

Annotations

of the materials under Art. 76 (1) with which
Assoc. Prof. Dr. Zhelyazka Dimitrova Raykova
participates in the competition for professor,
by: higher education area 1. Pedagogical sciences;
professional field 1.3. Pedagogy of Training in ... (Methodology of Physics
Education),
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Publications in scientific magazines and conferences

1. **Raykova, Zh.** (2008). Scientific Literacy and Some Opportunities for its Formation in the Physics Education in the Secondary School, Scientific Works, p. 45, Book 2.

The article examines various definitions of scientific literacy as well as its components and levels. It seeks their connection with physics education at Bulgarian secondary school through some of the basic educational documents. For that purpose the National Educational Standards for educational content and the National Curriculum of Physics and Astronomy, for 8th grade are reviewed.

2. **Raykova, Zh.**, Solunov, Hr. (2008). Opinion on the topic "Transformers", Materials from the 36th National Conference on Physics, 3-6 April 2008, Sofia.

The report shares ideas and recommendations on the topic of "Transformers", which can help physics teachers, according to the requirements of the 2001 curriculum.

A brief methodical analysis of the curriculum content of the transformer theme, which is currently being studied at the 9th grade of the Bulgarian school is presented. The results of studying student knowledge on this topic are described and analyzed. The study includes 88 students from 4 schools in Plovdiv. The analysis of the student answers from the conducted test shows that the topic of

transformers is not easy for the students. The authors share an idea of organizing pupils' cognitive activity during the transformation lesson.

3. **Raykova, Zh.** , Mitrikova, R., Valtonen, S. et al. (2009).

A joint program among the universities of Helsinki, Jyvaskyla, Torun, Plovdiv and Tartu for the pedagogical practice of students, future science teachers (EU TRAIN - COMENIUS European Project 2.1), 37th National Conference on Physics Education, Rousse, Bulgaria.

The article presents the results of the work on a European project (EU TRAIN), related to improving the quality of the pedagogical practice of students, future physics and chemistry teachers, to the Bulgarian physical community. A joint flexible program for the pedagogical practice of trainees from the project participants visiting another country was created. The results of the interaction among educators from four European universities who teach future teachers in physics and chemistry are described. The best examples of the pedagogical practice and the comparison between the traditions in these countries have been included in the creation of a common training program for trainees to become teachers in physics and chemistry.

4. **Raykova, Zh.**, Ivanov, Dr., Welzel-Brauer, M. et al. (2009). The Effective Use of Information Computer Technologies in Natural Sciences Education - European Project "CAT-The effective use of computer-aided teaching and learning materials in science teaching ", 37th National Conference on Physics Training, Rousse, Bulgaria.

The rapid penetration of ICT in everyday life affects the learning process in European schools. Many researches have shown that the use of ICT in the training in most countries, regardless of the subject, focuses on fragmented information from the Internet. Very few teachers use standard information tools and applications. The reason for this is the difficulty of integrating ICT with instructional lessons, the problems of time spent working with computer applications during the lesson, and the lack of ICT skills of teachers. This is reported by the European Commission, which in its "Lifelong Learning Program" emphasizes the need to increase teacher knowledge and skills in the implementation of ICT in education. This is the goal of the CAT project: The Use

of Computer Aided Teaching and Learning Materials in Science Teaching - a Teacher Training Course with a European Perspective.

The article outlines the tasks and prerequisites for creating the project, the organization of the work of the partners and some results of their joint activities. It describes the content of a manual for the training of teachers of science. The manual contains facts, criteria, teaching methods and methods for assessing the use of ICT in education, as well as good practices from the six European countries participating in the project.

5. **Raikova, Zh.** , Nezelova, D., Lamanuskas, V., Valanides, N., Pekel, O. (2009). Improving the quality of the preparation of students, future teachers of natural sciences through European cooperation (European project: Improving Quality of Science Teacher Training in European Cooperation (IQST)), 37th National Conference on Physics Training, Rouse.

The modernization of teacher education in science requires its synchronization with the views and ideas of researchers from other European countries. This is a prerequisite for the creation of the European project "IQST - Improving Quality of Science Teaching", coordinated by Pallas University in Olomouc, Czech Republic.

The aim of the project is to develop and test in practice training modules for the preparation of students, future teachers of natural sciences. These modules were developed by a team of university lecturers from five European countries based on their ideas and experience. The unifying base of all modules is the constructivist approach and the comparison between the curriculum for the training of science teachers in each participating country. The article presents the topics, content and structure of the different modules. Special attention is paid to the training module prepared by the Bulgarian team.

6. **Raykova, Zh.** , Koleva, M. (2009). Active learning and some examples of how to organize it in teaching the theme "Atomic core" in school, Scientific papers, p. 46, vol. 2, Plovdiv University, Plovdiv.

In the article the issues of the active learning are viewed. Various definitions of this didactical approach are considered and the role of active learning for the

increasing of the efficiency of teaching process is underlined. Some hindrances against the organization of the active learning are showed and some of the most frequently used techniques are traced. The examples given are connected with the teaching of the topic “Atomic nuclei” in secondary school.

The article could be useful for physics students and teachers, as well as for experts involved in physics education.

7. Nezvalova, D., Lamanauskas, V., **Raikova, Zh.**, D.Z., Valanides, N., Pekel, O.F. (2009). The Training Modules for Improving Quality of Science Teacher Preparation: Methodological, Procedural, and Didactical Issues. In.: V. Lamanauskas (Ed.), Development of Science and Technology Education in Central and Eastern Europe (Proceedings of 7th IOSTE Symposium for Central and Eastern Europe, 14-18 June 2009). Siauliai: Siauliai University Publishing House, pp. 104-111, ISBN 978-9986-38-978-1.

The constructivist perspective is becoming a dominant paradigm in the field of science education. While a great deal has been written in recent years about constructivist learning theories and their applications to elementary and secondary school classrooms, much less has been said about the implications of these ideas and practices for teacher education. This approach in the initial science teacher training is still not too common in many European teacher training institutions. It is a reason why a group of science teacher educators from five European countries (Bulgaria, Czech Republic, Cyprus, Lithuania and Turkey) focused on this topic. These countries cooperate on the Project IQST Improving Quality of Science Teacher Training in European Cooperation – constructivist approach (the Socrates – Comenius 2.1 programme of the European Commission).

The report presents the main ideas that are being worked on within the project and some of the results.

8. **Raykova, Zh.**, (2009). Some Possibilities for Formation and Development of Procedural Scientific Skills in Physics Education, Scientific Papers, vol. 2, p. 46, Plovdiv University, Plovdiv.

The theory of scientific procedural skills is an important component in the pedagogy and is an object of study mainly from the specific methodologies related to the study of scientific subjects.

