

## EXPERIMENTAL WORK TO PREPARE FUTURE PHYSICS TEACHERS FOR THE FORMATION OF STUDENTS' SCIENTIFIC WORLDVIEW

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**Abstract:** The proposed work is relevant due to the high interest of applicants for pedagogical majors in natural sciences in the Republic of Kazakhstan. The research aims to train teaching staff competent to formulate the scientific worldview of students; in turn, the scientific worldview is based on empirical and theoretical knowledge about the world as a whole and consists of the most fundamental laws and principles of nature. The following methods were utilized during the study: theoretical (synthesis, classification, generalization, deduction, induction, analogy, and modeling); empirical (observation, survey, questionnaire, and interview); experimental (stating, developmental, and diagnostic experiment); and qualitative and quantitative analysis of the study results. In the course of the study, a qualitatively new methodological system was developed to prepare future physics teachers to form students' scientific worldviews and reflect the results of the pedagogical experiment. We propose our model for preparing future physics teachers to shape the worldview of students in the process of integrated teaching of physics, as well as an original course that we have developed on determining effective forms, methods, and means in teaching physics. As a result of the research, it was determined that the most important components of the organization of the main activity in shaping the worldview of students are the development and use of educational and methodological enhancement, as well as solving problems of integration in the teaching of physics.

**Keywords:** modernization of education; updated educational content; physics teacher training; scientific worldview; integration of disciplines; physics teacher training model.

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### *Introduction*

The training of teaching staff has innovative directions in connection with the goals of education development programs in the Republic of Kazakhstan. This is associated with a new stage of civilization. One of the distinctive features of the updated content of education, which has been introduced into the general education system of the Republic of Kazakhstan since 2016, is the improvement of the pedagogical skills of teachers in the use of *cross-cutting topics* that will most effectively organize interdisciplinary connections in the classroom. As a result, preparing future teachers for integrated learning is a necessity of current education.

The goal of our work is to prepare future physics teachers competent to form the scientific worldview of students based on the integration of sciences since the integration of education has a crucial place for the development of the scientific worldview of students, which is an important result of innovative education. Preparing future physics teachers for the improvement of students' scientific worldviews is a purposeful process of teachers mastering a system of scientific and professional knowledge, skills, and abilities about the development of students' worldviews and the possibilities of increasing the level of their scientific knowledge based on integrated physics education.

For example, the authors propose to explore the internal relationships in the Solar System, considering such aspects as gravity, magnetism, nuclear processes, motion, attraction, biological systems, medicines, management, economics, and others. These relationships represent an opportunity to develop cross-curricular and integrated knowledge that has practical applications in solving real-world problems. This approach provides a framework for developing plans, technology solutions (including artificial intelligence), processes, procedures, and protocols that improve people's daily lives (Kurup, 2023).

With the increasing integration of education, the content and methods of teaching many academic disciplines have changed significantly, and the nature of educational activities has changed in many ways. In this regard, scientific and pedagogical understanding and search for ways to improve the process of teaching fundamental sciences, including an interdisciplinary approach, have increased. By implementing the interdisciplinarity of sciences, the connections between the natural environment, man, and society are determined since interdisciplinary learning is the best way to understand natural phenomena in the

real world (Rasmussen, 2010; Abylkasymova et al, 2021). At the present stage of the development of education, interdisciplinarity should be considered the most relevant principle of didactics.

*Theoretical framework*

In his scientific work, the author shows ways to build a scientific worldview for students by integrating the concepts *Nature of Natural sciences* and *Science of science* and proves that understanding the nature of science is a key point in training teachers in natural disciplines. This is explained by the fact that in science education, the concept of the *Nature of natural sciences* is an important topic because it forms students' scientific worldview, which is becoming a main element in the environment of pseudosciences (Koponen, 2021).

There are different psychologists' beliefs on determining the level of worldview. For example, the authors showed how the assimilation of knowledge at a high level is both reality and readiness to defend their views and beliefs in any situation (Dyachenko, 2006), while another researcher defines the level of worldview (Pakhomov, 1985) as the independence of knowledge and views. An individual's worldview is a phenomenon that combines intellectual and emotional-volitional characteristics of social culture, characterized by a high level of generalized manifestation of reality. The concept of a person's worldview is a somewhat later phenomenon; it arises in a person's adolescence, and the basis of its formation is the general educational orientation, system of worldview, and perception of the world (Bozhovich, 1997)

A guideline in the activities of a future physics teacher can be a high level of worldview advancement, characterized by the dominance of scientific views and beliefs, a deep understanding of the basic patterns of development of the surrounding reality, an adequate assessment of events and the socio-political situation in the country.

