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RFC: ATI120618V12

Revista Dilemas Contemporáneos: Educación, Política y Valores.

<http://www.dilemascontemporaneoseduccionpoliticayvalores.com/>

Año: VI

Número: Edición Especial

Artículo no.:5

Período: Agosto, 2019.

TÍTULO: Enfoques innovadores en la educación politécnica.

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RESUMEN: El artículo está dedicado a la creación de un modelo de un sistema metódico e ideas conceptuales de la educación politécnica en el proceso de enseñanza de la Física en la escuela secundaria en la etapa actual. Sobre la base del análisis científico y pedagógico de la literatura relevante y la documentación regulatoria sobre el problema en estudio, se identifican y justifican las etapas didácticas y las direcciones para la modernización de la educación politécnica en Kazajstán. Se determinan los principios socioeconómicos y pedagógicos de modelar formas y métodos organizativos que aseguran la efectividad de la educación politécnica en física en las condiciones de la producción moderna.

PALABRAS CLAVES: producción moderna, progreso científico y técnico, física y tecnología, educación politécnica, proceso de aprendizaje.

TITLE: Innovative approaches in polytechnic education.

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ABSTRACT: The article is devoted to the creation of a model of a methodical system and conceptual ideas of polytechnic education in the process of teaching physics in high school at the present stage. On the basis of the scientific and pedagogical analysis of the relevant literature and regulatory documentation on the problem under study, the didactic stages and directions for the modernization of polytechnic education in Kazakhstan are identified and substantiated. The socio-economic and pedagogical principles of modeling organizational forms and methods that ensure the effectiveness of polytechnic education in physics under the conditions of modern production are determined.

KEY WORDS: modern production, scientific and technical progress, physics and technology, polytechnic education, learning process.

INTRODUCTION.

In the modern world, a rethinking of the status of education, its purpose and role, both in the life and fate of an individual and in the sustainable development of societies takes place. The new concept of educational goals, which are interpreted from the standpoint of influence on the development of the individual, is coming to the fore.

The world community at the beginning of the twenty-first century defined the main role of education and formulated its main purpose as an opportunity for the full development of the personality. The requirements of life dictate the need to study production issues at a new qualitative level (Oporkin, 2005; Imashev, 2015). Students' knowledge of production should include basic provisions on the strategic line of the state and the government to accelerate the socio-economic development of our country. This means that schoolchildren should be familiar with the main areas of scientific, technical and organizational renewal of production, the economic aspects of production, issues of improving product quality, labor productivity, saving natural resources, integrated use of raw materials, i.e. with the main ways of intensifying production.

Pedagogical education should be entirely based on this concept. In a comprehensive school, the principle of polytechnism should be more fully realized, it should decisively increase the efficiency of training, improve the preparation of young people for independent living and work, educate conscious and active builders of the new society. In order to ensure the participation of every person in the intensification of scientific and technological progress, a comprehensive school with its labor potential is designed to successfully solve the problem of polytechnic education of students (Yutkin, 2005; Imashev, 2012).

Modern socio-economic transformations, the convergence of science and production, the introduction of innovative technologies determine the need for profound qualitative changes in the system of polytechnical training of the younger generation. The national education system is faced with the task

of creating a new type of universal specialist who is not only well acquainted with modern technology and technology but also has a high level of informational, entrepreneurial culture capable of creativity, reasonable risk and conscious analysis of their own productive (transformative) activities. In this regard, the issue of ensuring the polytechnic focus of the entire educational process of a general education school is of particular relevance. In modern conditions, polytechnic education is considered as a process and result of assimilation of systematized knowledge on the general scientific foundations of modern production, the formation of the skills and abilities necessary to handle typical (and accessible) tools of labor, the most common in various branches of production, as well as personality traits, allow you to navigate the entire system of social production (Imashev, 2012; Imashev, 2015).

Currently, the complex and relevant issues related to the further improvement of the polytechnic education system are being widely discussed. The most important provisions of polytechnic education, developed by scientists-teachers, are particularly relevant now, in the conditions of the modern scientific and technological revolution, when science becomes a direct productive force, a leading factor in the development of social production.

DEVELOPMENT.

Purpose of the study.

Polytechnic education from general pedagogical positions in pedagogical science is considered in some detail. A lot of research has been devoted to this problem, especially in the last two decades.

