UDC 373.5.091
https://doi.org/10.32405/2411-1309-2020-24-78-88

FEATURES OF THE «MECHANICAL AND ELECTROMAGNETIC WAVES» SECTION IN CLASS 9 PHYSICAL TEXTBOOKS

Dmytro Zasiekin,
Candidate of Pedagogical Sciences (PhD), Senior Researcher,
Senior Researcher at the Department of Biological,
Chemical and Physical Education of the
Institute of Pedagogy of NAPS of Ukraine,
Kyiv, Ukraine,
e-mail: dmytro_z@ukr.net,
ORCID ID: 0000-0002-9347-1930

The article deals with the methodical problem of realization of the content of the section «Mechanical and electromagnetic waves» in the textbooks for the 9th grade of the gymnasium. The concept of the section as a component of a comprehensive physics course for general secondary education institutions is substantiated.

Keywords: textbook, concept of physical education content, mechanical and electromagnetic waves.

Problem statement. The study of physics begins in primary school (gymnasium). According to the physics curriculum [1], the section «Mechanical and electromagnetic waves» was first included in the 9th class basic physics course. There is a need to develop a methodology for studying the specified section as a component of a comprehensive physics course for institutions of general secondary education, to study the features of the implementation of the content of this section in the textbook.

The purpose of the article. To this end, we analyzed the content of the curricula and textbooks, examined the principles of structuring and selection of the content of the educational material in the curricula and textbooks, methodical techniques for constructing texts and illustrations in textbooks, the effectiveness of the methodological apparatus of textbooks. The article presents the results of the analysis and identifies common approaches to solving the problem of structuring and content selection of a school physics course that will be useful for future

curriculum developers and textbook authors. Guidelines for teachers to improve the method of studying the specified section in the 9th grade of the gymnasium are formulated.

Analysis of recent research on the issues discussed in the article. Most researchers in the field of methods of teaching physics in general secondary education, consider the general issues of formation of the content of education [2, 3, 4], the peculiarities of methods of studying both separate sections, and the peculiarities of studying physics at a particular concentration (grades 7-9, 10-11 classes) or levels (profile, standard) [4, 5] or certain didactic components of these methods, such as: teaching aids and teaching support (including textbooks) [6, 7], forms and methods cognitive activity of students, theoretical basis for the development of didactics of physics, innovative approaches that ensure the modernization and improvement of existing practices training. In these works, among other issues, the methodical methods of studying mechanical and electromagnetic oscillations and waves in primary school are considered as examples, however, as a separate problem, the study of the features of studying the section «Mechanical and electromagnetic waves» in the 9th grade of the gymnasium was not carried out.

The main material studies with full justification of scientific results. The theoretical basis of the study is the results of our analysis of the curriculum in physics for grades 7-9 [1], textbooks for the 9th class of institutions of general secondary education [8-12], methodological and educational manuals, methodical lessons.

The Physics Curriculum for 7-9 classes of general secondary education institutions provides for the study of the following questions: «The emergence and propagation of mechanical waves. Sound waves. Speed of sound propagation, length and frequency of sound wave. Sound volume and pitch. Infrared and ultrasound. Electromagnetic field and electromagnetic waves. Speed of propagation, length and frequency of electromagnetic waves. The dependence of the properties of electromagnetic waves on frequency. The scale of electromagnetic waves. The Physical Basics of Modern Wireless Communications and Communications» [1].

As a result of studying these issues, students should *understand* the concepts of wave process, the conditions of formation of mechanical and electromagnetic waves; *formulate* definitions of physical quantity (wavelength and frequency, sound volume and pitch); *to know* the physical basics of modern wireless communications and communications, the dependence of the properties of electromagnetic waves on frequency; *compare* the properties of sound and electromagnetic waves of different frequencies; *assess* the effects of vibration and noise on living organisms; explain the value of modern communications and communications. Also be able to solve problems

of different types *using* formulas of correlation of wavelength, frequency and speed of propagation; to investigate during the laboratory work the sound vibrations of various sources of sound with the help of modern digital means.

