

2.5 Basic principles, content and tools of scientific and research education in institutions of higher education

Today, one of the modern directions of the education model is the research activity of students of higher education. According to the Law of Ukraine "On Higher Education", the role, tasks and organization of scientific research work in institutions of higher education are radically changed, since the second (master's) level of education is obtained according to the educational-professional and educational-scientific program, which necessarily includes research (scientific) component.

In addition, economic and social reforms carried out in Ukraine significantly change the requirements for training personnel. A modern employer needs a creative and proactive specialist who has organizational skills and the ability to direct activities to improve production processes by introducing new scientific and technical achievements into practice. Therefore, the specificity of the work of higher education institutions requires an organic combination of educational and research work of teachers and higher education graduates of higher education.

Scientific and research activity is a complex scientific and creative process that involves deepening theoretical knowledge of the researched problem, analysis of research in this field, development of skills to apply one's own knowledge in practice, improvement of independent work skills in accordance with the requirements of the specialist market. Research activities of students of higher education are one of the most important means of improving the quality of training and education of specialists with higher education who are able to creatively apply the latest achievements of scientific and technical progress in practical activities.

General principles of organization of scientific and research training in institutions of higher education

Both foreign and domestic scientists consider the issue of research training. Thus, according to domestic scientists (Babanskyi Yu., Tiahlova Ye., Zymnia I.,

Khutorskyi A., etc.), research activities to realize the pedagogical potential in forming a worldview should be based on six main principles (Fig. 1).

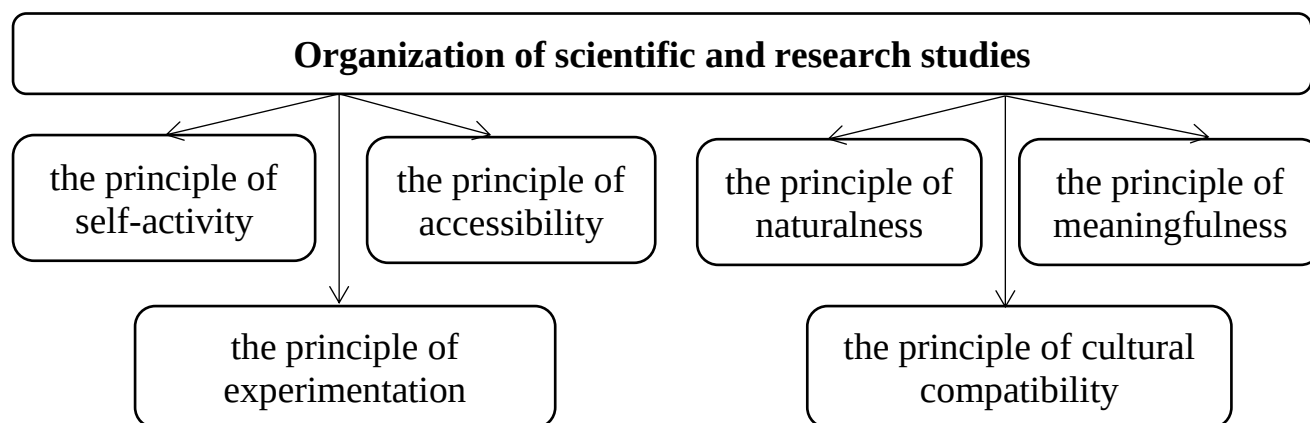


Figure 1. Principles of organization of scientific and research training in institutions of higher education.

The principle of self-activity is one of the main principles of the organization of scientific and research training, since the independent activity of a student of higher education in the course of scientific research is the main indicator of understanding the researched problem, an indicator of the formation of his worldview position. It is the principle of self-activity that is supported by the principles of accessibility, naturalness and experimentation.

The principle of accessibility of education is the correspondence of the content, scope of the researched material, methods and organizational forms of education to the age and individual capabilities of those seeking higher education, their existing knowledge and ideas. In the domestic didactics, the accessibility of education is interpreted as a measure of difficulties and does not mean adaptation to the level of actual development of the student of higher education, but focuses on the nearest prospects of development. In order to ensure the availability of education, it is important for the teacher to know the complexity of the studied material.

