

IMPLEMENTING RESEARCH-BASED TEACHING METHODS IN SECONDARY SCHOOL LABORATORY ACTIVITIES TO MEASURE OBJECT MASS

A.B. Abdulayeva* , N.Zh. Zhanatbekova , B.R. Sakibayeva , K.R. Zhakpayev 

Zhetysu University named after I. Zhansugurov, Republic of Kazakhstan, Taldykorgan

*e-mail: abdulaeva1aigerim@gmail.com, n.zhanatbekova@mail.ru, bakhorl@mail.ru,
kuanish.zh@mail.ru

Abstract. The aim of the research is to substantiate the methodology of development of students' science process skills on the basis of educational-experimental work of research character with application of research methods and experimental verification of its effectiveness. Conducting educational and experimental work in physics at school allows to practice such elements of research activities as planning research, conducting it, processing, analyzing and presenting the results and getting conclusions. Also it is directed on development of research type of thinking of students and activation of a personal position in educational process on the basis of acquisition of subjectively new knowledge. A number of complementary methods were used to implement the aim of the research and solve the tasks: analysis of scientific research in order to determine the relevance of the problem under study and its theoretical foundations; method of pre-experimental research. In this study, the concept is divided into three sub-concepts: 1) Mass Definition, 2) Oscillation and 3) Simple Pendulum oscillations. The study used a pre-experimental method. One group pre-test-post testing scheme was used. 28 students grade IX from a secondary school in Taldykorgan participated in the study. The process of improving students' science process skills was examined based on the normalized analysis of pre-test and post-test scores on three sub-concepts. The results of the study showed the effectiveness of application the research teaching method for the improvement of science process skills in the study of physics. Scientific novelty of the research consists in identifying objective didactic conditions and methods (techniques) of stage-by-stage management of the process of improvement of students' science process skills in the process of teaching and research activity. The paper is for educators, scientific community, and dealing with the development of students' research activities at teaching Physics.

Keywords: Research Method of Teaching, Laboratory Work in Physics, Determining Mass of an Object, Scientific Process Skills, Oscillation.

Introduction

The initial concept of body mass students receive in the seventh grade of a secondary school. Its further development is carried out throughout study of the entire school physics course. In particular, students should get an idea of two ways of experimental measurement of mass: 1) by the method of interaction of bodies, 2) by weighing bodies on lever scales. It is important that students understand connections of mass with other physical quantities and methods of measurement.

For development of knowledge about mass of an objects, it is possible to consider with students, when studying mechanical vibrations, the problem of determining the mass of objects by using a spring pendulum.

It is known that harmonic oscillations of a body mass m , suspended on a spring with the spring stiffness constant k , arise under the action of the spring's elastic force. The oscillation frequency of such spring pendulum is determined with the following formula (1):

$$\nu = \frac{1}{2\pi\sqrt{\frac{m}{k}}} \quad (1)$$

If a pendulum oscillates n times for the time t , its frequency can be expressed as (2):

$$\nu = \frac{n}{t} \quad (2)$$

From these two formulas we obtain the expression for the mass of the object on the spring pendulum (3):

$$m = \frac{kt^2}{4\pi^2 n^2} \quad (3)$$

The experimental work comes to measuring the time intervals t_s and t of two objects which masses are respectively m_s (taken as a standard) and m (unknown).

If the number of oscillations made by objects is the same, then, considering the last formula, we get (4)

$$m = m_s \frac{t^2}{t_s^2} \quad (4)$$

When the objects of the known mass m_s and mass $m+m_s$ make n oscillations, respectively, for the time intervals t and t_s , then the desired mass m is found as follows (5):

$$m = m_s \left(\frac{t^2}{t_s^2} - 1 \right) \quad (5)$$

The role of physical experimentation has become increasingly significant in both the education and intellectual development of students. In today's learning environment, it is no longer enough to merely provide students with subject knowledge. It is equally essential to cultivate in them a scientific worldview and to transform theoretical knowledge into deep-seated convictions about how the world operates. Through direct interaction with natural phenomena, physical experiments enable students to recognize the material nature of the universe and comprehend its laws. Moreover, such activities foster an emotional connection with the process of discovering scientific facts, making students active participants in knowledge generation, thereby deepening their intellectual engagement and emotional resonance [1, 2, 3].