We share the author's point of view (Karwasz et al, 2023), who emphasizes that interdisciplinary learning should stimulate students to develop an in-depth interest in exploring and understanding the world around them and a willingness to apply acquired skills in everyday life. Presenting physics as an integral part of a wide range of scientific disciplines will allow us better to understand the nature of the world around us and, therefore, use acquired knowledge more effectively in everyday situations.

What is important in physics teaching today is the method of improving a child's functioning in the world by helping him overcome his difficulties through acquired skills and meaningful interaction with the environment (Akpan et al, 2016). According to several scholars (Kline, 2016; Newell, 2007), interdisciplinarity is integrative: knowledge from different fields of science merges and changes through integration, which can be useful in solving modern complex problems since an interdisciplinary approach contributes to the formation of a holistic understanding.

Magaji et al, included a thorough review of relevant literature, focusing on problem-based learning with a particular focus on science teacher education. Problem-based learning has the potential to improve science knowledge, and this approach can also promote the integration of science and mathematics, which in turn promotes an interdisciplinary approach to teaching and learning, including the STEM field (Cavadas, 2022).

Rodriguez-Torres et al, conducted research on the preparation of future teachers for interdisciplinary competencies in universities and identified the areas in which students feel more confident and those where they need to develop further. Using confirmatory factor analysis, the researchers developed a model designed to assess students' perceived mastery of interdisciplinary competencies within educational programs. They also found that there were difficulties in identifying differences in the types of knowledge and ideas between different areas of study, making problem-solving difficult. The study concluded by recommending that higher education institutions create learning processes that encourage interdisciplinary work to ensure effective student learning.

That is, in this context, the question arises for ourselves what will we consider in this work and how will we achieve it? First, let's make a list of questions:

1. How do we determine the worldview interest of students?
2. How do we develop a model for the formation of the worldview of future teachers in physics?
3. How do we achieve the result in the practical experiment section in the formation of the worldview of future physics teachers?

### *Materials and Methods*

For different types of worldviews, we explored the methods of scientific perspective and the role of the future physics teacher in the field of scientific

perspective. A scientific worldview is formed through the transfer of physical pictures of the world (PPW). PPW is one of the highest levels of systematization of physical knowledge; PPW is a model of nature built on the basis of the systematization of basic concepts, translations, theories, and hypotheses, taking into account the historical stage of the development of physics.

Einstein believed that the highest task of physics was to discover the basic elements of elementary batteries, from which a picture of the world could be logically deduced. It is a fact that the modern physical picture of the world (MPPW) is a generalization of the most important results: mechanics, thermodynamics, physical theories of electrodynamics, relativity, quantum mechanics, cosmology, etc. Its main methodological ideas are highlighted below.

- Materiality and unity of the world. The structure of matter (substance and field). Unity of particle-wave properties.

- The universality of movement and interaction of matter (4 types of interaction).

- Basic forms of existence of matter (space, time, and motion). The relationship between space and time.

- Inceasability and indestructibility of matter.

- Inexhaustibility of matter (matter exists as an infinite variety of different states and structures - matter, antimatter, physical fields, crystals, liquids, gas, plasma, cosmic bodies, elementary particles, etc.).

- The principle of causality as a statement about the universal causality of phenomena in the real world. The nature of interaction is the reason for the movement, change, and development of things and phenomena. The idea of an objective dialectical relationship between cause and effect is the basis of the modern worldview.

The modern scientific picture of the world includes the basic laws of Natural Science and the most important concepts of individual sciences: movement and development, matter and field, elementary particles, etc. - the synthesis of natural science disciplines and philosophy allows us to form a naturalistic worldview.

In its history, natural science has constantly strived to build a unified picture of nature, uniting physical reality and living nature. After creating a model of the expanding Universe, in which the increasing complexity of material systems and processes was visible, from elementary particles to galactic formations, the following questions began to arise: How could the Universe

develop and self-organize to its current level? What are the mechanisms of evolution of inanimate nature? The works of Prigogine are associated with the discovery of nonequilibrium structures that arise as a result of irreversible processes in which system connections are established by themselves, i.e., processes of self-organization are observed, which have received the general name *synergetics* (Condorelli, 2016). Processes of self-organization are possible under a number of conditions: the system must be open, nonequilibrium, nonlinear (multiple paths of development), etc. With the help of synergetics, it was shown for the first time that self-organization processes can occur in the simplest systems of inanimate nature if appropriate conditions exist.

It is important to develop a methodology for improving modern pedagogical education in the interdisciplinary teaching of natural sciences, namely the integration of biology with chemistry and physics (Handtke, 2022). One of biology's generalizations is that *all living organisms obey physical and chemical laws*.