The principle of naturalness consists in the fact that the topic of scientific research undertaken by a student of higher education should not be invented by the teacher. It should be real, interesting and genuine, which means it should be realistic. Its

naturalness lies in the fact that the student of higher education will be able to explore it independently, he can feel the possibilities of solving the problem himself.

The principle of meaningfulness of the performed scientific work. In order for the knowledge acquired during scientific research to become truly personal values of the student of higher education, they must be realized and understood, and all his activities during scientific research must be subordinated to the search for a single field of values within the framework of the problem. This is possible if the goal of scientific research, the task, the problem, the research hypothesis are not ready-made statements formulated by the teacher, but the fruit of reflection, a kind of insight of the student of higher education.

The principle of experimentation (the principle of clarity). In pedagogical literature, there are different interpretations of the term "visibility":

- visual aids include only what is perceived by sight, exclude objects and processes from visual aids, and leave only illustrative, visual aids;
- expanding the meaning of the concept of "visuality" and extending it to the ideas formed as a result of listening to figurative language or reading literature.

In scientific and research activities, students of higher education get to know the properties of substances, phenomena and processes not only visually, but also with the help of other analyzers.

The principle of cultural relevance is the education of a higher education student in the culture of observing the traditions of scientific research and novelty, originality of approaches in solving a scientific task. This principle can be considered a principle of creative scientific research activity, when student of higher education brings something of his own to the research, which makes it possible to make scientific research unique and original. Parkherst E., Draiver R., Torndaik E. Parkhurst E., Driver R., Thorndike E., etc.), the principles of the organization of scientific and research training are replaced by requirements aimed at the effective functioning of the mechanism of scientific and research training (Table 1.).

Table 1.

Requirements for the effective functioning of the mechanism of research
training in institutions of higher education

№	Requirements
1	To encourage students of higher education to formulate the ideas and ideas they have, to express them implicitly
2	To acquaint students of higher education with phenomena that contradict existing ideas
3	To encourage suggestions, conjectures, alternative explanations
4	Provide opportunities for higher education students to explore their assumptions in a free and relaxed environment, especially through small group discussions
5	Provide higher education students with the opportunity to apply new representations to a wide range of phenomena and situations, so that they can evaluate their applied value

In general, the ideas of domestic and foreign scientists and teachers are similar: the former are characterized by more concreteness and a clear connection with the principles and approaches of the domestic methodology, for the latter – the humanization of education.

Scientific and research activities are based on the research abilities of the individual, both the student of higher education and the teacher.

Scientific and research abilities are individual and psychological features of a student of higher education, which ensure a successful and high-quality process of finding, mastering and understanding new information. At the heart of research abilities is search activity.

Research skills should be understood as the following skills: to see a problem, develop a hypothesis, observe, conduct a research experiment, define concepts, analyze and summarize research results, etc.

Thus, the research work of higher education applicants can be carried out on the basis of various components of the higher education system, but specific principles must be followed for effective implementation (Table 2).

Table 2.

Characterization of the specific principles on which scientific and research training in higher education institutions is based