In this article the definition of science process skills, their classification and importance for school practice are viewed. Considerable attention is paid to their formation and development. Some ways to form science process skills in physics education in secondary school, such as observation, data collecting and processing, and communication, are described.

9. Welzel-Breuer, M., Stadler, H., **Raykova, Z.**, Erb, R., Lavonen, J., Buty, C., & Ioannidis, G. S. (2010). CAT: The effective use of computer aided teaching and learning materials in science teaching – A teacher training course with an European perspective. In *Contemporary science education research: teaching* (pp. 395-402). Presented at the ESERA 2009 Conference, Ankara, Turkey: Pegem Akademi. Retrieved from http://www.esera2009.org/books/Book1_CSER_Teaching.pdf

A huge amount of excellent computer aided teaching and learning (CAT) material already exists in Europe, but there is far less experience and competence in using and choosing these materials effectively. This is especially true with respect to getting girls and boys interested to study science, and motivated to get acceptable learning results. Recent research results from science education show that there are good chances of improving the classroom practice if the materials are appropriately used and adapted to the specific needs within the schools of the different countries. A transfer of those results into teaching practice within Europe will be organized by our project.

International scientists and teachers, experienced within this field work together and adapt their nationally oriented ideas and research results to those needs. The intention is to design and test modules for a teacher-training course which enables teachers to judge the quality of CAT environments in science teaching, to adapt best-practice examples of those environment to their own teaching, and to evaluate it afterwards. For this purpose, we use already existing environment of the different project-countries. We will show that discussing and judging the quality of CAT for science teaching is an actual question in all European countries. The project is realized with support of the LLP program of the European Union.

10. Welzel-Breuer, M., Graf, S., Sanchez, E., Fontanieu, V., Stadler, H., **Raykova, Z.**, Erb, R., Lavonen, J., & Ioannidis, G. S. (2010). Application of computer aided learning environments in schools of six European countries. In G. Çakmaki & M. Taşar (Eds.), *Contemporary science education research: Scientific Literacy and social aspects of science* (pp. 317-327). Presented at the ESERA 2009 Conference, Ankara, Turkey: Pegem Akademi. http://www.esera2009.org/books/Book_5.pdf

The purpose of the EU funded project “the effective use of Computer Aided Teaching and learning materials in science teaching” is to create a teacher training course for science teachers that allows teachers to get acquainted with the latest research results in this field.

Teachers who decide to take part in the course will get to choose among several modules available to them. This paper describes the development and implementation of a questionnaire based survey that aimed at finding out the

1. Actual practice of working with CAT materials in schools
2. Teachers’ needs concerning the use of CAT materials in science lessons
3. Experience with the use of CAT materials and with training courses
4. Infrastructural Conditions at schools in different European countries
5. Personal opinions towards use of CAT in class
6. General Information on teachers and on schools.

The survey had been consciously implemented before the project consortium decided on the specific course contents. A method specifically developed for this purpose, and also described in this paper, was implemented to use the survey’s results as an additional means of reflection. This paper will also give an insight at selected results of this survey and discuss their probable consequences for the design of the teacher training course.

11. Welzel-Breuer, M. Graf, S., Sanchez, E., Fontanieu, V., Buty, C., Stadler, H., Nagel, C., **Raikova, Z.** Erb, R.; Lavonen, J.; Ioannidis, G. S.; Garyfallidou, D. (2010). IKT im naturwissenschaftlichen Unterricht in 6 Europäischen Ländern. In: Höttecke, D. (Hrsg.). Gesellschaft für Didaktik der Chemie und Physik (GDGP). Entwicklung naturwissenschaftlichen Denkens zwischen Phänomen und Systematik. Jahrestagung der GDGP in Dresden 2009, pp. 467-469.

The aim of the EU-funded project "Teaching and learning materials in science teaching" is to develop an international course for in-service education for science teachers to familiarize them with the latest research results and

developments in this field. This will enable them to get acquainted with the scientific developments in this area and effectively use the computer environment for classroom teaching. In order to adapt the course as closely as possible to the needs of teachers and the conditions of schools in different European countries, a survey of the target group was conducted in January/February 2009. Its aims are to gather information on the current practice of using ICT in the classroom, the IT infrastructure in the school, the needs of teachers, the experience of using ICT in the classroom, participating in other training courses, personal opinions of teachers on the use of ICT .

The survey is in the form of a written questionnaire given to at least 50 teachers from each of the six partner countries. During a meeting with the partners some intercultural differences were revealed in the interpretation of this topic and their applicability to the different school contexts was discussed.

The article describes how were distributed the poll and the methods for elaborating of the the results. Some results of the poll are also described: Disappointment of teachers from not very good working conditions at schools (almost everywhere), problems with the management of pupils' cognitive activities when using ICT in the lesson. The course develops a solution to these problems. Students are offered specific interesting and applicable examples such as lesson plans, teaching materials, instructions for managing school activity, etc.

12. Welzel-Breuer, M., Stadler, H., **Raikova, Z.**, Erb, R., Lavonen, J., Buty, C., Ioannidis, G. S. (2010). Das europäische Forschungs - und Entwicklungsprojekt CAT. In: Höttecke, D. (Hrsg.). Gesellschaft für Didaktik der Chemie und Physik (GDCP). Entwicklung naturwissenschaftlichen Denkens zwischen Phänomen und Systematik. Jahrestagung der GDCP in Dresden 2009, pp. 350-352.

Although there are already a large number of computer aided teaching and learning materials (CAT materials) in Europe, very few of them have sufficient value for their effective use in the real school environment. New research shows that the opportunities for improving teaching practice are good if computer materials are adequately used by teachers adapted to the needs of schools in each country, and with easy-to-follow teacher guides.

One of the aims of the CAT project is to prepare and use state-of-the-art scientific results related to this topic and good examples of teaching practice.

Scientists and teachers from six European countries with experience in this field and in close cooperation within the framework of the SAT project adapt their ideas and set up an international postgraduate course for science teachers. This course enables participants to assess the pedagogical capabilities of the computer learning environment (CAT) for scientific education, adapt and integrate examples in their teaching practice, and evaluate their own teaching on the success of learning.

The course as a content is published in a manual that contains four modules:
M1: How to Recognize "Good" Computer Teachers? (Criteria)
M2: What learning methods should be used in lessons with computer learning environments? (Methods)
M3: How do we evaluate and improve student success in using computer environments? (Action Test)
M4: Testing and testing examples from 6 countries (Best Practices)
Quality assessment tests for each module have been developed.

The developed course offers the opportunity to build professional skills so that teachers can be sure they can successfully use computer-based learning environments in their classroom practice.

13. Katsarova, K., **Raikova, Zh.** (2010). Formation of Experimental Skills in the Study of the Mechanics Section in the 8th Class of the Secondary School of Education, Scientific papers, item 47, v. 2, Plovdiv University, Plovdiv.