The purpose of the work is to create a model of a methodical system and conceptual ideas of polytechnic education in the process of teaching physics in high school in the context of modern production.

In accordance with the purpose, the objectives of the study are determined:

1. To identify the socio-economic, organizational and pedagogical conditions for the improvement of polytechnic education in high school.
2. To reveal the main trends in the development of polytechnic education in the study of physics in the secondary school system.
3. To create a system of methods and tools to enhance the polytechnic training of students in the process of studying the physical fundamentals of the main directions of scientific and technological progress.
4. To check the effectiveness of the established methodical system by conducting an experiment.

The goals and objectives of polytechnic education are determined by the socio-economic development of society.

Analysis of numerous studies devoted to the problem of the implementation of the principle of polytechnicism in the educational process of secondary schools gives reason to summarize the basic theoretical and methodological provisions of the foundations of polytechnic education, both in general and considering the specifics of the regional characteristics of the process of socio-economic development of Kazakhstan (Imashev, 2012; Imashev, 2015).

A great contribution to the development of the theory and practice of polytechnic education was made by A.G. Kalashnikov, M.I. Kalinin, A.V. Lunacharsky, S.M. Shabalov, M.N. Skatkin, S.G. Shapovalenko, P.R. Atutov, S.Ya. Batyshev, Yu.K. Vasiliev, I.D. Zvereva, V.G. Zubova, A.G. Kalashnikova, V.S. Ledneva, P.I. Stavsky, D.A. Epstein, and others. They revealed the functional nature of polytechnic knowledge, considered possible approaches to determining the content of polytechnic education in the context of the scientific and technological revolution. Nevertheless, this problem, given the objectives of the reform of general education and vocational schools, must find a

new, economic, theoretical rationale and practical solution. Questions of the theory of polytechnic education students studied A.V. Bugayev, S.U. Goncharenko, V.R. Ilchenko, E.V. Korshak, A.V. Kaspersky, A.I. Lyashenko, M.T. Martynyuk, A.I. Pavlenko, L.I. Reznikov, V.G. Razumovsky, A.V. Usova, A.M. Sabo, A.V. Sergeev, M.I. Shut, N.T. Glazunov, and others [2, 4, 5]. Scientists and educators considered polytechnic education, polytechnic training of young people as an important social problem, as it solves many social issues such as comprehensive development of the personality of schoolchildren by familiarizing with the scientific foundations of production, by introducing into the process of productive labor; preparing students for the conscious choice of a profession forms the ability to navigate the entire production system. Thus, the social basis of polytechnic education of students in secondary schools is the need for the production of highly skilled workers who are able to successfully navigate and adapt to the rapidly developing scientific and technological progress.

The didactic foundations of polytechnic education constitute the most important component of his theory and practice. Despite the great experience gained by the secondary school, there is no clear systematization of the content of polytechnic education, often teaching methods are used in practice that weakly mobilize students' own activity (Imashev, Barsay, Abykanova, Kuanbayeva, Bekova, & Shimakova, 2014; Imashev, 2015). This situation is due primarily to the insufficiently developed didactic foundations of polytechnic education. The fact is that the methods and forms of organization of polytechnic education, recommended in the methods, are often characterized superficially, and most importantly, without considering the specifics of polytechnism.

Knowledge of scientific laws in itself is not polytechnic but becomes such as a result of their functioning in the field of production. The methodological basis of the work is the theory of knowledge; theory of development and formation of a person as active, creative, socially adapted to the activities of the individual; modern theories about polytechnic education; theory of the whole

pedagogical process, a systematic approach to the study of new technology and production technologies.

In this paper, a new methodical system of education and a holistic educational process are considered, organized on the basis of studying the most important areas of scientific and technological progress in the physics course (Davydov, 2005; Imashev, & Rakhmetova, 2019).

The scientific novelty of the research is as follows:

- The scientific and theoretical foundations of polytechnic education at the present stage in the study of physics in high school in Kazakhstan are determined.
- Proposed conceptual provisions based on a scientifically based methodological system of polytechnic training of students.
- A model of the methodical system of polytechnic education of students in the process of teaching physics was created, its criteria, indicators, levels were determined, its effectiveness was experimentally proved.
- The socio-economic and pedagogical principles of modeling organizational forms and methods were determined, ensuring the effectiveness of polytechnic education in physics in the conditions of modern production.