№	The name of the principles	Characteristics of the principles
1	The principle of focusing on the cognitive interests of the student of higher education	scientific research is a creative process, creativity cannot be imposed from the outside, it is formed only on the basis of an internal need, in this case – the need for knowledge
2	The principle of freedom of choice and responsibility for one's own learning	only under the condition of implementation of the principle, higher education becomes the individual goal of the student of higher education
3	The principle of mastering knowledge in unity with the methods of obtaining it	acquainting the student of higher education not only with scientific knowledge, but also with the methods and sources of their acquisition
4	The principle of relying on the development of independent information search skills	the development of the higher education student's needs and abilities to acquire scientific knowledge, with the aim of transforming knowledge into a tool for creative exploration of the surrounding world
5	The principle of assimilation and processing of information	assimilation by the student of higher education of methods of obtaining information and correct processing of the acquired scientific knowledge
6	The principle of combining productive and reproductive teaching methods	the use of scientific and research teaching methods should be combined with the use of reproductive methods. From the point of view of scientific and research training, planned observations and experiments, ready-made conclusions given for assimilation in a textbook or a teacher's presentation create the impression of completeness and irrefutability of knowledge in a student of higher education, but do not allow students of higher education to feel the process of acquiring knowledge. However, research education emphasizes the relativity of knowledge, transforms such generalizations and conclusions into the basis of the emergence of new questions, initiates the formulation of new problems and stimulates the student of higher education to solve them independently.
7	The principle of forming ideas about the dynamism of knowledge	the understanding by the student of higher education that human knowledge in the surrounding world is not dogmatic, it develops and evolves, constantly changing
8	The principle of forming an idea of research as a lifestyle	the training of higher education seekers of special knowledge, the development of their abilities and skills in scientific and research activities are considered as the basis for the development of behavior based on the dominance of manifestations of search activity in various life situations
9	The principle of facilitating interaction between a teacher and a student of higher education	the task of a teacher at a higher education institution is not to transmit information to a higher education student, but to perform the function of activating and facilitating conscious learning, forming the ability to self-educate. He must be able to investigate various problems, thus find any answers and be able to teach this to students of higher education. A facilitator is a teacher who stimulates and directs the process of independent search for information and joint

Continuation of table 2

		activities of higher education seekers, supports the desire for self-realization, self-improvement and self-development.
10	The principle of using author's educational programs	an educational program designed for creative educational and research interaction between a student of higher education and a teacher. The educational program in research studies is always author's and is developed on the basis of the general educational program of the institution of higher education

The educational program developed in accordance with research training consists of three components, and therefore includes three independent programs: training, research activities, monitoring (Fig. 2).