The authors of the article describe the organization and the carrying out of the pedagogical experiment concerning elaboration of the model for formation of experimental skill by studying of the Mechanics chapter of the student's book in 8th grade. This model should combine the requirements of the national educational documentation, the available technical resources of the physics laboratory in the school and author's ideas about chosen teaching content.

The National Educational Standards are examined through the importance of the experimental skills in the physics education. Some possibilities for formation of the definite experimental skills by studying of the lessons from chapter "Mechanics" are examined. Special attention is paid to the ways of how this activity could be done in normal school conditions.

The described research methods, some results and some general conditions could be useful for the physics teachers and future physics teachers as it stimulates them to work purposefully and consciously for building some

experimental skills in students by including various teaching methods and resources.

14. Lavonen, J., Krzywacki, H., Erb, R., Bühler, B., Jurke, T., Welzel-Breuer, M., Graf, S., Sanchez E., Fontanieu, V., Nagel, C. **Raykova, Z.** et Ioannidis G. (2010). Promoting science teachers' ability to adopt usable ICT tools in practice: design of a European teacher education course. In B. Lazar & R. Reinhardt (Eds.), *Proceedings of the XIV IOSTE Symposium*, June 13-18 2010. Bled, Slovenia: Socio-cultural and Human values in Science and Technology Education, Ljubljana, IRI UL, Institute for Innovation and Development of University of Ljubljana, pp.661-670, ISBN 978-961-92882-1-4. <http://files.ecetera.si/IOSTE/526.pdf>

Since adopting usable ICT tools to be used in science teaching and learning is still a challenge for teachers, there is a need to support teachers and enhance their potential regarding this matter. The prototype of an in-service teacher education course aiming at helping European science teachers to adopt usable ICT tools in their classrooms has been designed. In this paper, we discuss the problem analysis behind the design. In accordance with design-based research procedure, the first step was the theoretical analysis of the usability of ICT tools. Secondly, an international survey was conducted in order to clarify the needs and constraints of using ICT tools in science. Based on the survey, not only technical but also pedagogical usability should be introduced and discussed with the teachers during the course. Lastly, we discuss the course design from the perspective of problem analysis and the attempt to address the needs regarding ICT tools in science education.

15. **Raykova, Zh.** (2010). Constructivist Approach in Physics Education, *Physics*, Vol. 3, Sofia, ISSN 0204-6946.

The article examines the importance of constructivist theory for the science education and particularly in physics education. The principles of constructivist learning and the principles of constructivist teaching are also described. Attention is drawn to the new role of the teacher in the constructivist learning environment. Some arguments are also being considered against this theory.

16. **Raykova, Zh.** (2011). Didactic Properties in Studying the Elementary Element in the Physics School Course, 39th National Conference on Physics Training, Sofia.

Questions about modernizing the school physics course should always be brought up-to-date. Incorporating knowledge from the state-of-the-art achievements of physics in secondary school textbooks is a necessity for the information society we live in. The updating of the physical content content is related to the inclusion of topics from the theory of particle physics. This trend is reflected in physics curricula and textbook content. This raises the need to explore the didactic possibilities for organizing effective training on these topics.

The aim of the article is to review the didactic features of the curriculum content of elementary particle physics and to propose methodological guidelines for the effective study of the subject matter.

The characteristic features of this subject are its abstractness, the qualitative character, the impossibility to use mathematical toolkit, the wide application of the method of analogies and its rapid content renewal. All this determines its learning as difficult for students. These difficulties are caused by the vast amount of scientific content, the great number and varied terms and the inability to incorporate experiments into the lessons.

The didactic description of the topics of elementary particle physics is a prerequisite for further methodological studies and recommendations for their more effective study.

17. Katsarova, K., **Raykova, Zh.** (2011). An opportunity to practice a practical elementary elementary physics class in the 10th grade by using photographs from the bubble chambers, the 39th National Conference on Physics Training, Sofia, Bulgaria.

In accordance with the abstraction character of the curriculum content of elementary particle physics, it is not possible to carry out physical experiments at school. The article offers the opportunity to organize a practical occupation using photographs of bubble chambers made in real physical experiments and placed on the Internet. The aim is to create practical skills in students to work with a real document and to understand knowledge about elementary particles.

The article describes the didactic tasks of such a lesson and the stages of its preparation and conducting. The study assignments to selected photography and their possible answers are proposed.

The use of physical documents from a physical experiment raises students' self-esteem and enhances their motivation to study physics. Students gain an insight into the state of science, some methods of research, as well as strengthen and deepen their knowledge of elementary particle physics.

18. Lavcheva, G., **Raikova, Zh.** (2011). Ability to overcome didactic difficulties in studying the Atom-to-Space section -10 class, Physics, issue 4, Sofia, ISSN 0204-6946.

The purpose of this article is to describe some of the difficulties in studying the physical knowledge related to the structure of the matter and to suggest ideas for overcoming them based on accumulated personal impressions and the result of many years of experience.

Difficulties are due to the large amount of knowledge distributed in a few lessons; the variety of physical knowledge - concepts, laws, physical devices and numerous applications; impossibility to do physical experiments in school conditions. Opportunities for overcoming them can be found in the efficient organization of independent work of students, in the realization of inter-subject relations and the use of computer animations.

Shared experience and some of the ideas described in this article can be useful to physics teachers.

19. Vitlarov, Kr., **Raykova, Zh.** (2011). Opportunities for formation of scientific literacy in the study of a physical module from "Man and nature" in 5th and 6th grade, Scientific papers, Plovdiv University, Faculty of Physics, issue 4, vol. 37.

The article justifies the need for a purposeful formation of scientific literacy among students aged 12-13. An overview of existing definitions of scientific literacy and some views on the components of scientific literacy is made. The national curriculum (2001) of the subject "Man and nature" (grades 5 and 6) is considered in terms of the opportunities it offers for building scientific literacy. The ideas considered are a first step towards a more in-depth study of the possibilities of forming scientific literacy in the study of natural sciences in the 5th and 6th grade

20. **Raykova, Zh.,** Lavcheva, G. (2012). Teaching Physics and Astronomy in Vocational Schools - Problems and Perspectives. 40th National Conference on Physics Training, Gabrovo, Bulgaria.

The article reviews the state of physics education in a professional high schools (vocational schools). This topic is relevant given the forthcoming development of new curricula in physics and astronomy. The state of physics education in vocational schools is burdened with the problems of the vocational schools themselves. In the state of demographic collapse, most vocational schools face the challenge of recruiting students. In this sense, the basic criterion for students to choose a school is the quality of education, including that in physics, which is the basis of technological subjects.

In this type of school, especially those with a technical focus, most students have a keen interest in physics. This proves a study done by authors for the participation in Maturational States Exam of students from a Vocational High School (PGEE) in Plovdiv. Many students from this kind of school prefer to continue their study in Technical Universities and Physics Faculties.