Since the scientific paradigm is formed, first of all, of natural science knowledge, we can list the following basic ideas of natural science:

- All mechanical movements can be described by a set of Newton's laws.
- Energy does not disappear; during all transformations, it passes from more useful to less useful forms (the first and second laws of thermodynamics).
- Matter in nature is presented in the form of substance and field.
- Space and time are interconnected and represent the forms of existence of matter.
- All substances are made of atoms.
- The properties of a substance depend on which atoms are included in its composition and how they are arranged.
- Nuclear energy is released when mass is converted into energy.
- Electricity and magnetism are two sides of the same force.
- All living things are made up of cells, which are the factories of life.
- All living things are based on a genetic code.
- All living things are connected to each other and their environment.
- The Universe arose in the past at a certain moment, and since then, it has been expanding.
- Stars are born, live, and die, like everything else in the world.
- The surface of the Earth is constantly changing, and there is nothing eternal on it.

- Synergetics is the basis of the idea of global evolutionism: it can be considered an important component of the natural science picture of the world.

As a result of the research, it turned out that in higher educational institutions, the process of training physics teachers to form students' scientific worldviews is not carried out systematically. When conducting the study, the authors used the following types of methods: theoretical (synthesis, classification, generalization, deduction, induction, analogy, and modeling); empirical (observation, survey, questionnaire, and interview); experimental (stating, developmental and diagnostic experiment); statistical (qualitative and quantitative analysis of the study results).

To fulfill the objectives of the research work, a model (Figure 1) has been developed to prepare future physics teachers to systematize the research process and develop the scientific worldview of students in physics lessons. Our proposed model for preparing future physics teachers for the development of students' scientific worldviews consists of the following six main components:

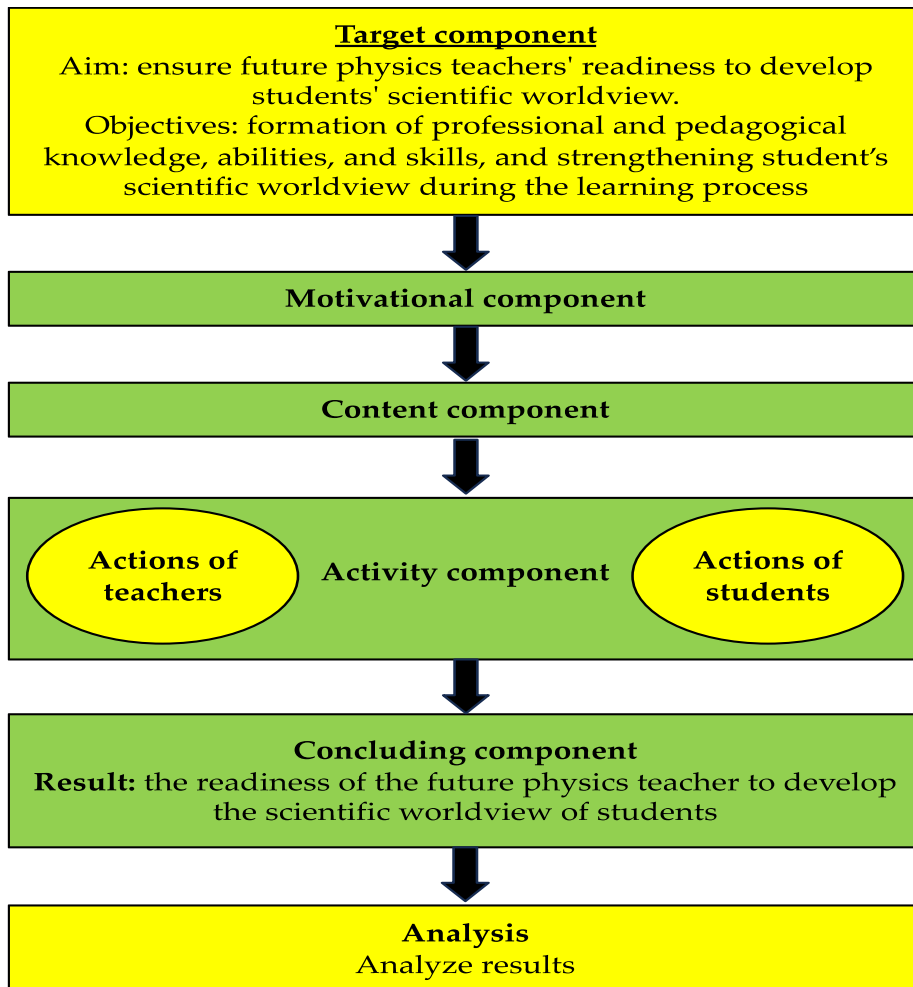


Figure 1. Model of the process of preparing future physics teachers for the development of students' naturalistic worldview

Preparation of physics teachers for the development of students' empirical worldview takes place only when all the components in this model are joint and interconnected. The integrity of this system is expressed in the unity of teaching, its content, and procedural components. At the same time, the integrity of the system, considered in practice, is realized by a set of tasks of training sessions,

the content of professional training, as well as the actions of teachers and students, a combination of various forms, methods, and teaching aids.

