A05F7A0 Алматы, улица Сатбаева 16а, контактный телефон: 8777 422 00 00, e-mail: g.mussabekova@turan–edu.kz.

Ризаходжаева Гулнара Абдумажитқызы – PhD докторы, педагогикалық шетел тілдері кафедрасының қауымдастырылған профессоры, Қожа Ахмет Яссауи атындағы Халықаралық қазақ-түрік университеті, Қазақстан Республикасы, X42F6X7 Түркістан қаласы, Б.Саттарханов көшесі 29, байланыс телефоны: 8777 025 49 49, e-mail: Gulnara_rizahodja@mail.ru.*

Акешова Мадина Мурзахановна – PhD, тілдер мектебінің қауымдастырылған профессоры, Халықаралық туризм және қонақжайлылық университеті, Қазақстан Республикасы, X43C6T4 Түркістан қаласы, Рабиға Сұлтан Бегім көшесі 14Б, байланыс телефоны: 8701 159 23 95, e-mail: madina_shakh@mail.ru.

Абдуламит Индира – педагогикалық шетел тілдері кафедрасының магистрі, Қожа Ахмет Яссауи атындағы Халықаралық қазақ-түрік университеті, Қазақстан Республикасы, X42F6X7 Түркістан қаласы, Б.Саттарханов көшесі 29, байланыс телефоны: 8777 422 91 22, e-mail: abdulamit.indira@mail.ru.

Мұсабекова Гүлжан Закариевна – п.ғ.к., журналистика және аударма ісі кафедрасының қауымдастырылған профессоры, «Тұран» университеті, Қазақстан Республикасы, A05F7A0 Алматы қаласы, Сәтбаева көшесі, 16а, байланыс телефоны: 8777 422 00 00, e-mail: g.mussabekova@turan–edu.kz.

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IMPROVEMENT OF PEDAGOGICAL EDUCATION IN PHYSICS: METHODOLOGICAL SYSTEM OF ADVANCED TEACHING OF CLASSICAL MECHANICS

Ualikhanova B.S. – PhD, Head of the Physics Department, South Kazakhstan Pedagogical University named after Ozbekali Zhanibekov, Shymkent, Republic of Kazakhstan.*

Omarov O. – PhD student, South Kazakhstan Pedagogical University named after Ozbekali Zhanibekov, Shymkent, Republic of Kazakhstan.

The relevance of the researched issue arises from a comprehensive examination of the systemic characteristics of classical mechanics, application of the hypothetico-deductive approach within this theory, the insufficient inclusion of these elements in educational curricula. This article seeks to substantiate, devise systematic approach to teaching classical mechanics within the broader physics curriculum of a pedagogical university. Employing the dialectical method, specifically emphasizing the unity of system, method, along with a systemic-structural perspective, the integration of theory, practice, an activity-oriented teaching approach, constitutes the primary means of investigating this matter.

The article introduces systematic approach to teaching classical mechanics in the general physics curriculum of pedagogical university. This approach is scientifically grounded, shaping future physics educator through subject-specific professional training, a focus on teaching rooted in observable phenomena. The criteria for learning outcomes in classical mechanics are delineated, justified, aligning with the objective of cultivating systemic knowledge in conjunction with scientific understanding, teaching methods based on observable occurrences. Systematic approach aims to equip educators for evolving conditions in professional education, emphasizing the creation of scientific, methodological support for monitoring educational quality.

Key words: *Methodological system, mechanical phenomena, phenomenon-based learning, activity approach, professional training.*

СОВЕРШЕНСТВОВАНИЕ ПЕДАГОГИЧЕСКОГО ОБРАЗОВАНИЯ ПО ФИЗИКЕ: МЕТОДИЧЕСКАЯ СИСТЕМА УГЛУБЛЕННОГО ПРЕПОДАВАНИЯ КЛАССИЧЕСКОЙ МЕХАНИКИ

Уалиханова Б.С. – PhD, заведующий кафедрой физики, Южно-Казахстанский педагогический университет имени Өзбекәлі Жәнібеков, г. Шымкент, Республика Казахстан.*

Омаров О. – докторант, Южно-Казахстанский педагогический университет имени Өзбекәлі Жәнібеков, г. Шымкент, Республика Казахстан.