Polytechnic training of schoolchildren includes their knowledge of the general scientific foundations of modern technology and the ability to solve production and technical problems using physical knowledge (Bugayev, 1981; Imashev, 2012).

Methodical foundations of improving polytechnic education in the process of teaching physics, which include determining the approximate content of applied material, levels of polytechnical knowledge and the criteria for their assimilation, as well as the rationale for the possibility and necessity of

strengthening the polytechnic conditionality of studying physics in accordance with the requirements of scientific and technological progress at the present stage (Rieffel & Polak, 2011).

The credibility of the research is confirmed by the introduction into practice of a number of schools of the methodical system developed by the authors, materials of polytechnic content in physics and guidelines for using the system of polytechnical knowledge and skills in the educational process, as well as their positive assessment is given by teachers.

The scientific apparatus of this study and basic concepts were formulated, the material on the problem of polytechnic education in the process of teaching physics was analyzed and systematized (Jain & Verma, 2014; Imashev, Abykanova, Rakhmetova, Tumysheva, Moldasheva, Ilyasova, & Shahimova, 2016a). The following methods were used for theoretical, comparative analysis of the scientific literature on the problem, observation, survey methods, modeling, synthesis, study and analysis of the pedagogical experience of schoolteachers, pedagogical institutes, experiment, systematization, and generalization of results, development, and implementation of recommendations.

The practical significance of the work lies in identifying the most important trends characterizing the modern development of polytechnic education; to create a model of a new methodical system for polytechnic teaching physics in the conditions of modern production; in the development and implementation in the educational process of scientifically grounded technical and technological material, which is based on a polytechnic principle, reflecting the applied direction of teaching physics; in substantiating the didactic essence of the composition and structure of the simulated system of knowledge and skills that determine the main role of polytechnic education in the development of practical training of students in the process of teaching physics.

The paper identifies theoretical prerequisites for applying a set of methods in the practice of teaching: an explanation of technical devices such as means of labor, demonstration of work processes; explanation of the principles of operation of objects of technology through the application of

knowledge of basic sciences; laboratory and practical work on the in-depth study of the means of technology; solving a system of problems (including problem ones) aimed at polytechnical analysis of structures (Bugayev, 1981; Baranov, 2005).

Polytechnic training is a system of techniques and tools aimed at the formation of skills to apply existing knowledge in the formulation and solution of intellectual and practical problems.

New forms and means of polytechnic education, with necessity, require the creation of an adequate methodical system that ensures:

- Methodological substantiation of the principles of selection of polytechnic material in physics for various forms of its presentation.
- Methodical substantiation of the choice and ensuring the systematic character of the totality of didactic means for the implementation of the polytechnic principle in the study of physics.
- Methodological support of various forms of educational activities and types of studies in physics.
- Development of guidelines for improving polytechnic education, considering the modern conditions of teaching school physics course.
- Differentiation of training such as a methodological rationale for the choice of profile training and vocational guidance of physical education in high school.
- The wide use of modern achievements of science and technology in the process of teaching physics in a comprehensive school (Pinskiy & Razumovskiy, 2007; Imashev, Kuanbayeva, Rakhmetova, Salykbayeva, Turkmenbayev, Issatayeva, Murynov, & Gainieva, 2019).

The content and effectiveness of the use of the methodical system of polytechnic teaching physics, on the one hand, are connected with the didactic and methodical possibilities of new technologies in combination with the means of traditional methods of teaching physics. On the other hand, thanks to

the implementation of the methodical system of teaching physics, there is an improvement in the polytechnic training of students in the process of studying physics.

The methodical system provides the teacher and the student with a set of methodologies, methods, techniques, and tools for teaching physics, combining the best achievements of polytechnic education methods and modern means of teaching physics. In accordance with the paradigm and goals of modern education, the objects of polytechnic education in physics are the student and their joint activity with the teacher. In contrast to the model of the traditional teaching of physics, it is the provision of effective activities for the acquisition by students of the possibility of developing their personal qualities based on studying the main issues of science and technology become decisive in shaping the system of polytechnic teaching physics in school.

