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THE PRINCIPLE OF HISTORICISM AND WAYS OF ITS IMPLEMENTATION IN A PHYSICS COURSE

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Abstract. This study investigates the role of the principle of historicism in physics education, emphasizing its impact on students' scientific competencies. By integrating historical elements into secondary school physics curricula, educators can enhance students' engagement and understanding of scientific concepts. The research highlights that the historical approach not only deepens students' comprehension of physics as an experimental science but also fosters critical thinking, problem-solving skills, and a broader scientific worldview. An empirical analysis was conducted to assess the current implementation of historicism in physics lessons among teachers in the Carpathian region. The study revealed that while historical elements are not widely used due to time constraints and limited resources, they significantly enhance students' motivation and interest in physics. A student survey confirmed that historical narratives, particularly those involving major scientific discoveries, contribute to a more engaging learning experience. The research outlines various strategies for incorporating historicism at different stages of physics lessons. These include historical references to introduce and summarize topics, problem-solving activities based on historical events, experiments replicating classical scientific discoveries, and interactive methods such as quizzes, simulations, and discussions. Additionally, the study suggests using multimedia resources, including 3D animations and video demonstrations, to illustrate historical scientific breakthroughs effectively. The findings emphasize that historicism not only reinforces conceptual learning but also aids in the development of analytical skills and scientific literacy. The study recommends that educators systematically integrate historical content into physics teaching through diverse instructional techniques, thereby bridging the gap between theoretical knowledge and its historical development. Ultimately, the incorporation of historicism in physics education fosters a deeper appreciation for scientific progress and enhances students' ability to connect past discoveries with contemporary scientific advancements.

Keywords*:* physics education, didactics, historicism, scientific competencies, student engagement, critical thinking, problem-solving.

Nothing contributes so much to the general development and formation of children's consciousness as acquaintance with the history of human efforts in the field of science
Paul Langevin

1. INTRODUCTION

One of the fundamental methods of cognitive activity, which has been used by researchers for a long time, is the principle of historicism. Its use can form a vision of physics as an experimental science, which is based on the principles of observation, hypotheses, research, modeling, experiment, and the

formation of conclusions. Historicism is one of the key elements in conducting any scientific research, in particular, pedagogical. The reason for this is that the beginning of scientific research should be the study of already existing theories and advances in this field. The study of the history of the study makes it possible to identify key directions in further work and trends in the development of ideas about the phenomenon or process under study.

The role of historicism in pedagogy is quite significant since it is one of the key means for confirming the veracity of the fundamental concepts that are being studied. If the content of the didactic process is confirmed by historical sources, then it acquires higher reliability. Therefore, didactic activity is based on the elements of the history of science.

The application of the principles of historicism is also one of the ways to achieve the triune goal of the lesson, which is the basis for the teacher to plan their actions with students, and predict the final result of the lesson. As you know, the triune goal includes an educational, developmental, and educational component.

The analysis of the history of the development of science, its main problems, and stages of setting up some experiments forms students' ideas about the development of the structure of science as a whole. Understanding the history of human efforts in the field of science, like nothing else, affects the overall development and formation of a scientific worldview and critical thinking in students. The development of a scientific worldview, first of all, is based on a conscious and in-depth assimilation of scientific facts; One of the ways to improve these criteria is historicism. The development of scientific vision is a multifaceted and complex process that contains several components, some of which are based on the application of the principles of historicism. Having clarified the relationship between imaginary models and experiment, theory and practical developments, it is possible to achieve the main goal of studying the course of physics as an element of the natural education field.

In addition to the formation of a scientific worldview, the use of the principles of historicism is also one of the grounds for improving the development of students' thinking. The development of students' thinking is a key task that teachers face in developmental learning. Thought operations, such as analysis, synthesis, comparison, generalization, concretization, analogy, etc., are components of mental activity. By applying elements of historicism in teaching, such as the study of historical discoveries, the analysis of the points of view of various scientists on theories of the occurrence of physical phenomena, the reflection of previous topics and the systematization of the topic discussed in the lesson using historical schemes, we influence the development of the operations listed above. Skills in working with literary sources also belong to a number of generally accepted skills and abilities. The use of historical sources in working with students allows you to form these skills.

Using information of historical content, in particular, references to the discovery of various laws, characteristics of the results of experiments set by scientists, and chronological boundaries of the use of the law during the period of discovery, we form in students an understanding of the experimental method of studying nature; We introduce the limits of the use of theories and laws, situations when theoretical assumptions have not been confirmed experimentally and the actions of scientists in such cases (Slyusarenko, 2010)

The practical application of the principle of historicism in teaching physics requires detailing the forms of using historical material, dividing historical data by type, nature of their use, methods and techniques in the teacher's work during the lesson.