The analysis of the textbooks shows that the content of the substantive issues is grouped differently by the authors in the paragraphs that are shown in Table 1.

Table 1

Textbook	Contents of the part «Mechanical and electromagnetic waves»
Physics Grade 9 (authors Baryakhtar V., Dovgiy S., Bozhinova F., Kiryukhina O.)	§ 17. The emergence and propagation of mechanical waves. Physical quantities that characterize waves **Exercise 17** § 18. Sound waves. Infrasound and ultrasound **Exercise 18** **Laboratory work №6** § 19. Electromagnetic field and electromagnetic waves **Exercise 19** § 20. Scale of electromagnetic waves § 21. The physical basis of modern wireless communications. Radiolocation Encyclopedic page We summarize the section III **Self-test tasks for Section III** Indicative topics of the projects. Topics of reports and messages. Topics of experimental research
Physics Grade 9 (authors Golovko M., Neporozhnya L., Koval V., Melnyk Y., Sipiy V.)	§ 21. Wave phenomena in nature and technology **Exercise to § 21** § 22. Sound waves and their properties **Exercise to § 22** § 23. Sound volume and pitch **Exercise to § 23** § 24. Infrared and ultrasound and their use **Exercise to § 24** § 25. Electromagnetic waves and their properties **Exercise to § 25** § 26. Physical basics of radio communication § 27. Modern communications and communications. Radiolocation. **Exercise to § 27** The Training project together Learning to solve physical problems on wave phenomena. **We detect subject competence in the section «Mechanical and electromagnetic waves»** The main thing in section 3

Physics Grade 9 (authors Zasiekina T., Zasiekin D.)	§ 21. The emergence and propagation of mechanical waves **Exercise 12** § 22. Sound waves. Speed of sound propagation **Exercise 13** § 23. Acoustic and physiological characteristics of sound **Laboratory work №6** § 24. Electromagnetic field and electromagnetic waves § 25. The scale of electromagnetic waves § 26. The principle of radio communication. Radar **Exercise 14** § 27. Physical basis of modern wireless communications and communications **Check yourself** We carry out educational projects Summary of the section «Mechanical and electromagnetic waves».
Physics Grade 9 (by Sirotiuk V.)	§ 17. The emergence and propagation of mechanical waves **Tasks and exercises** § 18. Sound waves. Speed of sound propagation, length and frequency of sound wave. Sound volume and pitch § 19. Infrasound and ultrasound **Tasks and exercises** § 20. Electromagnetic field and electromagnetic waves. Speed of propagation, length and frequency of electromagnetic waves § 21. Properties of electromagnetic waves. The scale of electromagnetic waves § 22. The physical basics of modern wireless communications and communications **Laboratory work №6** **Tasks and exercises** **Test your knowledge** Tests
Physics Grade 9 (authors Shut M., Martyniuk M., Blagodarenko L.)	§ 20. The emergence and propagation of mechanical waves. Types of mechanical waves. Wave energy. Wave characteristic. **Exercise 20** § 21. Sound waves. Speed of sound propagation **Exercise 21** § 22. Reflection of sound. Infrared and ultrasound **Exercise 22** § 23. Electromagnetic field and electromagnetic waves. Speed of propagation, length and frequency of electromagnetic waves **Exercise 23** § 24. Scale of electromagnetic waves. The concept of radio and television. Radiolocation. **Exercise 24** **Tests section 3** Tasks for Section 3

As can be seen from Table 1, in two textbooks, the content of the section is grouped into five paragraphs, in two textbooks into seven, and in one textbook into six. The number of exercises varies from three to seven. The three textbooks contain sections on the implementation of educational projects and instructions for laboratory work. Each textbook has a task for the final evaluation.

