

## PEDAGOGY

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### Educational and research activity at the mathematics lessons as a form of formation of study and research skills of secondary school pupils

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**Abstract.** This article deals with the essence of the concepts of "scientific research activity". The components of study and research skills are characterized in the article. The teaching methods in the context of formation of study and research skills of secondary school pupils at the mathematics lessons are defined in the article.

**Keywords:** activity, skills, educational and research activity, study and research skills.

**Statement of the problem.** Integration processes of various fields of science and technology in modern conditions are becoming closer, integrate increasingly knowledge. These processes are reflected in the learning process in secondary schools where topical remains the problem dealing with the formation of a holistic understanding of the world and person's place in it, scientific thinking and world view, preparing students to synthesize and transfer knowledge from one science to another, to the professional activity in highly developed information environment with a high rate of change and obsolescence of information.

One of the current methodological problems of organization of educational process at the mathematics lessons is the massive introduction of innovative learning technologies, which are often borrowed and not adapted to the Ukrainian school, leading to a decline of students' knowledge, including the deterioration of the quality of knowledge in mathematics. Of course the teacher can not avoid any changes in education reform and these changes from year to year will be more global and faster. However, today's teacher must learn to isolate the base of each innovation and design it based on the prevailing national experience of teaching mathematics. Logically important in the teaching of mathematics are detailed aspects of the phenomena, there is interest in depth study of the essential features of innovation in teaching mathematics, including their structural components, hierarchies, relationships and modifications which, as for the system approach, substantially alter the very essence of innovation.

Updating the State Standard of secondary education (Cabinet of Ministers of Ukraine dated November 23, 2011 № 1392) encourages teachers to seek new areas of self improvement methodology of teaching the subject. According to the content of the above document we can talk about priorities in selecting innovations that will successfully resolve the methodological issues: the development of individual skills, the use of a schoolboy in practice acquired knowledge of different subjects; a successful adaptation of the child in society and his professional fulfillment in the future; the formation of abilities to collective action and self-education.

The above information makes it relevant to the choice of a teacher trajectory of methodological update of teaching academic subjects of mathematics. One of these areas

of the trajectories we consider the problem of organization of educational and research activities of students.

**The aim** of the paper is to reveal the essence of the term "educational and research activity of a student" by providing psycho-educational evaluation of scientific achievements of psychologists, teachers, methodologists. To specify the structural components of study and research skills and teaching methods from the perspective of organization of educational and research activities of secondary school students at the mathematics lessons.

**Analysis of recent research and publications** showed that the problem of learning and research activities of students is the subject of scientific analysis of domestic and foreign scholars whose research is complicated branching of scientific approaches to this issue and the ambiguity of the scientists' conclusions. S. Rubinstein, O. Leontiev, V. Shtoff, N. Talyzina and others observe various aspects of cognitive activity in their works. The research activity of students has been the object of study of such scholars as L. Kovbasenko, O. Mykytiuk, I. Nikitina, V. Palamarchuk, O. Savenkova, O. Savchenko and others. The works of V. Andreiev, A. Aleksyuk, V. Guzeiev, I. Lerner, E. Polat, M. Skatkin, I. Chechel and others are devoted to the development of direction of learning and learning activities. Studies devoted to the psychological characteristics of teaching pupils and students, teaching skills patterns of skills are performed by A. Aleksyuk, Y. Babanskyi, V. Davydov, L. Zankov, G. Kostyuk, V. Krutetskyi, I. Lerner, M. Makhmutov, I. Kharlamov, M. Shamaiev etc.

Development of theoretical and methodological aspects of teaching mathematics is reflected in the writings of the method of forming mathematical knowledge (G. Bezv, M. Burda, M. Ignatenko, Y. Koliyahin, Z. Sliepkan, A. Stoliar, N. Tarasenkova, I. Teslenko, M. Shkil, N. Shunde).

Still not denying a significant contribution to solving this problem, made the above authors, it should be noted that the term "educational and research activity of students" needs analysis and refinement.