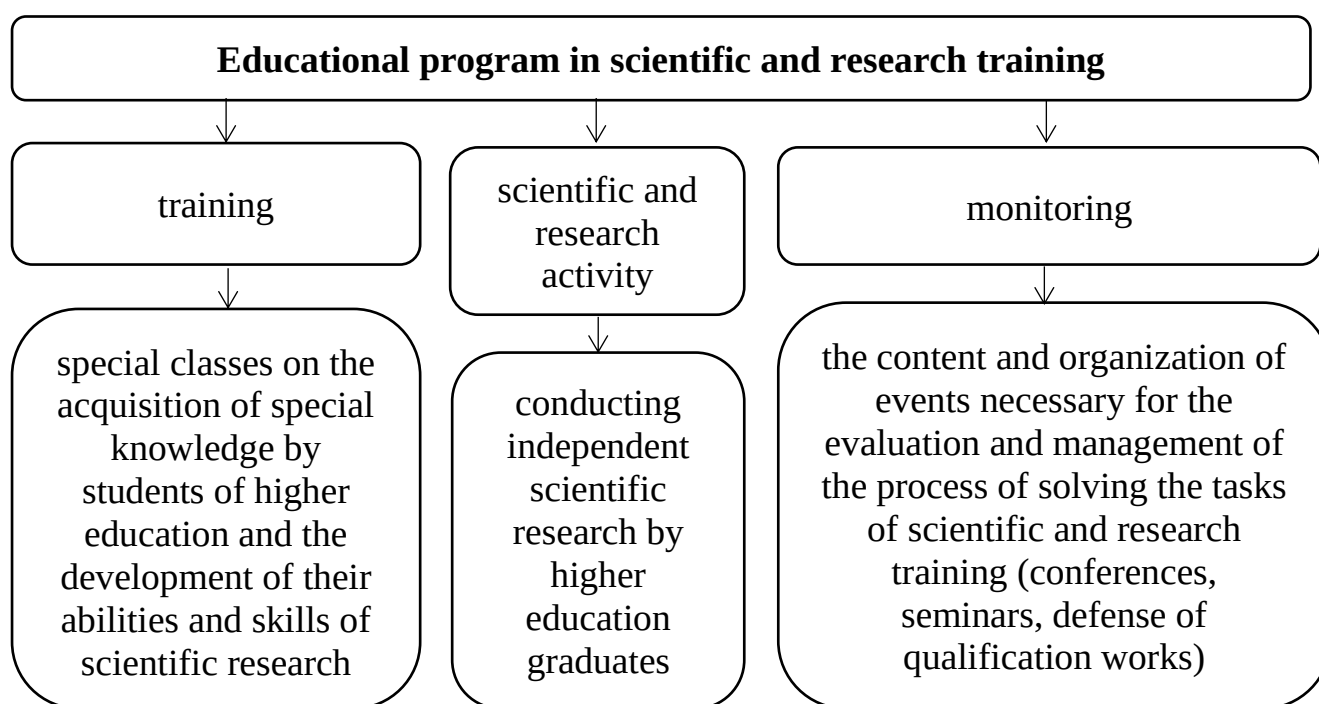


Figure 2. Components of the educational program in scientific and research training and their characteristics.

During the training on the development of scientific and research abilities, students of higher education should acquire special knowledge, abilities and skills of scientific research, such as: see problems, ask questions, put forward hypotheses, define concepts, classify, analyze, generalize, observe, conduct scientific experiment, draw conclusions, structure the material, prepare presentations, explain, prove and defend the results of your research.

The programming of this educational material is carried out according to the principle of "concentric circles". Lessons are grouped into relatively complete blocks, which are independent links of the general chain. Having passed the first round during the first year, it is advisable to return to similar classes in subsequent courses of study.

These special training classes are necessary throughout the entire period of study at a higher education institution. The periodicity of this work should be determined, focusing on the individual characteristics of those seeking higher education.

It is natural that while preserving the general orientation of tasks, they should become more difficult depending on the course of study. In addition, many of the tasks used in these trainings can be solved repeatedly by students of higher education. In this case, the depth of solving the problem should be changed.

The main content of the "scientific and research activity" program is the conducting of independent scientific research by students of higher education and the implementation of personal creative projects by them. This program is the main, central part of the educational program of research training. Classes within its framework are designed in such a way that the degree of independence of the student of higher education in the process of scientific research gradually increases.

The "monitoring" program is of particular importance in the educational program. A student of higher education should know that the results of his scientific research and creative design are also interesting to other researchers. A student of higher education needs to master the practice of presenting the results of his own scientific research, master the skills of arguing his own judgments, learn to summarize and report the results of a scientific experiment, explain and defend the conclusions made.

A teacher prepared to solve the tasks of scientific and research training must possess a number of characteristics, a set of specific skills that should be characteristic of a successful researcher, in addition to them, special abilities and skills, specifically pedagogical, are required.

They can be characterized as follows:

1. Be hypersensitive to problems. To be able to find and present real educational and research tasks to students of higher education in a form that is understandable for them.
2. To be able to captivate students of higher education with a didactically valuable problem, making it their own problem.
3. To be able to perform the functions of coordinator and partner in scientific research. Helping higher education seekers to avoid directives and administrative pressure.
4. To be able to be tolerant of the mistakes of higher education students, made by them in their attempts to find their own solution. Offer help or refer to the necessary sources of information only in those cases when the student of higher education begins to feel the hopelessness of his search.
5. Organize events for conducting observations, scientific experiments and various practical studies.
6. Provide an opportunity for regular reports of working groups and exchange of views during open general discussions.
7. To encourage and develop a critical attitude towards scientific research activities.
8. To be able to stimulate proposals for improving work and putting forward new, original directions of scientific research.
9. Carefully monitor the dynamics of interests of higher education seekers in the researched problem. To be able to finish conducting scientific research and work on discussion and implementation of solutions in practice before the appearance of signs of loss of interest in the problem among students of higher education.
10. Be flexible and, while maintaining high motivation, allow individual applicants of higher education to continue working on the problem on a voluntary basis while other applicants are looking for ways to approach a new problem.

Content of scientific and research training in institutions of higher education

In the conditions of informatization and intellectualization of society, the training of future specialists, focused only on the assimilation of ready-made knowledge, loses

its relevance. In the modern conditions of the information society, pedagogical technologies for the development of the creative qualities of the individual, one of which is scientific and research, have become very relevant. The analysis of literature data and work experience in institutions of higher education makes it possible to state that the content of research training of students of higher education should be considered as certain interrelated categories (Table 3).

Table 3.