Physics education in this type of school faces the following challenges:

- The unified physics curriculum is not the best solution for vocational school students
- The inclusion of a lot of physical knowledge in special subjects (electrical engineering, electrotechnics, etc.) leads to fragmentation in their learning and lack of depth
- Reduced number of physics lessons in vocational schools leads to a decrease in quality of learning of the special subjects
- There is no uniform terminology of the curriculum in physics and technical subjects. Repeatability and overlapping of learning content is common.

The authors offer ideas to overcome the about problems in the educational documentation and in physics methodology in vocational schools.

21. **Raikova, Zh.,** Vitlarov, Kr. (2012). Some notes on the teaching on the subject "Man and nature" - 6th grade, Scientific papers of the Paisii Hilendarski University of Plovdiv, issue 37, vol. 4.

The article shares ideas of a young teacher, discussed with his lecturer, to teach certain components of physical knowledge in Module "Man and Nature" (6th grade). Some teaching methods are described that are appropriate for a relevant age

group and for the peculiarities of physical content. These methods are applied in the learning practice, their results are discussed and assessed as effective under certain conditions.

The article is interesting to current physics teachers and students as well as future physics teachers.

22. **Raykova, Zh.**, Todorov, St. (2012). Study of Environmental Attitudes of Students in Physics, Scientific Papers of the University of Paisii Hilendarski, issue 37, vol. 4.

The article describes an analysis of the results of the Danlep questionnaire for physics students. Danlep's survey is a relatively new method of exploring ecological attitudes, covering the most significant sociological, economic and ecological issues, and combining them with the new ecological paradigm. It was first translated and applied by a team of Bulgarian scientists led by Assoc. Prof. Dr. Zdravka Kostova in 2011.

In our case, results have been obtained that lead to the following conclusions. Physics students from all courses at the Faculty of Physics have no clear idea of the economic and environmental impact of the growing population of our planet. According to respondents, people have the right to change the environment according to their needs, but not to dominate it. However, they are convinced that people can understand and control natural laws. Students assess the danger of over-industrialization, but half of the respondents believe that nature can recover itself.

Overall, the environmental attitudes of most of the 36 randomly selected student physicists can be identified as hesitant. Students are aware of ecological problems, but can not determine their dimensions and tend to ignore them. They assume that ecological crisis is possible in the future, when others will solve these problems.

The survey was received with great interest from the students and its results convinced us that the issue of ecological education continues to be relevant and important and has a place in physics education.

23. **Raikova, Zh.**, Stoyanova, D. (2013). Using the "augmented reality" technology with mobile devices in the training on the subject "Man and nature" in elementary school, 41st National Conference on Physics Education, 25-29 September, Sofia, Bulgaria.

The article discusses the didactic capabilities of "augmented reality" technology with mobile devices in the acquisition of science knowledge in Bulgarian elementary school. These opportunities are sought on the one hand in modernization of the learning process by applying new teaching practices in organizing and conducting training on the subject "Man and Nature" and on the other side - in creating a new learning environment through integration between the real world and the virtual world. Some didactic options of mobile technologies, combined with "augmented reality" technology, are described to ensure their optimal application under the conditions of traditional schooling.

24. **Raykova, Zh.**, Trayanova, N., Stoyanova, D. (2013). Changing the didactic structure of the lesson for new knowledge in physics using some electronic forms of education, the 41st National Conference on Physics Education Issues, 25th International Conference on Physical Education, 25-29 September 2013, Sofia, Bulgaria.

The paper examines some aspects of the physical education process in which electronic forms of education are applied. The use of server-based computer stations and appropriate software applied to physics training create a new learning environment. Opportunity to organize problem training in the study of "Electromagnetic Waves" (9th grade) is described by using Phet simulations in such an environment. Changes in the didactic structure of a lesson for new knowledge in physics are followed using digital training tools: Classroom Manager electronic platform, simulations, multimedia and internet.

25. Pisanova, K., **Raykova, Zh.** (2013). Quantum Information, Reports 41th National Conference on Physical Education Issues, 25-29 September, Sofia, Bulgaria.

The rapid development of quantum-information technology in recent years is linked to the need to promote the basic ideas of quantum information. This article is an attempt to respond to this need. It briefly outlines the physical principles of quantum computing, quantum teleportation and quantum cryptography, with particular attention to the braided quantum states, which are the basic physical resource of quantum information. The examination is consistent with the preparation of students in physics and mathematics at the end of secondary education. For a more detailed understanding of the main areas of quantum

information (quantum computing, quantum communications, and quantum cryptography), the references cited in the article refer to internet links where the relevant materials can be freely obtained. In conclusion, the introduction of some concepts of quantum information in the curriculum for the Physics and Astronomy Physics and Astronomy (Module 4 - Contemporary Physics) in the 12th grade is discussed. The article is oriented towards physics and astronomy teachers and students with a strong interest in this discipline, and would also be useful for initial acquaintance with the main areas and ideas of quantum information.

26. **Raykova, Zh.**, Stamboljieva, Ant., (2013). An attempt to apply the constructivist approach to studying the law of Archimedes, Scientific Papers of the University of Paisii Hilendarski, book 38, v. 4, pp. 219-229.

The article describes the author's attempt to apply a constructivist approach to studying Archimedes' law. Some of the didactic characteristics of the study content are described and its choice for the undertaken research is justified.

A design of the lesson about the floating of the bodies for the 6th grade. It examines how to apply some of the principles of teaching of the constructivist approach. A detailed study of student preliminary knowledge, demonstration experiments, and updating their knowledge is described in details. The suggestions and conclusions made may be used as a guidance for teachers who teach the subject "Man and Nature" in the 6th grade to apply constructivist ideas in the teaching practice.

27. **Raykova, Zh.** (2014). Why is the Finnish education system successful and what is it teaching us?, 42nd National Conference on Physics Training, 8-11 September 2014, Stara Zagora, Bulgaria.

The Finnish education system is often exemplified as one of the most successful. The results of various international studies showed it. The personal observations and studies of the author related to the work on two European projects (EU TRAIN 2009 and CAT-2010) are the basis for writing this report in order to share ideas and give thought. According to specialists, the strength of the Finnish education system is due to several factors:

- Exceptional concern of government governing institutions for the quality of education. Education issues have been recognized as an important national priority.

- Equal access to quality education for every citizen of the state. All schools are equally good (there are no elite schools)
- High prestige of the teaching profession and high professional qualification of teachers. The attraction of strong cadres in the teaching profession is an important condition for its prestige. Teacher training is through effective training and practice.
- The role of school principals is the leader in action. They provide guidance, support and motivation for teachers.

The Finnish educational system offers certain ideas that can be borrowed and adapted to Bulgarian conditions.

28. **Raykova, Zh.** (2015). Possibilities of the inquiry based approach to build motivation for studying science, Bulgarian chemical communications, v 47/special Issue B, pp. 508, Sofia, Bulgaria.