Исследуемая проблема приобретает актуальность с точки зрения глубокого изучения системных свойств классической механики, применения гипотетико-дедуктивной методологии в данной теории и необходимости недостаточного включения этих аспектов в учебные планы и *программы. Цель статьи-обоснование и разработка методической системы обучения классической механике в курсе общей физики педагогического университета. Ведущим методом изучения данной проблемы является диалектический метод, в частности принцип единства системы и метода, а также системно-структурный подход, взаимосвязь теории и практики, деятельностный подход в обучении. В статье представлена методическая система преподавания классической механики в курсе общей физики педагогического университета, научно обоснованная, определяющая будущего учителя физики на основе профессиональной подготовки по предмету и обучения на основе феномена. Требования к результатам обучения классической механике в курсе общей физики определяются и обоснованы в соответствии с целями формирования системных знаний в единстве с научными познаниями и методами обучения, основанными на явлениях. Методическая система направлена на адаптацию педагогов к новым условиям профессиональной деятельности в сфере образования и направлена на разработку научно-методического обеспечения мониторинга качества образования.*

Ключевые слова: *методологическая система, механические явления, явление-ориентировочное обучение, деятельностный подход, профессиональная подготовка.*

ФИЗИКА ПӘНІ БОЙЫНША ПЕДАГОГИКАЛЫҚ БІЛІМ БЕРУДІ ЖЕТІЛДІРУ: КЛАССИКАЛЫҚ МЕХАНИКАНЫ ТЕРЕҢДЕТІП ОҚЫТУДЫҢ ӘДІСТЕМЕЛІК ЖҮЙЕСІ

Уалиханова Б.С. – PhD, Физика кафедрасының меңгерушісі, Өзбекәлі Жәнібеков атындағы Оңтүстік Қазақстан педагогикалық университеті, Шымкент қ., Қазақстан Республикасы.*

Омаров О. – докторант, Өзбекәлі Жәнібеков атындағы Оңтүстік Қазақстан педагогикалық университеті, Шымкент қ., Қазақстан Республикасы.

Зерттелетін мәселе классикалық механиканың жүйелік қасиеттерін терең зерттеу, осы теорияда гипотетикалық-дедуктивті әдіснаманы қолдану және осы аспектілерді оқу жоспарлары мен бағдарламаларына жеткіліксіз енгізу қажеттілігі тұрғысынан өзектілікке ие болады. Мақаланың мақсаты-педагогикалық университеттің жалпы физикасы курсында классикалық механиканы оқытудың әдістемелік жүйесін негіздеу және әзірлеу. Бұл мәселені зерттеудің жетекші әдісі-диалектикалық әдіс, атап айтқанда жүйе мен әдістің бірлігі принципі, сонымен қатар жүйелік-құрылымдық тәсіл, теория мен практиканың байланысы және оқытудағы белсенділік тәсілі. Мақалада педагогикалық университеттің жалпы физикасы курсында классикалық механиканы оқытудың әдістемелік жүйесі ғылыми негізделген, болашақ физика мұғалімді пән бойынша кәсіби құбылысқа негіздеп оқыту негізінде анықтайды. Жалпы физика курсында классикалық механиканы оқыту нәтижелеріне қойылатын талаптар құбылыстарға негізделген ғылыми таным мен оқыту әдістерімен бірлікте жүйелік білімді қалыптастыру мақсаттарына сәйкес анықталады және негізделген. Әдістемелік жүйе педагогтарды білім беру саласындағы кәсіби қызметтің жаңа жағдайларына бейімдеуге бағытталған және білім беру сапасының мониторингін ғылыми-әдістемелік қамтамасыз етуді әзірлеуге бағытталған.

Түйінді сөздер: *әдістемелік жүйе, механикалық құбылыстар, құбылысқа негіздеп оқыту, белсенділік тәсілі, кәсіби дайындық.*

Introduction.

The professional training of a future physics teacher begins with the study of classical mechanics – the most important fundamental physical theory underlying modern physics. In the process of studying classical mechanics, knowledge of contemporary scientific methods of understanding nature is formed. From a professional standpoint, it is also important that in the general physics course, classical mechanics is presented, as in senior high school, in its Newtonian formalism (Lagrangian and Hamiltonian formalisms are considered in the theoretical physics course). The article focuses on the methodological system of teaching classical mechanics in the general physics course of a pedagogical university. The course of general physics of a pedagogical university aims to form future teachers ' systematic knowledge of physical theories and methods of scientific knowledge of nature in their dialectical relationship and interdependence, to foster theoretical thinking and the formation of a scientific worldview. Physical theory is the direct source of the content of physical education. In this regard, the solution of methodological problems of formation of system knowledge, a systematic theoretical.

