PLOVDIV UNIVERSITY "P. HILENDARSKI"

FACULTY OF PHYSICS AND TECHNOLOGY

DEPARTMENT OF "EDUCATIONAL TECHNOLOGIES"

ANNOTATIONS OF THE MATERIALS UNDER ARTICLE 65 OF RULES FOR DEVELOPMENT OF THE ACADEMIC STAFF OF P. HILENDARSKI UNIVERSITY OF PLOVDIV

of head assistant doctor Hristina Georgieva Petrova

Candidate in associate professor competition

Field of higher education
1.Pedagogical sciences

Professional direction
1.3 Pedagogy of teaching .....

Scientific specialty
Methodology of teaching physics

Content

Publications in scientific journals included in the word system of reference, indexation and evaluation with Impact rank and Impact factor

Publications in referenced and indexed journals abroad

8**.** Ivanov D., ***Petrova Hristina.*** Capillary effects. (2000). Physics education, 35 (4), 262-266 UK, 2014, ISSN 0031-9120 (print), ISSN 1361-6552 (online),……..……14

9**.** Ivanov D., Nikolov S., ***Petrova Hristina***. (2014). Testing Bernoulli ' s law, Physics education, 49 (4) July, 436–442, UK, 2014, ISSN 0031-9120 (print), ISSN 1361-6552 (online), **Impact rank** 0,240 14

Publications in referenced and indexed Bulgarian Journals and Scientific papers

10. ***Petrova, H***. (2013) Developing graphical knowledge and skills through solving graphical problems on uniform rectilinear and uniformly accelerated motion Physics: Methodology of education № 1, ISSN (print) 1314-8478, ISSN (online) 1314-8761.....14

11. ***Petrova, H***. (2013) Developing students' knowledge for uniformly accelerated motion through solving graphical problems, Scientific works, Physics, 38 (4), ISSN 0861–0029.....15

12. ***Petrova, H.*** (2014) Graphical representation and solving graphical problems on phase transitions, Physics: Methodology of teaching, vol. 1 (2), 29-34, ISSN (print) 1314-8478, ISSN (online) 1314-8761.....15

13. ***Petrova, H.*** (2014) Some ideas for developing students ' key competences in Physics education in secondary school. Education and technologies, vol. 5, 171-174, ISSN 13141791.....15

14***. Petrova, H.*** (2015) Formation of meta-subject universal skills in students, Pedagogy, vol. 4, ISSN 1314–8540 (Online), ISSN 0861–3982 (Print)……..16

15. ***Petrova, H.*** (2015) Graphical interpretation of the phenomenon photoelectric effect in secondary school. Scientific papers, vol. 39, book 4, Physics, 221-231, ISSN 0861–0029...17

16. ***Petrova, H.*** (2015) Activation of students' cognitive activity with the help of graphic tasks in the study of Thermal Phenomena in eighth grade, Education and Technology,

vol. 6, 261-265, ISSN 1314 17

17. ***Petrova, H.*** (2016) Formation of skills for solving educational tasks with physical content in the teaching of Man and Nature in fifth and sixth grade, Education and Technology magazine, vol. 7, ISSN 1314-1791……..17

18. ***Petrova, H.*** (2016) Usage of the graphical method in solving physical problems from the Dynamics in secondary school. Education and Technology, vol. 7, ISSN 1314-1791……..18

Publications from scientific conferences with international participation

Publications from national scientific conferences and scientific sessions

Monographies

Textbooks and educational appliances

Author's verification
about the contributory character of the works

Of head assistant doctor Hristina Georgieva Petrova
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Type and number of the works presented for review

Monographies 1
Educational appliances 3
Publications in scientific journals, included in the world system for reference, indexation and evaluation with Impact rank (SJR) and Impact factor 7
Publications in referenced and indexed journals abroad 2
Publications in referenced and indexed Bulgarian journals and scientific papers 18
Publications in national conferences, published in full text 5
Publications in scientific conferences with international participation 1

Total number of the works: 37

My scientific research activity is in these directions:

- Innovative educational technologies
- Graphical modeling in Physics education
- Information and communication technologies in education
- Content, methods and techniques of the Physics experiment
- Applying of the reflexive approach in Physics education
- Forming of meta-objective universal skills among students

31 of the presented publications are written only by me.

Publications have contributory character. Didactic technologies for applying of the graphic method, of the reflexive approach, and of the meta-objective approach in Physics education in secondary schools are developed. They are technology for applying of the graphic method in Physics education (article № 30), technological model for applying of the graphic method while

solving Physics problems (article № 4), contemporary methodological approach for forming new skills and knowledge in Physics education with graphical modeling's help (article № 3), technology for applying of the reflexive approach in Physics education (article № 29), technology for forming meta-objective universal skills among students (article №5, article № 14).

Methods for solving graphical tasks in Physics education are developed (article № 2). Such methods were missing until now in Methodics of Physics.

Methods for graphical presenting of experimental results are elaborated (article № 13).

Methods for solving problems about constructing a Physics graphic, based on experimental results, methods for solving problems about constructing a graphic based on a formula, methods for solving problems through defining the area below the graph's line, methods for solving problems about description and explanation of Physics process or movement, both graphically presented, methods for solving problems about defining a formula for graphically presented dependencies, methods for solving problems about transforming graphics from one coordinate system to another (article № 4) are presented.

