Modern Approach to Creating University Learning Courses: Using Network Ideas for Creating a Hypertext (On Example of Courses on Physics and Concepts of Modern Science)

A. V. Barmasov[1,2(✉)], A. M. Barmasova[2], E. N. Stankova[1], M. N. Bukina[1], D. A. Lisachenko[1], and S. O. Vysotskaya[1]

[1] St. Petersburg State University,
7-9, Universitetskaya Nab., St. Petersburg 199034, Russia
{a.barmasov, e.stankova}@spbu.ru, {mariabukina72, l23sony}@rambler.ru, da@fr.spb.ru
[2] St. Petersburg State Pediatric Medical University,
2, Litovskaya ul., St. Petersburg 194100, Russia
abarmasova@yandex.ru

Abstract. The total computerization of the last decades changes the structure of the information, the way of its use and the nature of human thinking. Science is rapidly developing, the inter- and trans-disciplinary links arise, and education becomes more intensive, but it also has its new problems. The way of thinking, the textbooks and education need to be adapted, combining the speed and flexibility with the stability and integrity of course units. In this situation, the digital educational information and the learning process itself acquire some hypertext (HT) features with its pro et contra which needs to be considered. We believe that a course should be built around a minimalist core, which contains all basic concepts, is closed and self-sufficient, and is surrounded by relatively independent HT-type structures with well-defined limits. We implement this concept based on our extensive teaching experience in a wide range of matters (physics, natural science, linguistics), at various levels and within different extents of courses.

Keywords: Computer technology · Hypertext · Teaching physics · General physics · Laboratory practicum · Virtual laboratories · E-lab · Computer mind · Clip thinking · Algorithmization in physics and language teaching

1 Introduction

As we know, the computer is not only a tool for all kinds of information processing, such as computing, search, representation, organization, etc., but it also affects the thinking style [1], although in different ways, depending on whether a person had studied programming and improved his thinking in the algorithmic direction, or just used a computer for entertainment. In the latter case, there will be mosaic thinking [1].

© Springer Nature Switzerland AG 2019
S. Misra et al. (Eds.): ICCSA 2019, LNCS 11622, pp. 655–666, 2019.
https://doi.org/10.1007/978-3-030-24305-0_48

In general, the computer age stimulated an increasing interest in hypertext (HT), its history and theory [2]. Furthermore, the computerization (and the progress as a whole) greatly influenced the technology and the quality of teaching and learning: (a) the diversity and the availability of textbooks increased, (b) the virtual learning technologies emerged, (c) the nature of thinking, perception, and comprehension changed.

We need to take it into account and try to get some benefit from it. This is the goal of our article: to give our understanding of specific problems and to suggest some techniques in order to improve the quality of teaching in three groups of matters where we have an extended convergent experience: (a) Physics for faculties of natural sciences [3–5], (b) Concepts of Modern Science (CMS) for students in humanities, (c) Foreign language for scientists [6–8].

HT has been extensively studied in linguistics, computer and cognitive studies [9]. In turn, we use this concept for a very practical purpose, as a theoretical basis for efficient high school courses. All the techniques described below were tested successfully in several St. Petersburg universities.

2 Modern Computer and Network Technologies Used in the Teaching of Physics at the Universities of St. Petersburg

In order to better understanding the HT meaning in education, we give a brief overview of our educative techniques and consider the role of digital techniques. It is not enough now to have only "printed course" [10–16]. This printed publication can and should be supplemented with advanced multimedia materials [17–19]. An imaginative visualization obtained by using multimedia materials is widely used also in order to bring the "theoretical" science in everyday life. The main feature of these courses is the degree of coverage of practical issues and their relevance. Among the main features of such courses is that a large amount of the background material allows using this knowledge during laboratory and practical studies, and links to Internet sites are provided where students can find additional and more detailed background information [11–15, 20, 21].

Blackboard Learn-Learning Management System (LMS Blackboard Learn) [22] and distance learning system – MOODLE (an acronym for Modular Object-Oriented Dynamic Learning Environment) [23] are used as platforms for creation, storing and presentation of various educational materials [21]. Almost the only important difference of these two systems is that Blackboard Learn is a fully commercial product; while MOODLE is open-source software using the "freemium" payment model (one gets the basic elements free of charge, but must pay for extra options). If one needs a powerful system and has the resources to pay for it, then Blackboard will be a good choice (e.g. the authors use it at St. Petersburg State University since 2012). If the budget is limited, but the ambitions are still high, MOODLE will be a good choice (e.g. Russian State Hydrometeorological University) [21].