2. RESEARCH OBJECTIVE

The object of our research is the use of the principle of historicism by teachers in methodological activities. The task, accordingly, was to create methodological recommendations for the use of historical facts in physics lessons (grades 7-9) according to the content of one of the model curricula offered by the Ministry of Education and Science of Ukraine (Maksymovych, 2023), to outline the ways of

implementation and ways to introduce elements of historicism into the educational process.

3. RESULTS AND DISCUSSION

The principle of historicism in the study of physics consists, as noted above, primarily in the study of the development of fundamental ideas and the study of the reasons for their formation. For a better understanding of the state of application of the principle of historicism in teaching physics among teachers of the Carpathian region, we prepared and conducted a survey. It made it possible to analyze the competence of teachers in the ways of implementing historicism and the relevance of its application at present.

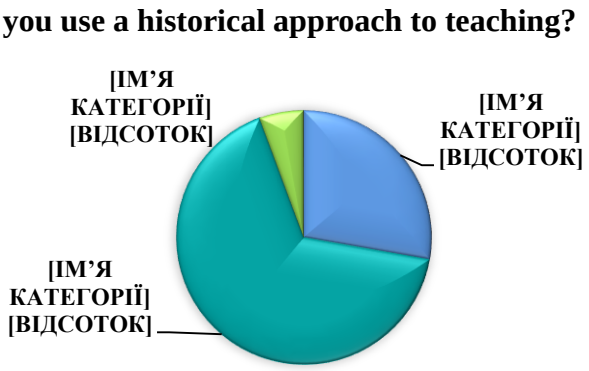

Fig. 1. The level of teachers' use of the historical approach in teaching physics
Source: Own elaboration

As can be seen from the diagram (Fig. 1), only 5.6% of teacher respondents do not use historicism when teaching physics or use it infrequently. That is, the use of elements of historicism in the study of physics is one of the ways of presenting the material. Teachers often neglect the inclusion of this aspect in teaching due to the lack of classroom time, because it requires careful analysis and the use of additional sources of information to confirm historical data and integrate them into the topic of the lesson. In pedagogical practice, historical facts or references already provided in the textbook are most often used, which do not require additional involvement of third-party information.

To get an exhaustive idea of the expediency of implementing the principle of historicism in the study of physics, it was important to find out thestudents' attitude to historical elements in the classroom. Therefore, we also surveyed students of grades 7-9 of Lyceum No. 24 of the Ivano-Frankivsk City Council, which shows that they are mainly interested in historical facts about scientific discoveries (Fig. 2).

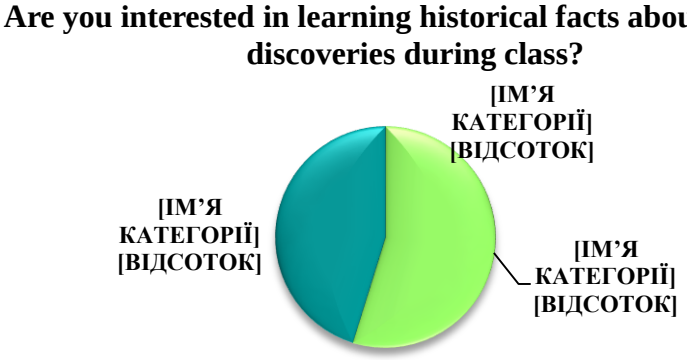

Fig. 2. The level of students' interest in the history of physical discoveries
Source: Own elaboration

According to the data obtained (Fig. 2), it can be argued that the use of elements of historicism in teaching physics contributes to the interest of students in its study. However, it is important not only to present historical references or data from the biography of scientists but also to use a variety of teaching methods and additional sources (3-D animations, simulations of historical events, and video demonstrations) (Fig. 3).