**The main material.** The basis of psycho-pedagogical analysis put the process of student's activity. A general learning theory, whose foundations were laid by J. Comenius, I. Pestalozzi, A. Distverveh and extended by K. Ushinskyi, P. Kapteriev, S. Shatskyi, P. Nechaiev,

P. Blonskyi, L. Vygotskyi, as well as in teaching psychology (D. Elkonin, P. Halperin, V. Davydov, I. Linhart, I. Lompsher, N. Talyzina etc.) was formed the psychological theory of study activity of personality. Theory of activity is represented as a system of methodological and theoretical principles of study of mental phenomena. The main object of study is the activity. This approach is examined on two levels: the principle of unity of consciousness and activity (L. Rubinstein) and the problem of community structure of internal and external activities (O. Leontiev).

In his writings L. Rubinstein considers the activity as a set of actions to achieve goals. The main features of the activity L. Rubinstein believes to be sociality (activity is only by an individual); activity as the interaction of subject and object is meaningful, objective; activity is always creative and independent. Activity is determined by its object not directly, but only indirectly through its internal, specific patterns (due to objective reasons, etc.). This is a partial manifestation of the general principle of determinism developed: external causes operate only through the internal conditions of the comma or why these external influences are indicated. From these perspectives, the theory of thinking as an activity and as a process is created [6].

According to the theory of O. Leontiev, the person is described only by those mental processes and features that contribute to the implementation of his activity. The hierarchy of activities forms the core of personality. The main characteristic of the individual is self-awareness, i.e. the individual's awareness of himself in the system of social relations. Each age period of personal development, according to the theory of activity corresponds to a certain type of activity that takes a leading role in the formation of new mental processes and personality traits.

G. Shchukina reviews activity as the main manifestation of human activity, his social purpose. The essence of human activity is to transform reality, the active influence of the individual on the objective world. The scientist identifies the following basic properties of the general phenomenon: Targeting (transformation of the overall goal into specific tasks); transformative nature (activity with a view to improving their environment, transformation of the world); objectivity (its objective material basis is expressed here, its relation to the objective world); conscious character (reveals its subject, which is found in goal-setting, in predicting the activity, in promising aspirations) [7].

Thus, we can conclude that not separate features define the characteristics of human activity, but their relationship causes the unity and integrity of any type of activity and its variability. During the activity not only familiarization of child's objective world happens, but also the formation of attitude to it, to his place in this world, to society, to people with whom he learns.

From the standpoint of the general theory of activity psychologists distinguish the notions of "educational activity" and "cognitive activity". The term "educational activity" is a rather controversial concept. In scientific studies, there are three basic positions of the interpretation of this concept, namely: 1) it is defined as a synonym of the notion "learning"; 2) it is regarded as the leading type of activity in the early school years (a special form of social activity, which manifests itself through meaningful and

educational actions); 3) it is observed as one of the activities of pupils and students, aimed at their acquiring of theoretical knowledge and associated skills and abilities in the areas of social consciousness through dialogues (polylogues) and discussion (D. Elkonin, V. Davydov).

Thus, in learning the student begins not with the consideration of sensory-specific diversity of reality, but with already selected by others general internal foundations of this variety. The students' educational activities is built in accordance with the method of presentation of the theoretical knowledge, with the method moving from the abstract to the concrete.

Learning activity will be efficient only if it is organized in a way, when the student knows what to do: think, predict the results of activity, correlate them with the received results, draw conclusions.

P. Halperin emphasized that knowledge is the method of learning actions. The development of methods of action is the social order of society for learning. That means of the action are the goal of education.

G. Atanov as educational activity understands a specifically organized human activity, which manifests itself in the process of interaction with the outside world, and this interaction is vital in solving life important problems that are crucial to the existence and development of human [2, p. 58]. The scientist says that the model of activity consists of the following elements: need – motive – aim – subtopic – exercises – actions – procedures – result, a system formation factor is the order of these elements [2, p. 59-60].

As for the structure of educational activity, it is determined by the nature of interaction between its elements. But the question about the composition of the main structural elements of learning activity in educational psychology is still not resolved unanimously.

Analyzing the concept of "cognitive activity" we draw attention to the fact that this concept is broader than the notion of "educational activity" because knowledge is not only for learning, but also for the "discovery" of a new one. G. Shchukina in her scientific works uses the terms "educational" and "cognitive activity" as equal, in which there is mastering of academic subjects and necessary means and skills with the help of which the student receives education [7, p. 96]. This definition allows to set that the subject of learning is the content of subjects.

