

GENESIS OF THE SCIENTIFIC APPROACHES TO ENSURING THE QUALITY OF A PHYSICS TEXTBOOK FOR SCHOOL

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The article deals with the problem of a textbook on physics as the basic element of the teaching and methodological provision and a means of implementing the revised learning content. It was proved that the formation of examination procedures manual is one of the priorities of the national physics didactics at all stages of development of school physical education. Based on the historical and methodological analysis, the author highlights the genesis of scientific approaches to the development of didactic requirements as priority conditions to create high-quality textbooks for secondary schools.

The attention is focused on enhancing a cultural studies content of the category of the quality of a physics textbook, which is now seen not only as a the necessary retransmission of the content-based curriculum in physics, but also, above all, as a complete didactic system, aimed at achieving the objectives of school physical education. It was emphasized on increasing the relevance of search mechanisms for improving the procedure of selection experts as one of the key stages of textbooks, development of the scientifically based criteria for assessing the quality of a textbook on physics.

Keywords: school physical education goals, key and subject competencies of the pupils, quality of a physics textbook, didactic requirements, criteria.

Problem statement. One of the priority areas in the development of the secondary education in Ukraine is updating its content in accordance with the personality-oriented, activity- and competence-based approaches. A textbook remains to be a core for the educational and methodological provision as well as the main tool to implement the updated training content. Traditionally, the quality of school education is designed for the content thoroughness and its

implementation in the school textbooks. In terms of informatization of the educational sector and the relentless expansion of educational information sources, the requirements and the social expectations for a modern textbook are fundamentally changing.

In spite of the fact that in the history of the homeland physics didactics, the challenge of creating a high quality manual is one of the most pressing, it remains to be less explored. Historical and methodological analysis of this issue is of a general scientific and practical importance as it is founded for forming the criteria base of a modern physics textbook.

Analysis of the recent researches. Some aspects of the scientific substantiation of the tools to ensure the quality of a school Physics textbook was researched in the works of the leading homeland educators. In the beginning of 2000's, the problem of the scientific substantiation of the principles of physics textbooks design was further developed in the context of the outlined problems. In particular, L. Yu. Blahodarenko substantiated the didactic approaches to developing the content of a physics textbook for the secondary school as the leading means of implementing the physical component in the educational area "Natural Science" of the State standard of basic and secondary education [1]. N. L. Sosnytska developed a system of scientific and methodological criteria for assessing the content of the school physics course and its implementation in the textbooks [7].

The scientific and practical search of the scholars, trainers and teachers laid in the basis of the creation of a textbook that implements school physics education content which has been specified in the standard of the first generation (2004). The work on the physics textbooks that are developed according to the standard of the second generation (2011) continues to be performed. Nowadays the problem of the quality of the physics textbooks remains a priority for both

the state educational policy in general and the didactics of physics as an educational area in particular.

Formulation of the article purposes (setting a task). Taking into consideration the abovementioned issues, the article is aimed at the summarizing the experience of the homeland theory and methodology of teaching physics by means of the historical and methodological analysis and identify the promising ways as well as the tools to provide for the creation of high-quality physics textbook.

The main body. For the first time in the history of the homeland physics didactics, the issue of improving the quality of a textbook was raised on the pages of *Journal of Experimental Physics and Elementary Mathematics* scientific and methodological magazine by E. K. Shpachynskiy, a talented methodologist. In his introductory lecture for the students of the training courses for the physics and mathematics teachers in Odessa that was published in 1893, it was underscored that the issue of physics textbook is an integral part of physics methodology. The reasons for the poor quality of a textbook that were distinguished by the scholar was the unwillingness of the competent professionals to work on this problem (for example, they were the famous professors of the physical departments at the universities that have experience in creating textbooks); conservatism, which appears to disregard the scientific progress, the tradition of using the textbooks that were created a few decades ago, under the circumstances that were peculiar for the significant changes in the requirements for the secondary school; the haste in preparing and publishing a textbook [2].

