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Practice-Oriented Tasks for Increasing Motivation in STEM Education

Abstract

Introduction. The study addresses the problem of enhancing student motivation in learning cause-and-effect relationships in nature through the implementation of practice-oriented educational tasks and illustrative materials. *Methodology and Methods.* A pedagogical experiment was conducted with control and experimental groups, where active teaching methods were applied in the experimental group through the performance of practical tasks designed to identify cause-and-effect relationships using illustrative materials. *Results.* It was established that meaningful and didactically well-structured learning activities play a crucial role in fostering student motivation by enabling learners to engage consciously with educational content in real-life contexts. The experimental group demonstrated significantly higher student engagement compared to the control group, showing greater interest in practical activities and higher motivation to succeed. Successful completion of practice-oriented tasks instilled a sense of achievement and self-confidence in students. *Scientific novelty.* The effectiveness of practice-oriented tasks as a motivational tool that promotes active and conscious learning in studying cause-and-effect relationships in nature has been proven. *Practical significance.* The developed approach can be applied to improve the quality of the educational process, achieve defined learning objectives, and sustain increased student motivation for research-based and project-oriented learning activities.

Keywords: education, practice-oriented training, didactics, motivation, educational activity, causal relationships.

Introduction. According to Aleksashina I., the education system is currently undergoing a period of reform associated with changes in content and the search for optimal teaching methods and technologies that can meet the growing demands of both the individual and the state. The study of the Natural Sciences still occupies a leading position, as it determines the level and style of scientific thinking. This is a natural science that fully reflects the ability of the human mind to analyze any incomprehensible situation, identify its fundamental, qualitative and quantitative aspects and bring the level of understanding to the possibility of theoretical forecasting of its nature and the results of its development over time. Natural Science Education is one of the components of preparing the younger generation for an independent life (Abdimanapov et al., 2018; Balabaeva et al., 2011). Along with other components of education, it ensures the comprehensive development of the child's personality during his studies and upbringing at school.

The problems of education of love for nature and care for it were studied by Gaisin (1995), Moiseeva (1996), Tsvetkova (2000), Chawla (2006), Bukovskaya (2007), Perkins (2010), Abdimanapov (2018), Anđić & Maurović (2024), Mazitova (2007) and others. Such scholars as L.N. Bozhovich, A.A. Leontiev, S.L. Rubinstein, D.B. Elkonin, and others have made significant contributions to the study of the developmental characteristics of preschool and primary school children, particularly regarding their interaction with the external environment (Yasnitsky, 2010). At different times, various scientists were engaged in the problems of natural sciences. A great contribution to the formation of natural science ideas in modern educational systems was made by O.I. Donina, F.Yu. Siegel, V.N. Komarov, B.V. Kukharkin, E.P. Levitan, E.A. Paladyants, F. Hoyle, S. Hawking and others (Artemieva, 2007). For example, Hawking (1988) reasoning a statement related to natural science as follows: «it makes no sense to ask if the theory is true, because we know that reality depends on the theory».

Mumtaz (2000) considers this approach based on the principle of observation (indirect measurements that confirm or refute the theory) to be the most optimal for fruitful knowledge of the level of reality that is inaccessible to direct perception and control and whose phenomena are impossible. It explains that it must be embodied in familiar images and understood from the point of view of the accessible consciousness of a person. Natural science is also valuable because it helps to understand man's place in the world as an integral part of nature, without which his existence is impossible, he is the most intellectual and highly spiritual being responsible for the future of the biosphere.

The subject of natural science is studied scientifically in secondary schools as the legal links between the system «natural environment-мan-society», as well as a sense of responsibility for maintaining the environment clean, improving the natural environment without creating environmental problems. In this regard, cause and effect are interrelated-combined with natural substances and actions. The depth of the definition of cause-effect relations by means of the outstanding establishes the general theoretical degree of the original scientific creation.It is necessary to teach the student the same principles:

- each manifestation has its prerequisites and results, it is necessary to be able to understand it, (a combination of these factors);
- forecast of the likely outcome (consequences) according to the set of factors;
- resumption to a predictable extent of possible factors that led to a real result;
- there are not only one causal relationship, but also many relationships that can determine these factors;
-fixing the causal relationship in schematic or tabular form.