N. Polovnikova uses the term "cognitive activity" and defines it as a conscious, deliberate process, expressing students' active attitude to master the knowledge, skills, and methods of their production [5, p. 131]. Unfortunately, this definition does not reveal the nature of these processes.

The problem of academic knowledge (but not educational and research activity) is revealed in the works of L. Aristova. She understands the learning is understood as a type of knowledge [1, p. 7]. The difference between the scientific and educational knowledge, according to her point of view, "is that in the scientific knowledge there are wider relationships between images and they are expressed more clearly, the results of knowledge are more specific, in academic knowledge the formation of these bonds prevents not so much a lack of images and concepts in the personal experience of students but their similarity, which naturally leads to less specific conclusions, gener-

alizations "[1, p. 18]. L. Aristova indicates the number of signs that showed the convergence of academic and scientific knowledge and as a consequence - the need to streamline the new term "educational and cognitive activity." Namely, students' mastering of complex concepts with little life experience, intensification of educational process in school, which is based on increasing the level of its content, the pace of its development, an increasing trend to go beyond the limits of the content knowledge set by school, the research of new by students, their desire for discovery [1, p. 24-25].

Arrangement of the concepts of "educational activity" and "cognitive activity" led to a new concept of "educational and cognitive activity" (G. Shchukina), which she sees as "a special activity", "common activity", "a form of cooperation between a student and adult", where the cognitive processes of socialization of the child are improved.

Educational and cognitive activity of the student in the learning process G. Shchukina specifies in the following areas:

1. The contact with ability of other people (teacher, classmates and others) in which there the exchange of experience, the types of activity, its methods, resulting in a widening of the base knowledge of subject areas of activity.

2. The changing nature of activity from performance, active performance, actively self performance to creatively self performance and as a result is the ongoing development of the individual.

3. The changing the position of the student: from performance to the active position to the position of the subject.

4. The formation of the individual in the learning process is due to the changes in regulatory mechanisms (internal and external). The level of self-regulation is the main indicator and mechanism of formation of the student's individuality.

5. The changing of student's position in relationships between subjects in the "teacher-student" system leads to student's self-help skills through activity, independence, cognitive interest.

6. Introspection of learning that influences the change in student's position in the educational and research activity leads to the development and formation of the student's individuality.

Teachers should take into consideration these areas in the process of learning in the classroom, because they change the position of the student in the teaching and learning activity that promotes to form individuality.

At the present stage of educational reform, we are observing an interest of teachers to organization of the research activity of children. Exploring this question, S. Rakov in his scholarly work "The formation of mathematical competencies of mathematics teachers based on the research approach in education using information technology" stated, that developing principles of nature matching J. Comenius in the work "Out of School Labyrinth" examines the four stages of learning: autopsy (self-monitoring), autopraksy (practical exercise), autohresy (use of received knowledge and skills during new circumstances), autoleksy (self-presentation of the results of activity).

J. Comenius believed it necessary to teach students in such important way, so "they will take knowledge not of the books but observe to research and understand the objects themselves, but not remember only people's observations and explanations."

Recently, the literature discusses issues related to the detailed research activity, particularly in the area of educational and research organization (S. Korshunov, N. Nedodatko, I. Kravtsov), search (B. Skomorovskyi, V. Redina), research (G. Tshemistrova, O. Anisimova, L. Shevchenko) work.

According to the definition given by A. Obukhov, educational and research activity of students is creative process of common activities of the two entities (a teacher and a student) to find the unknown, during which the translation of cultural values is held between them, which results in the formation of ideology. Describing teaching and research activity, he emphasizes the basic function: students' desire of the knowledge of the world, themselves and themselves in the world [4]. We believe that the purpose of educational and research activity of students is providing targeted personal development, acquisition of research skills, mastery of knowledge that are perceived as new and personally meaningful only in relation to a specific single individual. The subject of these activities can be educational and research objectives, which in essence are informative and oriented to the "zone of proximal development" of the child. The teacher's work of formation of students' study and research skills is preceded by a successful, effective implementation of educational and research activity of students.

We believe that educational and research activity is student's activity focused by a teacher as a result of which the students has got formed and generalized methods of solving individually or socially significant problems. As a conclusion: any activity is carried out by solving problems, including learning activity is carried out by solving educational problems, which make up educational and research tasks in a particular system, whose solution is not an end, but is a method to achieve educational purpose.