Experimental competencies, like academic skills, evolve across several levels: the reproductive level (replication), the partially exploratory level (identification and application in similar contexts), and the investigative or creative level (original inquiry). A central goal of physics instruction is to nurture experimental competencies at the investigative (or creative) level – that is, to cultivate proficiency in the processes associated with scientific inquiry.

However, in many schools laboratory work is still reduced to following step-by-step instructions with predetermined results, which prevents students from experiencing real inquiry and highlights the urgent need for methods that foster genuine experimental and research skills.

Various studies have implemented diverse instructional models and technologies to support the development of students' scientific process skills. For example, Gunawan et al. utilized a guided inquiry approach through a virtual laboratory [4]; Siregar et al. introduced a scientific inquiry model supplemented by the Algodoo media tool and measures of quotient adversity [5]; Wijaya et al. applied a practicum module grounded in guided inquiry [6]; Harahap, Nasution, and Manurung examined the effects of blended learning environments on students' learning outcomes and inquiry abilities [7]; and Beichumila, Bahati, and Kafanab incorporated computer simulations and animations [8]. The efficacy of these approaches has been well-documented.

According to Cherkas, one of the most promising ways to align the instructional process with the nature of scientific inquiry is the research-oriented approach. In this approach, learning is organized to mirror the methods and sequence used in genuine scientific investigation, allowing students to build and hone their research competencies through practice [9].

In this context, scientific process skills can be defined as a student's ability, during experimental activities, to carry out intellectual and practical tasks that adhere to the logic of scientific inquiry. Students with well-developed scientific process skills can independently engage in experimental investigations and draw conclusions. In other words, when conducting an experiment or tackling a research-based assignment, students should be able to:

- Observe and recognize a problem within the context of that observation.
- Formulate a hypothesis to address the identified problem.

- Design and carry out an experimental test of the hypothesis.
- Analyze the results and assess the validity of the hypothesis.
- Derive practical conclusions for the application of the acquired knowledge.

Developing these abilities depends critically on selecting an instructional method that encourages students to creatively solve problems and apply the scientific method. The research method of teaching fulfills these requirements. Its essence lies in its ability to:

- Nurture creative thinking and inquiry-driven activity.
- Guide students to apply existing knowledge to new situations, thereby gaining fresh insights.
- Build mastery of the methods of scientific inquiry through hands-on research.
- Foster a genuine interest in learning, making inquiry an intrinsic motivational force [10].

Based on the above theoretical background, this study aims to implement the research teaching method in a laboratory context for determining an object's mass in ninth-grade physics classes. The introduction provides the context for the work, its theoretical and practical significance, and the research questions addressed.

Materials and methods

The primary goal of this study is to justify a methodological approach for nurturing students' scientific process skills through inquiry-based experimental work.

The object of the study is the teaching process for physics in a general secondary school setting.

The research hypothesis is that students' scientific process skills can be effectively developed when physics teaching is organized within the framework of the scientific method, employing inquiry-based experimental tasks that illustrate the structure and behavior of physical systems.

To accomplish this goal, the following objectives were established:

- To review literature on inquiry-based experimental instruction.
- To justify the methodology for fostering scientific process skills using inquiry-based experimental activities.

The methods used to achieve these objectives included:

- Literature review and theoretical analysis to assess the significance of the problem and its theoretical foundations.
- Pre-experimental studies for initial examination of the teaching approach.

The data collected for this study consisted of pre- and post-test scores administered to assess students' proficiency. The instruments were specifically designed to measure five indicators of scientific process skills: problem identification, hypothesis formulation, experimental design, data analysis, and drawing conclusions. Each test included 15 multiple-choice items (three per indicator). Scoring followed a simple rubric: 1 point for a correct response, 0 points for an incorrect one, with sub-scores calculated for each indicator to allow for a more detailed skill profile. The sample comprised ninth-grade students from a secondary school in Taldykorgan, Kazakhstan. The population included eleven ninth-grade classes (approximately 30 students per class), from which one class of 28 students was selected as the experimental group.

The intervention was implemented within the physics topic «Studying body mass» which was structured into three sub-concepts: (1) mass definition, (2) oscillations, and (3) spring pendulum oscillations. Each sub-concept was taught through inquiry-based laboratory activities that required students to observe a physical phenomenon, formulate hypotheses, design and conduct experiments, and interpret results. Pre-test items were aligned with these sub-concepts to assess students' initial knowledge, while the post-test contained parallel items to measure conceptual development after instruction.