The methodological system for studying the directions of scientific and technological progress should, of course, basically correspond to the common method of teaching physics, at the same time it is necessary to make wider use of a number of new methods that have proven their effectiveness (Altshuler & Chervova, 2008; Imashev, 2011; Imashev, Zhazylbaeva, Salykbayeva, Shimakova, Yerekeshova, Suleimenova, & Syrbayeva, 2016b).

Under the methodical system, we understand the goals and objectives, the content, forms, methods, and means of polytechnic education in the modern paradigm of education. The proposed model allows achieving a high degree of preparedness of the level of polytechnical knowledge, skills, abilities and the formation of polytechnic competence. The model of the methodical system of teaching physics assumes the improvement of the polytechnic education of students with the wide use of modern advances in technology and production and an increase in the level of polytechnical training of schoolchildren by introducing new methods and special organizational forms of education. It has integrative, so-called system properties. The model of the methodical system of rational selection of

the content of an applied physical-technical material allows us to strengthen the polytechnic orientation of teaching physics (Bugayev, 1981; Imashev, 2011, 2012).

During the study, a model of a methodical system for teaching physics was created, which is shown in Figure 1.

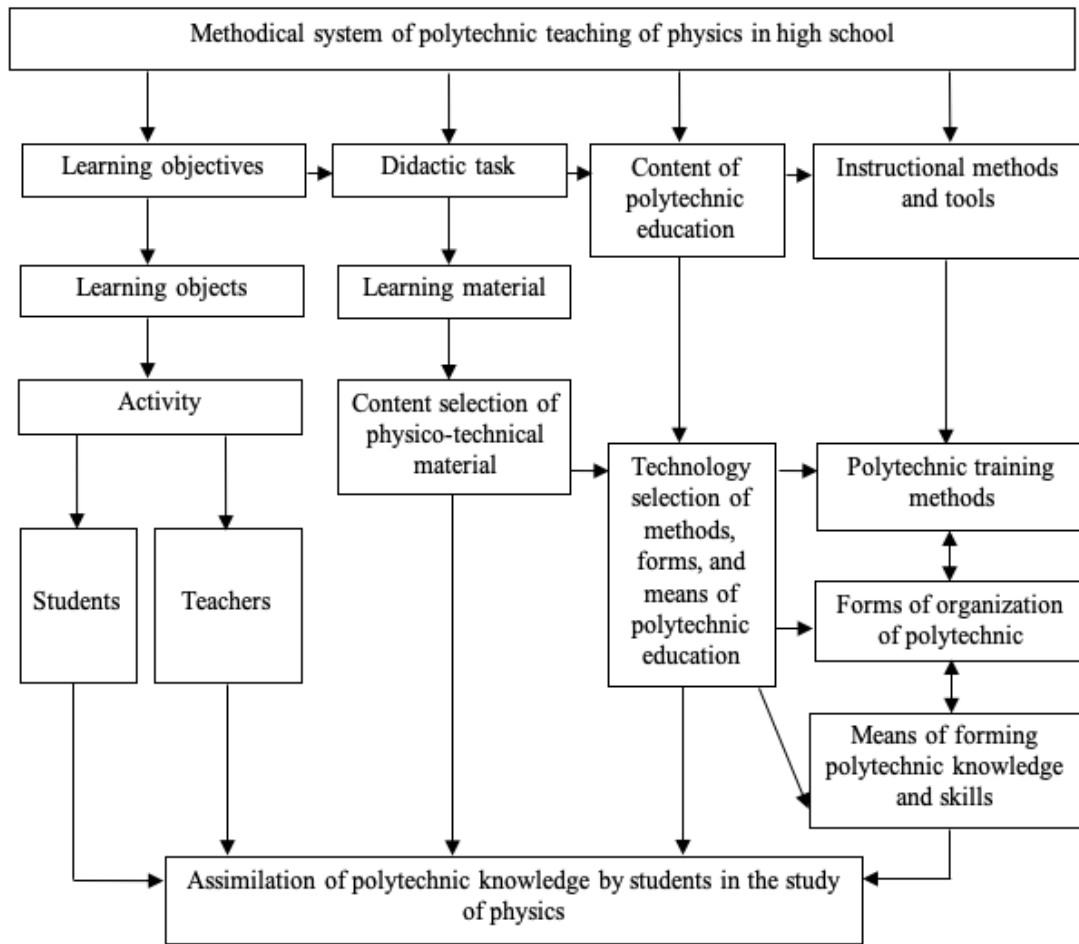


Figure 1. Methodical system of teaching physics.