Modern historical and pedagogical studies support the conclusion that the problem of a textbook quality is relevant at all stages of schooling and pedagogy. Besides, the development and the practical solutions are experienced by it in the period of changing the educational paradigm, which was

characterized by the growing role of the social and cultural factors, increasing the public attention to the textbook and its quality requirements. It was most clearly manifested in the active transformation of the national education system: foundation of a Comprehensive school in Ukraine (1917-1918), the introduction of a Labor Polytechnic School (the beginning of 1930s), the foundation of the national education system (the second half of 1980 – the beginning of 1990s), the change in the paradigm of school education (the second half of 1990s – the beginning of 2001s).

Therefore, among the priorities of the Ukrainian People's Republic, it was determined to ensure the new textbooks at the secondary schools. In January 1918, at the General Secretariat of Educational Affairs, a publishing department was established, and in the summer, the competition for the publication of textbooks was announced. By 1 January 1919, the publishing department was receiving the replicas of the books that were being submitted by the publishers under a pseudonym or a motto to provide an objective assessment of their quality, which was carried out in the subject commissions of the Ministry. The main requirements for the manuscripts were the accurate scientific content and the pedagogical level of the schoolbooks. Teachers were given the right to choose textbooks for the educational use in physics. During 1918-1919, the textbooks by P. Baranov, A.Zaliskyi, F.Shyndler were being published in Ukrainian for the secondary school level with a circulation of about 50 thousand of copies.

The problem of the quality of school textbooks in the USSR was paid attention again in 1926. There were the certain general requirements for the secondary school textbooks: ideological consistency; objective representation of the scientific development and its value; production slope; combination of the presentation of the scientific foundations and its practical application in a textbook; integration; proper Ukrainian language; quality of the design and

printing. In 1928, the procedures for the formation of the corporate bodies, reviewing manuscripts and production of textbooks were standardized. The first manual on Physics that were selected in accordance with the new procedure were the textbooks by L. I. Leushchenko and V. A. Frankowskyi for the 5th, 6th and 7th groups of studying.

In 1931, at the People's Commissariat of Education of Ukraine, a methodological commission that was entrusted with the function of developing the guidelines for the establishment of curricula, programs, textbooks, organization of their public discussion was founded. The competitive selection of textbooks manuscripts, which was coordinated by the People's Education Commissariat, was ensured by the consultants who were responsible for the specific school subjects. In order to participate in the contest there were the creative teams who submitted the textbooks manuscripts for publishing.

In this period, an efficient cooperation of the People's Education Commissariat and the Ukrainian Research Institute of Pedagogy (URIP) was launched; it had a significant function of the methodical examination of manuscripts as well as the development of the textbooks requirements, which were submitted to the contest. Most of the assistants were the part-time employees of the URIP and were directly involved in developing these criteria. In particular, the working group of physicists led by R. D. Ponomareva, the Professor, included such Institute scholars as A. Karlova and M. Zhydkoblinov who were appointed as a reviewer of a competition on physics textbook.

The first ever national didactics physics system of requirements for a textbook was created. The general criteria concerned the ideological consistency of the content, meeting the common approaches to the study of the children both in the urban and the rural areas, polytechnic education, scientific consistency, international education, emotional expressiveness, ensuring the connection with the production, and the design. The basic principles of physics textbooks were

determined to be the focus of the content of a textbook on the coverage of physical and technical foundations of modern production; the implementation of the principle of historicism in the presentation of physical theories; construction of analytical tools, oriented at the use of methods to enhance the educational process in physics.

Methodological requirements concerned the precise specification of the minimum of excursions, the feasibility of introducing issues and problems oriented at the certain production in each textbook chapter, availability of samples on production models and electrical works, bibliographies for students. One of the key requirements was the feasibility to develop the specific textbook guidelines for the teachers to process the educational material [5].