In such conditions, one of the areas of educational practice – practice-oriented tasks-begins to gain special weight.

- practice-oriented tasks allow you to significantly increase your learning motivation. Their relevance is due to the following circumstances:
- firstly, the effectiveness of teaching is significantly increased by increasing the personal status of the student and the practice-oriented content of the proposed task;
- secondly, in the process of interaction, feedback channels are constantly working in the «teacher-student» system;
- thirdly, students develop an interest in creativity, which allows them to learn the joy of creative activity.

The study of the motivating component of students activities makes it possible to obtain information about the quality of work of an educational institution, that is, schools. It is the motivating component that determines the student's ability to set and successfully solve educational tasks. The analysis of the data obtained as a result of the study determines the qualitative and quantitative indicators of learning motivation: the final level of development of motivation as a whole and the levels of development of its individual components (the presence of individual meaning of learning, the ability to set goals; the predominance of cognitive or social motives, external or internal motivation, the desire to achieve success or avoid failure, the implementation or absence of learning motives in behavior). The results obtained make it possible to identify ways to solve the identified problems, to draw the attention of teachers to methods of increasing the motivation of students of a certain age.

The most important requirement of society for the training of school graduates is the formation in them of a broad scientific worldview, based on solid knowledge and life experience, readiness to apply the knowledge and skills acquired from the school threshold throughout their lives. The implementation of this requirement involves the orientation of educational systems to the development of the qualities necessary for the life of students in modern society and the implementation of practical interaction with objects of nature, production, household. Motivation is a cornerstone of effective education, and its significance in science classrooms cannot be overstated. As educators and researchers delve deeper into the dynamics of science education, they are increasingly recognizing the pivotal role of practice-oriented tasks in enhancing students' motivation and engagement. The traditional model of science education, often characterized by lectures and theory-focused instruction, has shown limitations in sustaining students' interest and fostering a genuine passion for the subject. To address this challenge, a shift towards more practice-oriented tasks has gained prominence in contemporary pedagogical approaches (Sanat et al., 2022; Tikhonova et al., 2021; Slough et al., 2010). The integration of practice-oriented tasks in science lessons brings a transformative element to the learning process. It aligns classroom activities with real-world scientific applications, making science education more relevant and experiential. This approach is rooted in the idea that students are more likely to become engaged and motivated when they can see the direct implications and practicality of what they are learning. By immersing students in hands-on experiments, problem-solving exercises, and interactive projects, educators can ignite a sense of curiosity, exploration, and purpose in their students pursuit of scientific knowledge.

This paper explores the multifaceted relationship between practice-oriented tasks and motivation in science lessons. It delves into the theoretical underpinnings of motivation in the context of science education, discusses the benefits of practice-oriented tasks, and presents practical strategies for implementing these tasks in the classroom. Through this examination, we aim to shed light on the potential of practice-oriented tasks to revolutionize science education, enhance student motivation, and ultimately inspire a new generation of passionate and proficient scientists.

Materials and Methods. The scientific article used the following set of research methods, namely:

- analysis of psychological and pedagogical literature;
- generalization and systematization, study of documentation;
- empirical: experiment, interview, observation;
- use of diagnostic methods;
- analysis of the products of students activities.

Research methods: theoretical: generalization, systematization on the topic of research.

The subject of the study is practice-oriented tasks in natural science lessons as a means of increasing the motivation of students.

The purpose of the study is to get acquainted with the system of application of practice - oriented tasks to increase motivation for learning.

