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**INFORMATION TECHNOLOGIES AS THE TOOL OF EFFICIENCY
IMPROVING OF FUTURE PHYSICS TEACHERS TRAINING TO
LABORATORY SESSION IN OPTICS**

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The analysis of the problem of the use of information technologies implementation as the tool of the efficiency improving of future physics teachers training to execution of laboratory session in Optics is considered in the article. The problems and contradictions concerning ICT tools use in higher education institutions, the work of which is aimed at future physics teachers training are described.

Due to the specifics of future teachers training in higher education institutions, labor market requirements and public procurement, the main ICT tools are identified, that are effective in students' self-activity work to laboratory session execution. The developed list of electronic resources is divided into blocks according to the topics of laboratory works in Optics. The methodology of using of ICT tools at future students training for laboratory session on the example of individual topics is considered.

Keywords: *information technologies, training effectiveness, future physics teacher, laboratory session in Optics.*

Problem statement.

The constant updating of education directions in accordance with the needs of economic and social development of Ukraine requires specialists (in particular, future physics teachers) to master the skills of rapid reorientation and operation of a large amount of continuously changing information and to foresee the continuous professional growth. However, the modern credit-modular system of the educational process organization in higher education institutions requires the increasing of students' self-activity work, which leads to a reduction in the number of hours in curricula of future specialists training, which is allocated for classes, in particular, the laboratory-practical cycle of studies.

It should be noted the deterioration of the material and technical base of the physical laboratories of the specialized departments led to the contradiction – the demands of society to the professional level of future physics teachers and the actual level of their professional training.

Information technologies “based on the methods of collecting, storing, processing, transmitting and providing the messages using computers and computer networks” have broad opportunities for solving the problem [7]. The use of information and communication technologies as the tool to increase the effectiveness of future physics teachers training is determined the need to increase the level of professional skills, which, in conditions of updating natural and mathematical education, is a necessary condition for improving its quality.

The analysis of state of ICTs implementation in the educational process has shown the educational institutions have some difficulties, including:

- insufficient provision by the information and communication technologies and other equipment - 44%;



- insufficient qualification of teachers and lectures for implementation and use of information and communication technologies - 15%;
- conservatism in the use of information and communication technologies in the educational process - 12%;
- insufficient software development - 20%;
- introduction of information and communication technologies without preliminary testing - 9% [4].

Among the reasons that keep back the use of information and communication technologies in higher education institutions, organizational and technical ones were called -the lack of free access to computer equipment and the difficulties with timely repair of computer equipment.

It should be noted the analysis of the state of ICT tools use in higher education institutions, its' work is aimed at training of future physics teachers, has found such contradictions:

1) the need of the laboratory session implementation in the general course of Physics (in particular Optics) in accordance with the requirements of modern physical education and the lack of sufficient practical training at secondary school learning;

2) the objective didactic potential of ICT using during the preparation for experimental tasks implementation of the laboratory session in Physics (in particular, Optics) and introduction degree of this potential in order to ensure the dynamism, efficiency and effectiveness of the teacher's practical activity.

The presence of these contradictions was confirmed by the problem's actuality of effectiveness increasing of future physics teachers training by means of information and communication technologies.

Article's purpose.

The purpose of the paper is to clarify the possibilities of ICT using as a means of effectiveness increasing of future physics teacher training at performing laboratory session in the general course of Physics (in particular, Optics).

To achieve the purpose, the following tasks should be completed:

- to analyze the methodological literature of the research problem;
- to reveal the possibilities of ICT tools using at future physics teachers training;
- to reveal the methodology of students' self-training at performing laboratory session in Optics with the help of IC technologies.

The analysis of scientific and methodological literature has shown that the problem of information technologies using in the educational process is thoroughly and comprehensively investigated by native and foreign scientists. In particular, R. Gurevich, M. Zhaldak, Y. Zhuk, I. Zakharova, O. Ivanitsky, M. Kademiya, O. Kruts, V. Monakhov, S. Tkachenko and others studied the problem of ICT use in high school; O. Moreva, O. Spivakovskiy, E. Oспенikova, S. Chandayeva, V. Sharko and others investigated the possibility of ICT tools using in learning process of higher education institutions. However, the problem of IC technologies use in the training process of future physics teachers to laboratory session execution is devoted the insufficient attention.

Main material.