The professional scientific review of the manuscripts of the textbooks on physics was the Institute of Physics of the All-Ukrainian Academy of Sciences in Kiev. The objective conditions for joining the efforts of academic and methodological sciences to create a high-quality textbook were ensured. Thanks to O. H. Holdman, the director of the Institute of Physics, the academician, the review has been raised to a high level.

In the achieves, O. H. Holdman's review of the physics textbook for the 7th grade created by L. I. Leushchenko and V. A. Frankowskyi was preserved; it was submitted to the contest in 1931. In the review, the academician conducts a detailed analysis on the features of the methodological construction of a textbook and its scientific level. The focus was put on the textbook material, the actual state of physical science, analytical tools, appearance and quality of the textbook figures. O. H. Holdman highlights the need to eliminate inaccuracies in the use of terminology, definitions simplification, thorough figures of the structure of technical devices used in the textbook elements of the homeland production. In this way, he gives a positive feedback for the presentation of new topics, in particular the formation of electrical oscillations, the concept of a

sound wave, transmission vibrations, and the role of a detector. In the general conclusion, the reviewer considers it appropriate to issue a handbook with the relevant editorial corrections and improvement of the methodological presentation of the training material [6]. By means of this approach to the organization of the procedures for the evaluation of physics textbook for the seventh grade by L. I. Leuschenko and V. A. Frankowskyi, the edition of 1931 was one of the best examples of a homeland textbook.

The progressive development of the process of creating a textbook on physics culminated in 1933 with the introduction of a stable textbook in the USSR. For more than half a century, physics was not included in the list of subjects that took part in the Republican contest, and the schools had no textbooks by the homeland authors.

The formal opportunity for the competitions organization was declared in the Soviet republics in agreement with the Ministry of Education of the USSR in February 1986 against the background of the active democratic processes. Furthermore, the all-Union competition was held for the physics textbooks, and the national school regained the stable traditional textbooks.

However, it was the first step towards the deployment of textbooks in Ukraine. Since the second half of the 1980s, a qualitative physics textbook is considered as one of the important conditions for the reform in school physical education. However, only general requirements for the school textbooks were clearly specified; they were the following: its scientific and ideological content; systematic representation of the educational material in the full compliance with educational programs; logic and consistency of presentation; ensuring consistency with internal subject and interdisciplinary connections; orientation of the textbook content at the formation of a scientific outlook and willingness to work, morality; a combination of a study of basic scientific ideas, theories, laws, concepts with their practical use; availability of content; expressive

language of a textbook; qualitative artwork and printing of textbooks, correspondence to the printing and hygiene standards. For the first time, the concept of “a methodological apparatus of a manual” and the requirements for it (focus on the development of pupils’ cognitive and creative abilities, including challenges to the general theoretical and practical skills of mental and physical labor, the use of electronic computers and computer equipment) [4].

Progressive lay-outs of the homeland didactics of physics have been implemented in the systems of the first textbooks of independent Ukraine, developed by A. I. Buhaev, S. U. Honcharenko, Ye. V. Korshak, A. I. Lyashenko, M. T. Martyniuk, V. F. Savchenko, V. V. Smolyanets in the 1990s.

The proof of the cultural content of the phenomenon of the homeland physics textbook and a determining influence of its development on the social and cultural factors that, in our opinion, are the regularity of updating the quality of textbooks and the issues of its expert selection is on the stage of changing educational paradigm, which, in its turn, reflects the changing demands and expectations of the society. In particular, the problem of creating a high-quality textbook for the secondary school of the new generation was raised on the state level in connection with the reform of secondary education, transition to 12-year period of school study, the implementation of the ideas of profession-orientation and the introduction of the State Standard of the Comprehensive Secondary Education of the first generation in 2004.

The requirements to the scientific content and intelligibility that were set in the expertise of the scientific institutions of the National Academy of Sciences and the Academy of Pedagogical Sciences became stricter. The basic requirements for a textbook were divided into three groups: content requirements, requirements to the structure, and requirements to educational and analytical tools.