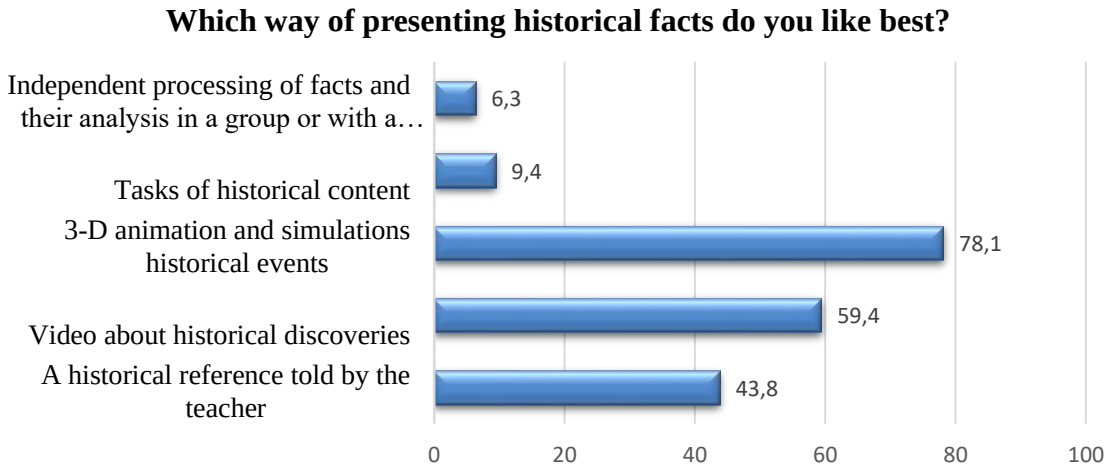

Fig. 3. Application of various teaching methods and additional sources

Source: Own elaboration

The data obtained allow us to assert that the introduction of elements of historicism is expedient in the study of physics and allows, in addition to increasing the level of interest in the study of physics, to form key competencies in students using various teaching methods.

Thus, including historical material, we can apply traditional methodological techniques that are used in teaching a physics course (Fig. 4).

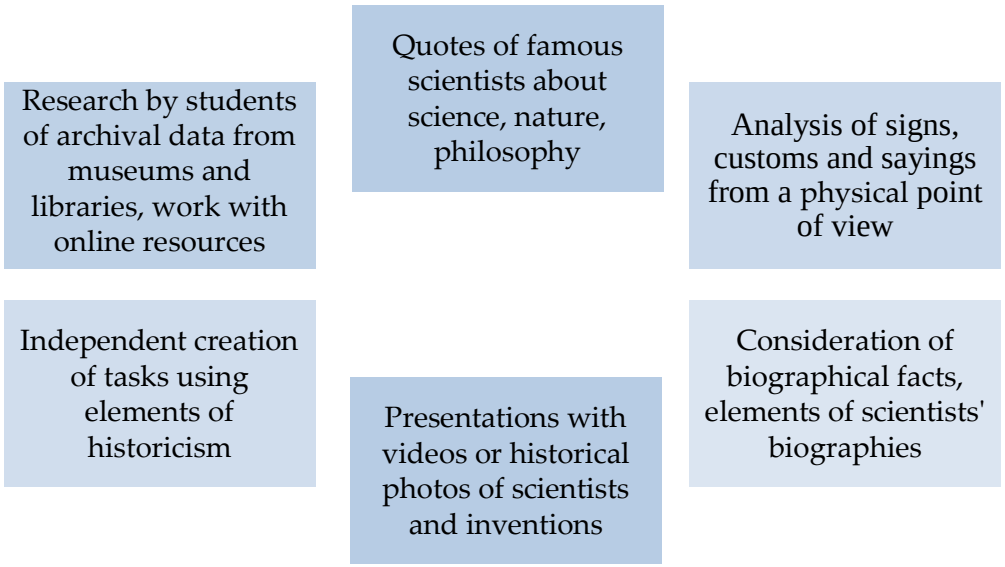

Fig. 4. Methodological techniques for the introduction of historicism

Source: Own elaboration

However, not all elements of the lesson can be used in the study of historicism. For example, setting up an experiment using museum devices is possible only in virtual laboratories, because it is almost impossible to reproduce them in laboratory conditions. In this regard, clarity when using historical material can be ensured with the help of diagrams, tables, photos, and videos of the reproduction of historical installations. Also, for better perception, it is worth presenting students with quotes from

scientists, depicting the features of the historical periods in which they lived, their working conditions, and a possible (often not accurate) description of the discovery itself.

In addition, when using historical material, the teacher should form problematic issues, in the discussion of which it is necessary to involve students. The problems formed by the teacher contribute to the emergence of discussions, sometimes disputes, and can be a topic for seminar classes. As you know, the topic that causes discussion lends itself better to memorization by students, because it requires the analysis of all the data presented to choose the most rational opinion. One of the variants of the problematic question can be the analysis of the corpuscular and wave theory of light (for example, using the inverted learning method, where we first form groups that in the next lesson must present and analyze the advantages and disadvantages of the chosen theory).

