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PROBLEMS OF APPLICATION OF ACTIVE LEARNING METHODS IN PHYSICS AND METHODS OF SOLUTION

Abstract. This article discusses the problems that arise when using active methods of teaching physics in the educational process according to the updated curriculum, and ways to solve them. The analysis of documents, survey methods, analysis of the results of scientific research on the topic. Analysis of domestic and foreign articles. As a result of the study, problems, difficulties and a number of ways to solve them were identified when using active teaching methods by teachers of physics and natural science.

In addition, the classification and benefits of active teaching methods are presented. Examples of active physics lessons, practical exercises are considered. It guides students in solving theoretical problems and issues of daily life. It is convenient to systematize a large amount of information in lectures and practical exercises, where the main issues of the topic are explained and recommendations for independent study of the material are given.

The results of scientific research can be a useful and auxiliary tool for students, young professionals, teachers of physics and natural science in higher and special educational institutions.

Keywords: physics, natural sciences, methods of active learning, problem, case study.

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Физика пәнінен белсенді оқыту әдістерін қолдану мәселелері және оны шешу жолдары

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Аңдатпа. Бұл мақалада жаңартылған оқыту бағдарламасы бойынша білім беру үдерісінде физика пәнінен белсенді оқыту әдістерін қолдану кезінде туындайтын мәселелер және оны шешу жолдары қарастырылады. Тақырып аясында ғылыми зерттеулерді жүргізуде құжаттарды талдау, анкеталау әдістеріне, нәтижелерге талдау жүргізілді. Отандық және шет елдік мақалаларға талдаулар жасалды. Зерттеулер нәтижесінде физика және жаратылыстану пәндері бойынша білім берушілердің оқытудың белсенді әдістерін қолдану кезінде туындайтын проблемалар, қиындықтар және оны шешудің бірқатар жолдары көрсетілді.

Сонымен қатар, белсенді оқыту әдістерінің жіктелуі мен артықшылықтары көрсетіледі. Физикадан белсенді оқыту дәрістері, практикалық сабақтардың мысалдары қарастырылады. Ол білімалушыларды күнделікті өмірден алынған теориялық проблемалар мен мәселелерді шешуге бағыттайды. Дәрісте, практикалық сабақтарда көлемді мәліметтерді жүйелеп беру қолайлы, мұнда тақырыптың басты мәселелері нақтыланып, материалдың өзіндік тұрғыдан игерудің әдістемелік нұсқаулары берілгені жайлы баяндалады.

Ғылыми зерттеулер нәтижесі жоғары оқу орнында және арнаулы оқу орындарында педагогикалық бағытта білім алатын студенттерге, жас мамандарға, мектеп қабырғасында және жоғары оқу орындарында білім беретін физика және жаратылыстану пәні мұғалімдеріне пайдалы, сонымен қатар көмекші құрал болуы мүмкін.

Кілт сөздер: физика, жаратылыстану пәндері, белсенді оқыту әдістері, проблема, кейс.

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Вопросы применения методов активного обучения физике и способы их решения

Аннотация. В данной статье рассматриваются проблемы, возникающие при использовании активных методов обучения физике в учебном процессе по обновленной учебной программе, и способы их решения. Проведен анализ документов, методы анкетирования, анализ результатов научных исследований по теме. Анализ отечественных и зарубежных статей. В результате исследования были выявлены проблемы, трудности и ряд путей их решения при использовании активных методов обучения преподавателями физики и естествознания.

Кроме того, представлена классификация и преимущества активных методов обучения. Рассмотрены примеры активных занятий физикой, практических занятий. Он направляет студентов к решению теоретических задач и вопросов повседневной жизни. Систематизировать большой объем информации удобно на лекциях и практических занятиях, где разъясняются основные вопросы темы и даются рекомендации по самостоятельному изучению материала.

Результаты научных исследований могут быть полезным и вспомогательным инструментом для студентов, молодых специалистов, преподавателей физики и естествознания в высших и специальных учебных заведениях.

Ключевые слова: физика, естественнонаучные дисциплины, активные методы обучения, проблема, кейс.

Introduction

The future of the state and society depends on how effectively the educational process is organized. The modern school is constantly improving and changing. In this regard, the modernization of the content of modern education has led to the transformation of the educational process. The updated curriculum and new standards are based on a competency-based approach, according to which the structure of curricula has changed: action has been taken on the expected outcome, rather than on the established learning material that must be mastered. This showed a change in student perception, ie the transition from traditional learning to collaborative learning. One of the ways to implement these tasks is to create an effective method of improving the level of development of students' thinking, activating their scientific and cognitive activities, motivating them to study and learn through the use of various rational methods.