The analysis of scientific literature has also shown the functional properties of modern information and communication technologies provide the educational process with the following objectives:

- ability to collect, store, transmit, transform, analyze and use of various information;
- ensuring the continuity of education and lifelong learning;
- development of personal-oriented learning, additional and advanced education;
- significant expansion and improvement of organizational provision of the educational process (virtual schools, laboratories, universities, etc.);
- increase of activity of studying subjects in organization and conducting of educational process;
- independence of the educational process from the place and time of learning;

- significant improvement and enrichment of methodological and software educational process;
- ensuring the possibility of choosing the learning individual trajectory;
- development of independent creatively personality;
- development of independent search activity of the student, development of new types of activity [2, 6].

It should be noted the modern information technologies introduction allows implementing new approaches in the organization of educational process in the course of general Physics in high school. Moreover, the ICTs use can increase the intellectual level of students and facilitate the solving of technological, design, economic, and environmental issues; the Internet is a source of information for creative projects designing, significantly expansion of learning visibility, as well as operational control over knowledge and skills mastering [3].

The integral part of the studying process of Physics is the demonstration experiment and laboratory session. Properly organized physical experiment serves as an effective means of training such traits of personality character as persistence in achieving the goal, carefulness, diligence in obtaining facts, accuracy in work, ability to observe, allocate essential features, etc. [3].

Agreeing with the opinion of M. Zhaldak, we believe that modern physics teacher should:

1. to understand the essence of information and information processes, their role in the process of learning of surrounding reality and creating human activity, in the management of technical and social processes, in providing communication with the environment;

2. to select and formulate the purpose, perform the task setting, put forward hypotheses, build information models of the studied processes and phenomena, analyze them with the help of modern ICTs and interpret the obtained results, systematize the facts, synthesize, comprehend and formulate conclusions, generalize observations, predict the consequences of decisions and be able to evaluate them;

3. to obtain a sequence of operations and actions in the activities, develop a program of observation, experiment;

4. to use the powerful applications of computers, systems of working out text, numeric and graphic messages, data, databases and knowledge, subject-oriented application systems, telecommunication systems;

5. to understand the artificial intelligence essence, knowledge models, intellectual-search systems;

6. to understand mathematical modeling essence, the adequacy of investigated phenomenon model, the problem statement correctness, the stability of the method of solving and the corresponding algorithm, the influence of errors on the results of calculations, the mastering of the elements of computational and program culture;

7. to master the basics of programming, modern subject-oriented information technologies;

8. to master the basics of robotics [1].

The aforementioned contradictions determine the need to use new approaches to self-activity organization of students, which is a prerequisite for improving the effectiveness of future physics teacher training. Successfully chosen ICT-tools help to optimize the students' independent cognitive activity. In the research, we identified the main ICT tools that are effective in self-activity of laboratory session implementation:

1) modern electronic textbooks, electronic encyclopedias, digital education resources, electronic interactive simulators, Internet resources, etc.;

2) various audiovisual means that demonstrate physical experiments and allow multiple reproductions;

3) simulation of processes that are difficult or impossible to reproduce under normal conditions;

4) virtual physics cabinets and modern virtual laboratories that allow carrying out of complete laboratory works using electronic models of the necessary equipment;

5) conducting blogs-electronic notebooks in Physics;

6) the use of cloud services (Google Docs, SkyDrive, etc.), that provide fundamentally new opportunities for knowledge transfer: online lectures, webinars, integrated practical lessons, cooperative labs;

7) interactive tests for self-checking and knowledge generalization [8];

8) the designing of mental maps using the software "mind-mapping", which implements the visualization of the relationship between the individual concepts and phenomena [5].

The analysis of the state of ICTs use at preparation for the laboratory session in Optics has shown that most teachers give the general list of literature and electronic recourses of corresponding course in Physics, without specifying the correspondence between different types of educational and practical activities. There are significant gaps in future physics teachers training for laboratory session in Optics implementation.

Studying this problem, we developed the list of electronic resources distributed into blocks according to the topics of laboratory works in Optics, which is given in Table 1.

Table 1.