The content of scientific and research training of students of higher education

№	Content of scientific and research activities
1	A component of the educational process, which directly affects the content and nature of the teaching of educational components, changes the requirements for the level of training of higher education applicants, their creative development, abilities and skills
2	The field of intellectual creative activity of an individual, an effective means of self-realization
3	A condition for the development and spread of scientific culture, innovation, creativity, as well as renewal of the intellectual potential of society

Thus, the didactic tasks of research activity in a higher education institution are:

- provision of high-quality educational training for students of higher education;
- purposeful formation in the personality of the student of higher education of ways and procedures of creative cognitive search - new forms, methods, means of knowing reality and life activities;
- development of intellectual abilities, research skills and creative potential of students of higher education and formation of an active, competent, creative personality on this basis.

The analysis of studies on the problems of the organization of scientific and research activity makes it possible to assert that for those seeking higher education, the most effective form is collective-individual search and research activity, which ensures in joint activities the gradual mastering of the methodology of conducting scientific research (familiarity with the stages, methods of selection and processing information, drawing up a research program, analysis, generalization and evaluation of results, etc.)

and individual self-determination of each student of higher education at each of the stages of scientific research regarding the choice of form and method of own participation in a joint creative work. In the last course of study for students of higher education, individual scientific research of a problem in the chosen field is more characteristic and significant.

During the creation of a methodical model of scientific research activity in a higher education institution, the teacher, first of all, should foresee and plan the implementation of the main constituent stages of scientific research (Table 4).

Table 4.

Methodical model of scientific and research activities in institutions of higher education

Stage	Characteristic
I	Gradual diversification of directions and depth of scientific research
II	Step-by-step expansion of the individual participation of the student of higher education (from choosing at his own will his participation in the conduct of a collective scientific experiment to individual scientific research and responsibility)
III	Consistent accumulation of experience in scientific and research activities (from collective planning, conducting, analysis, generalization, design, presentation of experiment results to individual scientific research of the problem)
IV	Gradual growth of independence of students of higher education in research activity (from initiated, motivated and organized by the teacher to individual)
V	Consistently increasing the requirements for the scientificity of the research, compliance with the procedure of its organization
VI	Expansion and diversification of scientific research methods

During the implementation of research training in the educational process of higher education institutions, it is necessary to reorient teachers from information-imperative didactics to personal-oriented, creative ones. That is, in the scientific-research approach, the teacher first of all provides certain recommendations to students of higher education and encourages them to creative activity, valuing any of their activity either by degree (barely noticeable, small, significant, etc.) or by type (social, emotional, intellectual, scientific, creative, physical, etc.).

In the conditions of specialized training, institutions of higher education, subject to the fulfillment of state education standards, are given the right to plan work independently, choose a profile and, accordingly, courses of choice, new forms of training (design, construction, research work, etc.), which creates conditions for the maximum realization of potential opportunities and creative abilities of the individual. Mechanisms for organizing individual research activities of higher education applicants should include schedules of special courses, electives, circles, practical seminars and webinars, student scientific societies, studios; schedules of consultations by academic supervisors, group and individual classes; information and reference databases, etc.

Based on the diversity of interests, needs and abilities of higher education students, three interrelated directions of research activity of higher education students in the process of learning various educational components are distinguished:

- classroom educational and research;
- extracurricular research;
- extracurricular independent study.

The creation of optimal conditions for the activity of higher education seekers in the specified areas provides favorable conditions for the organization of scientific and research activities.

Also, the implementation of scientific research activities in the educational process of higher education institutions involves the implementation of five organically related types of training: frontal, collective, group, individual, individual-group.

The main form of face-to-face and collective training is classroom training (practical, seminar, laboratory). Group and individual training is carried out both in the classroom and outside the classroom. The main goal of individual and group training is to include students of higher education in the process of self-study (in the library and at home).

The experience of collective and individual creative activity acquired by higher education students becomes the basis for conducting, starting with the graduation course, individual research work (qualification work) at conferences, seminars,

congresses, symposiums, webinars, etc. Such work already involves an independent scientific study of a problem in the chosen field with maximum compliance with the standards and requirements generally accepted in science.