The numerous scientific works, including: G. Bezv, M. Burda, Z. Sliepkan, N. Tarasenkova, V. Shvets and others, are devoted to the research of psychological and educational process of assimilation patterns of mathematical concepts, solving exercises, proving theorems at various stages of learning, reviewing of various ways of enhancing educational and cognitive activity in the study of mathematics and abilities of management of this activity. We think it is necessary to focus on certain aspects of students' educational and research activity in at the mathematics lessons by detailing essential component of the activity, namely, learning and research tasks. The learning and research tasks are closely related to informative (theoretical) generalization, they lead the student to the development of skills to summarize and organize educational material, to learn the new ways of action.

In the course of teaching and research tasks students form educational and research skills, such as: intellectual and creative (the skills to ensure the effectiveness of thinking operations of comparison, analysis, synthesis, generalization, classification and provide effective mental activity); social and interactive (the skills based on the actions, aimed at establishing and maintaining effective

interaction between members of the activity); perceptual and informational (the skills, supported by the actions of active perception, memory, storage, reproduction and structuring of information, they are observed in realization of the effective process of perception information and operating with its contents); organizational adaptative (the skills to provide a productive entry of a child to informational and educational environment, it is performed by actions of planning of independent activities in accordance with its objective, selecting methods dosyahnennyya purpose and the necessary means of determining the sequence of actions in sprukturi activity), reflexive and analytical (the skills by means of self-analysis of actions as the process of obtaining the result and self-regulation as a process independent of the target of the activity and its implementation).

Singled out the methods of teaching mathematics, which usually depends on the learning material available means, etc. we will pay our attention to the research method as one of the methods that allow to create study and research skills of students at the mathematics lessons. As noted by G. Bevz, there are two interpretations of the research method: it is the method in which the teacher provides the students themselves to "open" theorems, formulas, patterns, etc., that are studied by themselves, it is the method in which, along with the generalization of required knowledge a teacher asks students certain questions and exercises that require their research [3].

Example of a study and research task in mathematics on the theme "Square of the circle" (grade 5).

Think what practical actions you need to perform on a piece of paper to confirm that the area of a circle is calculated using the formula  $S=\pi r^2$ . Use a circle template and scissors. Be ready to demonstrate your version of the task to your classmates in the classroom.

**Task:** Confirm that the area of a circle is calculated using the formula  $S=\pi r^2$ .

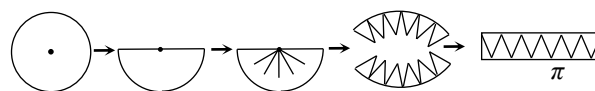
**Equipment:** A sheet of paper, compass, pencil, ruler, scissors.

**Algorithm performance:**

1. Build a circle of arbitrary radius, using the compass. Point O is the center of the circle.
2. Cut the circle with scissors.
3. Bend the model of the circle to the diameter of the circle.
4. Cut the model of a circle to the diameter.
5. Make cuts from the center of the circle to the outside circle.
6. Disconnect the two parts of the circle.
7. Merge of the parts circle, so that each sector of the first part is placed between the sectors of the second part.

**Conclusion:** The founded figure is a rectangle whose length is equal to  $\pi r$ , and width is equal to  $r$ . Using the formula for finding the area of a rectangle, we find that  $S=\pi r \cdot r=\pi r^2$ .

**Stages of model**



**Conclusions.** Educational and research activity is student's activity aimed by a teacher as a result of which the student has got the formed and generalized methods of solving individual or social significant problems. Any activity is carried out by solving problems, including educational and research activity is carried out by solving educational problems, which make up learning and research tasks in a particular system, whose solution is not a target but a method to achieve educational goals. However, we conclude that this issue requires improvements and generalizations in terms of disclosure of the components of activity based on factual material of the mathematics.

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#### Голодюк Л.С. Учебно-исследовательская деятельность на уроках математики как средство формирования учебно-исследовательских умений учащихся основной школы

**Аннотация.** В статье раскрыта сущность понятий "учебно-исследовательская деятельность". Охарактеризованы компоненты учебно-исследовательских умений. Определены методы обучения в контексте формирования учебно-исследовательских умений учащихся основной школы на уроках математики.

**Ключевые слова:** деятельность, умение, учебно-исследовательская деятельность, учебно-исследовательские умения.