Data analysis involved comparing pre- and post-test results to evaluate the effectiveness of the inquiry-based teaching method. The normalized gain metric was used to measure improvements in students' scientific process skills, calculated with the following formula:

$$\langle g \rangle = \frac{\text{score of posttest} - \text{score of pretest}}{\text{score of ideal} - \text{score of pretest}} \quad (6)$$

Normalized gain criteria which proposed by Hake [11] can be seen in Table 1.

Table 1 – Normalized gain criteria

$\langle g \rangle$	Criteria
$\langle g \rangle \geq 0.7$	High
$0.3 < \langle g \rangle < 0.7$	Moderate
$\langle g \rangle < 0.3$	Low

Source: Compiled by Hake [11]

Thus, the study design is a single group pretest–posttest. The three sub–concepts formed the instructional sequence, and both pre– and post–tests were disaggregated accordingly to allow for normalized gain analysis at the sub–concept level.

Results and discussions

Studying body mass in the IX grade of secondary school based on research method of teaching was implemented in three sub–concepts: (1) mass definition, (2) oscillations, and (3) spring pendulum oscillations. The results of the normalized gain analysis for each topic are presented in Table 2.

Table 2 – Normalized gain recapitulation in each sub–concept

AverageScore				
Sub–concept	Pre–test	Post–test	$\langle g \rangle$	Criteria
1	3.56	6.23	0.41	Moderate
2	3.45	5.65	0.34	Moderate
3	4.12	7.34	0.55	Moderate
Overall	11.13	19.22	0.43	Moderate

Source: Compiled by the authors.

The data indicate that students achieved moderate gains across all three sub–concepts, with normalized gain values ranging from 0.34 to 0.55. The lowest improvement was observed in the topic of oscillations ($\langle g \rangle = 0.34$), while the highest was recorded in spring pendulum oscillations ($\langle g \rangle = 0.55$). The overall normalized gain was 0.43, which also falls within the moderate category.

These findings suggest that implementing the research method of teaching provided measurable improvements in students' understanding of the targeted sub–concepts. However, the variation in gain across topics points to different levels of conceptual difficulty: the relatively lower score on oscillations may reflect the abstract nature of the concept, whereas the stronger performance on spring pendulum oscillations indicates that concrete experimental activities helped students grasp the underlying principles more effectively.

Similar findings have been reported by numerous researchers [12, 13, 14, 15], who emphasize the effectiveness of inquiry–based teaching methods in cultivating students' scientific process abilities.

According to the American Association of Physics Teachers (1998), laboratory programs should pursue the following goals:

1. Developing the Art of Experimentation– to engage students in meaningful experimental activities, including the design and execution of investigations.
2. Building Experimental and Analytical Skills– to enable students to gain proficiency in basic experimental techniques and data analysis.
3. Fostering Conceptual Understanding – to help students grasp fundamental physics concepts.
4. Developing Understanding of the Nature of Knowledge in Physics– to enable students to understand the role of direct observation and distinguish inferences based on theoretical considerations from those arising from experimental outcomes.

5. Developing Collaborative Learning Skills– to foster teamwork abilities that are vital for long-term academic and professional success [16].

Laboratory work in physics is a form of experiential learning that allows students to perform scientifically structured experiments and observe phenomena under well-defined conditions. The experimental method gives students the opportunity to establish cause-and-effect relationships between phenomena, exploring the connections between measurable quantities that characterize the behavior and properties of physical systems.

The primary benefit of physical experimentation in learning is that it allows students to observe the evolution of phenomena under controlled conditions, minimizing external influences and making results reproducible. The widespread use of experimental work in teaching physics promotes a more accurate understanding of the nature of scientific inquiry, providing evidence-based insights and reinforcing the reliability of experimental conclusions.

In the literature, experimental work is sometimes described as any activity involving measurement, equipment assembly, or device examination. However, this characterization is too simplistic. True experimental work goes beyond measurement and must contain an investigative element – a process where a phenomenon is recreated under artificially controlled conditions, its behavior is studied, and its dependence on other variables is analyzed.

Every experiment begins with a hypothesis, a statement that guides both the purpose and design of the investigation. The experimental process must be structured to test this hypothesis, providing a clear link between theoretical reasoning and empirical evidence.