List of electronic resources to laboratory session in Optics

	Laboratory Work Topic	Content of E-resource	E-Resource Access Mode
1	Determination of the power of the light source by the Jolly photometer.	Photometry (<i>presentations</i>)	http://nsportal.ru/shkola/fizika/library/2013/01/31/optika ; http://edufuture.biz/index.php?title=Презентація_на_тему_«Фотометрія._Сила_світла._Силовий_потік._Освітленість»
		Light intensity, illumination (<i>video fragments</i>).	https://www.youtube.com/watch?v=-NQCK909Uc https://www.youtube.com/watch?v=Gizh9L-2xkw&index=18&list=PLeOlm2kq0HcSkFdOgPr7bdTb2RXjZyyTU
2	Cooling valve photocell.	Ventilation photoelectric effect (<i>theoretical material</i>).	http://fhtb.narod.ru/photoelement.pdf
		Inner photo effect (<i>video fragment</i>).	https://www.youtube.com/watch?v=bMkaZ-o1m6Q ; https://www.youtube.com/watch?v=fAwlFobkJ3o
		Light intensity, illumination (<i>video fragment</i>).	https://www.youtube.com/watch?v=-NQCK909Uc https://www.youtube.com/watch?v=Gizh9L-2xkw&index=18&list=PLeOlm2kq0HcSkFdOgPr7bdTb2RXjZyyTU
3	Determination of the length of the light wave using a diffraction grating.	Diffraction of light (<i>video fragment</i>).	https://www.youtube.com/watch?v=7D9OnwZGqP4
		Diffraction grid (<i>video fragment</i>).	https://www.youtube.com/watch?v=hCU_beywf7o
		Diffraction grids with different periods (<i>video fragment</i>).	https://www.youtube.com/watch?v=i1qR0B3uYzQ
		Video fragment, abstract, diffraction problem on a diffraction grating.	https://www.getaclass.ru/

	Laboratory Work Topic	Content of E-resource	E-Resource Access Mode
		Diffraction grid (<i>interactive model</i>).	http://mieen.ru/about/intellect_sobstvenost/elektronnie-uchebno-metodicheskie-kompleksi/interaktiv_optika.html#optic4
		Diffraction optics	http://physics.nad.ru/Physics/Cyrillic/DG10/dg10rus.htm
		Experimental determination of the light wavelength (<i>virtual laboratory work</i>).	Project Senina V.G., Korsakov, 2011 (based on the ideas of site http://school-collection.edu.ru/collection/)
4	Determination of the radius of curvature of the lens and the length of the light wave at observing Newton's rings	Interference of light at viewed from thin plates and films (E.K.Naimi)	http://misis.ru/Portals/0/Download/Press/2011/Interference_notes.pdf
		Observation of light interference	http://www.virtulab.net/index.php?option=com_content&view=article&id=349:2009-08-22-11-55-36&catid=40:17-&Itemid=100
		Jung's research	https://www.youtube.com/watch?v=p3ffGBh6Rbo
		Light interference (<i>educational film</i>)	https://www.youtube.com/watch?v=vobxcZ6Xe3E
		Newton's Rings, Jung's Interference research (<i>interactive models</i>)	http://mieen.ru/about/intellect_sobstvenost/elektronnie-uchebno-metodicheskie-kompleksi/interaktiv_kvant_fizika.html#atom2
		Newton's Rings (<i>physical experiment</i>)	https://www.youtube.com/watch?v=bCKYsO6AQI
5	Determination of sugar concentration in solution using a sugar meter.	Light polarization (<i>educational film</i>)	https://www.youtube.com/watch?v=YzdPVY4myv0
		Video, Abstract, Tasks of Light Polarization	https://www.getaclass.ru/
		Linear and circular polarization of light (<i>animation models</i>)	http://physics.nad.ru/Physics/Cyrillic/optics.htm
6	Malus Law Verification.	Light Polarization, Double refraction (<i>educational film</i>)	https://www.youtube.com/watch?v=YzdPVY4myv0 ; https://www.youtube.com/watch?v=OaYrZmUIKOM
		Polarization, Polaroids (<i>interactive models</i>)	http://mieen.ru/about/intellect_sobstvenost/elektronnie-uchebno-metodicheskie-kompleksi/interaktiv_optika.html#optic4
		Expansion of a linearly polarized light wave (<i>animation models</i>)	http://physics.nad.ru/Physics/Cyrillic/el.htm