Structural models of basic graphical skills, such as skills for constructing a Physics graphic and skills for extracting information from a graphic, are developed. They are the foundation of the structure of teacher and students' activity while forming and developing graphical knowledge and skills (article № 4).

All types of Physics graphical tasks are systematized and algorithms for solving are elaborated. They represent generalized rules, which lead and control students' activity (article № 1). Algorithms are concretized for "Kinematics" (article №10), "Phase transitions" (article № 12), "Dynamics" (article № 18). Applying of the algorithms is illustrated with exemplary solved problems.

Basic didactic requirements for the teacher during planning and using the graphical method for solving tasks are systematized like a generalized plan (article № 2).

Methodical instructions for both the teacher and the students are connected with successful solving of graphical tasks and are introduced and developed in the educational process (article № 2).

Specific methodical instructions for the teacher and the students while solving graphical tasks on topics such as "Photoelectric effect" (article № 33), "Kinematics" (article № 10) and "Dynamics" (article № 18) are elaborated and applied in the educational process.

Some ideas for development and improvement of the graphic method in Physics education are presented (article № 3, article № 10, article № 15).

The book of Physics graphical tasks for the secondary school section "Thermal phenomena" can be used successfully by students-future Physics teacher while their education in university and their pedagogic practice at school, by Physics teachers and by students who are interested in Physics.

The methodical guidance for teaching "Kinematics" and "Thermal phenomena" with graphical method is extremely useful for Physics pedagogical practice. Developments contain interesting ideas and approaches. By contrast with the existing educational content, in which a process is presented with only one graphic, in the methodical guidance all possible graphical representation for a process are given and analized. Methodical developments can be used by the students practitioners, by beginner Physics teacher and by teachers with Physics practice of many years, because through them the idea of applying of the graphical modeling in Physics education is upgraded.

Methodical guidance for applying of the graphic method in studying "Dynamics" and "Statics" is appropriate for teaching secondary school students and students- future Physics teachers. System of tasks, which serve for expansion and broadening the mandatory educational content, is elaborated. Exemplary classification of the tasks from "Dynamics" and "Statics" is developed. Algorithms for their solving are presented.

Among the new ideas of developing and improving the graphic method in Physics education the idea of computer graphical modeling of Physics objects, processes, phenomena and laws takes important place. Comfortable and accessible way of applying of the computer graphical modeling while studying "Kinematics" with the help of the *Internet resource Volfram Mathematica* online is presented (article № 27). This method can be used for constructing graphics and while studying other Physics sections.

Contemporary generation requires more. They anticipate receiving knowledge and information by dynamic, intriguing and interesting way. In order to come up to these expectations teachers need to use information and communication technologies' advantages. As a result they accomplish qualitative transformation of the teaching and studying process. Some aspects, connected with developing, applying and evaluating the computer presentation (article № 6) and the new functions of the teacher in education with information and communication technologies (article № 7) are considered.

Didactic modeling is part of educational-cognitive activity. This define its significance for forming and developing the students' knowledge and skills. Important aspects of studying Physics is the usage of models of Physics objects, processes and phenomena. In article №24 psychological, didactic and methodological aspects of computer modeling in Physics education are considered.

Methodology for physics lessons with compter models is developed. They are lesson of new knowledge, research lesson, computer laboratory work. The methodology of their carrying out is presented.

The emphasis is put on the idea of using the program *Mathematica* in Physics education while the focus is on graphical representation of Physics dependencies.

Article № 26 presents methodological ideas for the application of PhET (Physics Education Technology) simulations in physics education. The possibility of applying the simulations in distance learning is also considered.

Pedagogical reflection on scientific and educational knowledge giver rise to ideas of modernizing educational aims, educational content, methodical system of methods, approaches and didactic means of education. A model for applying of the reflection in Physics education is presented (article № 29). The main aspects are connected with modernizing personal, intellectual and praxeological reflection in Physics education.

Physical experiment is an important visual method in teaching physics. It activates the cognitive activity of students, develops thinking, forms lasting knowledge and practical skills.

We develop three new methods for testing Bernoulli' s law, that are different from the standard tube with varying cross-section. They are all applicable in physics education in secondary school and may even be useful for university-level educators (article №9).

We propose a new way of demonstrating the capillary effects. We examine capillary tube with a variable cross section, in which there is a column of fully wetting or fully non-wetting liquid. These models of capillary tubes are constructed from glass plates (article №8). The demonstrations are presented in front of the students using a overhead projector.

The meta-subject approach implies translation of the educational content not as information to remember, but as knowledge for application. The basic

abilities of the students such as thinking, imagination, goal setting, understanding, action are developed through it.

A technological model based on the application of the meta-subject approach in the Physics training in the secondary school is presented (article №5). The technology we offer can be used for studying in all the sections of Physics in secondary school. Its implementation in school practice would allow a real increase of the quality of the learning process in physics through work with the students' abilities.