The hypothesis of the study is that if the training of students in natural science lessons is built on the basis of solving practice - oriented tasks, then this increases the motivation to learn.

Research objectives:

1. Study of the state of the problem under study in the scientific and methodological literature.
2. Familiarization with the methodological requirements for practice-oriented tasks.
3. Ability to develop and use practice-oriented tasks in the educational process.
4. Checking the effectiveness of using practice-oriented tasks to increase motivation.

Research base: MPI «Secondary School named after D. Kunaev» in the Glubokovsky District of East Kazakhstan region.

Results. The introduction substantiates the relevance of the problem. The purpose, object and objectives of the study are formulated, the scientific novelty of the work, theoretical significance, practical value are indicated, the stages of the study are distinguished. Practice-oriented learning is a type of training, the main goal of which is to form students ' skills and skills of practical work, which are currently in demand in various areas of social and professional practice, as well as the formation of an understanding of where, how and why the acquired skills are used in practice. Practice-oriented learning is a form of learning. Its main goal is the formation of students ‘ practical work skills, which are currently in demand in various areas of social and professional practice, as well as the formation of an understanding of where, how and why the acquired skills are used in practice.

The practice-oriented type of training is aimed at addressing a key question: what should be the content and forms of instruction that ensure a shift in the educational process toward the essential understanding of knowledge and concepts, while primarily fostering the ability to carry out practical tasks and apply skills in real-world contexts? This approach emphasizes the reproduction and reinforcement of practical skills and experiences in the professional field chosen by the students (Budnyk, 2021). At the tactical level, this reorientation is realized through the integration of a set of practice-oriented training courses into the modern educational system. These courses are specifically designed to develop students’ competencies, focusing primarily on practical skills, applied abilities, and relevant hands-on experience.

One of the most effective ways to influence the educational process and guide it in the desired direction is through the deliberate organization of learning conditions by the teacher. Moreover, effective learning depends on the appropriate didactic use of visual aids to support the achievement of educational goals. In essence, the teacher’s primary organizational task is to create conditions in which students develop psychological readiness and openness to pedagogical influences. It is evident that only under such circumstances can the educational process be expected to yield meaningful and effective outcomes. Today, the issue of training effectiveness is becoming increasingly pressing due to a marked decline in students’ interest in learning within the mass education system. A significant portion of students demonstrate little to no motivation to acquire knowledge and skills. In this context, it is essential to address the shortcomings of the educational process and to continuously stimulate students’ interest in academic subjects through a diverse arsenal of pedagogical methods. This engagement, or “educational momentum”, largely depends on the teacher - specifically, on their ability to conduct lessons in an engaging and effective manner.

A well-designed practice-oriented task enhances students’ understanding of thematic material, supports their ability to answer both self-generated and teacher-posed questions, and facilitates successful completion of assigned learning objectives (Namestovski & Kovari, 2022). It is important to emphasize that the teacher’s role in developing such tasks is both essential and decisive. Without the integration of practical tasks into the learning process, education risks becoming a purely formal exercise for many students-lacking in meaning, relevance, and tangible outcomes. As a result, students may struggle to successfully complete even basic assignments, undermining the effectiveness of the educational process.

Practice-oriented tasks are derived from real-life contexts and environments, aiming to develop practical skills essential for everyday life (Liu et al., 2023). These tasks often incorporate elements such as local history materials and components of production processes. Their primary goal is to cultivate the ability to act effectively in socially meaningful situations. While grounded in previously acquired knowledge and skills, such tasks challenge students to apply their learning in practical, often unfamiliar, scenarios-thereby bridging the gap between theory and practice.