In General, the research problem is expressed to align the content of physical education, methods and means of teaching, learning goals and objectives of the professional physical education at the pedagogical University. The problem of studying the methodological system of training, due to the contradictions in the traditional content of physical education in the course of classical mechanics, is the contradictions between:

- conceptual properties of the kernel of the physical theory and empirical construction of the course content of classical mechanics, due to subject material terms of the conceptual origin of physical concepts and laws;

- the dialectical principle of the unity of the system of scientific knowledge and phenomenon-based learning, the deep essential content of classical mechanics and the limited, fragmentary coverage of theoretical methods of cognition in traditional training courses;
- a rather large volume of educational material for the general physics course and the requirement of the standard of higher professional pedagogical education in the specialty of physics.

Methods and Materials. Within the framework of theoretical knowledge, a system of theoretical deductive consequences of the core of the theory of different levels of generalizations is formed by means of deductive inference. Examples of the consequences of the core of classical mechanics are solid mechanics, the theory of mechanical vibrations, and the theory of laminar fluid flow. In the theoretical description of specific physical systems, more complex model objects are introduced into the structure of deductive consequences than a material point (an absolutely solid body, an absolutely elastic body, an incompressible liquid, etc.) [1, p.23]. Let's explain that the essence of the hypothetico-deductive method lies in the initial formation of a "hypothetical construction, which is deductively unfolded, forming a whole system of hypotheses, and then this system undergoes empirical testing, during which it is refined or specified [2, p.128]."The introduction of more complex models into the structure of deductive consequences is dictated by the tasks of describing the features of specific physical systems and which reflect the essential properties that determine the features of these specific systems [3, p.447].

Theoretical knowledge is a means of explaining empirical facts and a means of understanding processes in a fragment of reality. The explanation provides answers to the questions: why, what is the reason? Physical theory explains the physical phenomenon by its own means and within the limits of applicability. The explanation reveals the nature, the cause of the fact, the laws of the existence of the fact. The objective side of cognitive activity prevails in the explanation. Understanding is derived from the knowing subject, although the process of understanding is directed at the object and is determined by the nature of the object. The content of the category "understanding" reflects the state of development of science at a given historical moment. Explanation and understanding are mutually conditioned: understanding contains the elements of explanation, and explanation contains the elements of understanding. The physical theory describes the state and predicts the change in the state of the physical system, which is a necessary condition and prerequisite for the implementation of purposeful transformative activity [4.p.219].

The system of knowledge and the system of methods of cognition form a dialectical unity, permeate each other, which should be reflected in the curriculum of general physics. Otherwise, the task of forming a systematic knowledge of physical theories is not solved. For example, a misunderstanding of the nature and technology of these methods of knowledge as abstraction and modeling, leads to misunderstanding of the model character of physical theories, operating model objects and their relationships reflecting the knowledge of the intrinsic properties of physical systems and their essential relationship and communication. In this case, the statements of the physical theory are perceived either as something that does not relate to real reality, or, on the contrary, theoretical objects and their relations are identified with reality.

Methods of cognition of the physical world are discussed below. Here we note that in accordance with the stages of scientific knowledge, empirical, theoretical and general logical methods of knowledge are distinguished.

The basis of the existence of humanity is activity – an active and purposeful interaction of a person with reality, the result of which is the transformation of reality. The object of scientific cognitive activity is scientific knowledge that is acquired either in research activities aimed at discovering new, previously unknown knowledge, or in educational cognitive activities. The knowledge acquired in the learning process is subjectively new for the learner [5.p.222].

In psychological terms, the activity includes the components: the motive of the activity is the subject that drives the activities; the objective of activity - idea of activity; a means of achieving the goals that can be considered as preconditions to the exercise of the existence and activities. The relationships between the components are mobile. In this regard, Ul-Haq Z, Khurram B, Bangash A notes: "Since the final goal of an activity is achieved in a whole series of actions, the result of each of these actions, being a means in relation to the final goal, is at the same time an end for this particular action" [6.p.241].

Kanchana S, Patchainayagi S, Rajkumar S allocated three units in the activity: 1) a separate activity defined by the subject of the activity; 2) action - a process subordinated to the idea of the result and purpose of the activity; 3) onepaifim - the method of performing the action [7.p.57]. Han M, Feng S, and Chen C used a system-structural approach to study the structure of cognitive activity [8.p.1809].