At the same time, one of the most pressing issues of modern education is to increase student activity in the classroom. The formation of knowledge, skills and abilities of students in the field of physics occupies a leading place in the curriculum of basic, secondary and general secondary education, which is determined by the practical importance of physics in the formation of a unified scientific image of the world. Successful teaching of “Physics” depends on the teacher's direct professional experience and competence, focusing on the results of the learning process. We believe that the teacher must use a variety of methods and tools to organize the learning process of students and monitor its results, and the help of active learning methods is significant.

Research methods. When performing research in this direction, the following research methods were used: analysis, analysis of documents, questionnaires, analysis of results. The analysis of domestic and foreign articles is carried out.

Results and discussion

Teaching methods are a complex, multifaceted, multidisciplinary phenomenon. Teaching methods reflect objective laws, goals, content, principles and forms of teaching. Teaching methods play teaching, developing, educating, motivating and supervisory-corrective functions in the educational process [1].

There are many types of methods used in the modern pedagogical process. Today, four ways of grouping methods are widely recognized in pedagogy. Methods are classified according to various criteria:

- by the nature of educational activities: reproductive, problem, research, exploratory, explanatory-visual, detailed search (heuristic), etc.;
- depending on the level of activity of the teacher and the student: passive, active, interactive;
- by source of educational material: words, visuals, actions (practice);
- on the methods of organization of educational and cognitive activities: methods of formation of knowledge, skills, abilities in practice, methods of testing and evaluation of new knowledge.

Active (active) form of learning is a step into the developmental methods of search, research, specific problem-solving, which generate cognitive motives and interests in an organized, algorithmic, planned form and method of organizing the didactic process for teaching and creativity [2].

Advantages of active learning methods: first, they are active because they are mainly intellectual and physical games; secondly, they replace the passive monologue with the active exchange of ideas of all participants in the educational process, turning students and learners into passive listeners and “speaking” “energetic, motivated, creative, demanding players and coaches (player-coaches)” of an organized team; thirdly, these methods are used by all available forms of oral and written communication and activate the hidden potential of the participants in the traditional way; Fourthly, as a result of the use of all the intellect in us, the process of acquiring knowledge, skills, abilities, qualities and values is significantly intensified. The methods are so active that they apply not only to lessons, seminars, training tasks, but also to relaxation, breaks and

even extracurricular activities. Interestingly, the activity of 36 participants during the break is higher than during the performance of practical tasks and exercises [3].

Many scientists have studied the effectiveness of active teaching methods.

G.D. Kuznetsova explains that the essence of learning is the correction of knowledge and skills of students, through the well-organized systematic control, students develop the skills to work, perform tasks responsibly, and develop the desire to achieve high results. He also emphasizes that one of the ways to improve the quality of teaching is the proper organization of the learning process, clearly explaining the need for proper planning of learning activities, including components such as the stages of the lesson, the organization of the class, teacher-student interaction [4].

According to O. Ozcan & C. Gercek, not only theoretical and practical knowledge of a physics teacher is enough for students to understand the connection between physics and everyday life, but also the ability to convey it to the student through the use of effective teaching methods. Scientists conduct experiments with senior students in order to test the qualifications of students through active approaches and content-oriented approach, and analyze the collected data using the method of content analysis. According to the results of the analysis, the lack of knowledge about the application of active methods in the educational process and the applications used in the lessons of physics teachers of additional specialties [5].

In order to determine the relative effectiveness of experimentation and discussion (group work), scientists M. Marušić, J. Sliško conduct experiments based on changing the perceptions of high school students in the traditional study of physics and promoting the development of logical and creative thinking in active learning. As a result, for students who participated in the control group for one semester (participation – 91 students), there was a change in the development of logical thinking by 11%, and the attitude of students to the development of creative thinking by 20.9%. The results of the experimental group (85 students) showed a significant change in the development of logical thinking in 31.7%, and the attitude of students to the development of creative thinking increased by 36.4%. These results showed that both types of active learning have improved students' understanding of the impact of teaching physics on the development of logical and creative thinking [6].