Qualitative analysis of the content of the textbooks also shows the varying degrees of content and detail, the volume of additional material. At the beginning of the section study, the authors of three textbooks [8, 9, 10] resort to motivational appeals in which they focus on different aspects. In particular, attention is drawn to the fact that different mechanical and electromagnetic waves exhibit similar properties and are described quantitatively by the same laws [9]. Because of the advances in physics, namely the experimental discovery of electromagnetic waves that can propagate in space, it has become possible to create fundamentally new means of communication — from wireless telegraph, radio and television to satellite and cellular communications. And that these tools are part of the information technology of modern technogenic society [8, 9, 10]. That the manifestations of oscillations and waves can be observed in many natural phenomena and in man-made devices and technologies [8, 9, 10].

Analysis of the textbooks shows that the authors applied different approaches to the formation of concepts and physical quantities, describing mechanical and electromagnetic oscillations and waves, chose different numbers of them. According to the program [1], students need to understand the concepts of the wave process, the conditions of formation of mechanical and electromagnetic waves; formulate definitions of physical magnitude (wavelength and frequency, sound volume, and pitch).

Consider how the authors of the textbooks implemented the requirement of the program to formulate the concept of the wave process and the conditions of occurrence of mechanical waves. As a physical process, the wave is the propagation of fluctuations in the medium. Considering that mechanical oscillations were studied in 7th grade, the need to actualize them at the beginning of the study of the wave process was discovered by four groups of authors, with varying degrees of repetition: from one sentence «In the class of 7th grade physics you studied mechanical fluctuations» [8, 12], in more detail [9, 10] (definitions, examples, types of oscillations, physical quantities describing oscillations).

The notion of a wave process is given by most collectives by defining the concept of a mechanical wave. In this case, with varying degrees of detail and specifying features: «Mechanical wave is called the propagation of oscillations in an elastic medium» [8], «Mechanical wave is the process of propagation of oscillations in an elastic medium over time, accompanied by the transfer of energy from one point to another» [9], «Mechanical wave — the process of propagation of oscillations in an elastic medium over time» [10], «Wave — the process of propagation of oscillations in any medium. A wave is a change in the state of an environment that propagates in

space and carries energy »[11],« The process of propagation of oscillations in space is called wave because wave motion »[12].

The introduction of the concept in most cases [8, 9, 11, 12] was at the beginning, before explaining the mechanism of formation of a mechanical wave. The authors again take different approaches to the conditions of appearance and propagation of mechanical waves. In the textbook [10] the simulation method is applied and the wave propagation process is explained and illustrated on the model of the elastic medium and summarized as a list of conditions. In the textbook [11] through the system of experiments. In other textbooks, it is more abstract in nature than the propagation of oscillations in an arbitrary elastic medium.

Most authors [8, 10, 11, 12] stated that mechanical waves are transverse and longitudinal (longitudinal), emphasized the properties of mechanical waves (in particular, that the wave motion is not accompanied by the transfer of matter, which during wave propagation occurs energy [8, 9, 11, 12].

Let's further analyze how such a requirement of the curriculum is implemented in textbooks, such as the formulation of determination of physical quantities, in particular wavelength and frequency, sound volume and pitch.

Four teams of authors have made almost the same determination that the wavelength is the distance over which the wave extends over a time equal to the period of oscillation. The textbook [11] provides the following definition: «The wavelength is the distance between the nearest one-to-one points of wave that oscillate in the same phase.» All textbooks provide drawings that illustrate the concept of wavelength, its symbol and unit, the formula for the frequency, period and speed of the wave. The wave frequency is not found in any of the textbooks.

We have given an example of analyzing only the first paragraph of the section «Mechanical and electromagnetic waves» in the textbooks. Further analysis shows that the implementation of the program material is carried out with varying degrees of content selection. This is despite the fact that in each author group [8-12] there is a representative of a working group on writing a training program [7]. There are also different methodological approaches that the authors have applied, based on the tasks that they believe should be addressed in the process of studying this section.

Although this section was first introduced into the basic physics course, the technique of studying mechanical and electromagnetic oscillations and waves has established approaches and is based on the widespread use of methods of clarity, analogies and modeling, experimental verification of conclusions by analogy; a detailed study of any one, the most illustrative example, the fundamental properties and methods of study of oscillations and waves, with the subsequent application of the learned concepts to other cases.