In the monography "Graphical modeling in Physics education" the idea of the essence of graphical modeling is developed further. Multiple aspects of applying of the graphical modeling of Physics objects, processes and phenomena are considered. Developments of the author and of other authors are systematized. They are intended to wide application in educational practice, especially in Physics education.

All presented contributions will help teachers who teach pedagogics of the Science education, respectively teachers who teach methodics of Physics education, in further rationalization, theoretical development and practical applying of graphical modeling in education, of reflexive approach in education and of information and communication technologies in education.

Annotations

of the materials under article 65 of Rules for development of the academic staff of P. Hilendarski University of Plovdiv

Publications in scientific journals included in the word system of reference, indexation and evaluation with Impact rank and Impact factor

1. ***Petrova, H.*** **(**2014). Developing students graphical knowledge and skills through solving physical problems with graphical method. Chemistry: Bulgarian Journal of Science Education, 23 (4), 527-534, ISSN 0861-9255 (print), 1313-8235 (online). Abstracting/Indexing: **SCOPUS** ISSN 08619255, **Impact rank 0,216**

Classification of graphical problems in Physics education and algorithms for their solution are both presented. The application of graphs in teaching and learning Physics helps students to understand easier the meaning of natural laws.

Algorithms for solving graphical problems are universal. They can be specified and applied to all physical sections that are studied in secondary school.

2. ***Petrova, H*** (2015). Graphical problems in Physics Education in Secondary school. Chemistry: Bulgarian Journal of Science Education, 24, (1), 88-94, ISSN 0861-9255 (print), 1313-8235 (online), **Impact rank 0,202** Abstracting/Indexing: **SCOPUS** ISSN 08619255

Complete classification of graphical problems in physics education is presented.

We also offer a methodology developed by us for solving graphical problems. Some basic methodical instructions for the teachers are also considered. They related to the successful solving of graphic tasks by the students.

3. ***Petrova H***. (2015). Formation of new knowledge through graphical modeling in Physics education. Chemistry: Bulgarian Journal of Science Education, ISSN 0861-9255 (print), 1313-8235 (online), **Impact rank 0,202**, Abstracting/Indexing: **SCOPUS** ISSN 08619255

The author offers modern methodological approach for the formation of new knowledge in Physics education in secondary school. It is associated with the inclusion of graphical modeling of the physical laws, processes and phenomena. The sequence of actions aimed at revealing the inner meaning of the study and assimilation of the students is described.

The methodical approach is related to the creation of learning models in the joint activity of the teacher and the students. Hence its heuristic nature proceeds. The new learning models are graphical (schemes, diagrams, tables, graphs of functional dependencies between physical quantities) and symbolic mathematical (formulas of physical quantities and laws).

Specific examples for the application of the approach in the study of Kinematics in the tenth grade, as well as in the study of electrical phenomena and patterns that characterize them in the ninth grade are presented.

Our suggested approach enriches the theory and practice of teaching physics with new ideas for forming a system of student knowledge and skills for working with models, interpretation and logical thinking.

4. ***Petrova, H.*** (2016). Developing students' graphic skills in physics education in secondary school. IOSR Journal of Research and Method in Education, Volume 6, Issue 5, Ver. I (Sep.- Oct.2016), 123-126, e-ISSN 2320-737X, print ISSN 2320-737X, **Impact factor 1,179**

Methods for solving problems about constructing a Physics graphic, based on experimental results, methods for solving problems about constructing a graphic based on a formula, methods for solving problems through defining the area below the graph's line, methods for solving problems about description and explanation of Physics process or movement, both graphically presented, methods for solving problems about defining a formula for graphically presented dependencies, methods for solving problems about transforming graphics from one coordinate system to another are presented.

Structural models of basic graphical skills, such as skills for constructing a physics graphic and skills for extracting information from a graphic, are developed. They are the foundation of the structure of teacher and students' activity while forming and developing graphical knowledge and skills.

5. ***Petrova, H.*** (2015). Formation of Meta-Subject Knowledge and Skills In the process of Training in Physics in Secondary school. Bulgarian Chemical communications, Volume 47, Special Issue B 515-520, ISSN 0324-1130, **Impact Factor 0,349**

The meta-subject approach implies translation of the educational content not as information to remember, but as knowledge for application. The basic abilities of the students such as thinking, imagination, goal setting, understanding, action are developed through it.

A technological model based on the application of the meta-subject approach in the Physics training in the secondary school is presented.

The technology we offer can be used for studying in all the sections of Physics in secondary school.

Its implementation in school practice would allow a real increase of the quality of the learning process in physics through work with the students' abilities.

6. ***Petrova, H.*** (2016). Some Aspects Related to the Development, Implementation and Assessment of Educational Computer Presentations. Chemistry: Bulgarian Journal of Science Education, volume 25, (4), 627-633, In Bulgarian, ISSN 0861-9255 (print), 1313-8235 (online),
Impact rank 0,192

The basic didactic requirements for computer presentations, their place in the lesson and organizational forms to work with them are considered. They are contemporary visual aids.

Some requirements for presentations of information on the slide and the style of the slide are listed.

Indicative criteria assessing educational computer presentations are proposed. The criteria and indicators are respectively: content criterion, indicators - completeness, understanding of the described processes, availability of discussion materials; design criterion, font formatting indicator; literacy criterion.