The most important characteristics of practice-oriented tasks, as outlined by educational standards (subject-based, interdisciplinary, and applied), include the following:

- significance of the outcome - whether cognitive, professional, cultural, or social - which plays a key role in fostering students’ cognitive motivation;

- contextual formulation - tasks are presented as real-life plots, scenarios, or problems that require students to draw on knowledge from various sections of a topic, across different disciplines, or from everyday experiences not explicitly stated in the task description;

- multiformat data presentation - information within the task may be displayed in diverse formats such as diagrams, tables, charts, or graphs, thus requiring students to identify and interpret various types of representations;

- application of results - the task indicates, either explicitly or implicitly, the potential areas or contexts in which the solution or results can be applied, thereby reinforcing the relevance and transferability of knowledge.

In addition to the four established mandatory characteristic features, practice-oriented tasks are divided into the following:

1) in terms of structure, these tasks are non-standard, i.e. in the task structure, some of its components are unknown;

2) the presence of redundant, missing or contradictory data in the case of the task, which leads to a voluminous formulation of the condition;

3) the presence of several solutions (different degrees of rationality), these methods may not be known to students and will need to be built.

Practice-oriented tasks have three difficulty levels, which are presented in the table below. (Table 1).

Table 1. *Difficulty levels of practice-oriented tasks*

Levels	Practice-oriented tasks	Compliance with the level of competence
1 level	Practical conditions designed to solve one theoretical fact.	Playback level
2 level	To solve a set of several scientific ideas, it is necessary to solve knowledge from different sciences, using individual observations in a practical situation.	Communication level
3 level	When looking for several ways to solve the same problem, it is necessary to consider solutions using the research method.	Reflection level

In the process of identifying causal relationships, practice-oriented tasks can be employed to achieve various learning objectives at different stages of the lesson. One of the key purposes is to enhance student motivation. At the initial stage of implementing a practice-oriented learning framework, it is advisable to introduce first- and second-level tasks, progressing to third-level tasks - the most complex - only at the final stage. This progression aligns with the increasing cognitive challenges presented to students. First-level tasks present minimal difficulty, typically involving concrete objects within a contextual narrative. Solving such tasks generally requires the application of a single theoretical concept to a practical situation. Second-level tasks serve as a bridge between the simpler first-level and more complex third-level tasks. They necessitate integrating several scientific concepts, drawing on interdisciplinary knowledge, and incorporating personal observations. Third-level tasks are the most challenging, involving the identification of specific objects and the relationships between them. These tasks demand a research-oriented approach, including situation modeling, exploration of new material, and the consideration of multiple solution strategies.

The tasks of the first two levels of difficulty typically do not pose significant challenges for students, serving as preparatory exercises for more complex third-level problems. A key feature of third-level tasks is not only the unconventional construction of the situational model but also the uncertainty involved in selecting appropriate methods for their resolution. This characteristic makes third-level tasks more closely aligned with practice-oriented tasks encountered in real-world conditions. The complexity level of practice-oriented tasks should be determined based on two criteria: the novelty of the objects presented to the students and the relationship within the substantive model of the problem; and the difficulty in choosing appropriate methods for solving the task.

The selection of these criteria is grounded in the understanding that students possess a certain base of acquired knowledge and life experience, which aligns with their age and the content of the school curriculum. For instance, solving tasks related to lightning (tasks 1–9) would not present significant challenges for high school students, as they have already accumulated the necessary subject-specific knowledge and relevant life experience. Therefore, such a task would be classified as low in complexity for them. Consequently, the complexity level of a practice-oriented task is not a fixed characteristic. For example, the same task assigned in both 5th and 6th grade may be evaluated at different levels of difficulty. This variation could be attributed to changes in the assessment of the first criterion during the learning process (the degree of novelty for students and the relationships within the content model). Determining the complexity levels of tasks helps identify core objectives whose solutions are mandatory for all students within a particular age group.

In turn, in a practice-oriented task, the following components can be distinguished that make up its structure:

- substantive: this component includes the content of the educational material, basic natural science concepts based on the solution of the proposed problem, stages of scientific modeling;
- active: this component is characterized by experience-oriented skills that are planned to be formed in students during the work on the proposed task;
- task: this component describes the system of classification of practice-oriented tasks and their levels of complexity;
- procedural: it is the latter that, by description, but not by essence, the proposed component defines the time periods for the implementation of practice-oriented tasks.