L.M. Drăghicescu and A.M. Petrescu believe that the learning process in science (chemistry, physics and biology) should not be based solely on the transmission and reception of information. Students find that they need to increase their search to analyze problem situations or solve specific predictive problems. Through problem-based learning and active learning technologies, science students determine that they acquire not only cognitive skills, but also a number of instrumental and transverse skills [7].

Although L. Deslauriers and L.S. McCarty recognize that active learning is the best method of teaching in the classroom, recent research has shown that most teachers choose traditional teaching methods, and addresses the long-standing question of why students and teachers oppose active learning. Comparing traditional teaching with active learning, using an experimental method and similar course materials, we found that students in the experimental group were more prepared, but less receptive. It was shown that the presence of such a negative correlation is partly due to the increase in cognitive effort required for active learning [8].

The direct involvement of students in the active learning process in the educational process is associated with the use of teaching methods.

A.M. Smolkin defined active methods of teaching as ways to increase the cognitive activity of students, which stimulates active thinking and practice in the process of mastering the material, when not only the teacher but also students are active [9].

In the new system of education, active learning methods are important in the formation of the individual. Active teaching methods are the methods that motivate students to think actively and practice in the process of learning the material. Active learning is the use of a system of methods aimed at the acquisition of knowledge and skills by students in the process of active thinking and

practical activity, rather than the teacher's presentation, memorization and reproduction of ready knowledge. The peculiarity of active learning methods is that they are based on the awakening of practical and thinking activity. Without it, there will be no progress in the acquisition of knowledge. The emergence and development of active teaching methods not only provide students with knowledge before learning, but also to ensure the formation and development of cognitive interests and abilities, creative thinking, independent intellectual work, etc. due to new tasks [10].

Choosing, using, and developing active learning and teaching methods is not an easy task, as teachers face many questions before using any approach, such as:

- Does this lesson correspond to the age of the students?
- What children are in the class, for example, different levels of abilities, number, gender, etc.?
- Do individual students have specific needs or circumstances that need to be considered in planning?

Before using a particular method of active teaching and learning, teachers need to ask themselves a variety of questions and constantly think about their role and actions in the process. An active learning approach connects new knowledge with previous knowledge, mistakes allow us to check ourselves, improve our understanding, and as a result change profound knowledge and attitudes. Active learning allows students to experiment on the basis of their own experience, to understand the meaning and form an understanding [11].

We see from the work of these researchers that active teaching methods are highly effective. However, science and physics teachers often prefer traditional teaching methods to active teaching methods. Why are teachers still inclined to traditional teaching in the educational process and why do they always use active teaching methods? We conducted research to find the answer to this question. The purpose of the study was to identify the difficulties encountered in the application of active teaching methods in physics and some natural sciences and ways to solve them. In order to achieve this goal, the analysis was carried out in order to solve the problems encountered by analyzing the articles and the following conclusions were drawn.

Active learning is a form of interaction between teachers and students during the lesson. If in a traditional lesson the main character of the teacher is in the managerial role, and in the lesson where the active method is used, the teacher and the students have equal rights.

Active teaching methods are the teaching methods in which the student's activity is creative, exploratory. Active teaching methods include didactic games, case studies, problem solving, algorithmic learning, brainstorming, etc. b. applies.

The effectiveness of the use of active forms and methods of teaching is measured by indicators of lesson effectiveness.

Indicators of lesson effectiveness:

- 1) motivation for the studied discipline;
- 2) constant cognitive interest in the subject;
- 3) the condition and level of the student in the classroom;
- 4) formation of components of educational activity (goal-setting activity, educational activity, control activity, assessment activity);
- 5) development of students' thinking skills (analysis, synthesis, comparison operations, the ability to classify important concepts);
- 6) improving the quality of education and training [12].

The use of active forms and methods of work contributes to the formation of personal qualities of students: independence, diligence, creativity, self-esteem.

However, it should be noted that some teachers are not able to quickly adapt to the latest innovations and constant changes in education reform. Admittedly, this is often the case with young professionals, experienced teachers, and teachers who prefer traditional teaching. The following steps are needed to determine the cause.

- it is necessary to identify and understand the common barriers to educational change;
- self-perception of teachers and self-determination of their roles;
- discomfort and fear of change;
- Teachers need limited incentives for change [13].