Inquiry Based Science Education (IBSE) is an important approach to teaching science that involves students to research and to use data as evidence of response to questions. It is believed that IBSE has potential to form scientific literacy and to improve understanding of scientific knowledge, to provoke interest and participation in science learning into the classroom. It is also a powerful motivational tool.

Teaching students to make research actually is involvement of students by teachers in the practice of science. This includes various activities and processes to answer questions and make experiments and to use models and logic and critical thinking. Engaged in the scientific process, like scientists, students use observations and experiments, draw conclusions, give explanations based on evidence.

One of the main advantages of this educational approach is to stimulate thinking and independent work of students, develop and strengthen their abilities to analyze and explore, create skills for long life learning, build motivation for learning and doing science.

This work is considered the place and role of the IBSE and tries to describe the opportunities for the formation of different types of motivation. A result of the training using IBSE in five Plovdiv schools and of the survey of the students is described. Conclusions are made, which identify and orient us in opportunities of IBSE approach in building motivation for study science.

29. **Raykova, Zh.**, Katsarova, K., Lavcheva, G., (2015). An attempt to apply the research approach in physics education in the study of light sources, the journal *Physics - Methodology of Learning*, vol. 1, pp. 56-67.

The aim of the article is to disseminate the authors' experience in applying the ISBE approach to study the topic of electrical lighting in physical education. Some of the characteristics of the ISBE are described and their manifestations in the training are traced. The education was organized within the framework of the "Chain Reaction: A Sustainable Approach to Inquiry Based Science Education" (FP7), in which the University of Plovdiv participated as a partner.

The article shares an example of a training on the subject of "Green Lighting", related to the transformation of electricity into light energy. Different types of modern lighting - a heat-lamellar lamp and energy-saving bulbs based on luminescent lighting (compact fluorescent lamps - CFL) are being explored by students. On this topic, applying the research approach, students from two schools of the city of Plovdiv - the Plovdiv School, headed by Mrs. Katsarova (2014) and PGEE headed by Mrs. Lavcheva (2015) have worked.

The article describes the way in which the learning process takes place through the research approach. The knowledge that is expected to be gained as a result of the learning process as they are in line with the curriculum is described. Some results of the students' study and the results of the training are presented in this article. Changes in the role of the teacher who organizes learning through the application of the research approach are described.

30. **Raykova, Zh.**, Trayanova, N. (2016). An Opportunity for the Research Approach for Non-Formal Training, 44th National Conference on Physics Training, 7-10 April 2016, Yambol, Bulgaria.

The article describes the peculiarities of the IBSE (research approach) approach and compares "learning through research" with traditional learning. An example of training is described by applying the research approach at the Vocational High School of Transport in Plovdiv. For a short time, students took on the role of researchers, who had the task of designing a portable hydroelectric power plant. Students explore the factors that influence the electromotive voltage produced by the generator. The article describes the process of study through research. The final results of the students explorer as well as the learning outcomes of the training are presented in the article.

Conducting training through the implementation of the IBSE approach convinces us that it has the flexibility and potential to be applicable to all types of students and to different forms of learning.

31. **Raikova, Zh.** (2016). The Chain Reaction project - an example of the application of the research approach in the context of non-formal physics training, 44th National Conference on Physics Training, 7-10 April 2016, Yambol, Bulgaria.

The successful research approach can be applied in organizing non-formal physics education and other science in secondary schools. This has been proven for three years through the work of 30 teachers with more than 300 students from 15 secondary schools across the country.

Within the framework of the project "Chain Reaction: A Sustainable Approach to Inquiry Based Education Science" (FR7), a special teacher training for the application of the research approach is organized as a partner of the University of Plovdiv. The research scenario in Physics (4), Chemistry (2) and Biology (2), and the resources for them, were used to conduct informal learning with students from all over the country aged 14- 16 years. Part of the experimental training was conducted in the current scientific laboratories of the University of Plovdiv under real research conditions.

The article describes the way in which pupils are taught and their results. Results of a poll with the students participating in the training are presented. Suggested examples of organizing learning through a non-formal learning approach are useful for teachers.

32. **Raykova, Zh., Stoyanova, D.** (2016). Didactic model for the use of the "Added reality" technology with mobile devices in physics education, Annual Scientific Methodology Magazine, Burgas, 2016, vol. 7, ISSN 1314-1791.

Until recently, augmented reality (AR) applications were mostly available for powerful computers. This made the AR technology expensive and hampered its widespread use in education. In recent years, the rapid development of the mobile communications entirely changed the situation. Today's mobile devices (smartphones, tablets, PDA) are as powerful as any PC or laptop. Their low price, powerful processors, the presence of a camera, GPS, accelerator, gyroscope and other sensors, make these devices ideal for augmented reality applications.

This paper presents our experience in using the mobile augmented reality technology in physics education. A didactic model for using this technology is described, which is applied in teaching "Physics and Astronomy" (9th and 10th grade) and "Man and Nature" (4th grade). Three methodical variants of application of this model are proposed, depending on the role of the teacher and students in the learning process. The results of a two-year pedagogical experiment are presented which show the advantages and disadvantages of the different methodical variants and doubtlessly prove the didactic possibilities of this technology to improve the learning process.

33. **Raykova, Zh.**, Vitlarov, Kr. (2016). A link between scientific literacy and the state educational standard for the curricular content of the subject "Man and nature", Annual scientific and methodological magazine, Burgas, vol.7 ISSN 1314-1791.

The fundamental role of the National Educational Standard for Educational Content (NES) requires formation of the scientific literacy. Therefore it needs to include related to the nature of science and the methods and specific ways to build scientific knowledge. Some of the requirements of NES determine the content, which has the potential to form the scientific world view as a component of scientific literacy. The article gives an overview of the capabilities of NES (2016) for Educational Content of the "Man and Nature" (grade 5-6) subject about building the individual components of science literacy.

34. Stoyanova, D., **Raykova, Zh.** (2016). Integrating mobile augmented reality technology in physics education at the secondary school, Proceedings of EDULEARN 16 Conference 4-6 Yuly 2016, Barcelona, Spain, pp.403-408, ISBN: 978-84-608-8860-4.

This paper presents a study that analyses the use of mobile augmented reality to support the teaching and learning of physics at secondary school. The didactic possibilities of this technology are explored by using a system of web and mobile applications.

The main components of this system are:

- Web-based application for QR code generation
- Mobile augmented reality application that works under Android and uses QR codes as markers
- Web-based database with digital resources.

The pedagogical experiment was conducted in real teaching conditions with 10th grade students. Plan scenarios of several selected lessons were prepared, whose structure and content allow teachers to use this technology in class by giving them various methodological advice. Classroom observation, reflective analysis of the learning process and questionnaires are used for data collection. Microsoft Excel and SPSS software are used for data analysis. Results doubtlessly show that the mobile augmented reality technology can improve student motivation and interest, and can successfully support the learning and teaching of physics in the secondary school.