The study of wave processes contributes to the formation of holistic ideas about the modern natural-scientific picture of the world: wave phenomena of different nature

have the same patterns and their manifestations and diversity prove the unity of micro, macro and megaworlds. In this section we can convincingly show the dialectical nature of the development of views, ideas and hypotheses (Hertz experiments prove the role of experiment as a criterion for the truth of Maxwell's theory, in particular the hypothesis of the existence of electromagnetic waves), the knowledge of the increasingly hidden mysteries of nature (corpuscular-wave nature of light electromagnetic field, which is differently manifested in different reference systems). And the most important study of this section is of great polytechnical importance, revealing the role of physics in the development of modern telecommunication facilities, optical devices and more.

Analysis of the textbooks on these parameters also shows a lack of consistency, but allows us to distinguish from the variety of approaches unique and typical, presented in different forms. For example, the volume of sounds, noise levels and their effect on humans can be represented in the form of a table [12], in the form of a scale [10, 11], a visual table [9]. Given that students do not study the formation of oscillations in the oscillatory circuit, the mechanism of formation and propagation of electromagnetic waves can be differently represented: a theoretical presentation of the material using an analogy with mechanical waves [8, 9, 12], a thought experiment [11], a description of a real experiment [10]. All authors emphasized the case that the hypothesis of the existence of electromagnetic waves formulated by James Maxwell on the basis of his theoretical findings was experimentally proved by Heinrich Hertz.

Even more diverse is the consideration of the physical basics of modern wireless communications and communications. Since there are no indications in the curriculum of which examples can reveal these physical basics, the authors chose at their discretion. This is cellular (mobile) communication [8, 9, 10, 11], radar [8, 9, 10, 12], radio [9, 10, 12], television [12], radio telephone [11], satellite communication [8, 9, 10, 11], GPS navigation system [11], Internet [11], email [11], Wi-Fi technology [9, 10, 11], Bluetooth technology [10], remote controls [10]. At the discretion of the authors, questions were also raised about ways of encoding information. In the textbooks [9, 10, 12] the processes of modulation and detection are openly disclosed, in the textbook [10] the analog and digital signals are mentioned.

Comparison of mechanical and electromagnetic waves, the detection of their similar and different properties was described as in the text of the relevant paragraphs in all textbooks without exception. As a generalization in the form of table and scale the comparative properties of mechanical and electromagnetic waves are presented in the textbook [10].

Conclusions of the study and prospects for further exploration in this direction. Our analysis shows that the problem of implementing the content of the section «Mechanical and electromagnetic waves» in the textbooks for 9th grade gymnasium is quite relevant and the conclusions we obtained during the study can be generalized

in solving the problem of structuring and selection of content of the school course of physics, and will be in an opportunity for future curriculum developers and textbook authors. The first thing we pay attention to is the change in the structure of the school physics course. The new two-concentric structure of the school course in physics, as noted by researchers [2, 3, 4] has both advantages and disadvantages. According to V. Buryak, the advantage is that the basic course is indeed relatively complete and covers a wider range of subjects. The main disadvantages in his opinion are that the initial information about a number of physical concepts, formulas, topics is difficult for students; certain topics are demonstrable and accessible only in upper classes; The section «Mechanical and electromagnetic waves» is more rationally placed before the section «Light phenomena» [2]. In our opinion, such shortcomings can be avoided if the concept of physical education content were developed, which would substantiate the content of the first and second concentrates, set clear tasks that should be solved in the course of studying each section, and peculiarities of methods of studying these issues at different stages. education. It is not insignificant, however, to track the deployment of substantive issues that are studied in propedeutical science courses in elementary school and in 5 (6) high school classes.