The solution of the problem consists of a proposal for execution, discussion, obtaining the final result, compiling the source materials and determining the goal necessary to solve the problem.

The form of setting any task, including a practice-oriented task, is understood as the specific formulation of the task condition, which characterizes all the input and output information necessary for solving it. Outgoing information on the task is considered data that students present as the result of work on solving the proposed task.

Politsinsky & Demenkova (2015) stated that «when presenting a practice-oriented task for solving, it should be borne in mind that it must be attractive for students of a particular class who have their own characteristics in terms of interests, life experience, and so on».

Thus, the typology of the above tasks, as well as the requirements for the form of setting a practical-oriented task and its content, make it possible to formulate the following methodological features of teaching the solution of practical-oriented problems in Natural Science:

- offering students a practice-oriented task, it is necessary to take into account their interests in everyday life and rely on their life experience;
- special attention should be paid to the formulation of the task, which should be attractive in form and content for specific students, only then it will be possible to ensure the conditions for the full inclusion of students in the work on the task, which should be perceived as the goal of educational activity at a certain time;
- when working on solving a problem, it is necessary to devote significant time to the modeling phase, i.e.presentation of the situation described in the report in the form of a situation model, which will be the final stage in solving.

Our experiment was conducted in the municipal state institution «Secondary School named after D. Kunaev» of the Department of education of the Glubokovsky District of the Department of education of the East Kazakhstan region. The experiment was held in natural science classes in students of the 6th grade (class 6 A-control group, class 6 B-experimental group, 2022-2023 academic year). At the first stage of the experiment, we conducted input diagnostics, the purpose of which was to study the level of motivation in order to track the activity of students in the learning process using the methods of Lukyanova & Kalinina (Smirnaya et al., 2022). The determination of the level of complexity of practice-oriented tasks was carried out according to two criteria:

- for the 1st students, it was necessary to clearly define the relationship between the novelty of objects and the content model of the problem;

- 2nd the difficulty of drawing conclusions and choosing methods for solving.

The results of the input diagnostics are shown below (Figure 1).

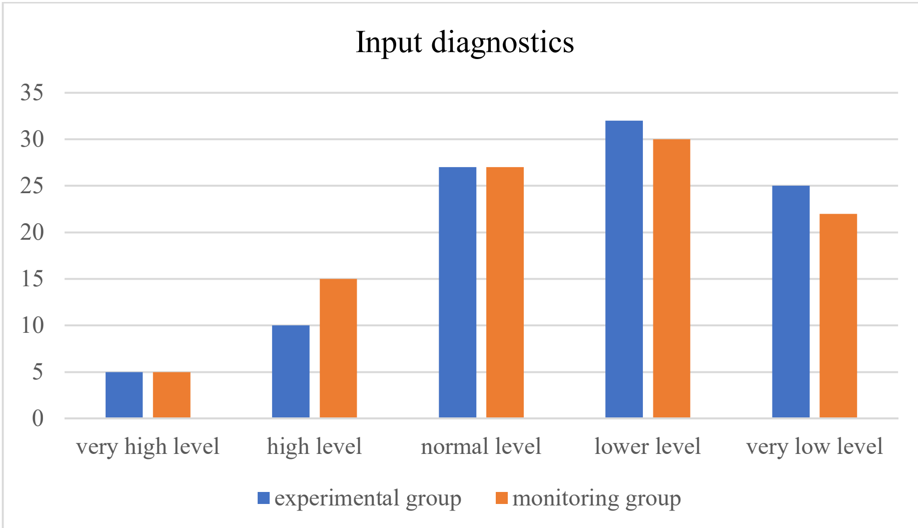

Figure 1: The results of the input diagnostics

From the results obtained during the analysis, we made the following conclusions:

During the formative experiment, two consecutive lessons were conducted, each lasting 45 minutes. In the experimental group, unlike the control group, the instruction was carried out using practice-oriented tasks specifically designed to enhance student motivation. Upon completion of the series of lessons, we conducted post-instruction diagnostics in both the experimental and control groups in order to draw a comparative conclusion regarding the effectiveness of the applied methodology.