The use of active teaching methods reflects the special psychological, pedagogical and technological training of teachers. In order to organize effective work with the help of active learning methods, it is necessary to consider the following mandatory rules:

- Involve all students in group activities;
- optimal composition of participants (lack of students of the same level in the group);
- psychological support from the teacher;
- organization of space;
- The principle of grouping (at the beginning of the work – free distribution, then random selection is used)

The introduction of active forms of learning increases the effectiveness of the educational process, promoting the development of students' thinking functions, creative activity, interest in learning. At the same time, it not only forms cognitive activity and independence of search, which are prerequisites for quality education, but also further develops [14].

The success of a lesson often depends on its organization and planning. Of course, its planning depends on the search, creativity and skill of the teacher.

The reasons that prevent the use of active approaches in the educational process can be divided into two groups: subjective and objective.

Subjective reasons:

- inactivity of teaching staff;
- lack of creative qualities (propensity to improvisation, flexibility and uniqueness of thinking, diversity of behavior ...);
- lack of methodological and didactic skills.

Objective reasons include:

- Insufficient knowledge of active methods of teaching, both theoretically (lack of a common methodology, a single conceptual apparatus), as well as methodologically;
- weak consequences of active teaching methods;
- Lack of a unified algorithm to achieve the goal.

A.A. Kisselyev, some special barriers are associated with the use of active learning, including limited class time; possible increase in training time; potential difficulties in using active learning in large classes; lack of necessary materials, equipment or resources [15].

However, teachers' efforts for active learning may be accompanied by students' lack of participation, inadequate use of high-level thinking skills, or insufficient learning, in which case teachers may feel out of control, lack skills, or be criticized for teaching in traditional ways. However, the type of obstacle and risk must be successfully overcome through careful, thoughtful planning.

Active learning is not only a high level of practical training that meets high quality and modern requirements, but also a quantitatively effective interaction of teachers and students.

The teacher's task is to find new things in the learning material that are unknown to students, as well as useful and relevant. One way to improve the quality of teaching is to properly organize the learning process. It is necessary to properly plan the learning process, which includes components such as the stages of the lesson, classroom space, teacher-student interaction, as well as the actual organization of student interaction.

In order to overcome the problems and internal barriers to the use of active methods in teaching, teachers need to:

- first of all psychological training;
- choose strategies that allow active learning;

- training of students;
- activities aimed at learning objectives [16].

Improving the teaching process of physics and cognitive activity of students based on increasing the search. In the process of cognitive activity, students not only acquire the required amount of knowledge, but also develop cognitive abilities and creative thinking [17].

Analyzing the above research, we offer general recommendations for achieving success and overcoming difficulties during the lesson:

1. When choosing a teaching method, the teacher must take into account the time allocated for the study of this topic, as well as the importance of the learning material for further learning activities of students.

2. In order to achieve results in the educational process, it is necessary to use active and systematic methods of teaching.

3. The key to success is a thorough, well-planned training, in-depth consideration and understanding of the types and methods of teaching.

4. When choosing group and collective forms of organization of work with students, it is necessary to take into account the individual characteristics of the study group and each student.

5. To form general and professional competence, it is necessary to take into account the specifics of the content of the study material, the objectives of training, time, the specifics of the student body, the availability of teaching aids.

6. Consider a lot of motivational moments, both in preparation and during the lesson. Motivate students according to their contribution to the lessons.

7. Not only the results of training, education and development, but also the image of communication – the emotional state of the lesson: monitoring not only the relationship, but also the relationship of students with each other, as well as individual working groups.

All types of active learning methods require communication with all participants. As a result, there may be various difficulties in the use of active learning methods, the main thing is to sufficiently apply the effectiveness of the action taken.

A. Alimov in his work “The use of interactive methods in higher education” offers the following example of the structure of lectures and practical classes on interactive teaching methods.

Active learning methods – describe the interaction of students in the form of interaction, conversation, dialogue. In other words, active methods differ from interactive methods in that students interact more broadly not only with the teacher, but also with each other, and focus on the predominance of student activity in the learning process. The learning process is carried out in the conditions of constant active interaction of all students. The teacher also creates a lesson plan (usually these are interactive exercises and tasks during which the student reads the material). Therefore, the main components of interactive lessons are interactive exercises and tasks performed by students. An important difference between interactive exercises and regular exercises is that students not only collect what they have read, but also learn new ones. The use of an interactive learning model involves modeling real-life situations, using role-playing games, and solving problems together. The dominance of any participant in the process or any idea is removed. This model teaches a humanistic democratic approach. Interactive learning technology is a collective organization of the learning process, based on the interaction of all its participants in the learning process, the student cannot complement each other [18].