Also, for the effective use of historical material, it is important to determine the key forms of its presentation (Fig. 5), because they affect the quality of assimilation of educational material and the formation of a scientific worldview.

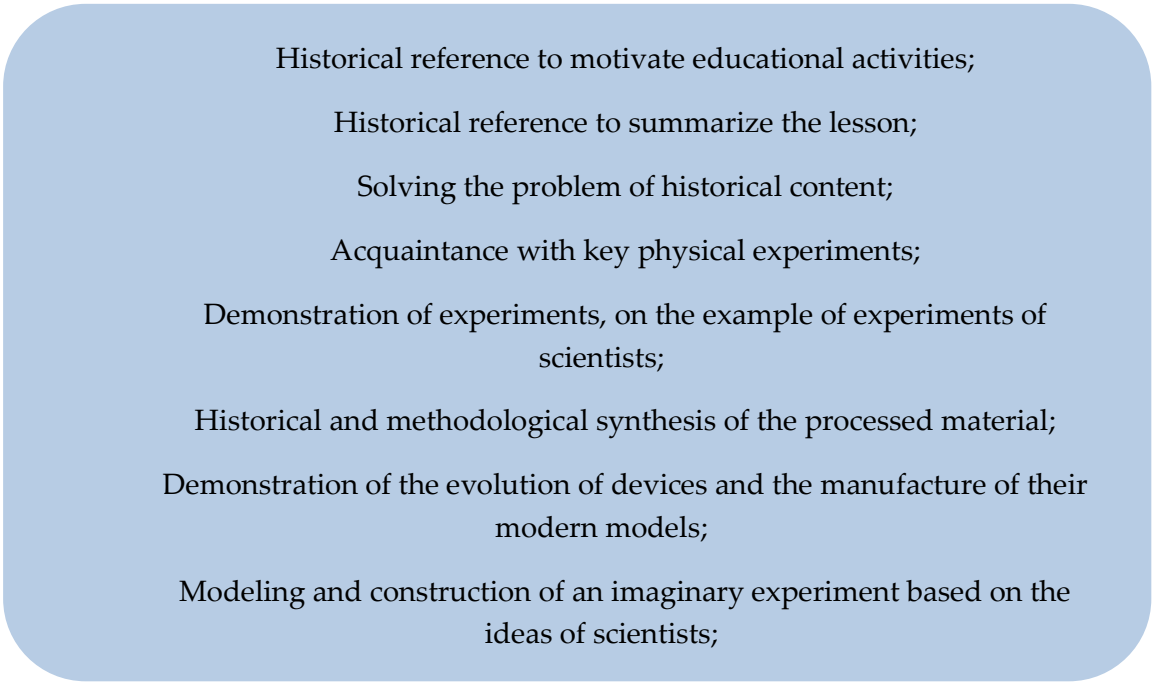

Fig. 5. Forms of presentation of historical material

Source: (Maksymovych, 2023)

An important stage in the creation of methodological recommendations for the implementation of historical facts in the process of studying various topics of physics is to take into account the content of model curricula created on the basis of the State Standard of Basic Secondary Education. The cross-cutting themes of these programs are aimed at forming students' interest in studying physics and the corresponding motivation of students, while the use of historical material reinforces this didactic goal.

The use of the principles of historicism allows you to form basic knowledge. The scientific worldview and the aggregate scientific and natural picture of the world and its astronomical component require the use of elements of historicism because it allows students to form an interest in education through the idea of how exactly the foundations of modern natural sciences were formed from theory to established laws (Maksymovych, 2023).

We have chosen the model program ‘Physics 7-9 grades’ for elaboration. (Maksymovych, 2023). This model program contains recommended topics for classes, which allow the teacher to independently form the desired vector of studying physics. Also, a clear advantage of this program is the wide range of proposed types of educational activities, which include problem-based learning, interactive methods, competence tasks, and interdisciplinary connections. The basic knowledge of the natural education

sector, which must be implemented in the curricula, consists of the following sub-items: methodology of natural sciences; astronomical component; scientific worldview, and the aggregate natural-scientific picture of the world (Cabinet of Ministers of Ukraine, 2020).

We will give brief historical references with examples of their implementation at different stages of lessons, ways to integrate historical facts when explaining new material, solving problems and performing practical or homework.

