nauka, 1985, 176 p.
5. Kolbina, E.V. Particularities of teaching mathematics to technical higher school students in the context of competence and contextual approaches // Theory and practice of social development 2015, No. 11. p. 273-277.

6. Smirnov E.I. Funding experience in professional training and innovative activities of a teacher. - Yaroslavl: Chancellor Publishing House, 2012. - 209 p.
7. Gershunsky, B.S. Philosophy of Education –M .: Flinta, 1998. - 432 p.
8. I.A. Zimnyaya, E.A. Shashenkov. Research work as a specific type of human activity. - Izhevsk-Moscow, 2011. -105 p.
9. Druzhinin, V.N. Experimental psychology. - SPb .: Peter, 2011. – 320 p.
10. Alekhina, I.V. Actual problems of the development of higher education. Transition to multilevel education // Collection of articles. Saint Petersburg: LTA Publishing House, 2013.234 p.
11. Kurovskoy, V.L. Didactic conditions for the formation of engineering and graphic skills and abilities of students of technical universities. Dissertation of the candidate of pedagogical sciences. - Khmelnitsky, 2018. 220 p.
12. V.A.Slastenin, I.F.Isaev and A.I.Mishchenko, E.H.Shiyanov. Pedagogy: textbook. 3rd ed. - M .: School - Press, 2000. 512 p.
13. Alekseev, A.V. Leontovich, A.S. Obukhov, L.F. Fomina, N.G. The concept of development of research activities of students //Research work of schoolchildren. 2002. No. 1. p. 24-33.
14. Vakjira MB Visual modeling as the basis for the formation of research activities of students of technical universities in the process of teaching mathematics // Modern problems of science and education (Electronic scientific journal). No. 1, 2014. URL: www.science-education.ru/115-11954 (date of access: 20.04.2021).
15. Konyaev, Yu.A. The method of unitary transformations in stability theory. // Publishing House of Higher Education Institution Mathematics. - 2002. - No. 2. - c. 41-45.
16. Konyaev, Yu.A. On some methods of stability research // Mathematical collection. - 2001. - Vol. 192, No. 3, - p. 65-82.
17. Konyaev, Yu.A., Mikhailov D.V., Vakdzhira M.B. Investigation of non-autonomous equations in the theory of gyroscopes // Yaroslavl Pedagogical Bulletin (Natural Sciences). - 2012. - No. 3. - Vol. 3. - pp. 40-43.
18. Yunusova D. Modern technologies of teaching mathematics. Textbook. - Tashkent: Science and technology, 2011. - 200 p.