The content of such scientific and research activities of higher education students consists in:

- individual self-determination regarding the choice of research direction and topic;
- development of the program and selection of research objects and methods;
- individual search and analysis of information on the problem of scientific research;
- analysis and generalization of materials, development of one's own position;
- preparation of research results in the form of research work in accordance with certain requirements;
- presentation of the results and conclusions of a scientific experiment and participation in competitions of scientific works, conferences of various levels;
- presentation and defense of research (qualification) work.

When involving students of higher education in scientific and research activities, it is necessary to prevent overloading, which can negatively affect their health. Therefore, this problem should be taken into account and solved in the process of optimizing the course of research work.

Means of scientific and research training in institutions of higher education

The main means of research training in institutions of higher education include: development of the ability to see problems, development of the ability to put forward scientific hypotheses, development of the ability to ask questions.

1. Development of the ability to see problems.

One of the most important traits of a true research scientist is the ability to see problems, especially where everything is clear and understandable to others. The German philosopher Friedrich Nietzsche noted that "... a great problem is like a

precious stone - thousands pass by until finally one picks it up." According to scientists, the correct formulation of the problem is the key to the success of scientific research.

Productive thinking is always related to problem solving. Thinking always begins with a problem, question or contradiction. This problematic situation determines the involvement of a person in the mental process, which is always aimed at solving some task. Research scientists note that thinking not only begins with a task, a problem, but also continues in the form of the emergence and solution of a number of successive cognitive tasks, problems in general. That is, the activation of learning is the organization of actions of higher education seekers aimed at understanding and solving specific educational problems.

The cognitive problem can be solved with different degrees of independence of higher education seekers and at different levels of cognitive activity. One of the ways is to show a sample solution of the problem by outstanding scientists. Some examples from the history of science can be given to illustrate to students of higher education.

Some foreign research scientists (V. Eshbi, V. Heizenberh) point out that finding and correctly formulating a problem is sometimes more important and more difficult than solving it. Therefore, the creative potential of a person is revealed, first of all, in his ability to approach a specific case in a non-standard way, to search and find the most optimal ways, effective methods of solving existing problems.

In domestic pedagogical science, many researchers (L. Vashchenko, M. Burhin, V. Zahviazynskyi, etc.) point out that the most general and essential skills necessary for search activity are:

- the ability to see the problem and relate the actual material to the problem;
- the ability to express the problem in specific cognitive tasks, to develop and specify it;
- the ability to see the relationship and subordination of problems, that is, to see a specific problem as a component of a more general one.

These skills form the basis for the development of creative abilities, in particular, the ability to see a problem. During the performance of works of a problematic nature, students of higher education analyze, synthesize, and independently transfer already

known techniques to a new situation in order to solve a new cognitive task. A student of higher education develops the ability to define a cognitive problem, the ability to separate parts from the whole, highlight the main thing, put forward historical hypotheses and conduct scientific research. If there is no independent processing of educational material, then there are no conditions for the development of thinking. However, the teacher always needs to set himself the goal of developing the thinking of students of higher education not spontaneously, but in a planned manner. The main stages of the development of problem vision in higher education students are shown in Table 5.

Table 5.

The main stages of the development of a problem vision in students of higher education

№	The main stages of problem vision development
1	The problem is given in a ready-to-solve form by means of the formed search problems
2	Acquirers are introduced to source data containing contradictions and inconsistencies, and are encouraged to identify and formulate a problem and research problem
3	The area or direction of searches to identify the problem is indicated
4	Acquirers, learning the logic of educational search, determine its direction, initial data, formulate the problem and the corresponding tasks.

In classical science, a problem (from the ancient Greek "problema" - task, task, difficulty) is a complex theoretical or practical question that needs to be solved, studied, researched. A problem is a clearly formulated question, and most often a set of questions that arise in the course of cognition. The very process of cognition, in this case, is interpreted as a sequential transition from answers to some questions to answers to other questions that arise after the first ones have been solved. The problem is expressed in the form of a cognitive task of a theoretical or practical nature, the solution of which creates a holistic view of the object of research.

The ability to see problems is an integral property that characterizes the thinking of a student of higher education, and it develops over a long period of time in a wide variety of activities. In order to develop this skill in the process of teaching one or

another educational component, it is recommended to develop special exercises and methods that will help to a great extent in solving this difficult pedagogical task.