7. ***Petrova H***. (2016).The new functions of teacher in training with information and communication technologies. Chemistry: Bulgarian Journal of Science Education, volume 25, (5), pp 786- 790, ISSN 0861-9255 (print), 1313-8235 (online), **Impact rank 0,192**

The application of information and communication technologies (ICT) in education changes the educational role of the teacher.

The specifics of the activity of teachers in the application of ICT in education are presented in the article. The emphasis is put on skills that teachers using ICT tools should have and basic requirements to them.

Publications in referenced and indexed magazines abroad

8. Ivanov D., ***Petrova Hristina.*** Capillary effects (2000). Physics education, 35 (4), 262-266 UK, 2014, ISSN 0031-9120 (print), ISSN 1361-6552 (online)

We examine capillary tube with a variable cross section, in wich there is a column of fully wetting or fully non-wetting liquid.

The direction in wich the liquid moves when the tube are placed horizontally is determened by means Pascals' law.

We promote the idea that the conical capillary tube is a hidraulic machine, whose two pistons are the liquid column' s free surfaces, wich have different radii.

We propose a new way of demonstrating the described capillary effects by means of that models of capillary tubes, constructed from glass plates.

The demonstrations are presented in front of a large audience using a overhead projector.

9. Ivanov D., Nikolov S., ***Petrova Hristina*** (2014). Testing Bernoulli' s law, Physics education, 49 (4) July, 436–442, UK, ISSN 0031-9120 (print), ISSN 1361-6552 (online) **Impact rank 0,240**

In this paper we present three different methods for testing Bernoulli's law, that are different from the standard tube with varying cross-section. They are all applicable to secondary school level physics education, with varying levels of theoretical and experimental complexity depending on students' skills, and may even be useful for university-level educators. Our experiments are wellsuited for use in project-based learning, either individually or as a single large project revolving around Bernoulli's law.

We also present examples of data we have collected with our experimental setups.

Publications in referenced and indexed Bulgarian Journals and Scientific papers

10. ***Petrova, H***. (2013) Developing graphical knowledge and skills through solving graphical problems on uniform rectilinear and uniformly accelerated motion Physics: Methodology of education № 1, ISSN (print) 1314-8478, ISSN (online) 1314-8761

The article discusses how students can develop graphical knowledge and graphical skills in their Physics education through graphical problems. Algorithms for their solution are described.

11. ***Petrova, H***. (2013) Developing students' knowledge for uniformly accelerated motion through solving graphical problems, Scientific works, Physics, 38 (4), ISSN 0861–0029

A methodical model for teaching uniformly accelerated motion in eighth grade with a graphical method is developed. The introduction of the concept of acceleration, the graphical representation of the law of speed, the graphical interpretation of the acceleration and the graphical determination of the distance traveled are carried out by applying the graphical method.

The model is used in technology based on the systematic and purposeful application of the graphical method in the teaching of physics in the eighth grade. The technology was experimented with eighth grade students in schools "P. Hilendarski " and "P. Evtimiy", Plovdiv.

12. ***Petrova, H.*** (2014) Graphical representation and solving graphical problems on phase transitions, Physics: Methodology of teaching, vol. 1 (2), 29-34, ISSN (print) 1314-8478, ISSN (online) 1314-8761

A modern methodical approach is presented. It includes graphical representation, creating and solving graphical problems on transitions between the states of matter.

A particular attention has been paid to the independant activity of the students. The approach has essential role for activation students' thinking, assimilation of knowledge and their application in practice.

13. ***Petrova, H.*** (2014) Some ideas for developing students' key competences in Physics education in secondary school. Education and technologies, vol. 5, 171-174, ISSN 13141791

The problem for developing students' key competences is topical in almost all over the world. It presumes that the students should observe, analyze, mold, read schemes, tables and graphs, work with various sources of information, discuss, work in a team, participate in project activities.

It reflects in the Bulgarian curricula in Science, in particular Physics. Therefore there is a need for organization of educational content and teaching with a view to develop key competences of students.

In this context, we present ideas for using effective and innovative approaches in physics education in secondary school. They suggest using graphical method, experimental method, problem oriented approach, intellectual and praxeological reflection, multimedia lessons, work in a virtual laboratory and others.

The ideas for the formation of key competencies of students in physics education are related to the formation of experimental and graphic skills of students. The methodology for graphical presentation of the results of the physics learning experiment is extremely useful.

14. ***Petrova, H.*** (2015) Formation of meta-subject universal skills in students, Pedagogy, vol. 4, ISSN 1314–8540 (Online), ISSN 0861–3982 (Print)

Our focus is on the idea of turning meta-subject universal skills into a central and leading link in the educational process. In this regard, we present our views on their formation in school education in primary, lower secondary and high school.

In the fifth or sixth grade the teacher must work purposefully in order to form the following meta-subject skills:

- application of the modeling action for testing the subject means and methods for actions in new, non-standard situations;
- mastering the basics of educational design by solving project tasks;
- realization of a written discussion as a form of individual participation in a joint search for new ways of solving learning tasks and as means of working from one's own point of view;
- mastering ways of working with cultural texts, setting out different positions on issues in one or another field of knowledge.