For example, when investigating the relationship between gas pressure and its volume, one might hypothesize that pressure increases as volume decreases, keeping the gas's temperature and mass constant. The experimental design must then be tailored to test this claim: selecting suitable equipment, planning observations, recording results, and conducting an analysis that allows for confirmation or refutation of the hypothesis.

In this context, students can be introduced to a generalized experimental procedure:

1. Clarify the goal of the experiment: understand the problem and consider possible approaches.
2. Formulate and justify the hypothesis.
3. Identify the necessary experimental conditions.
4. Anticipate potential factors that may affect measurement accuracy.
5. Develop a plan for the experiment:
 - a) Decide which observations will be made.
 - b) Identify the quantities to be measured.
 - c) Choose the equipment required.
 - d) Outline the sequence of experimental steps.
 - e) Prepare templates for recording results.
6. Prepare a schematic diagram of the equipment setup.
7. Assemble and configure the equipment.
8. Conduct the experiment, making observations and recording data.
9. Perform a statistical and mathematical analysis of results.
10. Estimate measurement errors.
11. Interpret the results and formulate conclusions (in words, symbols, or graphs).

This experimental algorithm is distilled into a set of requirements for laboratory work, serving as a guide for students:

1. State the title of the laboratory work.
2. State its purpose and justify the working hypothesis.
3. List the required equipment and materials.
4. Outline the experimental procedure.
5. Draw a schematic of the experimental setup.
6. Record observations and results in a table.
7. State conclusions clearly.

In this way, the inquiry-based teaching method promotes independent learning, fosters initiative, and develops students' scientific process skills. Notably, significant gains were observed in students' understanding of spring pendulum oscillation, yielding an N-gain score of 0.55, while the lowest gain was in the concept of general oscillation theory (N-gain = 0.34) [11].

Research by Alexander Aguado [17] similarly highlights how structured inquiry courses, comprised of exercises such as formulating questions, conducting literature reviews, gathering and analyzing data, and synthesizing results, help students build robust scientific inquiry capabilities.

The results of this study align with the findings of Iradat and Alatas [12], indicating that inquiry-based approaches enable students to deepen their understanding of scientific concepts and the experimental process. In agreement with the work of Gunawan et al. [4], this approach improves students' ability to formulate research questions and hypotheses, making experimental work a more effective and meaningful learning experience.

The experimental design and accompanying requirements used in this study fostered greater student independence and engagement, yielding deeper understanding and more significant development of scientific process skills across varying levels of inquiry. In laboratory work, an additional guiding research question can further deepen students' inquiry and conceptual mastery.

Conclusion

The results of this study confirm that using inquiry-based teaching methods in laboratory settings can effectively cultivate students' scientific process skills, yielding moderate normalized gain scores across all three sub-concepts examined (mass definition, oscillations, and spring pendulum oscillations). These findings support the central hypothesis that the scientific process can be effectively taught when the learning of physics is aligned with the methods and logic of scientific inquiry. In experiments conducted with spring pendulums, when the measured and standard masses were nearly identical, relative error remained under 4%; as the discrepancy between measured and standard masses increased, relative error rose, reaching approximately 20% when the ratio was 1:19.

Importantly, the study demonstrates that inquiry-based approaches not only improve students' conceptual understanding but also foster essential experimental thinking skills, even when experimental outcomes are not fully precise. This highlights the value of focusing on the development of scientific reasoning alongside technical accuracy. Furthermore, the gradual transition from teacher guidance to student-centered inquiry illustrates how inquiry-based learning can nurture independence, creativity, and scientific literacy.

Taken together, the findings suggest that the methodology elaborated in this research holds promise for wider implementation beyond physics. Its emphasis on process skills and inquiry can be adapted to other disciplines, such as chemistry and biology, where experimental reasoning and problem-solving are equally central. In this way, the proposed approach provides a pathway for strengthening students' scientific competencies across the broader science curriculum.

Financing information

This research has been funded by the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP22683901).