2. Development of the ability to put forward scientific hypotheses

New knowledge from any educational component is first realized by the acquirer-researcher in the form of a hypothesis. Therefore, one of the main, basic research skills is the complex ability to put forward hypotheses, make assumptions. This process requires originality and flexibility of thinking, productivity, as well as such personal qualities as determination and courage. Hypotheses are born both as a result of logical reasoning and as a result of intuitive thinking.

The main requirement for a hypothesis during a classroom session is its consistency with the actually existing material, so not all assumptions can be called a hypothesis. Unlike a simple assumption, a scientific hypothesis should be substantiated, indicate the path of scientific research in the process of studying one or another educational component. For scientific research in institutions of higher education aimed at the development of creative abilities of students of higher education, the ability to generate as many hypotheses as possible is important. A scientific hypothesis is often the factor that motivates the creative research potential of a student of higher education, encourages active creative activity while working on scientific material.

Proposing hypotheses, assumptions, and unconventional ideas are the mental skills that ensure scientific research and, ultimately, progress in any creative activity. They arise as possible options for solving the problem, and then, during the analysis of the literary material, their probability should be assessed. Thus, scientific hypotheses give students of higher education the opportunity to see a historical problem in a different light, to look at the situation from a different angle. Formation of the ability to develop hypotheses can be preceded by special trainings, practical seminars.

3. Development of the ability to ask questions

The ability of students of higher education to ask questions is directly related to the ability to develop scientific hypotheses. A significant role is played in the method of organizing scientific and research activities by asking correctly directed questions.

The terms "problem", "question", "problem situation" denote non-identical, but closely related concepts. A question is considered as a form of expressing a problem, and a scientific hypothesis is considered as a way to solve a problem. The question directs the thinking of the student of higher education to search for an answer, thereby activating the need for knowledge, involving him in mental work.

Any question can be conditionally divided into two parts - basic, initial information, and an indication of its insufficiency.

Questions are divided into five large groups:

- Closed questions - questions to which the answer "yes" or "no" is expected. They contribute to the creation of a tense atmosphere in the conversation, so such questions should be used with a strictly defined purpose. Closed questions are not asked when information needs to be obtained, but only when it is necessary to confirm or refute previously achieved results and conclusions of research work.

- Open questions - questions that cannot be answered with "yes" or "no", they require some kind of explanation. These are such questions as: "What?", "Who?", "How?", "How much?", "Why?". Such questions are asked when additional information is needed or when a student of higher education wants to find out the conditions and features of conducting scientific research.

- Rhetorical questions are questions that do not have a direct answer, as their purpose is to raise new questions and point to unresolved issues. The purpose of the posed rhetorical question is to activate the thinking of a student of higher education and direct him in the right direction of scientific research.

- Critical questions are questions that raise a whole set of new problems. Similar questions arise in those cases when students of higher education have already received enough information on one problem and have to move on to others.

- Questions for reflection – questions that force the student of higher education to reflect, carefully consider and comment on the results of his research.

In addition, the questions can be simple or complex. Difficult questions actually consist of several simple questions. Under such conditions, the conduct of scientific research work of higher education applicants is ensured.

Thus, the development of students of higher education independence and the formation of scientific and research abilities and skills is the main goal of modern education. The level of preparedness of a specialist for scientific and research activity depends on how developed his research skills are. It is the institution of higher education that must ensure the training of specialists who will be able to adapt to the conditions and requirements of the labor market, use new technical developments, apply their creative abilities, scientific and research abilities and skills.

The main goal of scientific and research training is the formation of students of higher education readiness and ability to independently, creatively assimilate and rebuild new methods of activity in any sphere of human culture. Posing problematic situations in classroom classes helps students of higher education develop cognitive activity, the ability to conduct independent research, solve certain tasks, put forward scientific hypotheses, that is, it promotes the development of self-organization, self-education, and self-determination, which in turn ensure self-development of the individual. In addition, scientific and research training is a means of forming the production functions of a future specialist, and in modern society, these are necessary conditions for a specialist to be successful.