Good results are obtained by conducting part of the lectures in the format of conferences, when students, after listening to another section of the general physics course, prepare reports on the basics of the physics of natural phenomena and processes occurring in living systems, based on materials prepared by their teachers [e.g. 17, 19, 21, 24–30].

Writing laboratory reports usually causes a lot of problems for university students. That is why a virtual group in a social network (vk.com/physlab) was created where students can find regularly updated information on the equipment in use, download needed brochures, textbooks, and tests, and get useful links and other necessary information. They also can contact their tutors by means of chat [34].

The authors have accumulated experience of teaching physics to medical students at St. Petersburg State University (Department of Medicine, Department of Dentistry and Medical Technologies), and at St. Petersburg State Pediatric Medical University, and have written several training manuals, taking into account this specificity [15, 16].

It is very important to give medical students basic knowledge, e.g. about telemedicine. The main purpose of telemedicine is the medical service of the remote patients who are far from the medical centres and have limited access to medical services. The telemedicine is based on modern technologies of transmitting and reproducing data that supports videoconferences and allows sending high-quality digital images at a distance in an effort to render more perfect reanimation aid, the fastest transportation of the patient and accelerated medical decisions. The telemedicine is impossible without experts having skills of working in remote locations. Medical school students can acquire such skills in the process of training within the grid segment, performing virtual labs and studying the educational materials in the remote access mode [21].

The infrastructure prototype of a distributed educational system developed by the authors can be viewed as a grid segment consisting of 5 sites located at St. Petersburg State University, St. Petersburg State Pediatric Medical University, Russian State Hydrometeorological University, St. Petersburg Mining University and St. Petersburg Electrotechnical University LETI. This Grid infrastructure could provide equal access to all kinds of resources for the students and lecturers in order to teach and study physics more efficiently [21].

The prototype of an informational infrastructure of a program instrumentation complex for carrying out a laboratory practicum on physics in a university should include: instrumental part for carrying out real physical experiments with the available equipment, program complex of virtual laboratories and a document management system, enabling students to learn the descriptions and to write reports on the laboratories and enabling professors to record student's results and to rate student's work appropriately [31–33]. Various scenarios for conducting classes in a virtual laboratory for both undergraduate students and masters, the ways of expanding the subject and technical capabilities of the virtual laboratory, methodical recommendations, and their possible technical solutions are offered in [33].

3 Theoretical Remarks

The Hypertext Notion. We understand the hypertext (HT) as a network with a text in its nodes, and we take into account the idea that the network representation of information is somewhat similar to the nature of the brain [9]. For our purposes, we will

distinguish disciplinary, inter-disciplinary and trans-disciplinary courses, where inter-disciplinary means the junction between two or more different sciences, while the trans-disciplinary refers to a network structure itself as a whole, with the elements of particular sciences in its nodes. Close vicinity (physics and chemistry, biology and medicine for example) is not required, but on the contrary, all interconnections are possible [1]. We do not restrict ourselves to a linear sequence of pages in a typical textbook, but we use the networking ideas [1].

Nowadays the educational texts are often in free access, with very easy navigation, so the content of HT, its meaning and understanding depend on result from the actions of the reader [1]. Normally a student cannot do it well and should not do it himself. This is why the primary task of today's teaching is not to provide information (which can be easily googled out), but rather to analyze it, systematize and construct causal relationships. In other words, we need not raw information, but a product of its deep processing being a basis of progress in advanced countries. The essence of education is the creation of a high value added information product, but not a waste of primary information resources.

We do not intend to estimate the HT as "good or bad", but we consider it as a reality of our world and try to rebuild the educative process according to the new information environment and the new train of thought, where the problem is not to get the information, but to select, reorganize and understand it.

Consider some HT peculiarities and issues arising from the practical use of courses and textbooks on physics, contrasted to CMS.

Physics: Courses must be logical and consistent, with a minimum of sudden transitions to other topics, approaches, definitions or systems of units over the network, because the aim is to build a good understanding of nature: the students learn to understand and, more importantly, create logic links and conclusions. And a self-consistency of the course must be never lost at any level. No runaway is expected.