At the second stage - the stage of self-determination (grades 7-9) we connect the meta-subject skills with the student's learning, information and communication literacy.

We associate learning literacy with the formation of two groups of skills: organization of one's own activity and ability to learn.

We also associate information literacy with two groups of skills: for receiving information and for creating, presenting and transmitting information. We associate communicative literacy with two groups of skills: for direct interaction with other people and for interaction through written texts.

15. ***Petrova, H.*** (2015) Graphical interpretation of the phenomenon photoelectric effect in secondary school**.** Scientific papers, vol. 39, book 4, Physics, 221-231, ISSN 0861–0029

The graphical interpretation of the basic laws of the photoelectric effect is presented. It is clear, accessible and interesting for students. The graphical interpretation can be successfully used in the teaching of physics in secondary school. This presupposes understanding of the physical nature of the phenomenon.

As a result, students develop quality, lasting and in-depth knowledge. Skills to interpret physical graphs and to quickly extract useful information from them are also being developed. In this way, students become interested in working with graphics.

16. ***Petrova, H.*** (2015) Activation of students' cognitive activity with the help of graphic tasks in the study of Thermal Phenomena in eighth grade, Education and Technology, vol. 6, 261-265, ISSN 13141791

The graphical tasks are a very valuable and original didactic tool in teaching Physics. They explicitly or implicitly present the functional dependence between physical quantities. The students analyze relationships and make certain conclusions in the process of problem solving. The result of solving graphical problems is new knowledge obtained in establishing new relationships and dependencies between physical quantities. These are indications of productive cognitive activity.

Methodical approaches for the organization of productive cognitive activity with the help of graphical tasks in the study of the section "Thermal Phenomena" in eighth grade are presented.

Applying these methodical approaches helps to activate cognitive activity and to form quality knowledge in Physics education.

17. ***Petrova, H.*** (2016) Formation of skills for solving educational tasks with physical content in the teaching of Man and Nature in fifth and sixth grade, Education and Technology magazine, vol. 7, ISSN 13141791

The research focus is on the students' ability to solve learning tasks with physical content in the teaching of the discipline Man and Nature in fifth and sixth grade. The knowledge and skills that presuppose their successful solution are discussed.

A classification of physical tasks is presented, adapted to the objectives of the study of Man and Nature in fifth and sixth grade. Emphasis is placed on

qualitative, experimental and graphic tasks. Examples of quality physical tasks that can be applied are presented.

The didactic functions of the experimental physical tasks in the teaching of Man and Nature are considered.

The main methodical requirements for successful solving of educational tasks with physical content in the teaching of Man and Nature/ in fifth and sixth grade are also considered.

18. ***Petrova, H.*** (2016) Usage of the graphical method in solving physical problems from the Dynamics in secondary school. Education and Technology, vol. 7, ISSN 13141791

Possibilities for use of the graphical method in solving physics problems from the Dynamics are presented.

Sample classification of graphical tasks is proposed. They are classified into the following groups: graphical representation of the dependence of force on displacement (in particular deformation), graphical representation of the dependence between force and velocity, graphical representation of the dependence between velocity and time, graphical representation of the dependence between force and time, graphical representation of the dependence between the potential energy and the deformation of the spring.

Available to students generalized rules for construction and analyzing graphics are developed. They facilitate and regulate the work of students.

The main didactic requirements for planning the teacher's activity while using graphical method to solve physics problems are systematized.

As a result solid and firm knowledge of basic quantities and laws in Dynamics are formed. The graphical skills and graphical culture of the students are developed.

19. ***Petrova, H.*** (2017) Methodology for teaching Isothermal process with a graphical method in eight grade. Education and Technology, vol. 8, 177-180, ISSN 13141791 (Print), ISSN 25351714 (Online)

The isoprocesses are important physical processes that have practical application.

A methodology for teaching an isothermal process with a graphical method is presented. It is accessible, visual and informative. The basic techniques of the method are used. They are graphical illustration, constructing graphics on experimental results, constructing graphics on other graphs, solving graphic tasks. Each isoprocess is described with only one graph in existing

learning content. All possible representations of the isothermal process are presented and analyzed.

This approach is constructive. The logical thinking of the students develops.

The proposed methodology has been experimented as an element of technology for forming graphical knowledge and skills. It can be combined very successfully with a computer presentation and interactive board. This method can also be applied in the study of isochoric and isobaric processes. Qualitative physics knowledge is formed and as a result students are interested in working with graphics.

20. ***Petrova, H.*** (2017) Developing graphic knowledge and graphic skills in the teaching of Man and Nature in fifth and sixth grade. Education and Technology, vol. 8, 181-184, ISSN 13141791 (Print), ISSN 25351714 (Online)

The graphic knowledge and skills have a specific character and interdisciplinary nature. They are part of the key competencies of the students. They play an important role in education as a tool of learning and a factor for positive learning motivation.