	Laboratory Work Topic	Content of E-resource	E-Resource Access Mode
7	Determination of refractive index of glass using a microscope	Determination of refractive index of glass (<i>virtual laboratory work</i>)	http://distolymp2.spbu.ru/www/lab_dht/ml/common/index.html
		Video, synopsis, tasks in geometric optics (light refraction, microscope)	https://www.getaclass.ru/
8	Determination of refractive index and average dispersion of liquids using Abbe refractometer	Video, summary, tasks in geometrical optics (refraction of light, complete internal reflection)	https://www.getaclass.ru/
		Light dispersion (<i>animation models</i>)	http://physics.nad.ru/Physics/Cyrillic/optics.htm
		Experimental determination of refractive index (<i>virtual laboratory work</i>)	Project Senina V.G., Korsakov, 2011 (based on the ideas of site http://school-collection.edu.ru/collection/)
9	Determination of the main focal distance of collective lens.	Video, summary, tasks in geometric Optics (collective lens, image in collective lens, scattering lens, magnifying glass)	https://www.getaclass.ru/
		Construction of images in lenses (<i>presentation</i>)	https://www.slideshare.net/0508510268/VJDOC12/ss-31373034
		Determination of optical force and focal distance of a thin lens (<i>virtual laboratory work</i>)	Project Senina V.G., Korsakov, 2011 (based on the ideas of site http://school-collection.edu.ru/collection/)
		Distortion in collective lens (<i>animation models</i>)	http://physics.nad.ru/Physics/Cyrillic/optics.htm
10	Study of the visual tube.(study of optical systems)	Video, <i>summary, tasks in geometric Optics</i> (collective lens, scattering lens, magnifying glass, telescope, reflecting telescope, refracting telescope)	https://www.getaclass.ru/
11	Determination of the focal distance of the concave mirror.	Reflection of light with a concave mirror (<i>flash model</i>)	http://www.virtulab.net/index.php?option=com_content&view=article&id=92:2009-08-22-11-54-42&catid=40:17-&Itemid=100
12	Determination of parameters of two-dimensional diffraction grating by diffraction and microscopic method	Observation of light diffraction	http://www.virtulab.net/index.php?option=com_content&view=article&id=349:2009-08-22-11-55-36&catid=40:17-&Itemid=100 https://www.youtube.com/watch?v=7D9OnwZGqP4

	Laboratory Work Topic	Content of E-resource	E-Resource Access Mode
13	Fresnel diffraction study	Observation of light diffraction	http://www.virtulab.net/index.php?option=com_content&view=article&id=349:2009-08-22-11-55-36&catid=40:17-&Itemid=100 https://www.youtube.com/watch?v=7D9OnwZGqP4
14	Fraunhofer diffraction study	Observation of light diffraction	http://www.virtulab.net/index.php?option=com_content&view=article&id=349:2009-08-22-11-55-36&catid=40:17-&Itemid=100
		Light diffraction (<i>video fragment</i>)	https://www.youtube.com/watch?v=7D9OnwZGqP4
		Fraunhofer diffraction study on the slit (<i>virtual laboratory work</i>)	https://ido.tsu.ru/cd-dvd/0/1410/
		Fraunhofer's diffraction on one and two slits (<i>animation models</i>)	http://physics.nad.ru/Physics/Cyrillic/optics.htm

Let's consider the self-activity methodology of students to perform laboratory session in Optics.

At the work "Determination of the length of light wave using a diffraction grid", the stages of self-activity of students foresee the following actions:

1. to study the instructions for laboratory works provided by the teacher. In this case, the student should consider the theoretical material, note in the notebook the order of work, learn the list of necessary equipment and instructions.

2. Watch video-fragments. Describe the physical experiments shown in video clips.

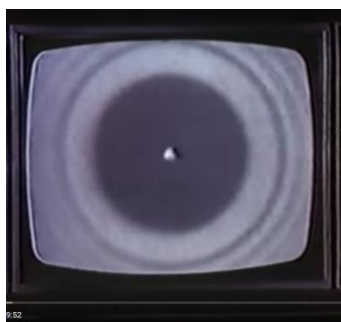


Fig. 1. Video fragment "Light Diffraction" screenshot.

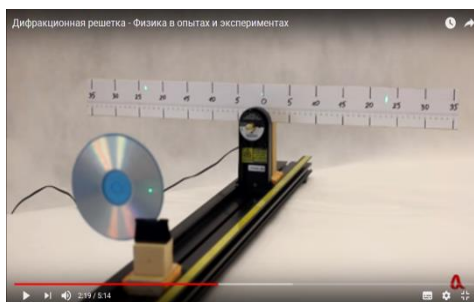


Fig. 2. Video fragment "Diffraction Grid" screenshot.

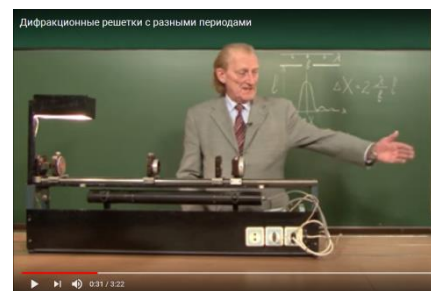


Fig. 3. Video fragment "Diffraction grids of different periods" screenshot.