LITERATURE:

- 1 Darmaji D., Kurniawan D.A., Irdianti I. Physics Education Students' Science Process Skills //International Journal of Evaluation and Research in Education. – 2019. – Vol. 8. – №. 2. – P. 293–298.
- 2 Farkhodovna A.M. The problems of preparing students for the use of school physical experiment in the context of specialized education at secondary schools //European Journal of Research and Reflection in Educational Sciences Vol. – 2020. – Vol. 8. – №. 9.
- 3 Khaparde R. What are the objectives and goals of physics laboratory courses? A survey of college teachers //Journal of Physics: Conference Series. – IOP Publishing, 2019. – Vol. 1286. – №. 1. – P. 012037.
- 4 Gunawan G. et al. Guided inquiry model through virtual laboratory to enhance students' science process skills on heat concept //JurnalCakrawalaPendidikan. – 2019. – Vol. 38. – №. 2. – P. 259–268.
- 5 Siregar E., Rajagukguk J., Sinulingga K. Improvement of science process skills using scientific inquiry models with algodo media and quotient adversity in high school students //Journal of Transformative Education and Educational Leadership. – 2020. – Vol. 1. – №. 2. – P. 53–65.

6 Wijaya B.R., Setyawan A., Citrawati T. Validity of practicum module based on guided inquiry to facilitate students' science process skills: Array //CITRA: International Journal of Community service, Informatics, Technology, Research in education, Art and humanities. – 2021. – Vol. 1. – №. 1. – P. 89–99.

7 Harahap F., Nasution N.E.A., Manurung B. The Effect of Blended Learning on Student's Learning Achievement and Science Process Skills in Plant Tissue Culture Course //International Journal of Instruction. – 2019. – Vol. 12. – №. 1. – P. 521–538.

8 Beichumila F., Bahati B., Kafanabo E. Students' acquisition of science process skills in chemistry through computer simulations and animations in secondary schools in Tanzania //International Journal of Learning, Teaching and Educational Research. – 2022. – Vol. 21. – №. 3. – P. 166–195.

9 Черкас А.А. Развитие познавательной деятельности учащихся при выполнении исследований лабораторного эксперимента по физике //Автореф. дисс.... канд. пед. наук. – 1978.

10 Лернер И.Я. Дидактические основы методов обучения : монография / И.Я. Лернер. – Москва : Педагогика, 2004. – 186 с.

11 Hake R.R. Interactive–engagement versus traditional methods: A six–thousand–student survey of mechanics test data for introductory physics courses //American journal of Physics. – 1998. – Vol. 66. – №. 1. – P. 64–74.

12 Iradat R.D., Alatas F. The implementation of problem–solving based laboratory activities to teach the concept of simple harmonic motion in senior high school //Journal of Physics: Conference Series. – IOP Publishing, 2017. – Vol. 895. – №. 1. – P. 012014.

13 Abd Rauf R.A. et al. Inculcation of science process skills in a science classroom //Asian Social Science. – 2013. – Vol. 9. – №. 8. – P. 1911–2017.

14 Samsudin A. et al. The use of computer simulation in cooperative learning to minimize students' misconceptions of momentum and impulse //2014 international conference on advances in education technology (icaet–14). – Atlantis Press, 2015. – P. 72–74.

15 Siahaan P. et al. Improving students' science process skills through simple computer simulations on linear motion conceptions //Journal of Physics: Conference Series. – IOP Publishing, 2017. – Vol. 812. – №. 1. – P. 012017.

16 American Association of Physics Teachers. Goals of the introductory physics laboratory //American Journal of Physics. – 1998. – Vol. 66. – №. 6. – P. 483–485.

17 Aguado N.A. Teaching research methods: Learning by doing //Journal of Public Affairs Education. – 2009. – Vol. 15. – №. 2. – P. 251–260.

REFERENCES:

1 Darmaji D., Kurniawan D.A., Irdianti I. (2019). Physics Education Students' Science Process Skills. International Journal of Evaluation and Research in Education, vol. 8, №. 2, pp. 293–298.

2 Farkhodovna A.M. (2020). The problems of preparing students for the use of school physical experiment in the context of specialized education at secondary schools. European Journal of Research and Reflection in Educational Sciences Vol, vol. 8, №. 9.

3 Khaparde R. (2019) What are the objectives and goals of physics laboratory courses? A survey of college teachers. Journal of Physics: Conference Series. IOP Publishing, vol. 1286, №. 1, P. 012037.

4 Gunawan G. et al. (2019). Guided inquiry model through virtual laboratory to enhance students' science process skills on heat concept. Jurnal Cakrawala Pendidikan, vol. 38, №. 2, pp. 259–268.