The starting psychological category of structural analysis is the operation in the sequence "operation - action - activity". By the method of preliminary crushing of units of activity (microstructural analysis) it is revealed that " ... an integral assessment of the situation can occur before the dismemberment of perception, and even more so the memorization of its elements. This circumstance is analogous to the intuitive perception of truth, which manifests itself in the most complex mental activity for the formation of the conceptual core of physical theory.

By Sidneva, A. N. the concept of step-by-step formation of mental actions and concepts, as well as the concept of the orienting effect of mental actions and the types of training corresponding to this effect is put forward [9.p.22].

The most important goal of educational cognitive activity is to master students ' skills and methods of mental actions, which can be reflected in the system of practical and theoretical tasks in physics.

Analyzing the features of the implementation of meaningful generalization and the formation of theoretical thinking in teaching, U. Baizak considers the process of mastering educational material as a didactically organized model (educational model) of the process of real scientific research and scientific presentation of the material [10, p.101].

These principles of organizing educational material are realized in the unity of substantive and procedural aspects of learning, correspond to the stages and sequence of scientific knowledge, and can be regarded as general methods of studying the physics course. As we have previously discussed the application of the hypothetico-deductive methodology in teaching physics, it is an important aspect of fostering scientific thinking in students and ensures the systematic assimilation of fundamental physics concepts. This methodological approach is based on the scientific method, which involves formulating hypotheses, testing them, deducing logically consequent conclusions, and then experimentally verifying these conclusions.

Here are several aspects emphasizing the significance of applying the hypothetico-deductive methodology in the context of physics education:

- Stimulation of scientific thinking: The hypothetico-deductive method supports the development of skills in formulating assumptions and deriving logically justified conclusions. This contributes to the formation of scientific thinking, the ability to analyze phenomena, and construct logically reasoned arguments.
- Active student participation: When using this methodology, students actively engage in the learning process. Formulating hypotheses, conducting experiments, and analyzing results stimulate interest in the subject and facilitate better comprehension of the material.
- Practical application of knowledge: The hypothetico-deductive method includes experimental confirmation or refutation of hypotheses. This imparts a practical orientation to education, allowing students to see how theoretical concepts are applied in practice.
- Formation of research skills: Students, by applying the hypothetico-deductive method, develop research skills. They learn to design experiments, collect and analyze data, and draw conclusions based on the obtained results.
- Preparation for scientific activities: The hypothetico-deductive method serves as the foundation of the scientific method used in scientific activities. Applying this methodology in the educational process prepares students for deeper research and understanding of physical phenomena. These principles of organizing educational material are realized in the unity of substantive and procedural aspects of learning, correspond to the stages and sequence of scientific knowledge, and can be regarded as general methods of studying the physics course. As we have previously discussed the application of the hypothetico-deductive methodology in teaching physics, it is an important aspect of fostering scientific thinking in students and ensures the systematic assimilation of fundamental physics concepts. This methodological approach is based on the scientific method, which involves formulating hypotheses, testing them, deducing logically consequent conclusions, and then experimentally verifying these conclusions.

Students in their cognitive activity carry out "quasi-research", while "... academic subjects should be constructed in accordance with the method of scientific presentation of the material" [11, p.132].

These principles of the construction of educational material are implemented in the unity of the content and process aspects of training, correspond to the stages and sequence of scientific knowledge and can be considered as general methods of studying the course of physics.

In traditional general physics courses, the information-compounding style of presentation prevails, in which the main attention is paid to the description of empirical facts and the consideration of deductive consequences of the theory. However, very little attention is paid to the analysis of the epistemological genesis of the basic laws and model objects of the theory, the place of theoretical generalizations in the structure of the theory. The lack of a clear distinction between empirical regularities and theoretical laws, the distinction between the basic laws and deductive consequences of the theory makes it difficult to form a systematic theoretical knowledge about the content structure of the theory. The implementation by the teacher in his professional work of a creative, at the same time systematic and methodically sound course of high school physics involves the teacher's knowledge of the content structure and system properties of physical theories. These questions are practically not considered in general physics courses.

From the above review that in the pedagogical science and epistemology ways of formation of the system of theoretical generalizations and systematic approach to the design of educational content: the structure of the course must correspond to the stages and the structure of scientific knowledge, to match the system properties and content structure of physical theories, meet the psychological regularities of formation of educational material and to reflect the activity of the nature of scientific knowledge. However, in traditional physics courses, the general psychological and pedagogical ideas of meaningful generalization are not implemented. Creating a methodological system for teaching physics in a pedagogical university, in particular, designing the content of a general physics course in order to form a systematic knowledge of physical theories, a scientific worldview and the education of theoretical thinking, is an urgent problem of the methodology of teaching physics in a pedagogical university.