In the process of training future physics teachers at Kazakhstani universities, educational programs are annually reviewed and updated, and the experts are members of the academic council of the university, secondary schools, colleges, etc. A new elective course, *Methodology of Integrated Teaching in Physics*, which we developed, was introduced into the master's educational program of the specialty 7M01502 - *Training of Physics Teachers*. Table 1 contains the thematic curriculum of this elective course and consists of two modules: the first module is Pedagogical Foundations of Integrated Physics Teaching, and the second module is Methodological Foundations of Integrated Physics Teaching.

The course aims to prepare future physics teachers to use integrated activities in physics lessons with other disciplines. Interdisciplinary connections arouse interest in knowledge, activate the student's mental activity, develop the students' scientific worldview, and, as a result, form a scientific picture of the world. This elective course, *Methodology of Integrative Teaching in Physics*, is aimed not only at developing integrative thinking among students but also at developing students' worldviews and ideas of the integrity of nature.

A pedagogical experiment was conducted with undergraduates admitted in 2022 in the specialty 7M01502—*Preparation of Physics Teachers* on the implementation of an elective course to prepare future physics teachers to develop students' scientific worldviews. 115 undergraduates took part in the experiment. The study used inductive, analytical, and synthesizing research methods. Table 1 below shows the plan for this elective course.

The elective course *Methodology of Integrated Teaching in Physics*, based on modular technology, was developed for 3 credits (45 classroom hours and 105 hours of independent work of master's students (IWM)).

Table 1. Thematic curriculum of the elective course program for master's students in the discipline *Methodology of integrated teaching of physics*

Topic	Number of hours		
	Lecture	Practical classes	IWM
Module I. Pedagogical foundations of integrated teaching in physics			

Theoretical classes			
1. Social prerequisites for the introduction of integrated physics education according to the updated educational program	2		7
2. The meaning and essence of the concept of “integration” in pedagogy	2		7
3. The importance and features of establishing interdisciplinary connections in teaching physics	2		7
4. The relevance of the formation of a scientific worldview among students in modern education	2		7
Practical classes			
1. One of the main features of the updated education program at school is the preparation of tasks to implement the continuity of disciplines in physics lessons		4	7
2. Ways to create a plan for integration classes in physics		4	7
3. Ways to establish interdisciplinary connections between physics lessons and humanities disciplines		4	7
4. Pseudosciences in shaping students’ worldviews		4	7
Module II. Methodological foundations of integrated teaching of physics			
Theoretical classes			
5. Features of the implementation of the formation of students’ scientific worldview through integrated physics education	2		7
6. Model for preparing future physics teachers to form students’ scientific worldview	2		7
7. The need to organize integration, with the humanities, training sessions in physics, aimed at developing the scientific worldview of students	2		7
8. Features of the organization of integration (with subjects of the natural sciences) training sessions in physics, aimed at developing the scientific worldview of students	1		7
Practical classes			
5. Methods for implementing the formation of		4	5

students' scientific worldview through integrated physics education			
6. Methods of using in the educational process a model for preparing future physics teachers to form students' scientific worldview		4	5
7. Methods for implementing interdisciplinary connections between physics and humanities lessons		4	5
8. Methods for implementing interdisciplinary connections between physics and natural science lessons		2	6
Total	15	30	105

*Results*

Determining the level of readiness of physics teachers to develop the scientific worldview of students

We count the preparation of future physics teachers to develop students' scientific worldviews as one aspect of readiness for professional activity for our research problem. This readiness can be considered a prerequisite for one's pedagogical activities' effectiveness in implementing the processes under study and correctly using pedagogical knowledge, skills, and abilities. In Table 2, we determined the levels of preparedness of future physics teachers to develop the scientific worldview of students. The criterion for future teachers' readiness for the process includes low, medium, and high levels. As we see from the analysis of this problem, a teacher can successfully implement the process of developing students' worldviews if he/she is ready for this process. The process of forming a physics teacher's readiness to develop students' scientific worldview should be understood as purposeful and specially organized.

Table 2. Characteristics of the levels of preparedness of physics teachers to develop the scientific worldview of students.