35. **Raykova, Zh.**, Vitlarov, Kr. (2017). Experimental activity in the study of the physical module of the subject "Man and nature" - an important factor for the formation of scientific literacy, Collective reports of the 45th National Conference on Physics Education, 06-09 April 2017, Sofia, pp. 215-220.

The article describes a research undertaken to assess the level of scientific literacy of 6th grade students. Characteristics of scientific literacy are assessed, such as the understanding of scientific concepts and phenomena and skills related to the application of scientific knowledge and acquired competencies in conducting an experiment.

A survey was conducted with students from three schools in Plovdiv, the results of which convinced us in the importance of experimental skills in the framework of the lesson on the subject "Man and Nature". Some possibilities for incorporating experimental tasks into the curriculum content of the subject's physical module are explored.

36. **Raikova, Zh.**, Stoyanova, D., Nikolov, St., (2017). Possibility to use the "Added Reality" technology for solving physical experimental tasks, Collection of Reports from the 45th National Conference on Physics Training, 06-09 April 2017, Sofia, Bulgaria, pp. 107-113.

The paper examines experimental tasks from different sections of the physical content curriculum using the "Augmented Reality" (QR) technology.

The QR code is placed in a suitable place next to the task description, and when activated, it shows a video clip that is a combination of a real-life experiment and animation. The real-life experiment can serve students as a benchmark for experimenting or benchmarking with their experiment. Animation helps analyze the physical situation and is a step towards solving the problem.

An attempt is made to apply the "Augmented Reality" technology in the physical learning process, which can stimulate students' self-activity, create the conditions for reflexive learning, and increase their interest in physics learning.

37. Totkov, G., **Raykova, Zh.**, Atanasova, M., (2017). Cognitive-didactic model when generating testing items on the topic of "Mechanical oscillation", Pedagogy, V. 89, N 7.

In this article a cognitive-didactic model is presented based on which testing items can be generated, which assess the achievements of students in the physics section "Mechanical oscillation". The model is based on the extended Bloom's Taxonomy and can be used in conventional physics education at Secondary school as well as in e-learning. An example test, which was constructed by applying the presented model, has been offered.

38. **Raikova, Zh.**, Vitlarov, Kr., (2018). Study of the natural sciences literacy of secondary school students at several schools in the framework of the international project "Views about Scientific Inquiry (vasi)", 46th National Conference on Physics training, Pleven, 13-15 April 2018, Bulgaria.

The article describes a research related to the scientific literacy among 11th grade students from three secondary schools in the city of Plovdiv within the VASI (Views About Scientific Inquiry) project. It is part of an international study involving 30 countries within this project. The aim is to establish student knowledge of how scientific research is being conducted. This knowledge is an important goal of science education around the world and an important component of scientific literacy. A specially-created survey explores the extent to which students know about:

- research begins with a scientific question and does not necessarily require hypothesis testing
- there is no single method or set of methods that apply equally to all studies
- the examination procedure is guided by the question
- different scientists who perform the same procedures may not reach the same conclusions
- research procedures can influence the results
- the conclusions of the research should be in line with the data collected
- scientific evidence is not yet scientific evidence

- explanations are made based on the combination of collected data and truths already established.

The conclusions of the analysis of the data showed that slightly more than half of the surveyed students have naive ideas about how researchers work and how research is being conducted. This is not surprising because the topic of research on science is not included in the science educational content. The results of this study may lead to changes in the curriculum of science.

39. **Raikova, Zh.**, Vuldjev, G., Moneva, N. (2018). A system of internet resources in physics education, 46 National Conference on Physics Education, 13-15 April 2018, Pleven, Bulgaria.

A modern tendency in training is its increasing integration with widely used electronic technologies in university training courses. Today's generation of students is technologically dependent and increasingly connects electronic technologies primarily with Internet. Students increasingly prefer to use visual internet resources to learn at any time and place.

One of the most important features of this trend in education is the vast amount of information that leads to significant difficulties. The most important of these is the uncontrollable quality of multimedia products freely distributed through various possible information channels on the Internet.

The report presents the work on building a didactic model of training of students in physics and engineering specialties, which organizes the learning process on the basis of a system of learning-internet resources created with the active participation of students.

40. **Raikova, Zh.**, Vuldjev, G., Moneva, N., Kamsalova, N., Nebi, A. (2018). Building a system of Internet learning resources in physics and evaluating their didactic value, Chemistry: Bulgarian Journal of Science Education, Volume 27, Number 3, 2018, pp. 424-430.

One of the main strands in the development of physics training is to integrate popular and widely used electronic technologies into training courses. Today's generation of students is not only technologically literate - it is technologically tied and dependent and increasingly connects electronic technologies primarily with the Internet. The World Wide Web offers students a huge amount of diverse

information resources through a host of educational sites and You Tube channels. Not all, however, have the necessary quality and academic accuracy.

The paper presents the work on building a didactical model of training of students in physics and engineering specialties, which organizes the learning process on the basis of a system of learning-internet resources created with the active participation of students. This is how to build a didactical model of training for students of physics and engineering specialties to organize the learning process on the basis of a system of learning-internet resources created with the active participation of students.

Given the innovative character of the research, its initial stage, the professional interest of the team members and the available input resources, the aim of the study specify to:

- designing and creating a system of educational video materials created to study different disciplines at the Faculty of Physics of the University of Plovdiv
- placing these materials on the Internet and turning them into a free internet-based learning resource
- research on the didactic value of the created internet resources. This is done both before and on the Internet, in order to ensure their quality, as well as their use by students in order to determine their pedagogical effectiveness.

Emphasis is placed on the student initiative in selecting elements of the curriculum to prepare in a suitable form for electronic distance learning, to train to draw up such teaching materials according to the didactic requirements.

As a concrete benefit, not only is the creation of a system of learning Internet resources that enrich the learning environment, but also creating conditions for stimulating the students of the faculty to participate actively in the learning process by developing an initiative, certain technological, educational and social skills.

41. Katsarova, K., **Raykova, Zh.** (2018). Model for the study of mechanical vibrations and waves in secondary school (IX class) with the application of the research approach, Chemistry: Bulgarian Journal of Science Education, Volume 27, Number 6, 2018, pp. 842-849.

Our dynamic modernity requires changes in educational approach that create the conditions for each student to participate by engaging in activities that develop his creative abilities and enhance the quality of the knowledge and skills he/she has formed.

The revolutionary development of information and communication technologies has created a new educational reality that offers opportunities for critical thinking, related to the recognition of science-based information and communication skills for successful and safe communication. This approach has undoubted importance in the study of physics in secondary school and therefore the development of a model for its application in the study of specific subjects from the curriculum content for the 9th grade of the Bulgarian school is a task of great practical value.