The methodological system of teaching physics is a system of dialectically interrelated components - the purpose of training, the content of education, methods, means and forms of training. The methodological system, being relatively independent, is an open system. Scientific knowledge has an activity nature, which determines the activity approach in teaching as one of the most important factors affecting the methodological system of training.

The direct source of the content of the general physics course is the physical theory (as a conceptual system), which has its own content structure of scientific knowledge, the corresponding elements of the structure and is formed by the methods of cognition. In this regard, the methodology of the study of the methodological system of training is as follows:

- dialectical method, in particular, the principle of unity of system and method, and the system-structural approach;
- the relationship between theory and practice and the activity approach in teaching.

The study of the problem was carried out in two stages:

At the stage of the experiment were analysed: traditional methodical system of teaching of General physics, pedagogical University; starting systematic knowledge of the physical theories of first - year students; the ability of students to handle cognitive actions.

In particular, the following are analyzed: the structure of educational programs for the General physics course, which determines the content of education at the pedagogical University; the content and structure of textbooks of mass physics, traditional methods and forms of teaching the course of General physics in high school. Diagnostics of systematic knowledge of physical theories of high school graduates who entered the first year of the Department "Physics" of the South Kazakhstan State pedagogical university, carried out from 2019 to 2023. During this time the first course was a total of 235 high school graduates. Testing was carried out at the beginning of the school year in the classes of the propaedeutic physics course, and then the same test questions were asked at home. Approximately two weeks before the test, the student is recommended to review the physics textbooks for grades 9-11.

Here is an example of one of the tests:

1. What is the difference between the laws of physics (the laws of physical theories) and the laws of nature?
2. Which group of statements - empirical generalizations or theoretical generalizations-are the main provisions of molecular kinetic theory?
3. What physical laws - empirical or theoretical – is the law of free fall of Galileo: all bodies at the surface of the planet in the absence of atmospheric resistance fall with the same acceleration?

The absence of a pronounced structure in the sequence of questions in the test allows to a certain extent to simultaneously identify the non-standard and mobility of the student's mental activity.

The teaching experience shows that the emphasized empirical construction of the course of general physics with an emphasis on empirical methods of cognition while ignoring theoretical methods (and the corresponding cognitive operations) creates a psychological barrier in the assimilation of the course of theoretical physics. We propose a variant of the course of classical mechanics, in which the educational material is constructed in accordance with the content structure of classical mechanics with a discussion of this structure, consideration of the epistemological genesis of the empirical basis, the theoretical core and deductive consequences, as well as the formation of skills in operating not only with empirical methods of knowledge, but also with theoretical methods.

In this regard, we considered it incorrect to compare the quantitative indicators of the systematic knowledge of classical mechanics in the experimental and control flows. To a certain extent, it is possible to compare the consistency of theoretical knowledge at the beginning and at the end of the first semester of general physics training (general physics begins to be read from the second semester of training in a pedagogical university and it is with classical mechanics in its Newtonian formalism).

The ascertaining experiment showed that high school graduates are insufficiently oriented in the structure of physical theory, have fragmentary, non-systematic knowledge of physical theories, knowledge is mainly based on the empirical perception of the physical world.

The formation of the proposed course was completed by the end of the 2022-2023 academic year. The level of systematic knowledge training material for the course of classical mechanics were evaluated in their spare time at the end of the semester (in late may) for the same tests that were given to first-year students at the beginning of the school year (in the framework of introductory course) with the inclusion of additional questions and seizure issues not related to mechanics. The paper contained standard tasks similar to those considered in the semester with the addition of one task of increased difficulty.

Here are examples of additional questions included in the tests:

1. List the elements of the content structure of classical mechanics. What element of the content structure includes the laws of planetary motion formulated by Kepler? What element of the content structure of mechanics includes the Meshchersky equation? What element of the content structure includes the principle of independence of interactions?
2. How should we understand the statement that Newton's laws are generalizations of empirical data?

Below are the results of diagnostic knowledge of first-year students at the beginning of the academic year within the framework of introductory course (start: September, October) and at the end of the school year is almost upon completion of the course of Newtonian mechanics (the end: April, may). A statistical assessment of the reliability of the effectiveness of the proposed methodological training system was carried out.