The next is a proposal to improve the structure and content of the curriculum. Structuring the content of educational material in the school course of physics take different approaches, but in any case it should cover: phenomena and processes, fundamental experiments, basic concepts and values, models, principles, laws and laws, theories, practical application of theoretical material. The selection of these components in the curriculum should set out a compulsory list of first-time students in the basic course, who must repeat the second-degree physics course and those who will study there for the first time. The wording of the substantive questions should not be taken as a hypothetical title for the paragraph or paragraph of the textbook. Rather, these should be methodological and substantive guidelines, tasks that must be addressed in the course of studying a particular section/topic. And most importantly, a clear description of the expected results that students should achieve in studying the relevant section and course as a whole.

References

1. Ministerstvo osvity i nauky Ukrainy (Navchalni prohramy dlia zahalnoosvitnikh navchalnykh zakladiv (2017 cherv.07) №804 Nakaz Ministerstva osvity i nauky Ukrainy Pro onovleni navchalni prohramy dlia uchniv 5-9 klasiv zahalnoosvitnikh navchalnykh zakladiv [Elektronyi resurs]. Dostupno: https://mon.gov.ua/ua/osvita/zagalna-serednya-osvita/navchalni-programi/navchalni-programi-5-9-klas.
2. V. I. Buriak, «Analiz zmistu kursu fizyky osnovnoi shkoly za novoiu prohramoiu», Zbirnyk naukovykh prats Kamianets-Podilskoho natsionalnoho universytetu imeni Ivana Ohiienka, vyp.21. s.171-175., 2015.

3. M.V. Holovko, «Problemy formuvannia zmistu bazovoho kursu fizyky ta metodyky yoho realizatsii v himnazii», Problemy suchasnoho pidruchnyka, vyp.21, s. 92—104, 2018. DOI https://doi.org/10.32405/2411-1309-2018-21-92-104
4. T.M. Zasiekina, «Onovlennia zmistu bazovoho kursu fizyky na zasadakh kompetentnisnoho pidkhodu», Zbirnyk naukovykh prats Kamianets-Podilskoho Natsionalnoho universytetu imeni Ivana Ohiienka, vyp. 20, s. 86—89, 2014.
5. D.O. Zasiekin, «Formuvannia elektrodynamichnoho kontsentru v kursi fizyky serednoi zahalnoosvitnoi shkoly», Zbirnyk naukovykh prats Kamianets-Podilskoho Natsionalnoho universytetu imeni Ivana Ohiienka, vyp. 17. S. 86—88. 2011.
6. D.O. Zasiekin, T.M. Zasiekina, «Vidobrazhennia zmistu rozdilu «Elektrodynamika» u pidruchnykakh fizyky dlia serednoi shkoly», Problemy suchasnoho pidruchnyka, vyp. 11, s. 283—287, 2011.
7. Yu. S. Melnyk, «Realizatsiia kompetentnisno oriientovanoi metodyky navchannia khvylovykh yavyshch u pidruchnyku fizyky 9-ho klasu himnazii», Problemy suchasnoho pidruchnyka, vyp. 20, s.231-239, 2018.
8. V. H. Bariakhtar, S.O. Dovhyi, F. Ya. Bozhynova, O. O. Kiriukhina, Fizyka: pidr. dlia 9 kl. zahalnoosvit. navch. zakl. Kharkiv, Ukraina: Vyd-vo «Ranok», 2017.
9. M.V.Holovko, L.V.Neporozhnia, V.S.Koval, Yu.S.Melnyk, V.V.Sipii, Fizyka: pidr. dlia 9 kl. zahalnoosvit. navch. zakl. Kyiv, Ukrina: Vydavnychyi dim «Sam», 2017.
10. T. M. Zasiekina, D. O. Zasiekin, Fizyka : pidruch. dlia 9 kl. zahalnoosvit. navch. zakl. Kyiv, Ukraina: UOVTs «Orion», 2017.
11. V.D.Syrotiuk, Fizyka: pidr. dlia 9 kl. zahalnoosvit. navch. zakl. Kyiv, Ukraina: Heneza, 2017.
12. M. I. Shut, M. T. Martyniuk, L. Yu. Blahodarenko, Fizyka: pidr. dlia 9 kl. zahalnoosvit. navch. zakl. Kyiv-Irpin, Ukraina : VTF «Perun», 2017.