The specificity of the learning content of the physical module of the subject Man and nature implies the initial formation of students' graphic knowledge and graphic skills. Some opportunities for developing the graphic skills of students in training on Man and nature Fifth and Sixth grade are considered. Emphasis is placed on skills to construct and analyze physics graphics. Algorithms for constructing physics graphics, verbal description and explanation of physical process and graphical determination of physical quantity are presented. They guide and facilitate students' work in solving respective graphical tasks. Specific examples of constructing and analyzing physics graphics are also considered. Concrete examples and algorithms are the most accessible way to initial development of students' graphic knowledge and skills.

21. ***Petrova, H.*** (2018) Solving physics problems with a graphical method in secondary school. Education and Technology, vol. 8, 266-269, ISSN 13141791 (Print), ISSN 25351714 (Online)

An innovative pedagogical practice in physics education is presented. Innovation is related to teaching methods. Emphasis is put on the usage of the graphical method in solving physical tasks.

Graphical tasks from different physical sections are presented. Tasks include constructing a physical graphics, retrieving information from graphic, analyzing graphics. A methodology for solving them is developed.

The proposed methodology can be implemented through a computer presentation and an interactive board.

The basic physical quantities and laws are learned more deeply in solving graphical tasks. On the other hand, students' graphic skills and graphic culture are developed. Students are also interested in working with graphics and developing their logical thinking.

Solving graphical tasks will help us to achieve the purposes, if this is systematically done and follow the common approach in both the teacher and the students' work. The main stages of this approach are presented.

22. ***Petrova, H.*** (2018) Methodology of teaching Isochoric and isobaric processes with a graphical method in eight grade. Education and Technology, vol. 8, 270-275, ISSN 13141791 (Print), ISSN 25351714 (Online)

The isoprocesses are important physical processes that have practical application.

A methodology for teaching isochoric and isobaric processes with a graphical method is presented. It is accessible, visual and informative. The basic techniques of the method are used. They are graphical illustration, constructing graphics on experimental results, constructing graphics on other graphs, solving graphical tasks. All possible representations of the processes are presented and analyzed.

This approach is constructive. The logical thinking of the students develops. The proposed methodology has been experimented as an element of technology for forming graphical knowledge and skills. It can be combined very successfully with a computer presentation and interactive board. Qualitative physics knowledge is formed and as a result students are interested in working with graphics.

23. ***Petrova, H.*** (2018) Usage of the graphical method in the study of the photoelectric effect in secondary school, Physics: Methodology of teaching, vol. 6, 167-172, ISSN: 1314 8478 Online ISSN: 1314 8761

The basic laws of the photoelectric effect are better understood when their graphical representation is used. It is important for students to interpret the graphs correctly because they contain the most relevant information.

The article presents the possibilities of the graphical method in studying the basic quantities and laws of the photoelectric effect. Emphasis is placed on the graphical interpretation of the physical laws of the photoelectric effect.

24. ***Petrova, H.*** (2019). Some aspects related to the use of computer modeling in teaching physics. Education and Technology, vol. 10, book. 2, 222-226, ISSN 1314-1791 (Print), ISSN 2535-1714 (Online)
DOI http://doi.org/10.26883/2010.192.1681

The main educational goal of each teacher is to improve the quality of students' knowledge. Usage of information technologies is a way to achieve it. Computer modeling of physical objects, processes and phenomena is one of the most promising areas of application of these technologies in teaching physics.

The psychological, didactic and methodological aspects of the implementation of compter modeling in physics education are presented.

The psychological aspect reflects the teacher-student-computer relationship. They suggest a flexible approach in the educational activities, enhancing cognitive interest and development of mental activity of students.

Didactic aspects are connected with obtaining qualitatively new learning outcomes. These are: the formation of long-lasting and profound knowledge, the development of the skills for application of theoretical knowledge, the formation of research skills, graphic skills, skills with specific computer programs, the development of students' creative thinking.

The article discusses different types of physics lessons with compter models: lesson of new knowledge, research lesson, computer laboratory work. The methodology of their carrying out is presented. The author focuses on the different possibilities of using computer models.

Methodical recommendations for the successful carrying out of lessons are also given. We also consider the compilation of tasks of varying complexity for computer models.

Emphasis is placed on the idea of using the program *Mathematics* in physics education. Our focus is on the graphical representation of physical laws.

25. ***Petrova, H.*** (2019). Forming graphical literacy among students in the teaching of Man and Nature. Education and Technology, vol. 10, book 2, 218-221, ISSN 1314-1791 (Print), ISSN 2535-1714 (Online)
DOI http://doi.org/10.26883/2010.192.1675

Our focus is on graphic literacy of students. It is part of the key competencies of students in international normative documents for the development of European educational systems.

The necessity of special training of students to work with graphic models is revealed. Such training can be realized in the training of Man and Nature of the third, fourth, fifth and sixth grades.

Methodology for forming graphic literacy during Man and Nature education.is presented. The methodology includes introducing students to the main features of the main types of graphic models - photographs, drawing, diagram, table, graph. Graphical images that are used from the third to the sixth grade are tracked. The emphasis is on the construction and analysis of the graphs as a specific graphic literacy. There is an opportunity to use the proposed methodology using modern audio-visual technical equipment such as a personal computer, a multimedia projector and an interactive board.