For example, a lesson in the 7th grade on the topic 'Micro-, macro- and megaworld. The role of astronomy in the study of the bodies of the mega world. The development of ideas about the structure of the solar system' opens up an opportunity for the teacher to present the idea of the structure of the solar system by such famous researchers as Claudius Ptolemy, Nicolaus Copernicus, Tycho Brahe, Johannes Kepler, Galileo Galilei, Giordano Bruno (a detailed description is given by QR code (Fig. 6)). Or we recommend using 3D animation at the Mozaik Education (https://www.mozaweb.com/uk/index.php), which can be worked out during the lesson with the teacher or independently by students before the lesson. For better assimilation of the material, at the end of the lesson, students are invited to solve the crossword puzzle 'Development of ideas about the structure of the solar system' (Fig. 7) (link for viewing https://learningapps.org/watch?v=p2ytz8nzt23).

Fig. 6

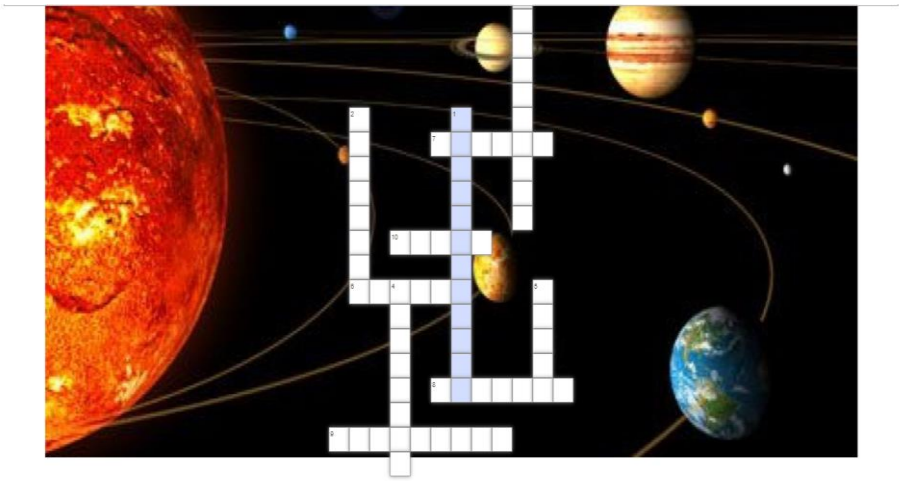

Fig. 7. The crossword puzzle "Development of ideas about the structure of the solar system"
Source: Own elaboration

When studying the topic 'Physical states of matter. Diffusion. Brownian motion. Osmosis' in the 7th grade at the stage of studying new material, we propose to use a historical reference on the discovery and study of Brownian motion by Robert Brown, Albert Einstein, Marian Smolukhovsky, Jean Perrin (a detailed description is given by QR code (Fig. 8). The presented historical reference can be worked out during the experiment (demonstration) 'Consideration of the movement of pollen under a microscope'; and simulations 'Physical states of matter' at the Vaščák (http://surl.li/nrajw) or PhET (http://surl.li/nrakf).

Fig. 8

In the 8th grade, the lesson 'The work of gas and steam during expansion. Heat machines. Internal combustion engine. Steam turbine. In researching the efficiency of a heat engine' we propose to start with a historical reference to the invention of the first steam engines by Heron of Alexandria, James Watt, Sade, and Carnot (a detailed description is given by QR code (Fig. 9))

Fig. 9

and the video 'Heron's Ball' and 'James Watt's Steam Engine' at the links http://surl.li/nekca; http://surl.li/neker at the Mozaik Education (https://www.mozaweb.com/uk/index.php). Under the stage of consolidating knowledge, you can offer students a quiz at the links http://surl.li/nekca, http://surl.li/neker, and problems with historical content: 'The steam engine made in 1827 by the Cherepanovs consumed 19.4 m3 of firewood per day. The power it produced was equal to 36 hp. Find the efficiency of the machine' (Severynova, 2017). A problematic issue of the following nature will also be effective for discussion: 'It is known that internal combustion engines are not used in submarines during sailing and immersion in water. Why?'.