3. Go to http://mieen.ru/about/intellect_sobstvennost/elektronnie-uchebno-metodicheskie-kompleksi/interaktiv_optika.html#optic4 . Watch the interactive model "Diffraction Grid". Explain the observed picture (Fig. 4).

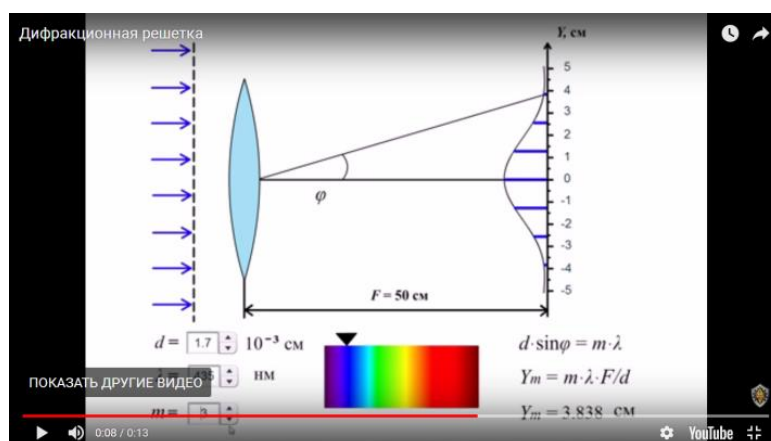


Fig. 4. Screenshot of "Diffraction Grid" interactive model.

In the work "Determination of refractive index and average dispersion of liquids using the Abbe refractometer" students should perform the following self-activity stages:

1. to study the instructions for the laboratory work provided by the teacher. In this case, student should study theoretical material, note in notebook the rules of work's procedure, learn the list of necessary equipment and instructions for their use.

2. Go to the link <https://www.getaclass.ru/> .

- in the section "Light Refraction" select "Tasks". Solve the proposed tasks; write the solution in the notebook;

- watch the video "Light Refraction". Describe the phenomena and explain it (Fig. 5).

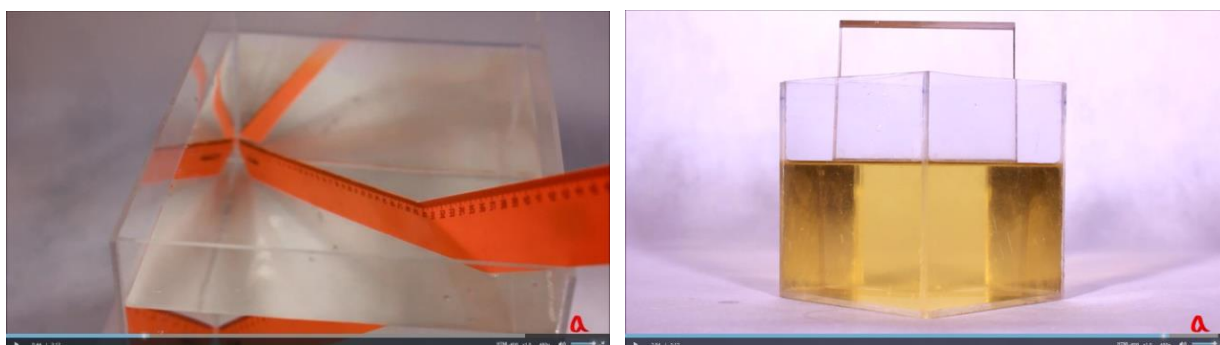


Fig.5. Screenshots of video "Light Refraction".