A criterion for the readiness	Levels		
	low	medium	high
	does not fully possess the skills and abilities	has knowledge about organizing	has the skills and abilities to

of physics teachers to develop the scientific worldview of students	of organizing the process of developing the scientific worldview of students; does not always understand and realize the importance of the process of developing students' scientific worldview	the process of developing students' scientific worldview, but finds it difficult to apply it in practice; interest in the process under study is episodic	organize the process of developing the scientific worldview of students and effectively applies them in the educational process; interest in this process and the desire to carry out this process in practical conditions are fully developed
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**A pedagogical experiment to prepare future physics teachers to form students' scientific worldview based on the developed methodological system**

The study involved master's students at the South Kazakhstan State Pedagogical University, major *7M01502 – Training of Physics Teachers*, and master's students of the same major at the

L.N. Gumilyov Eurasian National University. Ascertaining and formative experiments were carried out on the developed elective course *Methodology of integrated teaching of physics*.

The results of the experiment's experimental and control groups are shown below in Tables 3 and 4. Table 3 and Figure 2 contain data from the ascertaining experiment on three levels of teachers' readiness for this process. According to the data of the ascertaining experiment, it can be seen that the level of readiness of physics teachers for the process of forming the scientific worldview of students in the control and experimental groups is the same. According to Table 3, There were 3 levels of readiness of future physics teachers to develop the scientific worldview of students: Low, Medium, and High. The results of the experiment show that both Experimental and Control groups have the same ratio of readiness levels among the teachers. For example, approximately half of the group in both cases show a low level of readiness, one-

third keep a medium level, and only 16% are at a high level of readiness to upgrade the scientific worldview of the students.

**Results of the ascertaining experiment**

Table 3. Indicators of the level of readiness of future physics teachers to develop the scientific worldview of students (experimental and control groups)

Levels of readiness of future physics teachers to develop the scientific worldview of students	Experimental group	Control group
Low	49,5%	49,8%
Medium	34,1%	33,3%

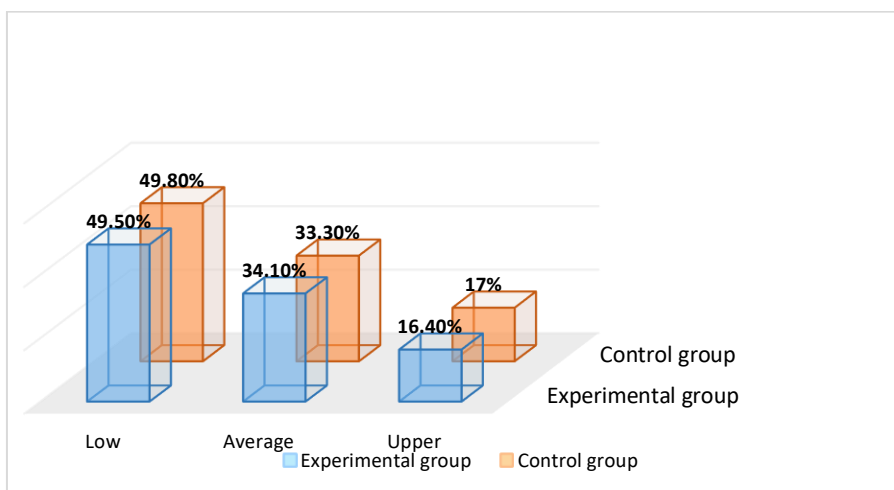


Figure 2. Diagram of indicators of the level of readiness of future physics teachers to develop the scientific worldview of students (data from the ascertaining experiment)

The relevant requirements were met when conducting the experiment and selecting the experimental and control groups for the formative stage. The high performance of the experimental group is clearly visible in the above diagrams.

***Results of the formative experiment***

Table 4 illustrates the results of the next experiment (formative). In this case, the results are slightly different between the Experimental and Control Groups. For instance, there are more teachers whose readiness level is low in the control group (34,8%) than in the experimental group. The medium readiness ratio for both groups is approximately 45%, but the level of high readiness of future physics teachers to develop the scientific worldview of students in the experimental group is about 1,5 times the level of that in the control group: 28% and 20%, respectively.

Table 4. Results of an experiment to determine the level of readiness of future physics teachers to develop the scientific worldview of students as a result of the introduction of a new elective course into the educational process (data from a formative experiment)

<b>Level of readiness</b>	<b>Experimental group</b>	<b>Control group</b>
Low	25,4%	34,8%
Medium	46,5%	44,5%
High	28,1%	20,7%