The aim of this article is to present the results of a pedagogical study with students from Plovdiv High School, related to the development of a model of the application of the research approach in the study of the topic of mechanical vibrations and waves. This model includes certain components related to the formation of learning research tasks and the development of scenarios for the study of certain phenomena and specific applications of mechanical waves. It describes the activities of the teacher and students related to certain constructivist teaching methods that are relevant to the research approach.

42. **Raykova, Zh.**, (2018). Laboratory of Physics and the Internet, Physics. Methodology of Training, vol.6., pp. 226-230, ISSN 1314-8478.

In recent years, more and more researchers in the field of education have been studying the effective use of the Internet and cloud technologies in the learning process. The question arises how Internet capabilities can be used in laboratory exercises. Does he have a place in the learning process to form experimental skills?

This article describes the experience of a team of lecturers and students of physics at the University of Plovdiv, related to the construction of a didactic model for the creation of internet resources in physics related to the laboratory practice and the study of didactic value. There is a technology for making video materials for laboratory exercises in physics, which after the necessary treatment are put on the Internet - You tube and DIPSIEL (the platform of the Faculty of Physics and Technology of the University of Plovdiv).

The analysis of the results of the poll conducted allows us to draw conclusions about the positive attitude of the students and the widely expressed interest and willingness to participate in the learning process.

The article describes the benefits and challenges of implementing the developed training model.

The developed model for preparing online resources for physics training is an innovation that is welcomed by students. Improving this model and its application in the study of other disciplines of a laboratory nature is an opportunity to modernize and optimize the learning process in higher education.

43. **Raykova, Zh.**, Vuldjev, G., Moneva, N. (2019). An Alternative Online Resources as an Approach in the Physics Education AIP Conference Proceedings 2075, 180017; 10th Jubilee conference of Balkan Physical Union (BPU-10), 26 – 30 August 2018, Sofia, Bulgaria.
<https://doi.org/10.1063/1.5091414>

As the online resources start to take a significant part in every aspect of our lives students from the Plovdiv University „Paisii Hilendarski” have developed a strategy for implementing video materials in the education process in the field of physics. There are many different advantages of this method from which both students and tutors can benefit in comparison with the stand alone conventional educational approaches. The basic idea of the project we are working on is to develop a sustainable and scalable system of online resources which will help the better understanding of basic principles and subjects in the physics education. Even more important is the fact that they will be created by students for students. Many scientists and researchers can confirm the benefits of using such resources. These resonance provide better time efficiency, the language used is more comprehensive for students. However, the accuracy is constantly monitored by experienced specialists in the matter being explained. In this article, we share our experience with the preparation of the online didactic video materials and evaluation of their effectiveness. We believe that the topic of the article is up to date and the methodology described in it is applicable to other subjects. This article is dedicated to physics teachers and researchers in the physics education.

44. **Raykova, Zh.**, Katzarova, K. (2019). An opportunity to study mechanical waves by the use of inquiry methods AIP Conference Proceedings 2075, 180019 10th Jubilee conference of Balkan Physical Union (BPU-10), 26 – 30 August 2018, Sofia, Bulgaria (2019); <https://doi.org/10.1063/1.5091416>.

Nowadays learning conditions, in which ICT plays a very important role, offer the opportunity to use inquiry methods in the study of a number of phenomena in the secondary school. One of the topics in physics for 16-year-old

students in the Bulgarian school is related to mechanical waves. A training with active implementation of inquiry methods on this subject has been conducted in two school years. A pedagogical experiment was conducted to determine the results of this type of training. This article describes the research methods and the results of the pedagogical experiment. This one may be of interest to researchers in science education and physics teachers.

45. **Raikova, Zh.** (2019). The Integrative Approach to Physics Education and some Contemporary Methods of Training and Assessment Related to it, Proceeding of the 47th National Conference on Physics Training, 4-7 April 2019, Veliko Tarnovo, Bulgaria.

Global problems of the present day have an integrating influence on all spheres of life and have an impact on the educational process. Integrative tendencies are increasingly identified as specific ways of improving the structure of learning content to help students more fully reflect upon the studied objects and phenomena and differentiated conceptual structures.

Consideration of the integrative approach to physics education is important, vast and appropriate for a serious scientific study. This plenary report presents some basic views, summaries and conceptual clarifications related to this topic.

The place and importance of the integrative approach in physics education, different forms of integration, structural and functional integrative tendencies, types of level of realization of the integration in the school course of physics and natural sciences are considered.

The basic ideas in physics training that provide integrated learning are described. Particular attention is paid to the training methods for the implementation of the integrated approach to teaching as well as to the methods of assessment in its implementation.

For the sake of objectivity and completeness, the report describes also some negative results from the implementation of the iterative approach.

The report is of interest to researchers in the field of physics education and current physics teachers. It provides ideas for discussion connected to the topic of the conference.

46. **Raykova, Zh.,** Grancharova, D. (2019). Opportunities of the Integral Approach in Physics and Philosophy for the Formation of Natural Science Literacy,

Collection of Reports of the 47th National Conference on Physics Education, 4-7 April 2019, Veliko Turnovo, Bulgaria.

The formation of natural science literacy is a common goal of the study of natural sciences, presumed by their unity in terms of the subject of study - nature in its diverse unity, and scientific methods and approaches. Given this, the application of an integrated approach to the physical education process is a good opportunity for a purposeful formation of natural science literacy. The article discusses a way of applying this approach based on the interrelation with philosophy. The study of some philosophical ideas (the objective existence of nature, continuous change and development, relationship between theory and practice) that have a world-wide meaning can be accompanied by examples of physics. This is an opportunity that can be used to deepen the understanding of physical knowledge and to build up natural science literacy.

Books

47. Epitropova, A., **Raikova, J.** (2007). Approaches to Competencies for Constructivist Science Teacher (in Bulgaria) in: Improving Quality of Science Teacher Training in European Cooperation (Compendium), Olomouc, ISBN 978-80244-1821-6.

The book presents the prerequisites, objectives and main outcomes of the IQST (Improving Quality of Science Teacher Training in European Cooperation) project in the Comenius 2.1 program.

A preliminary study in all participating countries shows the need to improve the quality of physical and chemical teacher training. The aim of the project is to apply the latest pedagogical theories in the preparation of future teachers of science. The constructivist perspective has become a dominant paradigm in the field of science education. Until now, this approach is not very well known in a number of European countries, including Bulgaria. The book describes the state of preparation of future science teachers in the countries involved in the project, the necessity and competencies of the constructivist science teacher, and the structure of the modules prepared by each participant.

In Chapter Two, the author describes the state of preparation for future physics teachers at the University of Plovdiv and details the competences of the constructivist physics teacher. The first step towards the development of student learning modules is described.