3. Go to <http://school-collection.edu.ru/collection/> . Using the clues to execute the virtual laboratory work (Fig. 6)

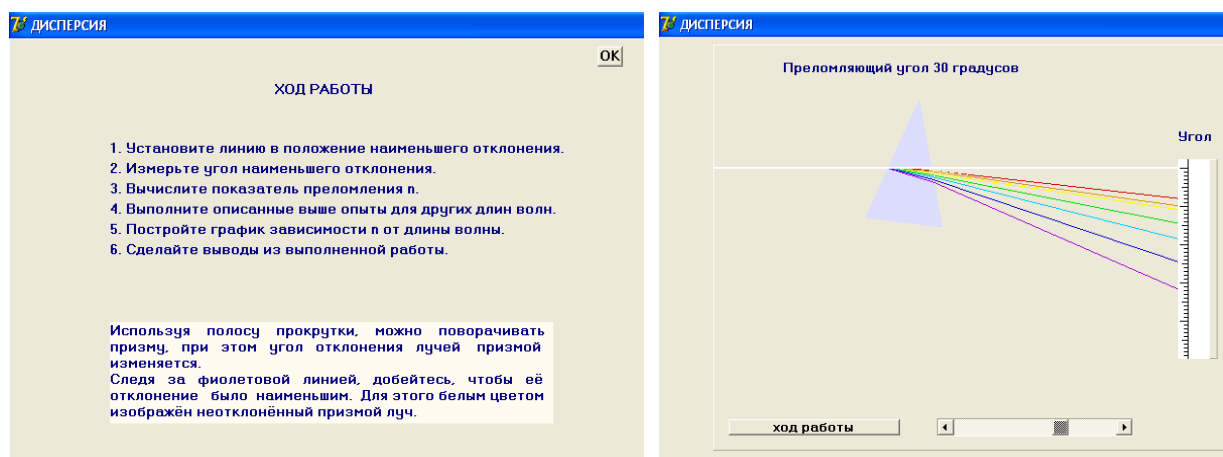


Fig.6. Virtual laboratory work "Light Dispersion Study" screenshots.

Conclusions and prospects of further research.

So, it can be argued that information technologies in the field of educational process organization in Physics substantially influence on the method of students' work and the results of their activities. ICT tools enable the teacher of higher education institution to introduce in the educational process differentiated, person-oriented and individual approaches to the organization of students' educational activities.

The practical implementation of the developed methodological recommendations with the use of information technologies has shown the increasing of the efficiency of students' work at laboratory session in Optics implementation. Besides, the ICT tools gives the possibility to intensify this process through operative access to information and significantly expanding search for the forms and methods of future teacher's professional activity.

The prospects of further research in this direction are development and implementation of the methodology of ICT tools use in conducting practical lessons in Optics.

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ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ ЯК ЗАСІБ ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ ПІДГОТОВКИ МАЙБУТНІХ УЧИТЕЛІВ ФІЗИКИ ДО ЛАБОРАТОРНОГО ПРАКТИКУМУ З ОПТИКИ

У статті проведено аналіз реалізації проблеми використання інформаційних технологій як засобу підвищення ефективності підготовки майбутніх учителів фізики до виконання лабораторного практикуму з оптики. Схарактеризовано проблеми і суперечності щодо використання засобів ІКТ у закладах вищої освіти, робота яких спрямована на підготовку майбутніх учителів фізики.

Зважаючи на специфіку підготовки майбутніх учителів у закладах вищої освіти, вимоги ринку праці та суспільне замовлення, виділені основні ІКТ-засоби, які є ефективними при самостійній підготовці студентів до виконання лабораторного практикуму. Розроблений перелік електронних ресурсів розподілений на блоки відповідно до тематики лабораторних робіт з оптики. Приділено увагу методиці використання засобів ІКТ при підготовці майбутніх студентів до виконання робіт лабораторного практикуму на прикладі окремих тем.

Ключові слова: інформаційні технології, ефективність підготовки, майбутній учитель фізики, лабораторний практикум з оптики.

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ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ КАК СРЕДСТВО ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ ПОДГОТОВКИ БУДУЩИХ УЧИТЕЛЕЙ ФИЗИКИ К ЛАБОРАТОРНОМУ ПРАКТИКУМУ ПО ОПТИКЕ

В статье проведен анализ реализации проблемы использования информационных технологий как средства повышения эффективности подготовки будущих учителей физики к выполнению лабораторного практикума по оптике. Охарактеризованы проблемы и противоречия относительно использования средств ИКТ в высших учебных заведениях, работа которых направлена на подготовку будущих учителей физики.

Учитывая специфику подготовки будущих учителей в высших учебных заведениях, требования рынка труда и потребности общества, выделены основные ИКТ-средства, которые являются эффективными при самостоятельной подготовке студентов к выполнению лабораторного практикума. Разработанный перечень электронных ресурсов разделен на блоки в соответствии с тематикой лабораторных работ по оптике. Уделено внимание методике использования средств ИКТ при подготовке будущих студентов к выполнению лабораторного практикума на примере отдельных тем.

Ключевые слова: информационные технологии, эффективность подготовки, будущий учитель физики, лабораторный практикум по оптике.