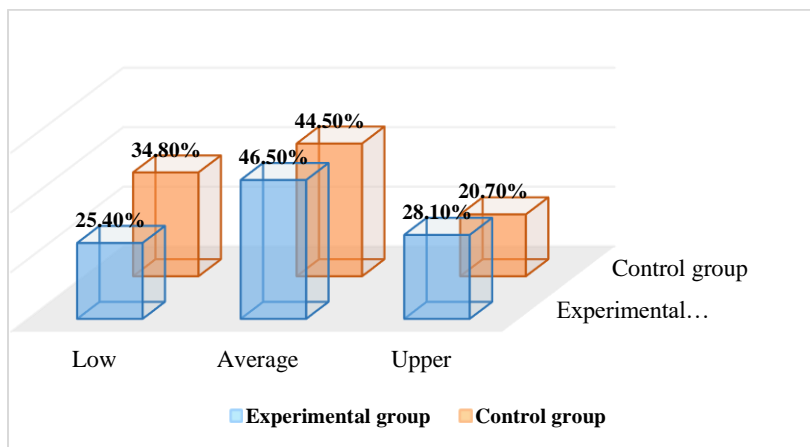


Figure 3. Diagram of indicators of the level of readiness of future physics teachers for the development of students’ scientific worldview as a result of the introduction of a new elective course into the educational process (data from a formative experiment)

#### 4.3. Element-by-element analysis results

To check the reliability of the results, we used element-by-element analysis. Let us give an example of an element-by-element analysis of a test assignment for undergraduates on the topic *Methods of integrated teaching of physics for the development of students' scientific worldview* :

1. Formulate the definitions of *worldview* and *scientific worldview*.
2. Name the negative factors influencing the development of students' scientific worldview in physics lessons.
3. Name innovative methods of teaching physics using the updated curriculum that is most effective for developing students' scientific worldview.
4. What organizational forms of teaching are most effective for developing students' scientific worldviews in physics lessons?
5. Reveal the essence of the concepts *integration of sciences* and *interdisciplinary connections of disciplines* and describe possible ways of using the integration of physics with other disciplines to develop students' scientific worldview.
6. Give examples of integrating physics lessons with other natural sciences and humanities.
7. Develop a short-term physics lesson plan that integrates other disciplines to develop students' scientific outlook.
8. Create a methodological system for developing students' scientific worldview through the integration of physics with other disciplines. For instance, interdisciplinary tasks, functional literacy tasks, demonstration experiments at home, and debates.

Each student could receive from 0 to 8 points for the completed task; it was accepted that a student who successfully answered 5 out of 8 questions had mastered the system of professional knowledge and skills, while a student who answered 4 or less had not mastered it. The results of completing the tasks are shown in Table 5.

Table 5. Analysis of the degree of development of professional knowledge and skills of future physics teachers in developing the scientific worldview of students.

To prove the reliability of our statements, it was necessary to determine whether the detected differences in the degree of mastery of professional knowledge and skills among students in the experimental and control groups were a consequence of the methodology used to prepare students for the development of the scientific worldview. For this purpose, the Kolmogorov-Smirnov criterion method of testing statistical hypotheses was used.

The value was calculated using the following formula:

$$T = \frac{1}{n} \max|\sum f_1 - \sum f_2| \tag{1}$$

where T is the value of the two-sided test statistics for samples of the same size, n is the number of students, and f1 and f2 are the numbers of students in the experimental and control groups who successfully completed the actions k times (k=1, 2, 3,...). The found expression T was compared with the obtained W1-α using the formula:

$$W_{1-\alpha} = \lambda_\alpha \sqrt{\frac{n_1 + n_2}{n_1 * n_2}} \tag{2}$$

where λ<sub>α</sub> is the quantile of the Kolmogorov function α is the significance level of this function. Thus, for the significance level α=0.05, the critical value is

Groups	Total master students	Number of students who successfully reflected elements of professional knowledge and skills on issues							
		1	2	3	4	5	6	7	8
Experimental	115	109	111	92	113	105	112	111	113
Control	115	89	90	78	83	52	60	78	93

λ<sub>α</sub>=1.36. The results of completing tasks for students in two samples, 1 (E) and 2(C), of 115 people each are recorded in Table 6, which is convenient for finding criterion statistics.

Table 6. Results of assignments completed by undergraduates in the experimental and control groups

Knowledge element number	Σf <sub>1</sub>	Σf <sub>2</sub>	Σf <sub>1</sub> - Σf <sub>2</sub>
1	109	89	20

2	111	90	21
3	92	78	14
4	113	83	30
5	105	52	23
6	112	60	52
7	111	78	33
8	113	93	20

Using the formula (1), we find the value of the two-sided test statistics for samples of the same size  $n_1=n_2=115$ . From Table 6, we calculate that the largest value of the expression  $\sum f_1 - \sum f_2$  equals 52, which means in accordance with formula (1)

$$T = \frac{1}{n} \max |\sum f_1 - \sum f_2| = \left( \frac{1}{120} \right) * 52 = 0.43$$

We calculate the critical value of statistics using formula (2) for large samples. For  $\alpha=0.05$  and  $\lambda_\alpha= 1.36$ ,  $n_1=n_2=115$ . according to formula (2)

$$W_{1-\alpha} = \lambda_\alpha \sqrt{\frac{n_1 + n_2}{n_1 * n_2}} = 0.18$$

Hence, the inequality is true  $T > W_{1-\alpha}$ , thus,  $0,43 > 0,18$ .