The model for the development of a system for teaching physics and its instrumental equipment that we have created allows us to organize and systematize polytechnic training of students when considering the physical foundations of modern engineering, automation, electronics, power engineering, instrument engineering, microprocessor technology.

We think of a methodical system as a whole, characterized by a certain polytechnic content.

As a result of the creation of such a methodical system, it is possible to implement a unified polytechnic orientation in teaching physics in school. The creation of a new methodical system for polytechnic training of schoolchildren in the process of studying physics should improve the quality and efficiency of training and education in the secondary school in accordance with the level of development of technology and the modern production (Voronov & Podoplelov, 2005; Imashev, 2011).

The use of new technologies in the educational process allows us to rebuild the traditional methodological system of teaching physics so that it becomes completely innovative. As noted above, the methodological system includes goals, content, methods, means, organizational forms of learning and monitoring students' achievement of learning goals. Such a systematic approach is applicable not only to the educational process, for example, in physics, as a whole, but also to a separate lesson.

The study examines the impact of the use of new organizational and pedagogical forms of tools on the methodical system of teaching physics. The system of polytechnic material in sections of the physics course contributes to a better understanding of the structure and operation of technical objects under study, forms the ability to make measurements and calculations, to explain the principle of their work. A new methodological system of training and a holistic educational process, organized on the basis of studying the most important areas of scientific and technological progress in the course of physics, can improve the quality of education in the secondary school (Rogachev, 2008; Imashev, 2015).

The key to the success and effectiveness of polytechnic education in the process of teaching physics is a systematic approach to it. We have developed a conceptual model of the pedagogical system of polytechnic education in the process of teaching physics in high school, consisting of three subsystems:

- Goals and objectives of polytechnic education in secondary schools.
- The mechanism for implementing the principle of polytechnism in the course of physics.
- The results of polytechnic education in the process of teaching physics.

The target component of the polytechnic education system is formed under the influence of the following factors: the socio-economic needs of society, scientific and technological progress, environmental conditions (Pinskiy & Razumovskiy, 2007; Imashev, 2011).

The mechanism for implementing the principle of polytechnism in the physics course includes:

- The study of the physical basis of the specific technical device.
- Students' understanding of the technical principle underlying the design properties of the device.
- Training in the ability to use specific technical devices that implement the studied physical and technical principle.

As a result of purposeful interconnected work of a teacher and a student, polytechnical knowledge and skills are formed based on this mechanism.

In accordance with certain tasks, the content of polytechnic education is formed, which is implemented as an interrelated activity of a teacher and a student. Moreover, the activity of the teacher, aimed at uncovering the physical foundations of modern production, involves guiding students' perception of polytechnic material considering the level of formation of skills and abilities, showing the practical application of the studied laws and theories in engineering. A pupil should not be a passive listener: his active cognitive-transformative, research-and-production, independent productive, exploratory, creative, research, labor activity are assumed (Imashev, 2015; Imashev et al., 2016b, 2019).

The result of applying a systematic approach to the educational process was a conceptual model of polytechnic education that we developed in the process of teaching physics in a secondary school, which is shown in Figure 2.

The conceptual model of polytechnic education is as follows: the study of the school course in physics should be based on the latest achievements of modern science and technology:

- The scientific foundations of technology, revealing the concepts, phenomena, and laws of physics, should be used in an accessible form when studying physics.
- The proposed model of polytechnic education of students in the study of physics includes a developed system of polytechnic knowledge and skills based on selected materials with regard to the development of technology.
- The effectiveness of the didactic system of polytechnic education is achieved by familiarizing with the basics of production and technology in the process of studying physics.

From the content of polytechnic material naturally follows the system of polytechnic knowledge and skills and their structure (Rogachev, 2008; Imashev, 2012). Therefore, the task of forming polytechnic knowledge and skills cannot be solved in isolation from the problem of the depth and strength of knowledge, polytechnic education of students. Pedagogical opportunities of physics course in polytechnic education of schoolchildren will then be most effective when the nature of the tasks for schoolchildren will be systematic and have different directions, and the steps of mastering the students with technical knowledge and skills will be observed.