In 2006, the scholars of the NAES of Ukraine have developed the psychological and the pedagogical requirements for the textbooks, which were distributed on the following groups: providing motivation study of the subject; availability of content for the pupils of a certain age; performance of a didactic, a developmental, and an educational function; and perfection of the analytical tools. According to these criteria, a competitive selection of a physics textbooks was ensured in accordance with the standards of the first generation.

In 2015, a contest for a physics textbook for the 7th grade of the secondary schools, which realizes the content of the physical components of the educational area “Natural Sciences” of the state standard of the second generation (2011) was held. An important feature of the procedure of examination of manuscripts was the introduction of the stage as the choice of teachers of physics electronic version of the draft manuscript of the textbook, the last review. The involvement of practitioners in this process made it possible to consider their requests to the new generation of textbooks and significantly increase the objectivity of the competition.

The competition of a physics textbook for the 8th grade that took place this year is based on the experience of the last year in several stages. In the first stage, the examination of electronic versions of manuscripts is carried out by the professionals (representatives of the research institutions of the NAS and the NAES of Ukraine, universities, methodologists and teachers of physics). After the manuscripts revision that was correspondent to the experts’ remarks, a Competition Commission made the decision to provide an appropriate marking and participation in the next phase, which involves the selection of textbooks by the secondary schools teachers.

It is for their applications, the distribution of the order for textbooks publishing will be ensured. It is noteworthy to state that unlike the previous competitions, the only psychological and pedagogical criteria for the peer

review of the parameters of a textbook draft (traditionally conducted scientific, psychological, pedagogical and methodological expertise) were developed. The main parameters that were a subject to examination, the following issues were determined: the correspondence of the textbook draft to the curriculum; textbook on project goals and objectives of education and modern educational paradigm; analysis of the structural components of project manual; completeness pursue opportunities to provide analytical tools of teaching and learning of students; appropriateness and effectiveness of the device orientation in the textbook; providing educational, developmental and health preservation functions; compliance to the gender approach in education [3].

A feature of these criteria is the guidance of experts to assess the manuscript as a whole didactic system that ensures the achievements of the goals set by the school physics education, formation and development of not only traditional subject competencies, but, above all, the key ones of high school students.

An important step in increasing the quality of the examination procedure, in particular, a physics textbook, in general, was the launch of the practical seminars by the Institute of Pedagogy in cooperation with the Ministry of Education and Science of Ukraine; they instructed the experts of the textbooks and initiated the formation of an expert environment as the basis for the objective and the systematic examination of a textbook. The scholars of the Institute have developed some guidelines for the features of the tutorials examination in the certain subjects.

A modern physics textbook that is created in accordance with the competence-based approach, is considered as a leading means for mastering the basic components of the training content, namely, the experience of the cognitive activities (is considered in the form of the academic performance, ie knowledge), experience of making exercises with the already known activity

methods (an ability to act), experience of creativity (the ability to take creative solutions to problematic situations) and experience of emotional and value attitudes (personal guidance).

Attention is focused on the formation of the subject expertise in physics, as a part of natural science competencies, which involves not only pupils' mastering a set of fundamental knowledge about nature but also, above all, the development of the skills and the ability to apply to natural knowledge, gaining some experience in solving different problematic and important situations, identifying value attitudes and behavior in accordance with the expected results.

In terms of a textbook content design methodology, the most difficult is to ensure gaining an experience of creativity by a pupil that is realized through the ability to provide innovative solutions as well as the experience of emotional and value attitudes. These goals are achieved by the creative direction of the content, for example, through the polyscientific approach to presenting the educational material that provides familiarization with different points of view on the interpretation of the physical phenomena or process that is being studied.

The main criteria for a quality of a physics textbook are the following: the clarity in setting the objectives in the process of studying the chapters and the certain topics; structuring of the learnt material in accordance with the didactic principles; a pupil's dialogue with the author and the availability of algorithms for solving the educational problems; a multi-level system of tasks that is focused on the individual educational trajectory of pupils and ensuring a situation of success, competenceorientated tasks that assure the formation of the subject and the key competences [3].