Based on the calculations, the hypothesis of the degree of formation of professional knowledge and skills of students in the experimental groups is accepted. It is significantly higher than that of students in the control groups.

### Discussion

Science and Education journal has a special issue called *Science, Worldview and Education*. Based on the research questions the journal focuses on, the topic of worldview is important since implementing the relationship between worldview and science in education is one of the principles of modern education (Matthews, 2009)

Akimkhanova et al, propose a game method for teaching physics. This method requires the teacher to look for interdisciplinary solutions and can be the basis of scientific and technical knowledge that students can apply in real life. This effective way of teaching physics also aims to develop cognitive processes (perception, attention, memory, and critical thinking skills).

At the same time, integrating subjects in the formation of students' scientific worldviews when teaching physics contributes to the formation of a

unified view of nature, a dialectical-materialistic understanding of students, familiarization with the history of physics, and the development of interest in the natural sciences (Yermekova et al, 2021).

A worldview can be characterized as a central systematization of specific concepts, affirmed by the emergence and rooting of the dominant value system in society (Rice, 2005; Royal, 2002). Therefore, integrating science with other disciplines is realized in forming students' worldview. Therefore, integrating science with other disciplines is realized in forming students' worldviews, and science is one of its specifically formulated components (Cobern, 1996).

Also, we conducted a study on the integration of physics and STEM, i.e., on teaching robotics to secondary school students based on developing educational technologies, integration processes, and interdisciplinary connections. Based on the results of the study, it was found that the introduction of robotics into the educational process entailed increased interest in the subject, the formation of new models of educational activities (including Lego technology), wider use of new information and communication technologies, development of information competence of students and teachers, the use of project and research teaching methods, the study of programming languages, improving the system of working with children based on the use of new methods of interactive learning, creating conditions that allow students to realize their abilities and interests more productively (Yermekova et al, 2021).

In the author's previous research, ways to use interdisciplinary connections to increase students' cognitive interest in physics, particularly using interdisciplinary connections between physics and history and historical data in physics lessons were examined (Kozhabekova et al, 2023).

We actively and purposefully use the enormous possibilities of the developed elective course to prepare physics teachers to form students' scientific worldviews. These opportunities are realized in various types and forms of the educational process, such as lectures, seminars, laboratory classes, essays, reports, and combined tests.

We developed *Methodology of Integrated Teaching of Physics* in the process of implementing the elective course where interdisciplinary connections between physics and various natural sciences and humanities were considered. Interesting tasks were selected to develop and form students' environmental consciousness, which is an important competency for the modern scientific worldview of students for the module *Physics in the Service of Ecology*. Since the problems of energy resources, their effective transformation, and equally

reasonable consumption are the most ambitious for the entire civilization, it is possible to consider the environmental problems of the electric power industry and possible ways to solve them.

From the above, one can see that a systematic, targeted update of the content of the program material of a physics course at school and university, with an emphasis on the integration of disciplines, will undoubtedly help motivate interest in the fundamental sciences, forming a scientific worldview and naturally improving the quality of teaching and education of students. But, in our educational system, there are numerous problems in implementing interdisciplinary connections between school disciplines. For example, in a long-term plan for the school year developed and approved by the Ministry of Education for a particular subject, it is not always possible to integrate the theme of one subject with another. That is, adjustments are required in curricula for the purpose of interdisciplinary integration of different subjects.

Handtke et al, present a case for the creation of a new theory-based instrument to assess self-efficacy beliefs in interdisciplinary science teaching. The authors' study focused on the situation in Germany, where interdisciplinary science education is mandatory for future teachers. For countries that lack interdisciplinary education for science teachers, such as Germany, only minor modifications of country-specific curricula may be required. In countries where interdisciplinary science teacher education already exists, curricula may need to be adapted to the specific country, and various barriers may need to be overcome.

Thus, our research does not pretend to be an exhaustive solution to the problem of preparing future physics teachers for the development of students' scientific worldview when teaching physics; it can be considered as one of the possible solutions to this problem. The prospects for the research are to find new ways to organize the training of natural science teachers to develop the scientific worldview of students in accordance with the need for modernization of education.

### *Conclusions*

The number of applicants for the educational program *Training of Physics Teachers* increases yearly at L.N. Gumilyov Eurasian National University, South Kazakhstan State Pedagogical University, and other pedagogical universities in our country. We believe that such interest among applicants to pedagogical specialties is because a number of measures are being taken in the Republic of

Kazakhstan to solve the tasks set by the state to prepare a teacher of a new formation and raise the status of a teacher. A law on the status of a teacher has been adopted. Moreover, the government of the Republic of Kazakhstan systematically increased teachers' salaries, the threshold score was increased to 90 for admission to teaching specialties, stipends have been increased for students of pedagogical specialties (almost twice), and the cost of the state grant has increased.