Використані джерела

1. Міністерство освіти і науки України (Навчальні програми для загальноосвітніх навчальних закладів (2017 черв.07) №804 Наказ Міністерства освіти і науки України Про оновлені навчальні програми для учнів 5-9 класів загальноосвітніх навчальних закладів [Електроний ресурс]. Доступно: https://mon.gov.ua/ua/osvita/zagalna-serednya-osvita/navchalni-programi/navchalni-programi-5-9-klas.
2. В. І. Буряк, «Аналіз змісту курсу фізики основної школи за новою програмою», *Збірник наукових праць Кам'янець-Подільського національного університету імені Івана Огієнка*, вип.21. с.171-175., 2015.
3. М.В. Головко, «Проблеми формування змісту базового курсу фізики та методики його реалізації в гімназії», *Проблеми сучасного підручника*, вип.21, с. 92—104, 2018. DOI https://doi.org/10.32405/2411-1309-2018-21-92-104
4. Т.М. Засєкіна, «Оновлення змісту базового курсу фізики на засадах компетентнісного підходу», *Збірник наукових праць Кам'янець-Подільського Національного університету імені Івана Огієнка*, вип. 20, с. 86—89, 2014.
5. Д.О. Засєкін, «Формування електродинамічного концентру в курсі фізики середньої загальноосвітньої школи», *Збірник наукових праць Кам'янець-Подільського Національного університету імені Івана Огієнка*, вип. 17. С. 86—88. 2011.

6. Д.О. Засєкін, Т.М. Засєкіна, «Відображення змісту розділу «Електродинаміка» у підручниках фізики для середньої школи», *Проблеми сучасного підручника*, вип. 11, с. 283—287, 2011.
7. Ю. С. Мельник, «Реалізація компетентнісно орієнтованої методики навчання хвильових явищ у підручнику фізики 9-го класу гімназії», *Проблеми сучасного підручника*, вип. 20, с.231-239, 2018.
8. В. Г. Бар'яхтар, С.О. Довгий, Ф. Я. Божинова, О. О. Кірюхіна, *Фізика: підр. для 9 кл. загальноосвіт. навч. закл.* Харків, Україна: Вид-во «Ранок», 2017.
9. М.В.Головко, Л.В.Непорожня, В.С.Коваль, Ю.С.Мельник, В.В.Сіпій, *Фізика: підр. для 9 кл. загальноосвіт. навч. закл.* Київ, Укрїна: Видавничий дім «Сам», 2017.
10. Т. М. Засєкіна, Д. О. Засєкін, *Фізика : підруч. для 9 кл. загальноосвіт. навч. закл.* Київ, Україна: УОВЦ «Оріон», 2017.
11. В.Д.Сиротюк, *Фізика: підр. для 9 кл. загальноосвіт. навч. закл.* Київ, Україна: Генеза, 2017.
12. М. І. Шут, М. Т. Мартинюк, Л. Ю. Благодаренко, *Фізика: підр. для 9 кл. загальноосвіт. навч. закл.* Київ-Ірпінь, Україна : ВТФ «Перун», 2017.

Дмитро Засєкін, *кандидат педагогічних наук, старший науковий співробітник, старший науковий співробітник відділу біологічної, хімічної та фізичної освіти Інституту педагогіки НАПН України, м. Київ, Україна*