CMS: The main task is to interest humanist students in sciences; so many comparisons, analogies, and links should be revealed between different sciences in order to show their close relationship, while strict qualitative results and perfect logic links are not expected. However, the students are not suggested to create or reproduce these links. So the HT trajectory in the CMS course can be run in an unlimited number of ways and directions, depending on the demands and interest of students.

4 HT and Textbook Paradoxes

Consider from the HT point of view some paradoxes associated with modern digital textbooks, compared to the paper age.

A Textbook and a Person. HT is often characterized by a fast run away from a starting point [1]. This is also a case of some large paper textbooks, for example [10–16], with lots of references to other pages, chapters, and volumes, followed by other references, even in rather simple cases. In such books, it is often hard to learn a separate paragraph because it is hard to understand where it begins and stops and it contains too many

references appearing stochastic for a novice reader. These books are not suitable for initial learning, but they can be rather an encyclopaedia for advanced studies.

Let us compare in terms of HT the interrelations of a textbook with an author, a teacher and a student.

Author: He (she) perfectly knows all the content and all the HT links in his book, fluently jumps between chapters and volumes in all simple and complicated cases, easily draws up links and analogies. Is sometimes unable to understand why students have problems when reading. The reason is that we can consider a physics textbook as written in some "foreign" language (formulas and logic) which is a kind of native language for the author. But we know that a native speaker is often unable to notice the problems in his own grammar [5].

Teacher: Is able to read and decode the HT of the author, but rarely follows it as a whole. Usually creates his own sequence from various sources

Student: Can easily be lost in a complex network structure of the textbook, jumps to other sources of information and is definitely lost.

What can a good teacher do for a real student? A good teacher may be considered as a "walking HT" who perfectly masters the material and all the interconnections feels the ambiance in the classroom and strictly follows the main trajectory, while making some improvisation when needed.

A Volume Paradox. Many textbooks have a similar thickness in spite of their level. About 300 pages in physics for a secondary school, the same for departments of biology or physics, a theoretical monograph and so on. In school textbooks, there are only a few formulas, but a lot of text, which is usually written for better understanding. However, note that five text pages need five times more efforts for understanding than only one page.

An Abundance Paradox. As our experience shows, a textbook longer than 100 pages is never read in its whole. Especially in the digital age where the choice of paper books is huge (in contrast to 40 years ago), and their electronic availability is unlimited. The knowledge risks becoming fragmented, mosaic and self-contradictory.

A Runaway Paradox. A runaway over hyperlinks in the age of the Internet, Google and Wikipedia can easily go to infinity. Consider the 5-volume course of physics [10] containing more than 3000 pages. In the paper age, the risk of runaway was noticeable but somewhat limited to these few volumes. Now there are no more limits, and we can quickly jump to other chapters, then to other textbooks, and fall in another system of assumptions and conclusions and finally in a different representation of the world. The runaway may become irreversible, with a kind of "phase transition": what will happen first, a correct understanding (of physics in our example) or a runaway to infinity. Maybe there are some kinds of attractors in such random travel, but one has to find a good one. We can compare this to the Mandelbrot set: it is very complex but invariant: a point from inside will not run away. Therefore, we can suggest a criterion for an educational HT: is it possible, in a real learning process, to stay within a few pages/paragraphs/chapters, and what is the average risk to run away too far, especially when only a small part of a course is to being studied.

Besides the runaway phenomenon, there also can be some points of the HT textbook with no entry. For example, inside long paragraphs, we can found some blocs whose importance is not restricted to this paragraph and which should constitute a separate paragraph referenced in the table of contents and is used in other paragraphs. Only a teacher (and not a student) can discover it and appreciate its importance.

All these paradoxes are not a hard problem for a teacher, but they usually overcome the student's abilities. Therefore, there is a great need for a brief, complete, consistent, clear course, which can be a kind of basis for an extended advanced course and can be adapted on the fly to any reality. This is just what we are doing. We believe that it can be an HT structure, and its basis can be a modular structure briefly described in [3].