Active learning lectures are lectures that cover the theoretical foundations of topical issues. Guides future physics teachers to identify theoretical research and problems from everyday life. It is convenient to systematize the materials in the lecture, the main physical phenomena are studied in the topics of the lecture, and methods of its independent study are given.

However, the opportunities of a traditional lecture (one-sided opinion, point of view, position, decision-making), based on the use of feedback, communication, increase the process of acquiring knowledge of physics, improve their interest and motivation.

The use of active learning methods makes the active participation of students in lectures an interesting and engaging process. Its features can be distinguished as follows:

- information is not available in active learning lectures;
- active learning lectures are based on the development and deepening of physical processes;
- Topics of active learning lectures are presented in the form of ready-made texts;
- active learning lectures are conducted in the form of dialogue;
- in active learning lectures the teaching material is presented not as a whole, but in a certain system;
- joint independent work of students is used in active learning lectures;
- In active learning lectures, knowledge is carried out through the thinking of students;
- Assessment notes, cases, etc. in active learning lectures. is carried out through;
- Active learning lectures are carried out through feedback.

Feedback on active learning is given at the end of the lecture by asking students a few questions to find out what they think, what questions they have, what they think about today's lecture. These answers will be used in the planning of future lectures and will be based on the feedback of students in the next lectures.

In connection with our study, the types of active learning lectures were identified:

- problem lecture;
- discussion lecture;
- lectures with cases;
- consulting lectures;
- conference lectures, etc.

Next, let's analyze how to use these lectures in the teaching process.

The peculiarity of the problem lecture is that it offers a debate situation in the learning process, different options for solving any problem, as well as engages students in active discussion of issues and joint decision-making. The purpose of the problem lecture is to deprive the student of the material and to involve students in active cognitive activity [19].

Problem-based learning is often used in lectures, because physics is of great practical importance in everyday life. Students must be able to explain natural phenomena in terms of the laws of physics. For example, reading the topic “Dispersion of light” and showing slides of I. Newton, the blue sky, the sunset (Figure 1) immediately raises a problematic question: why is the white light passing through the prism divided into the colors of the rainbow? Why is the sky blue? Why does the sky turn red at sunset?



Figure 1 – I. Newton's Experiment. Blue sky. Sunset.

Problem solving situations arise during frontal experiments in physics classes. For example, in an experiment on “Floating Bodies”: bodies of equal size are immersed in a glass of water, one made of wood, the other of aluminum, students notice that the aluminum body is sinking, and the wooden body is floating. Students immediately have a problem: why one body sinks and the other swims. Under what conditions do bodies float?

Contradictions can arise when considering different branches of physics, in particular when studying special relativity. According to the laws of electrodynamics, the speed of light in a vacuum is constant and maximum, while according to the laws of the classical theory of Newtonian mechanics, the speed of a body can be different with respect to different reference systems. How to eliminate the laws of electrodynamics or the laws of mechanics?

Created problem situations allow increasing the mental activity of students, to find solutions to problems.

In preparation for the discussion lecture, the teacher should focus on the following issues:

- identify key issues for discussion;
- preliminary preparation of controversial issues;
- identify issues of concern to students;
- give examples and arguments that provoke discussion on the topic.

“Nuclear Energy: Yes or No?” Two weeks before the event, participants will be selected, they will get acquainted with the game technology, roles will be assigned. The outcome of the game depends on the readiness of students, their personal qualities. Students take their responsibilities seriously, some prepare presentations for speeches, and others have abstracts. At the end of the game, I tell each student my opinion, because during the game they should all participate in the discussion.

“Discussion” allows you to effectively address the following issues:

- Helps students to consolidate, update, acquire new knowledge and skills;
- Promotes the development of intellectual, linguistic and creative abilities. Debate develops logic, critical thinking, allows you to form a systematic view of the problem, the relationship of events and phenomena, various aspects of their consideration;
- Contributes to the formation of a culture of communication, the recognition of many ways to solve the problem;
- Facilitates the implementation of communicative and interpersonal communication.

Lecture on case technology;

- Case-study method or case-by-case method (from English case – case, situation) – a method of active problem-situational analysis (case-solving) based on learning by solving specific problems-situations.

- Case-study method is a non-game active learning method and the following to gain experience in the following areas:

- identification, selection and solution of problems;
- understand the meaning of the details described in the work with information; analysis and synthesis of information and arguments; work with assumptions and conclusions; evaluation of alternatives; decision making;
- listening and understanding of other people, including teamwork skills.