Results.

The components of the structure of the methodical system of teaching physics are (Fig. 1) the goals of training, the content of physical education, methods, means and forms of organizing training. Further, the concept of the methodological system of training is considered mainly on the example of teaching classical mechanics in the general physics course of a pedagogical university.

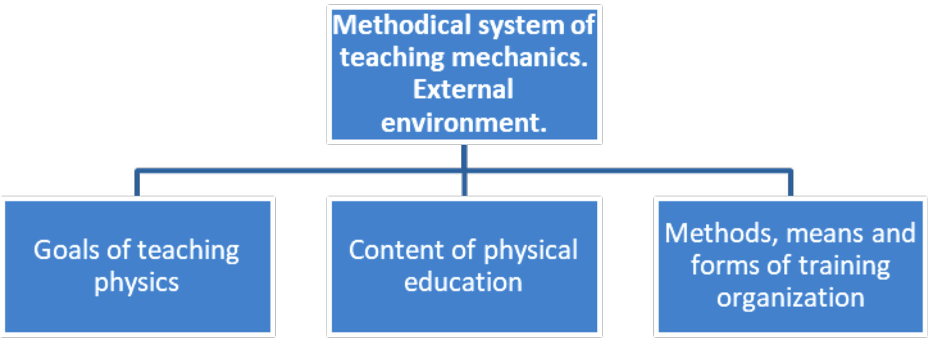

Fig. 1. – Organization of educational material, educational process and ways of interaction in the structure of relations "teacher-content of physical education-student", aimed at solving educational and educational tasks.

The objectives of teaching classical mechanics are in dialectical unity with the content of the course of physical theory. The goals of professional training of a future teacher in physics at a pedagogical university, which determine the content of the subject, are correlated with the functions of teaching - ideological, general, practical and educational-and the standard of higher professional education in the specialty 6B015-Physics. The objectives of teaching classical mechanics in the course of general physics include: the formation of system knowledge of classical mechanics as a conceptual system of knowledge; formation of knowledge of the content structure of classical mechanics as a physical theory; formation of knowledge of the properties of theoretical objects that operate in physical theory; formation of knowledge of the most important deductive consequences of the theory and their empirical interpretation (such as the theory of small-amplitude oscillations, the dynamics of rotational motion of a solid body, elements of incompressible fluid mechanics, elements of celestial mechanics, and some others); formation of knowledge of the basic empirical facts underlying classical mechanics as a theory; formation of a modern mechanical picture of the world as a component of the physical picture of the world; formation of knowledge of methods of cognition in the unity of the content of physical theory; formation of skills to apply cognitive actions; formation of a scientific worldview and education of theoretical thinking.

From the experience of teaching, it follows that the components of the "external environment", which mainly determine the effectiveness of the implementation of the goals of teaching classical mechanics, are: 1) the content and content structure of classical mechanics; 2) the activity nature of knowledge, methods of cognitive activity; 3) the systematic continuity of the high school physics course and the general physics course of a pedagogical university and the level of training in physics in high school; 4) the expressed professional orientation of the general physics course in the structure of the subject physical and mathematical training of the future physics teacher; 5) the cognitive independence of the student's personality, including the ability to self-regulate cognitive activity, the formation of motives for professional cognitive activity, knowledge of cognitive actions.

The activity of assimilation of the concept involves the motivation of introducing the concept into the structure of the theory. Various kinds of cognitive actions are learned when listening to a lecture course, in a laboratory workshop, a workshop on solving problems, in independent work, involving control and self-control in mastering the methods of activity and the content of physical theory. The activity approach to the content of education is based on the reflection in the content of education of actions that implement an adequate assimilation of concepts and physical theory as a whole. In this regard, the methodological requirement of the activity approach should be attributed to the source and factor of the formation of the content of education, i.e., to the "external environment" of the methodological system of teaching physics [12.p.269].

An important component of the "external environment" in which the methodical system of teaching mechanics to a first-year student functions is the training in physics in full secondary school. The level of formation of the student's knowledge of cognitive actions, knowledge of theoretical generalizations during the period of his / her training in secondary school significantly affects the actual content structure of the course of classical mechanics,

the choice of adequate teaching methods, the structure of organizational forms of training. The requirement of professional orientation of the course of general physics in the structure of the subject training of the future physics teacher significantly determines the structure of the course, the emphasis that must be placed in the educational process when disclosing the content of physical theory.