5 Siregar E., Rajagukguk J., Sinulingga K. (2020). Improvement of science process skills using scientific inquiry models with algodo media and quotient adversity in high school students. Journal of Transformative Education and Educational Leadership, vol. 1, №. 2, pp. 53–65.

6 Wijaya B.R., Setyawan A., Citrawati T. (2021). Validity of practicum module based on guided inquiry to facilitate students' science process skills: Array. CITRA: International Journal of Community service, Informatics, Technology, Research in education, Art and humanities, vol. 1, №. 1, pp. 89–99.

7 Harahap F., Nasution N.E.A., Manurung B. (2019). The Effect of Blended Learning on Student's Learning Achievement and Science Process Skills in Plant Tissue Culture Course. International Journal of Instruction, vol. 12, №. 1, pp. 521–538.

8 Beichumila F., Bahati B., Kafanabo E. (2022). Students' acquisition of science process skills in chemistry through computer simulations and animations in secondary schools in Tanzania. International Journal of Learning, Teaching and Educational Research, vol. 21, №. 3, pp. 166–195.

9 Cherkas A.A. (1978). Razvitie poznavatelnoi deiatelnosti uchašihsä pri vypolnenii issledovani laboratornogo eksperimenta po fizike [Development of cognitive activity of students while performing research on laboratory experiment in physics] //Abstract of the thesis of the Candidate of pedagogical Sciences. – 1978. (in Russian)

10 Lerner I. Ya. (2004). Didakticheskie osnovy metodov obucheniya: monografiya [Didactic foundations of teaching methods: Monograph]. Moscow: Pedagogika. 186 p. (in Russian).

11 Hake R.R. (1998). Interactive–engagement versus traditional methods: A six–thousand–student survey of mechanics test data for introductory physics courses. American journal of Physics, vol. 66, №. 1, pp. 64–74.

12 Iradat R.D., Alatas F. (2017). The implementation of problem-solving based laboratory activities to teach the concept of simple harmonic motion in senior high school. Journal of Physics: Conference Series. IOP Publishing, vol. 895, №. 1, P. 012014.

13 Abd Rauf R.A. et al. (2013). Inculcation of science process skills in a science classroom. Asian Social Science, vol. 9, №. 8, pp. 1911–2017.

14 Samsudin A. et al. (2015). The use of computer simulation in cooperative learning to minimize students' misconceptions of momentum and impulse. 2014 international conference on advances in education technology (icaet-14). Atlantis Press, pp. 72–74.

15 Siahaan P. et al. (2017). Improving students' science process skills through simple computer simulations on linear motion conceptions. Journal of Physics: Conference Series. IOP Publishing, vol. 812, №. 1, P. 012017.

16 American Association of Physics Teachers. (1998). Goals of the introductory physics laboratory. American Journal of Physics, vol. 66, №. 6, pp. 483–485.

17 Aguado N.A. (2009). Teaching research methods: Learning by doing. Journal of Public Affairs Education, vol. 15, №. 2, pp. 251–260.

ДЕНЕ МАССАСЫН АНЫҚТАУ БОЙЫНША ОРТА МЕКТЕПТІҢ ЗЕРТХАНАЛЫҚ ЖҰМЫСТАРЫНА ОҚЫТУДЫҢ ЗЕРТТЕУ ӘДІСІН ЕНГІЗУ

Абдулаева Ә.Б. , Жанатбекова Н.Ж., Сакибаева Б.Р., Жақпаев Қ.Р.*

І. Жансүгіров атындағы Жетісу университеті, Қазақстан Республикасы, Талдықорған қ.

*e-mail: abdulaeva1aigerim@gmail.com, n.zhanatbekova@mail.ru, bakhorl@mail.ru,
kuanish.zh@mail.ru