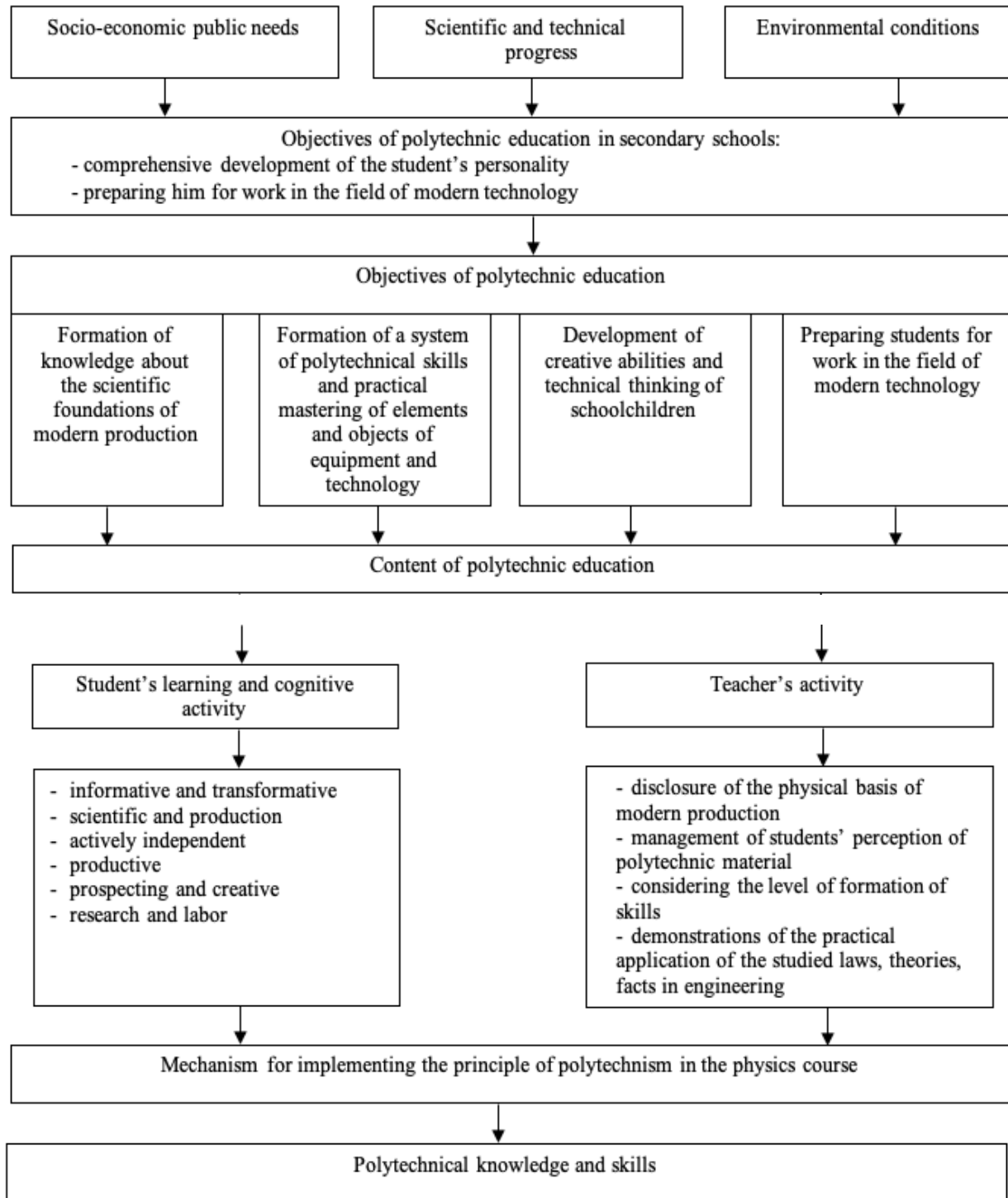


Figure 2. Conceptual model of polytechnic education in the process of teaching physics in high school.