Teaching method there are ways to organize the teaching material and the interaction of the teacher and the student to achieve educational and educational goals. Educational goals are realized in the structure of relations "teacher - content of the educational material student", therefore, the teaching method should be considered as ways of activity of the teacher and student, and how the "movement" of the content of educational material in the learning process.

In accordance with the solve educational tasks and active approach to learning we can distinguish the following teaching methods [13.p.87] and [14.p.82]: the method of reproduction (reproduction) of physical concepts and methods of cognitive activity in the study of specific physical systems; deductive playback (output) special cases of the fundamental aspects of physical theory in the assimilation of the content of physical theories and the solution of problems; the method of reproduction (reproduction) theoretical and empirical generalizations in the educational process, etc.

In the didactic model of the subject consists of two parts: main, which includes the content and for which a subject introduced into the curriculum, and means for learning, the formation of different skills, development and education of the individual.

The most important means of teaching are the methods of scientific knowledge acquired by students in the course of teaching physics. The means of teaching general physics should include material and technical means of teaching (laboratory installations, demonstration equipment, etc.), textbooks and problem books and teaching aids for organizing independent work of the student as components of the educational and methodological complex in physics, i.e. the material and methodological base for studying physics, in particular, the system of educational tasks. Modern teaching tools are computer multimedia tools, which include computer laboratory work, computer programs for group and individual knowledge control, electronic methodological manuals for organizing independent work of a student, electronic textbooks, etc.

Forms of organization of training - ways of providing educational services that take into account the mode of life of the student and his socio-psychological characteristics [15.p.299]. The main form of training is a lesson (in the course of general physics - these are lectures, practical, seminar and laboratory classes).

The methodology of scientific knowledge, the organization of scientific knowledge in physical theories, the role of formal and dialectical logic in the formation of physical concepts, laws and physical theory are analyzed in philosophical studies [16.p.278]. However, in the educational literature on the course of general physics, dialectical methods of forming the conceptual foundations of physical theory, the methodology of scientific knowledge are not properly reflected. In Goren, E., & Galili, I. [17.p.12] and Weissman, E.Y. and ect.[18, p.3] the analysis of the essential content of the conceptual core of classical mechanics is carried out. However, note that these textbooks are intended for students of higher education institutions and classical universities, these textbooks do not fully take into account the specifics of the professional needs of the future physics teacher. For the first time, we have scientifically justified the methodological system of teaching classical mechanics in the general physics course of a pedagogical university, which determines the professional physical education of a future physics teacher. The principles of constructing the content and structure of the course of classical mechanics as an academic discipline are determined, taking into account the system-structural properties of classical mechanics as a physical theory, as well as the predictive function of physical theory, formalized by the concepts of interaction and the state of a mechanical system. The purpose of the formation of system knowledge of a physical theory is proposed to implement by including in the course of system properties of classical mechanics in accordance with the principles of scientific cognition, the presentation of educational material in the unity of the system of scientific knowledge and scientific methods, disclosure in the course of the model character of classical mechanics as a physical theory, the logical Genesis of physical concepts and laws.

Discussion

The research design, while robust, carries inherent limitations such as the focus on the specific example of teaching classical mechanics in a pedagogical university. This specialization might limit the generalizability of the findings to other branches of physics or educational institutions. Additionally, the study primarily adopts a theoretical perspective, and the practical implementation of the proposed methodological system needs further empirical validation. The external factors influencing the effectiveness of teaching classical mechanics, as identified in the study, might vary across different cultural and institutional contexts, warranting caution in the broad application of the proposed system. Further research involving diverse student populations and educational settings could provide a more comprehensive understanding of the applicability and effectiveness of the suggested methodology.

The implications for future physics education research and methodological systems are significant. First, there is a need for more extensive empirical research to confirm the effectiveness of the proposed methodological framework, especially in different educational contexts and with different student populations. Comparative studies in different physics fields and universities can contribute to a more detailed understanding of the generalizability and adaptability of the system.

Moreover, future studies will explore the integration of modern teaching aids, such as computer-based multimedia tools, into the context of the proposed methodological system. Research on the impact of technology on student engagement, knowledge retention, and overall learning outcomes can provide valuable information for improving physics teaching methodologies.

Thus, future research will be aimed at enriching and improving the proposed methodological system, taking into account the identified limitations and exploring innovative ways to improve physics education at the university level.