26. ***Петрова, Х.*** (2020). Modeling with PhET simulations in physics teaching in secondary school. Education and Technology, vol. 11, 199-203, ISSN 1314-1791 (Print), ISSN 2535-1714 (Online)
DOI: http://doi.org/10.26883/2010.201.2270

A particularly important aspect of learning physics is using models of physical objects, processes and phenomena. Modeling is an important component of learning and cognitive activity. This determines its importance for the formation and development of students' knowledge and skills.

The Physics Education Technology (PhET) project creates useful simulations for teaching and learning physics and makes them freely available on the PhET web site: http://phet.colorado.edu The simulations are interactive, animated and visual.

Some ideas for their using in physics education are presented. They can be used in various of ways, including demonstration experiment as part of lecture, student group work or individual worksheets, homework assignments or labs.

The possibility for using simulations in remote education is considered. Students are given interactive assignments. They include interactive problems in the form of computer simulation and questions related to it. The students work with data which they analyze and present tabular and graphically. This approach suggest activities based on enquiry. In result their motivation and interest in physics increases.

27, ***Petrova, H.*** **(**2020). Use of the graphical method to study uniformly accelerated motion. Chemistry: Bulgarian Journal of Science Education, volume 9 (3), 414-421, ISSN 0861-9255 (print), 1313-8235 (online)

Graphical method in physics education is accessible, visual and informative.

The author presents new methodical approach for its applying in order to study uniformly accelerated motion. It is connected with applying of the Internet resource ***Volfram Mathematica Online*** and its graphical opportunities. Solving graphical problems is considered.

Methodology for extracting information from kinematic graphs is presented.

Publications from scientific conferences with international participation

28**.** ***Petrova, H***. (2014) Distance learning in secondary school - a challenge to the Bulgarian educational system. Conference with international participation "Contemporary Challenges for Pedagogical Science", Sofia

The purpose of the article is to research and analyze the attitudes of teachers to communicate with students in electronic educational environment. Methods used to fulfill the purpose are questionnaires and talks with teachers.

Considering the characteristics of communication in electronic educational environment and requirements of the modern teacher we determine the main directions in the preparation of future teachers related to communication in electronic environment:

- directions related to the preparation, planning and organization of communicative activities in electronic learning environment;
- directions related to the development of personal and professional qualities of the teacher, necessary for the implementation of communication in electronic learning environment.

Publications from national scientific conferences and scientific sessions

29. ***Petrova, H.*** (2012) Some ideas for applying the reflective approach in teaching physics in high school. Reports from 40th Anniversary National Conference on Physics Education, 225-228, Gabrovo

Pedagogical reflection on scientific knowledge and educational knowledge gives rise to ideas for updating the learning objectives, the learning content, the methodological system of methods, approaches and didactic teaching aids.

The issue of the application of the reflective approach in the teaching of natural sciences is considered. A model based on the application of reflective activity in physics education is presented. The main aspects are related to the updating of personal, intellectual and praxeological reflection in physics education.

30. ***Petrova, H.*** (2012) Formation and development of graphical knowledge and graphical skills in teaching physics in secondary school. Reports from 40th Anniversary National Conference on Physics Education, 355-358, Gabrovo

A technology based on the application of the graphical method in teaching physics in secondary school is developed. Its main goal is to provide appropriate conditions for the formation of quality physical knowledge and graphic skills of students.

The procedural block presents the activities for the implementation of the technology: solving physical problems with a graphical method, problem-solving physics graphs, graphical presentation of experimental results, construction of computer physical graphs and subsequent analysis and more.

The means for realization of the set goals are the graphic tasks, the graphic didactic materials, the computer graphics and others. The techniques of the graphical method are: construction of physical graphics, analysis of physical graphics, graphic illustration of experience, combination of graphics and drawings, variation of drawings in solving physical problems, etc.

Preliminary control aims to diagnose the current level of graphic knowledge and skills of students. The current control is carried out systematically in the course of the training. The final control aims to check the correspondence between the set main goals and the obtained results.

31. ***Petrova, H.*** (2013) About the formation of science literacy in the teaching of physics and other natural sciences in secondary school. Proceedings “Problems and perspectives for physics education in secondary school and universities”, Heron-Press Ltd., Sofia, ISBN 978-954-580-331-4

Our leading idea is to achieve science literacy by the student through science education based on humanistic approaches. We consider the possibilities for formation of natural science literacy in two aspects: humanization of the

methodical system of goals, learning content, approaches and humanization of communication in education.

The first aspect could be successfully developed by methodologists and teachers of natural sciences and find multifaceted applications in the teaching of physics, chemistry and biology.

The second aspect mediates the student-nature relationship. It is aimed at the student's personality and at the "spaces" in which the free expression of opinions, assessments and self-assessments are possible.

Ideas for application of effective and innovative methodological approaches with a view to forming the natural science literacy of the student are presented. These include the application of the graphic method, the developing potential of reflection, the constructivist approach, project research, e-learning and more.

32. ***Petrova, H.*** (2013) Scheme for active learning in the study of "Electrostatics" in ninth grade. Proceedings "Problems and perspectives for physics education in high school and universities", 140-143, Heron-Press Ltd., Sofia, ISBN 978-954-580-331-4

A scheme for active learning is presented, specified with a creative task on the topic of the section.