Аңдатпа. Зерттеу мақсаты – зерттеу сапатындағы оқу-эксперименттік жұмыс негізінде оқушылардың зерттеу дағдыларын дамыту әдістемесін негіздеу. Мектепте физика бойынша оқу-эксперименттік жұмыс жүргізу зерттеуді жоспарлау, оны ұйымдастыру, нәтижелерді ұсыну, өңдеу, талдау және қорытынды жасау сияқты зерттеу қызметінің элементтерін пысықтауға мүмкіндік береді. Сондай-ақ, бұл оқушылардың зерттеушілік ойлауын дамытуға және субъективті жаңа білім алу негізінде білім беру процесінде жеке ұстанымын белсендіруге бағытталған. Зерттеу мақсатын іске асыру және қойылған міндеттерді шешу үшін бірқатар қосымша әдістер қолданылды: зерттелетін мәселенің өзектілігін және оның теориялық негіздерін анықтау мақсатында ғылыми зерттеулерді талдау; экспериментке дейінгі зерттеу әдісі. Бұл зерттеуде негізгі тұжырымдама үшке бөлінді: 1) массаны анықтау, 2) тербеліс және 3) маятниктің қарапайым тербелісі. Зерттеуде алдын ала және кейінгі тестілеудің бір топтық схемасы қолданылды. Зерттеуге Талдықорған қаласының жалпы білім беретін мектебі IX сыныбының 28 оқушысы қатысты. Оқушылардың зерттеу дағдыларын жетілдіру процесі үш тұжырымдама бойынша тестілеуге дейінгі және кейінгі нәтижелерді қалыпқа келтірілген талдау негізінде зерттелді. Зерттеу нәтижелері физика бойынша оқушылардың зерттеу дағдыларын жетілдіру үшін оқытудың зерттеу әдісін қолданудың тиімділігін көрсетті. Зерттеудің ғылыми жаңалығы оқу-зерттеу қызметі процесінде оқушылардың зерттеу дағдыларын жетілдіру процесін кезең-кезеңімен басқарудың объективті дидактикалық шарттарымен әдістерін анықтау болып табылады. Мақала физиканы оқыту кезінде оқушылардың зерттеу қызметін дамыту мәселелерімен айналысатын мұғалімдерге, ғылыми қоғамға арналған.

Кілт сөздер: *зерттеу әдісі, физика бойынша зертханалық жұмыстар, дене массасын анықтау, ғылыми жұмыс дағдылары, тербеліс.*

ВНЕДРЕНИЕ ИССЛЕДОВАТЕЛЬСКОГО МЕТОДА ОБУЧЕНИЯ В ЛАБОРАТОРНЫЕ РАБОТЫ СРЕДНЕЙ ШКОЛЫ ПО ИЗМЕРЕНИЮ МАССЫ ТЕЛ

*Абдулаева А.Б. *, Жанатбекова Н.Ж., Сакибаева Б.Р., Жакпаев К.Р.*

*Жетысуский университет имени И. Жансугурова, Республика Казахстан,
г. Талдыкорган*

**e-mail: abdulaeva1aigerim@gmail.com, n.zhanatbekova@mail.ru, bakhorl@mail.ru,
kuanish.zh@mail.ru*

Аннотация. Цель исследования – обосновать методику развития у учащихся умений научного процесса на основе учебно–экспериментальной работы исследовательского характера с применением методов исследования и экспериментальной проверкой ее эффективности. Проведение учебно–экспериментальной работы по физике в школе позволяет отработать такие элементы исследовательской деятельности, как планирование исследования, его проведение, обработка, анализ и представление результатов, получение выводов. Также это направлено на развитие исследовательского типа мышления учащихся и активизацию личностной позиции в образовательном процессе на основе приобретения субъективно новых знаний. Для реализации цели исследования и решения поставленных задач был использован ряд взаимодополняющих методов: анализ научных исследований с целью определения актуальности исследуемой проблемы и ее теоретических основ; метод предэкспериментального исследования. В данном исследовании концепция разделена на три подконцепции: 1) Определение массы, 2) Колебания и 3) Простые колебания маятника. В исследовании использовался предэкспериментальный метод. Использовалась одгрупповая схема предварительного и последующего тестирования. В исследовании приняли участие 28 учащихся IX класса средней школы г. Талдыкорган. Процесс совершенствования навыков научного процесса у учащихся изучался на основе нормализованного анализа результатов пре– и посттестирования по трем подконцепциям. Результаты исследования показали эффективность применения исследовательского метода обучения для совершенствования навыков научного процесса при изучении физики. Научная новизна исследования заключается в выявлении объективных дидактических условий и методов (приемов) поэтапного управления процессом совершенствования умений учащихся в области естественнонаучных процессов в процессе учебно–исследовательской деятельности. Статья предназначена для педагогов, научной общественности, занимающейся вопросами развития исследовательской деятельности учащихся при обучении физике.

Ключевые слова: *исследовательский метод, лабораторные работы по физике, определение массы тела, навыки научного процесса, колебания.*