In summary, this study sheds light on the comprehensive and systematic approach to teaching classical mechanics in a pedagogical university, emphasizing the intricate interplay between educational goals, content structure, teaching methods, and the broader external environment, thereby providing a valuable foundation for the ongoing discourse on optimizing physics education methodologies. Further exploration is warranted to fully understand the long-term impact of the proposed methodological system on the development of systematic knowledge, theoretical thinking, and the overall professional preparation of future physics teachers in the field of classical mechanics.

This study establishes a platform for subsequent research on refining and implementing effective teaching methodologies in physics education, particularly focusing on the nuanced relationship between curriculum design, educational strategies, and the cognitive development of future physics teachers.

Our study's findings suggest that the methodological system for teaching classical mechanics in a pedagogical university effectively integrates theoretical concepts, practical applications, and cognitive skills, fostering a comprehensive understanding that positively influences the formation of future physics teachers' professional competencies. In comparison to prior research, this study contributes a comprehensive and tailored methodological framework for teaching classical mechanics in the context of a pedagogical university, addressing the specific needs and challenges faced by future physics educators.

Our results align with the hypothesis that the systematic integration of educational goals, content, and teaching methods, particularly within the context of classical mechanics in a pedagogical university, contributes significantly to the development of a robust foundation in physics education for future teachers. The practical relevance of these findings extends to informing curriculum development and teaching practices in physics education at pedagogical universities. The study underscores the need for further exploration into tailored methodologies that address the specific needs of future physics teachers. Our findings align with those reported in contemporary educational research, emphasizing the importance of an integrated and activity-based approach to physics instruction.

Recognizing the study's limitations, especially the lack of a longitudinal perspective, calls for future research to delve into the long-term impact of the proposed methodological system. The significance of our study lies in contributing to the ongoing discourse on effective physics education methodologies, with implications for enhancing the quality of teacher training programs.

Conclusion

The study showed that the construction of a system course of classical mechanics in the general physics of a pedagogical university can be carried out by correlating the content and structure of the course with the structure of classical mechanics as a system of scientific knowledge. The course content should reflect the dialectical relationship between the system of scientific knowledge and the methods of scientific knowledge. The conducted pedagogical experiment showed the effectiveness of the developed methodological training system for the formation of systematic knowledge of classical mechanics. The study of the methodological system of teaching classical mechanics in a pedagogical university is mainly theoretical in nature. Concept of system approach in the design of educational content, the activity approach in teaching the proposed course of classical mechanics has shown its effectiveness in the formation of a system of knowledge, the education of the theoretical thinking of the future teacher of physics at the initial stage of learning physics.

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Сведения об авторах:

Ualikhanova Bayan Saparbekovna – PhD, Head of the Physics Department, South Kazakhstan Pedagogical University named after Ozbekali Zhanibekov, Republic of Kazakhstan, 160019, Shymkent, 184a Ualikhanov Str., apt. 3, tel.: 87772657551, e-mail: bayano_87@mail.ru.*

Omarov Oralkhan – PhD student, South Kazakhstan Pedagogical University named after Ozbekali Zhanibekov, Republic of Kazakhstan, 160019, Shymkent, 125 Adyrbekov Str., tel.: 87479285593, e-mail: omarov.oralkhan@gmail.com.

Уалиханова Баян Сапарбековна – PhD, заведующий кафедрой физики, Южно-Казахстанский педагогический университет имени Өзбекәлі Жәнібеков, Республика Казахстан, 160019, г.Шымкент, ул.Уалиханова 184а, кв3, тел:87772657551. E-mail: bayano_87@mail.ru.*

Омаров Оралхан – докторант, Южно-Казахстанский педагогический университет имени Өзбекәлі Жәнібеков, Республика Казахстан, 160019, г.Шымкент, ул.Адырбекова 125, тел: 87479285593. E-mail: omarov.oralkhan@gmail.com.

Уалиханова Баян Сапарбековна – PhD, Физика кафедрасының меңгерушісі, Өзбекәлі Жәнібеков атындағы Оңтүстік Қазақстан педагогикалық университеті, Қазақстан Республикасы, 160019, Шымкент қ., Уәлиханов к-сі, 184а, 3-пәтер, тел:87772657551. E-mail: bayano_87@mail.ru.*

Омаров Оралхан – докторант, Өзбекәлі Жәнібеков атындағы Оңтүстік Қазақстан педагогикалық университеті, Қазақстан Республикасы, 160019, Шымкент қ., Адырбеков к-сі, 125, тел:87479285593. E-mail: omarov.oralkhan@gmail.com.