The scheme includes: (1) Updating the available knowledge for electrification of bodies, electric field, conductors and dielectrics and motivating students to explore the understanding related to the application of this knowledge; (2) Experiments to show electrostatic phenomena and to observe and analyze the changes in the behavior of the bodies used; (3) Compilation of options for practical application of knowledge.

The creative task is to construct an electroscope with available materials and to propose and implement experiments to demonstrate electrostatic phenomena.

The proposed scheme was implemented during a qualification seminar with 31 teachers of physics and astronomy in Pleven.

The teachers shared the opinion that the scheme is suitable for students and its implementation is quite possible both when studying the section "Electrostatics" and when studying other physical sections.

33. ***Petrova, H.*** (2015) Solving graphical problems in the study of photoelectric effect in secondary school. Proceedings of the National Conference on Physics Education, 141-145, Heron-Press, Sofia, ISBN 978-954-580-354-3

We offer typical graphic tasks that the teacher can use when teaching the phenomenon of photoelectric effect in secondary school. These are tasks for recognizing the graphics associated with the photoelectric effect; quality graphic tasks; tasks for comparison of physical quantities characterizing the photoelectric effect; tasks for constructing graphs based on experimental results; graphics interpretation tasks.

The main didactic goal for each type of tasks is presented.

Methodical guidelines have been developed for teachers and students in solving graphic problems on a photoelectric effect.

Solving graphical problems in the study of the photoelectric effect helps to form quality knowledge in students about the physical nature of the phenomenon, as well as to develop their graphical skills.

Monographies

Hristina Petrova (2021) Graphical modeling in Physics education. University publisher 'P. Hilendarski'. ISBN 978-619-202-652-3

In the monography some graphical modeling researchers' experience is generalized.

The aim of the research is to upgrade the idea of the essence of graphical modeling in Physics education.

Multiple aspects of applying of graphical modeling of Physics objects, processes and phenomena, which are taught during the educational process, are presented.

Some developments of the author and of other authors are systematized.

They are intended to wide appliance in educational practice, especially in Physics education.

Textbooks and educational appliances

1. ***Hristina Petrova*** (2014) Book with Physics graphical problems for the secondary schools section Thermal phenomena. University publisher "P. Hilendarski". ISBN 978-954-423-915-2.

The book contains qualitative and quantitative graphical problems with various character. Classification of the graphical problems from section "Thermal phenomena" is presented.

Algorithm for solving any type of problems is suggested. After that it is illustrated with exemplary solved tasks. Problems for independent work are presented.

The book contains training tasks and tasks with increased difficulty, which suppose quick wits, logical thinking and creativity during solving them.

Different difficulty of the problems gives opportunity so that the book can be used not only in the mandatory education' s frames but in the compulsory eligible preparation, in conducting contests and olympiads, in preparation for school-leaving and candidate-students Physics exams.

The book can be used successfully by the students-future Physics teachers during their university education and their pedagogical practice at school, by Physics teachers and by students who are interested in Physics.

2. ***Hristina Petrova*** (2015) Methodical guidance for teaching Kinematics and Thermal phenomena with the graphic method in the eight grade. University publisher 'P. Hilendarski'. ISBN 978-619-202-035-4

Methodical developments on topics such as "Kinematics" and "Thermal phenomena", which are taught in the eight grade, are presented. They include generalized rules for applying of the graphic method and original means for visualizing. This makes them really helpful for the Physics pedagogical practice.

The developments contain many interesting ideas and approaches. By contrast with the existing educational content, in which one process is presented with one graphic, in the methodical guidance all possible graphic representations of one process are given and analized. Its aim is to develop students' logical thinking.

Methodical developments can be used by the students practitioners, by the beginner Physics teachers, by teachers with Physics practice of many years, because through them the idea of the applying of the graphic method in Physics education is improved.

3. ***Hristina Petrova*** (2016) Methodical guidance for applying of the graphic method while studying Dynamics and Statics in secondary school.
ISBN 978-619-202-152-8

Theoretical bases of the problem with the meaning and applying of the graphic method in Physics education in secondary school are presented. Some

opportunities for applying of the graphic method while teaching topics from the sections “Dynamics” and “Statics” are considered.

The emphasis is put on applying of the graphic method while solving Physics problems from “Dynamics” and “Statics”. A system of 50 tasks, 35 of which are from the section “Dynamics” and 15 from the section Statics is presented. An exemplary classification of the problems from “Dynamics” is constructed. They are systematized in four groups: dependencies between strenght and moving, between strength and speed, between speed and time, between time and strength. In each of the groups various, interesting and different problems are presented. They suit requirements of the main didactic principles – scientific, system, succession and clearness. They develop students’ thinking. Some problems with increased difficulty, which can be used during Physics eligible preparation, are included. They are appropriate for students, who are interested in Physics.

In the guidance generalized rules for constructing a graphic, for analyzing a constructed graphic, which facilitate and regulate students work are presented.

The main didactic requirements for the teacher in planning and applying of the graphic method are systematized in the form of generalized plan.

The methodical guidance is current and helpful in Physics education. It can be used by students, by pedagogical faculty specialists, by masters – specialty Teacher of Physics and by Physics teachers.