The effectiveness of the model of the methodical system of polytechnic education in the process of studying physics in high school developed by us was tested by the pedagogical experiment. The results of experimental training prove the effectiveness of the introduction in the educational process of the model developed by us methodical system of polytechnic education in the process of studying physics in high school.

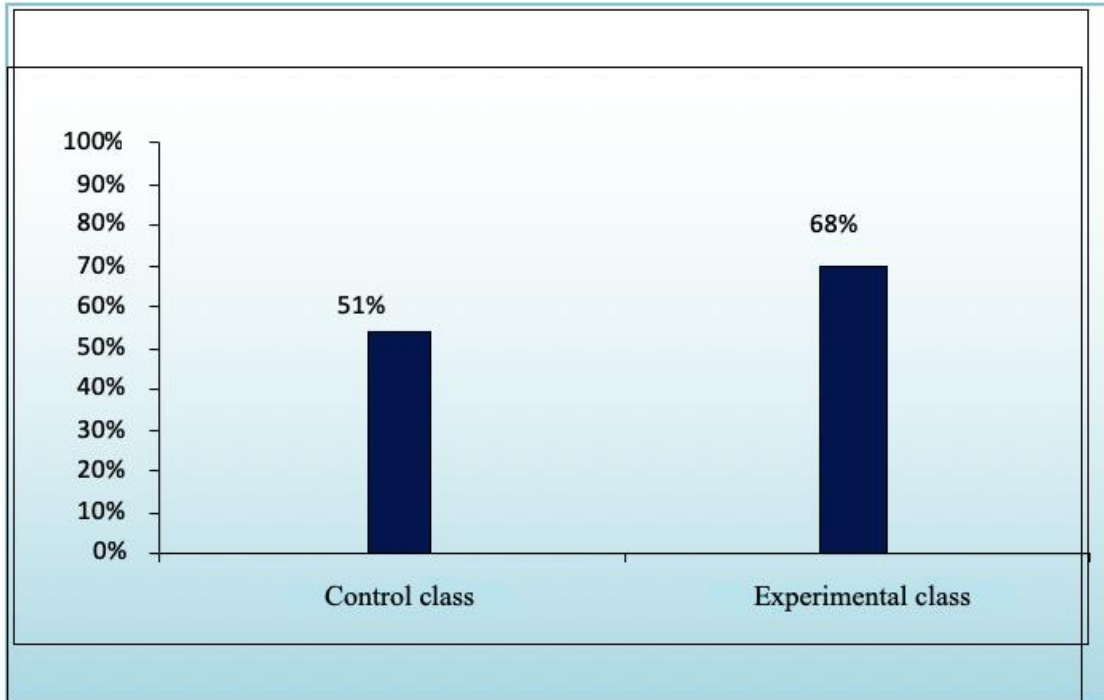


Figure 3. The result of using the model in polytechnic education.

As can be seen from Figure 3, students of the experimental class have most successfully mastered polytechnic material, this proves the validity of using the model of polytechnic training developed by us in the process of teaching physics.

CONCLUSIONS.

The following concrete conclusions were reached in this study:

1. The role and place of polytechnic education in improving the teaching of physics in high school are identified, a conceptual model of polytechnic education at the present stage is defined. The

proposed model of teaching physics includes a developed system of polytechnical knowledge and skills, based on selected materials, considering the development of technology.

2. Determined in accordance with the requirements of scientific and technological progress an important place in the content of polytechnic education, which should take the physical bases of technical objects, technological and production processes.

3. A technique has been developed for studying the physical foundations of modern production and a model for a methodical system of polytechnic education in the process of studying physics.

4. Identified ways to develop the content and methods of organizing studies aimed at the development of polytechnic knowledge and skills that students learn in the course of physics.

5. Experimental research of polytechnic education of students in the study of physics gives grounds to assert that polytechnic training, built on a new methodological basis in terms of production, effectively affects the teaching and educational process and the development of personality on all factors.

In the future, work on the study of polytechnic education of students in the process of teaching physics can be carried out in the following areas:

- Improvement of the content and system of polytechnic education, considering the study of new innovative technologies.
- Strengthening the connection of teaching physics with the productive work of schoolchildren.
- The formation of ideas about the technological aspect of the modern scientific picture of the world.

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RECIBIDO: 5 de julio del 2019.

APROBADO: 19 de julio del 2019.