48. **Raykova, Zh.**, (2008). Developmental Procedural Skills in Science Education - Constructivist Approach, Plovdiv University Press, Plovdiv, ISBN 978-954-423-483-6.

The book is related to the training on the respective training course. It is written in English and Bulgarian, which makes it possible to use foreign students participating in Erasmus exchange. The main task is to support the implementation of the classes by applying constructivist methods and to organize the students' own work efficiently. Topics under consideration are related to strategies for forming procedural skills for students in physics training and the application of active learning as an approach. This is based on the ideas of constructivism, for which a special place in the book is dedicated.

49. EU TRAIN towards a Common Curriculum for the Teaching Practice of Science Teachers, ed. by Lampiselka, J., **Raykova, Zh.** (2008). Plovdiv University Press, Plovdiv, ISBN 978-954-451-5

The book contains a description of the pedagogical practices of students, future teachers of physics and chemistry in the countries participating in the EU TRAIN project. Dr. Raykova is the author of a chapter in the book, which compares the organization and implementation of pedagogical practice in four European countries - Finland, Poland, Estonia and Bulgaria. The conclusions have served as a basis on which a common curriculum for the pedagogical practice of students from the participating countries is being developed. This program is used to exchange students from universities in these countries under the European Comenius 2.1 and Erasmus programs.

50. Welzel-Breuer M., Graf S., ..., **Raykova Zh.** (2010). The University of Plovdiv Press, Plovdiv, ISBN: 973-954-423-633-5.

The book is a guide to conducting a course with science teachers geared to building skills for using ICT in learning. The course was built as a result of the CAT - Computer Aided Teaching and Learning in Science project. The book includes not only materials with theoretical content that can be used in teacher

training, but also as a guide to self-study for teachers who use computer aided environments in their work.

Assoc. Prof. Dr. Raykova is a co-author of the chapter describing Module 3 - Self-Assessment of Self-Practice with Computer-Oriented Training and Study Materials through Activity Analysis.

51. **Raikova, Zh.** (2014). Handbook on Methodology of Training for Physical Problems, University Publishing House "Paisii Hilendarski", Plovdiv, ISBN: 978-954-423-930-5.

The book is a teaching aid to the course "Methodology of Physical Problem Solving". The theoretical part is focused on the structure of the lesson for solving physics problems, classification of physics problems, algorithms for solving different types of physics problems. Suggested solutions and methodical instructions for solving a number of typical physics problems are given. There are problems for independent work from the topics of mechanics, thermodynamics and electricity.

The book is actively used in the learning process.

52. **Raikova, Zh.**, Stoyanova, D., Kafadarova, N., Stoyanova-Petrova, S. (2014). Using "added reality" technology with mobile devices in the Teaching, Koala Press, Plovdiv, ISBN 978-619-7134-11-7.

The book explores the didactic capabilities of the "augmented reality" technology, which is the most advanced direction in the development of education aimed at integrating popular and widely used electronic technologies into the training courses. Such is the "augmented reality" technology, which combines real and virtual objects, combining animation, computer graphics, 3D Effects with the real world.

The book reviews existing apps for added reality used for education purposes. A didactic model for the use of "augmented reality" technology in the context of science education in elementary school is offered. There is a pedagogical study of the qualities of the model and a pedagogical experiment with students from the fourth grade of two schools in Plovdiv. The book describes results of the study, conclusions and guidelines for the future development of the topic.

53. **Raikova, Zh.** (2017). Methodology guide to solving physical problems - Part II, University Press "Paisii Hilendarski", Plovdiv, ISBN 978-619-202-221-1.

The manual is a second part of the above described training manual on the methodology of training for solving physical problems. It deals with tasks from mechanical vibrations, waves, magnetic field, optics, atomic and nuclear physics.

54. Mavrova, M., **Raikova Zh.** (2017). Model for conducting home experiments in Optics in the 7th grade, University Press "Paisii Hilendarski", Plovdiv, ISBN 978-619-202-276-1.

The book describes an interactive physics training model based on entertaining home experiments in optics for the 7th grade. An alternative to traditional methods is offered, including modern ICT applications and conditions for full participation of students. Specific scenarios for organizing training on geometric optics, compulsory curriculum tailored to the curriculum (2012) are proposed. Worksheets that can be used in the teaching practice and specially selected experimental tasks are applied. The developed learning model is useful for physics teachers.

Monograph

55. **Raykova, Zh.** (2019). Modern Trends in Physics Education, University Press "Paisii Hilendarski", Plovdiv, ISBN 978-619-202-441-3.

The monograph deals with the current condition and some of the most recent trends in the methodology of physical education in secondary school. The focus is on the themes of the constructivist paradigm in physics education and its application in Bulgarian schools, on natural science literacy as a current trend in the study of natural sciences and on the place of the research approach as an important tool for the realization of the latter.

Some ideas are dealt with for the first time in the context of physics training in the Bulgarian school. New opportunities have been sought to enrich the theory and practice of physics training by describing the results of research conducted by the author and sharing good practice with his experience.

The first chapter is devoted to the subject of constructivist theory in pedagogy and in particular to physics education. This theory is leading in the field of contemporary pedagogical psychology and pedagogy and in the theory of

science education, which also determines the large number of scientific publications devoted to constructivism. A constructivist approach to science education is perhaps the key to solving a number of contemporary education problems. An important specific feature of modern physics training is shifting the burden from traditional learning to constructivist one.

Constructivist theory is the basis on which research is developed (inquiry learning, learning by detection). The interest in it has been enhanced by teachers, scientists and international learning research organizations (PISA, TIMSS). This topic is discussed in the second chapter of the book. It shares experience in working on a European Chain Reaction project and dissertation research conducted at the University of Plovdiv.

The development of natural science literacy is a modern trend in science education, which aims at rethinking and updating the learning objectives towards the formation of knowledge and skills and competences to solve real problems. The complex and interdisciplinary nature of this knowledge and skills determines their place in education in natural sciences and in physics in particular.

The third chapter of the book discusses some aspects of the theme of natural literacy. This subject is extensive and requires a thorough understanding of scientific methodology and philosophy. Presenting it in the book is in accordance with studying physics at secondary school nowadays. The importance of natural literacy is related to its social significance. Being given the interconnectivity of society and its democratic nature, adolescents must be prepared in the future to truly assess the problems that affect the world around them and make informed personal and public decisions.

In the book, some trends in physics education are presented critically, showing both their positive and negative effects. These trends are typical of science education, but the context in which they are dealt with in the monograph and in the examples given are closely related to physics training. While writing the monograph, publications of internationally known authors were used to collaborate on projects and studies (Prof. Norman Lederman, Prof. Barbara Crawford, Prof. Mia Ranikmae, Prof. Lamanauskas), to talk to them and work with them on projects (VASI, EU TRAIN, IQST).