During the study of electromagnetic phenomena in the 9th grade in the lesson 'Magnetic Phenomena. Permanent magnets. Magnetic properties of substances and their applications. Interaction of magnets. Magnetic field. Magnetic Field Lines' we recommend using historical information that in the VI century BC were the first studies of the properties of natural magnets, which were carried out by Thales of Miletus. Interestingly, Chinese historians claim that twenty-two centuries ago in one of the palaces, there was a magnetic gate that did not allow weapons to be brought there. It should be noted that the history of the name of the magnet is contradictory. According to some sources, this name was invented by Euripides, for others – the magnet was named in honor of Magnis, a shepherd who saw strange stones sticking to his shoes, which contained nails and sticks, in which there was an iron tip. These stones were called magnetites. Turning the stick to the other side, the shepherd saw that the stones were not attracted to the tree. There is also an opinion that the magnet got its name from the province of Magnesia (Manissa) in Asia Minor, where the first magnets were found (Perkowitz, 2019). It is worth noting that the study of magnetism was carried out by many scientists. These are, in particular, Petro Peregrine; William Gilbert; Nicola Cabeo (detailed description is provided by QR code) (Fig. 10). In addition, we invite students to watch the demonstrations 'Magnet' at the link http://surl.li/nrcsq. To consolidate knowledge, we offer the game 'Thick Thin Questions', the task of which is to familiarize yourself with the historical background and answer the 'subtle' questions: Shepherd, what was the name of the shepherd who tended the sheep? Were the stones that the shepherd saw called...? The province in which the first magnets were found had a name? What kind of stick did the shepherd have? What was the name of the scientist who discovered the magnetic properties of amber? As well as answers to 'thick' questions: Why did the shepherd wrap the stick on the other side? Why did the magnetic gate not allow weapons to be brought into the palace? What would have happened if the attractive effect of the magnet had not been detected by Magnis?

Fig. 10

4. CONCLUSIONS

Thus, the use of elements of historicism in the course of physics of basic secondary education makes it possible to realize its key goal, namely the formation of natural science education of applicants, which plays an important role in the development of subject competencies and the level of general skills of the applicant. It was found that the historical elements of the subject increase motivation to study physics and natural sciences, due to the integration of students into the creative process of cognition of research and scientific discoveries.

Surveys show that historical elements are not used very often by teachers, but arouse interest among students and require more active implementation in the educational process because they allow for solving most of the pedagogical tasks of education.

The use of the given examples of the implementation of the principle of historicism through various

types of educational activities, namely interactive tasks, 3-D animations, videos with historical facts, platforms for conducting online experiments and simulations at different stages of the lesson, will help students understand the genesis and current state of key physical ideas, concepts and theories.

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Діана Лешко, Любов Яблонь, Іван Гасюк. Принцип історизму та шляхи його реалізації в курсі фізики. *Журнал Прикарпатського університету імені Василя Стефаника*, **12** (1) (2025), 96-104.

У дослідженні розглянуто роль принципу історизму у викладанні фізики та його вплив на формування наукових компетентностей учнів. Інтеграція історичних елементів у шкільний курс фізики сприяє підвищенню залученості учнів і глибшому розумінню наукових концепцій. Застосування історичного підходу не лише поглиблює розуміння фізики як експериментальної науки, а й розвиває критичне мислення, навички розв'язування задач та формує цілісне наукове світосприйняття. Було проведено емпіричний аналіз стану використання історизму у викладанні фізики серед учителів Карпатського регіону. Дослідження показало, що історичні елементи використовуються недостатньо через брак часу та ресурсів, проте вони значно підвищують мотивацію учнів і їхній інтерес до фізики. Опитування учнів підтвердило, що історичні оповіді, особливо пов'язані з науковими відкриттями, сприяють більш захопливому навчальному процесу. У дослідженні окреслено стратегії впровадження історизму на різних етапах уроку фізики, зокрема використання історичних довідок для введення й узагальнення матеріалу, розв'язування задач на основі історичних подій, проведення експериментів за зразком класичних наукових відкриттів, а також інтерактивні методи, такі як вікторини, симуляції та дискусії. Запропоновано використання

мультимедійних ресурсів, включаючи 3D-анімації та відеодемонстрації, для ефективної ілюстрації наукових проривів. Результати дослідження свідчать, що застосування історизму не лише покращує засвоєння фізичних концепцій, а й сприяє розвитку аналітичних навичок і наукової грамотності. Рекомендується систематичне включення історичних матеріалів у навчання фізики через різноманітні методичні підходи, що допоможе поєднати теоретичні знання з їхнім історичним контекстом. Загалом впровадження історизму у викладання фізики сприяє формуванню глибшого розуміння наукового прогресу та зв'язку між минулими відкриттями й сучасними досягненнями науки.

Ключові слова: навчання фізики, дидактика, історизм, наукові компетентності, залученість учнів, критичне мислення, розв'язування задач.