Cases help to increase the activity of students [20].

The materials of the interactive model set prepared for the lesson “Aggregate state of matter” for case technology are presented as follows (Figure 2):

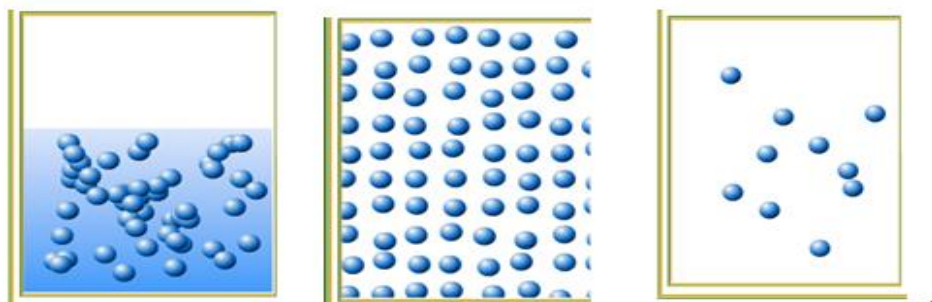


Figure 2 – Aggregate state of matter

Determine by interactive model?

- physical state of water
- Give a brief description of each case
- Formulation of physical properties of matter
- Give examples of scenes in nature.

Example of a case for the lesson “Melting and hardening of crystalline bodies” (Figure 3):



Solve the riddle:
What wonderful stars
On the coat and scarf?
Everything is carved, cut,
If you take it, it turns into water [21].

Figure 3 – Snow

When students guess the riddle, a picture appears.

- What's this? Explain it in terms of physics.
- What was the state of water?
- What was the process with matter?
- What is the transition temperature called? At what temperature does ice melt?
- What is the formula for calculating the amount of heat released in this process?
- What is the specific heat of fusion?

An example of the situation with the lesson “Boiling”.

“It was getting dark; on the table, shining,
The evening samovar whistled,
Heated the Altai kettle;

Light steam came out from under it [22].

- What thermal phenomena are we talking about?
- At what temperature does water boil?

- If water is poured into a samovar at a temperature of 20°C, what formula can be used to calculate the amount of heat used to boil water?

- What is the specific heat of vaporization?

An example of the situation in the lesson "Evaporation and condensation".

In front of the window Magzhan,

Breathe cool into the glass.

Blessed with deep thought,

On foggy glass

With a cute finger

He wrote the letters O and E with respect [22].

- What was the physical phenomenon when Magzhan breathed in the “cold glass”?
- Why is the glass “foggy”?
- What is the physical state of water?

By answering questions, students develop decision-making and teamwork skills.

Counseling – This type of lecture is similar to a conference lecture. Counseling combines the concepts of discussion, counseling, assistance, counseling.

The application of active learning methods in practical lessons is the final stage of learning materials. In this regard, such a lesson summarizes and evaluates the independent work of students.

In practice, compared to lectures, the main responsibility falls on the students, who play a key role in the lessons. In the practical lesson the student develops the skills of in-depth consideration of theoretical problems and their application in practice. Students express their opinions and positions through the activities of explaining, discussing, analyzing and evaluating the problem under discussion: we believe that it is very effective to organize practical discussions through group discussions and debates.

The following effective forms of learning theoretical material can be used in practice: finding solutions to problems, analysis and evaluation of information (statistical calculations in physics, approaches and conclusions to scientific research, legislation, etc.), comprehensive discussion of practical situations and ways to solve them is.

Based on the above structure of lectures and practical lessons, the use of active learning methods in the presentation of physics teaching materials can be said to be a topical issue in the context of modern education.

Conclusion

In conclusion, the effectiveness of active methods is determined only by the skill of the teacher and the strengthening of this skill. Therefore, the system and methods of teaching aids to increase the motivation of students require each teacher to master them in depth, implement them and the corresponding skills. Researchers and methodologists are considering ways to find new types of active methods in physics, taking into account the changing values of students, their motivation and the peculiarities of the development of society. In this regard, the updated curriculum considered the problems that arise when using active learning methods in the educational process and suggested ways to solve them. Within the framework of the research, an analysis of research was conducted, which resulted in a number of ways to solve problems. Based on the structure of lectures and practical classes, it can be said that the use of types and structures of active learning methods in the presentation of physics teaching materials is a topical issue. We believe that the results of this research will be a useful tool for students studying in the pedagogical field, young professionals, teachers of physics and science.

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