The results of the output diagnostics are shown below (Figure 2).

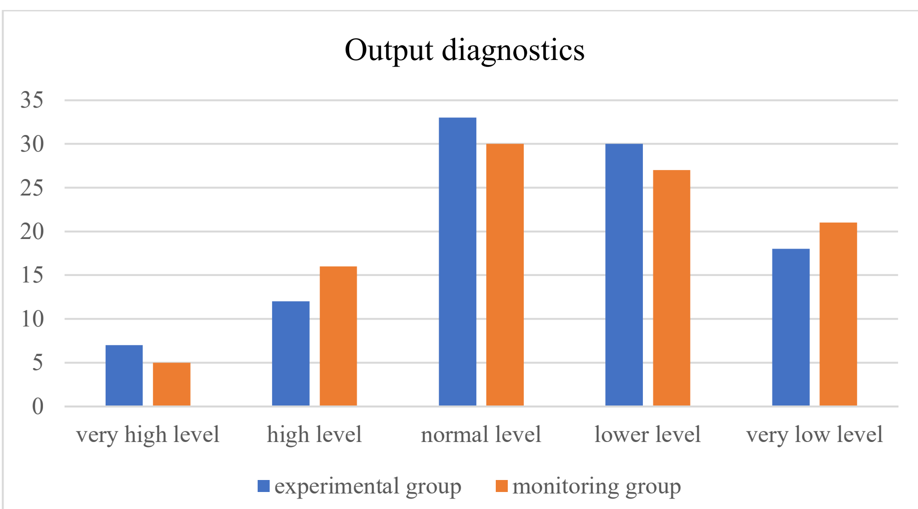

Figure 2: Results of output diagnostics

For the purpose of comparing the above diagrams, we compared the results of output diagnostics with the results of input diagnostics of the experimental and control group and showed below (Figure 3, 4).