Conclusions. The historical and methodological analysis demonstrates that the creation of a high-quality physics textbook for the secondary schools has been and remains a priority at all stages of development of school physics education and technical science in Ukraine. Therefore, there is a gradual shift

from the perception of a textbook as a basic and universal means of detailing the content of a physics course that has been determined by the curriculum to the rise of its role as an integral didactic system that achieves the goals of school physical education. Correspondingly, the requirements and the expectation for the quality of textbooks on physics are changing. Public demands and expectations are crucial in the development of a manual and are displacing narrow-subject orientation. A modern physics textbook is not limited to the formation of a subject competence and becomes a tool for the development of the key competencies of the secondary school pupils. Therefore, the problem of a textbook quality goes beyond the scientific area of physics didactics and a cultural context. Its solution will be possible if the authors of the textbooks and their main customers, namely, pupils, teachers, practitioners, parents and public take part in a meaningful dialogue. There is a growing urgency to improve the expert selection procedure as one of the key stages of a textbook creation, the foundation of professional organizations, and the development of the scientifically based criteria for assessing the quality of a textbook on physics.

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ГЕНЕЗА НАУКОВИХ ПІДХОДІВ ЗАБЕЗПЕЧЕННЯ ЯКОСТІ ШКІЛЬНОГО ПІДРУЧНИКА ФІЗИКИ

У статті досліджується проблема забезпечення якості підручника фізики як основного елемента навчально-методичного забезпечення та засобу реалізації оновленого змісту навчання. Обґрунтовано, що формування процедур експертизи підручника є одним із пріоритетів вітчизняної дидактики фізики на всіх етапах розвитку шкільної фізичної освіти. На основі історикометодичного аналізу висвітлюється генеза наукових підходів щодо розвитку системи дидактичних вимог як першочергової умови створення якісної навчальної книги для загальноосвітньої школи. Акцентовано увагу на посиленні культурологічного наповнення категорії якості підручника фізики, який нині розглядається не лише як універсальний засіб ретрансляції змісту, визначеного навчальною програмою з фізики, а насамперед як цілісна дидактична система, спрямована на досягнення цілей шкільної фізичної освіти. Наголошується на зростанні актуальності пошуку механізмів удосконалення процедури експертного відбору як одного з ключових етапів процесу підручникотворення, розроблення науково обґрунтованих критеріїв оцінки якості шкільного підручника фізики.

Ключові слова: цілі шкільної фізичної освіти, ключові та предметні компетентності учнів, якість підручника фізики, дидактичні вимоги, критерії.

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ГЕНЕЗИС НАУЧНОГО ПОДХОДА ОБЕСПЕЧЕННЯ КАЧЕСТВА ШКОЛЬНОГО УЧЕБНИКА ФІЗИКИ

В статье исследуется проблема качества учебника физики как основного элемента учебно-методического обеспечения и средства реализации обновленного содержания обучения. Обосновано, что формирование процедур экспертизы учебника является одним из приоритетов отечественной дидактики физики на всех этапах развития

школьного фізического образования. На основе историко-методического анализа освещается генезис научных подходов к развитию системы требований как первоочередного условия создания качественной учебной книги для общеобразовательной школы. Акцентируется внимание на усилении культурологического наполнения категории качества учебника физики, который сегодня рассматривается не только как универсальное средство ретрансляции содержания, определенного учебной программой по физике, а, в первую очередь, как целостная дидактическая система, направленная на достижение целей школьного физического образования. Отмечается рост актуальности поиска механизмов совершенствования процедуры экспертного отбора как одного из ключевых этапов процесса создания учебников, разработка научно обоснованных критериев оценки качества школьного учебника физики.

Ключевые слова: цели школьного физического образования, ключевые и предметные компетентности учащихся, качество учебника физики, дидактические требования, критерии.