ОСОБЛИВОСТІ РОЗДІЛУ «МЕХАНІЧНІ Й ЕЛЕКТРОМАГНІТНІ ХВИЛІ» В ПІДРУЧНИКАХ ФІЗИКИ 9-ГО КЛАСУ

У статті розглянуто методичну проблему реалізації змісту розділу «Механічні й електромагнітні хвилі» в підручниках для 9-го класу гімназії, який вперше включено до курсу фізики основної школи (гімназії). З цією метою проаналізовано зміст навчальних програм і п'яти підручників різних авторських колективів, досліджено принципи структурування й добору змісту навчального матеріалу в навчальних програмах і підручниках, методичні прийоми побудови текстів й ілюстрацій у підручниках, ефективність методичного апарату підручників. Аналіз засвідчує, що реалізація програмного матеріалу здійснена з різним ступенем добору змісту, і це при тому, що в кожному авторському колективі є представник робочої групи з написання навчальної програми. Різними є й методологічні підходи, які застосовували автори, виходячи із завдань, які, на їхню думку, мають бути розв'язані в процесі вивчення цього розділу. Особливу турботу викликають різні означення основних фізичних понять і величин цього розділу, їх кількість у підручниках. Уникнути подібних недоліків, на погляд авторів, можна, якби була розроблена концепція змісту фізичної освіти, що обґрунтовувала б змістове наповнення першого і другого концентрів, ставила чіткі завдання, які мають бути розв'язані в процесі вивчення кожного розділу, особливості методик вивчення цих питань на різних ступенях освіти. Зазнати змін має і структура навчальної програми. Зокрема, у ній мають бути чітко вказані явища і процеси, фундаментальні досліди, основні поняття й величини, моделі, принципи, закони та закономірності, теорії, практичне застосування теоретичного матеріалу. Виокремлення цих складників у на-

вчальній програмі має задавати обов'язковий перелік таких, що вперше вивчаються у базовому курсі, які повинні бути повторені в курсі фізики другого концентру, й таких, що вивчатимуться там уперше. Формулювання змістових питань не повинне сприйматись як гіпотетична назва пункту або параграфа підручника. Швидше, це мають бути методологічні й сутнісні орієнтири, завдання, які повинні бути розв'язані в процесі вивчення того чи того розділу/теми. І, найголовніше, чіткий опис очікуваних результатів, яких мають досягти учні під час вивчення відповідного розділу й курсу в цілому.

Ключові слова: підручник, концепція змісту фізичної освіти, механічні й електромагнітні хвилі.

Дмитрий Засекин, *кандидат педагогических наук, старший научный сотрудник, старший научный сотрудник отдела биологического, химического и физического образования Института педагогики НАПН Украины, г. Киев, Украина*

ОСОБЕННОСТИ РАЗДЕЛА «МЕХАНИЧЕСКИЕ И ЭЛЕКТРОМАГНИТНЫЕ ВОЛНЫ» В УЧЕБНИКАХ ФИЗИКИ 9-ГО КЛАССА

В статье рассмотрена методическая проблема реализации содержания раздела «Механические и электромагнитные волны» в учебниках для 9-го класса гимназии. Данный раздел впервые включен в базовый курс физики основной школы, поэтому возникает проблема обоснования концепции раздела как составляющей целостного курса физики для заведений общего среднего образования. С этой целью проанализировано содержание учебных программ и учебников, исследованы принципы структурирования и отбора содержания учебного материала в учебных программах и учебниках, методические приемы построения текстов и иллюстраций в учебниках, эффективность методического аппарата учебников. В результате анализа пяти учебников разных авторских коллективов установлено, что они отличаются глубиной и детализацией содержания раздела, различными формулировками основных понятий и их количеством. Избежать подобных разногласий можно, если изменить структуру учебной программы, выделяя в ней явления и процессы, фундаментальные опыты, основные понятия и величины, модели, принципы, законы и закономерности, теории, практическое применение теоретического материала. Должен быть указан обязательный перечень составляющих, впервые изучаемых в базовом курсе, и тех, которые должны быть повторены в курсе физики второго концентра. И, самое главное, четкое описание ожидаемых результатов, которых должны достичь учащиеся при изучении соответствующего раздела и курса в целом. Способы подачи материала, иллюстрации, системы заданий, структура учебников при этом могут быть различными, в зависимости от авторской концепции.

Ключевые слова: учебник, концепция содержания физического образования, механические и электромагнитные волны.

УДК 373.3.002.2+008