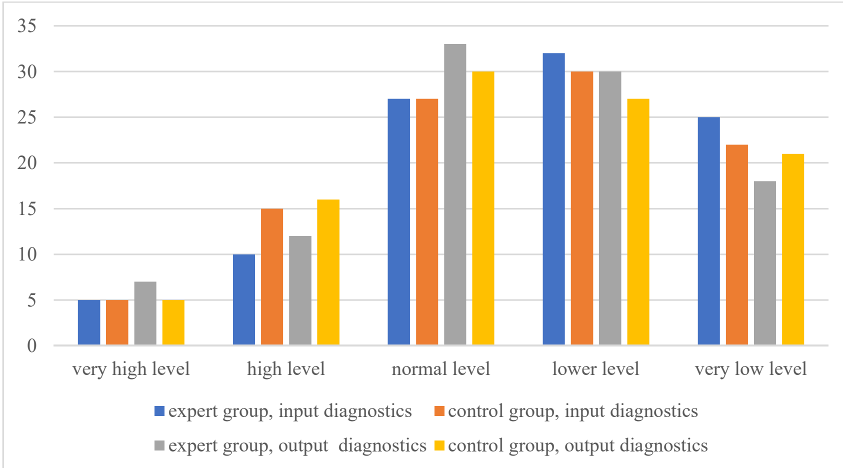

Figure 3: Comparison of input and output diagnostics results

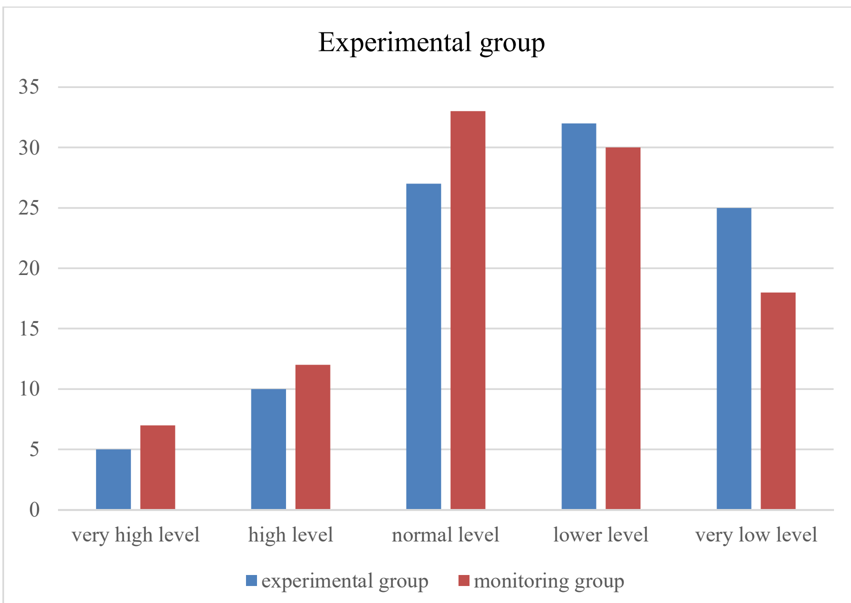

Figure 4: Comparison of the results of input and output diagnostics in the experimental group

Discussion. The data obtained from the control group did not demonstrate any significant changes. However, following the implementation of a series of lessons using practice-oriented tasks aimed at increasing student motivation in the experimental group, notable improvements were observed: the number of students exhibiting very high, high, and average levels of motivation increased, while the number of students with low and very low motivation levels decreased. These results indicate the positive impact of practice-oriented learning on student motivation.

In line with the humanistic approach to education, practice-oriented learning serves to overcome the gap between scientific knowledge and everyday human experience. It highlights the relevance of acquired knowledge to real-life situations and addresses issues encountered in daily living. While maintaining a consistent and logical presentation of scientific foundations at all stages of instruction, each topic also includes content that illustrates its practical significance and the role of natural laws in daily life. Practice-oriented learning differs fundamentally from traditional subject-centered education-not only in its goals and objectives but also in the organization of the learning process. A key distinction lies in the emphasis: subject-oriented systems prioritize the transmission of knowledge, often at the expense of developing students' practical skills.

In contrast, practice-oriented learning fosters the ability to apply knowledge in real-world contexts, thereby enhancing the overall quality and relevance of education.

Conclusion. Summing up the results of our work, we formulated the main goal as follows: to explore the system of implementing practice-oriented tasks to enhance students' motivation for learning. The ability to identify and analyze causal relationships is an essential quality for individuals seeking to understand the world around them. This cognitive activity not only stimulates students' intellectual engagement but also enhances the teaching process from a pedagogical perspective. To achieve this goal, we conducted a theoretical analysis of pedagogical literature, which enabled us to define methodological requirements for the design of practice-oriented tasks. Based on these findings, we developed a set of tasks that will be integrated into future Natural Science lessons to promote student motivation. At the second stage of the study, drawing on existing developments in pedagogical science, we carried out diagnostics to assess the level of motivation among 6th-grade students at our school. Entry-level monitoring, conducted using the methodology of M.I. Lukyanova and N.V. Kalinina, revealed that more than half of the students demonstrated low or very low levels of motivation. In light of these findings, we hypothesized that structuring Natural Science lessons around the solution of practice-oriented tasks would contribute to an increase in students' motivation. This hypothesis was confirmed in the course of the pedagogical experiment, thereby validating the effectiveness of the proposed approach.

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