In this regard, innovative educational technologies should be actively implemented, one of which is the methodology of integration teaching in physics in training physics teachers of a new formation in Kazakhstan universities.

As a result, the use of interdisciplinary tasks in physics lessons is helpful, particularly for students to identify contradictions between the need to explain surrounding phenomena and the lack of knowledge for such an explanation. Overcoming contradictions is a powerful incentive and means of developing literacy, scientific knowledge, and creative work. The method of teaching physics based on the integration of disciplines has enormous potential in developing students' scientific worldviews and creative activity.

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### **Кожабекова Эльмира Курбаналикызы**

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### **Болашақ физика мұғалімдерін білім алушылардың ғылыми дүниетанымын қалыптастыруға даярлау бойынша тәжірибелік жұмыстар**

**Аңдатпа:** Ұсынылған жұмыс Қазақстан Республикасында жаратылыстану ғылымдары бойынша педагогикалық мамандықтарға үміткерлердің жоғары қызығушылығына байланысты өзекті болып табылады. Зерттеу білім алушылардың ғылыми дүниетанымын қалыптастыруға құзыретті оқытушылар құрамын даярлауға бағытталған; өз кезегінде ғылыми дүниетаным жалпы әлем туралы эмпирикалық және теориялық білімге негізделген және табиғаттың ең іргелі заңдары мен принциптерінен тұрады. Зерттеу барысында келесі әдістер қолданылды: теориялық (синтез, жіктеу, жалпылау, дедукция, индукция, аналогия және модельдеу); эмпирикалық (байқау, сауалнама, сауалнама және сұхбат); эксперименттік (баяндау, дамытушылық және диагностикалық эксперимент); және зерттеу нәтижелерін сапалы және сандық талдау. Зерттеу барысында болашақ физика мұғалімдерін білім алушылардың ғылыми дүниетанымын қалыптастыруға және педагогикалық эксперимент нәтижелерін көрсетуге дайындау үшін сапалы жаңа әдістемелік жүйе жасалды. Біз болашақ физика мұғалімдерін физиканы интеграцияланған оқыту процесінде оқушылардың

дүниетанымын қалыптастыруға дайындауға арналған өз моделімізді, сондай-ақ физиканы оқытудың тиімді формаларын, әдістері мен құралдарын анықтауға арналған өзіндік курсты ұсынамыз.. Зерттеу нәтижесінде білім алушылардың дүниетанымын қалыптастырудағы негізгі іс-әрекетті ұйымдастырудың маңызды құрамдас бөліктері оқу-әдістемелік жетілдіруді дамыту және қолдану, сонымен қатар физика пәнін оқытудағы интеграция мәселелерін шешу болып табылатындығы анықталды..

**Кілт сөздер:** білім беруді жаңғырту; жаңартылған білім беру мазмұны; физика мұғалімдерін даярлау; ғылыми дүниетаным; пәндерді интеграциялау; физика мұғалімдерін даярлау моделі

### **Кожобекова Эльмира Курбаналиқызы**

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### **Практические работы по подготовке будущих учителей физики к формированию научного мировоззрения обучающихся**

**Аннотация:** представленная работа является актуальной в связи с высоким интересом кандидатов на педагогические специальности по естественным наукам в Республике Казахстан. Исследование направлено на подготовку компетентного преподавательского состава для формирования научного мировоззрения обучающихся; в свою очередь, научное мировоззрение основано на эмпирических и теоретических знаниях о мире в целом и состоит из самых фундаментальных законов и принципов природы. В ходе исследования были использованы следующие методы: теоретические (синтез, классификация, обобщение, дедукция, индукция, аналогия и моделирование); эмпирический (наблюдение, опрос, опрос и интервью); экспериментальный (повествовательный, развивающий и диагностический эксперимент); и качественный и количественный анализ результатов исследования. В ходе исследования была разработана качественно новая методическая система для подготовки будущих учителей физики к формированию научного мировоззрения обучающихся и демонстрации результатов педагогического эксперимента. Мы предлагаем собственную модель подготовки будущих учителей физики к формированию мировоззрения учащихся в процессе интегрированного обучения физике, а также собственный курс по определению эффективных форм, методов и средств обучения физике.. В результате исследования установлено, что важнейшими составляющими организации основной деятельности в формировании мировоззрения обучающихся являются развитие и применение учебно-методического совершенствования, а также решение задач интеграции в преподавании физики..

**Ключевые слова:** модернизация образования; обновленное содержание образования; подготовка учителей физики; научное мировоззрение; интеграция предметов; модель подготовки учителей физики