Our team performs all kinds of lectures, seminars and practical works in disciplinary, multidisciplinary and transdisciplinary matters in the range from physics to linguistics for students in science and humanities in all combinations at different levels [3–8, 11–15, 21, 31, 34–43]. So the courses must be very flexible and adapted for a fast restructuring.

5 Modular Structure of Physics Course

Let us give our vision of a minimum core in the course of physic. It should be a simple but complete, self-consistent and relatively independent description of a relatively complete set of physical phenomena. All logical chains and main HT nodes should be well visible [3]: Assumptions – Basic descriptions – Mathematical developments – Applications. All the needed links are internal. All formulas are derived in a simple and clear way, without excessive maths. The external links to more detailed and complex calculations are given, but they are well marked and not mandatory. The mathematical apparatus is given in its most simple form, which can in principle describe a phenomenon under consideration. This core is entirely accessible for students, and the teacher (and an advanced student too) can make use of a system of links. Such HT is easy in use and always correct and self-consistent.

In addition to the thematic principle, logical links are established when different phenomena, usually separated by hundreds of pages, are considered together from a single viewpoint. For example, parallelism in electric and magnetic fields, or a uniform approach to a set of quantum barrier problems (potential well, tunnelling, reflection), or some grammatical aspects [3, 8, 44]. Thus, we create something that can be: (a) read and understood in a reasonable time, (b) studied without the use of other sources, (c) used as a level of knowledge, (d) used as a basis for further study.

Note a similarity to a heterogeneous crystallization or writing a complex program. One of the ways to write a long program is to write a short sketch, which already performs some basic functions required from the program as a whole. Then small changes are made gradually, some blocks and functions added, the program grows up, but at any moment remains well debugged and runnable. Similar ideas allow improving the teaching of foreign languages if we are looking for simple and operable knowledge [6, 8].

Our HT structured course of physics is under construction but we will give some examples.

The Heisenberg Uncertainty Relation. The core is made of classical wave packet and get a purely classical uncertainty relation (the wave packet width in frequency or energy and its length in space or time) $\Delta\omega \cdot \Delta\tau \geqslant \pi$ from the most simple evaluations: we consider a sum of 2 sine waves with close wave numbers (beating), where secondary school knowledge is quite sufficient. Then we declare that this is also the case of the de Broglie wave, where Planck constant appears linking maths to quantum mechanics. Any new idea appears only when it is really needed, and not before. Thus, we obtain a correct result, although with a different numerical factor. This is a typical feature of approximate calculations: a correct idea, a simple calculation, and a reasonably close numerical factor. If needed, one can use [45], where complicated maths is employed for the same subject. By the way, the authors of [45] note that the strictness can be illusory.

The Electronic Structure of Solids. Typically a Schrödinger equation (denote SE this node of HT) occurs in a physics course as a generalization for the de Broglie waves (BW node). Then a particle in a potential well (PW) is investigated using a SE solution. That is, first one goes from BW to SE (and not in the easiest way), and then returns back to the PW node, with an illusory rigour. So we at first complicate things and then simplify them back. To avoid that, we can start with the de Broglie wave in the potential well (go from BW right to PW without going through SE) and immediately obtain the energy spectrum. Then we generalize it to a finite depth of the well, go to a double well, generalize the wave to negative energies (tunnelling) and split the spectrum into sublevels. In a similar way, we consider the statistical physics: the barometric formula can be generalized directly to the Fermi-Dirac distribution and used in metals and semiconductors without going to the general and strict Gibbs theory. When this material will be well understood by the students (but not before), we can go to other HT nodes in the same course containing all the needed mathematics, Schrödinger equations, Gibbs distributions, thus exploring the next level of complexity (Fig. 1).

Our course is being gradually created, and in some time we plan to build a textbook in an electronic form, with selectable levels of complexity, where hyperlinks will be marked and will point to level-defined nodes while maintaining the consistency and integrity of the course.

Linguistics. Similar ideas (initial minimalism followed by added layers, hypertext, and mathematical formalism) can also be used in such cross-disciplinary matter as foreign languages for scientists. Many grammar elements may be given under a strict mathematical-like form. For example, the tenses of verbs can be expressed in terms of basic elements and their combinations [6, 8], a foreign language can be compared to quantum mechanics [5], a business letter be represented under the form of multiple embeddings [6], and a textbook itself can be built as a well fragmented HT-ready material [7].

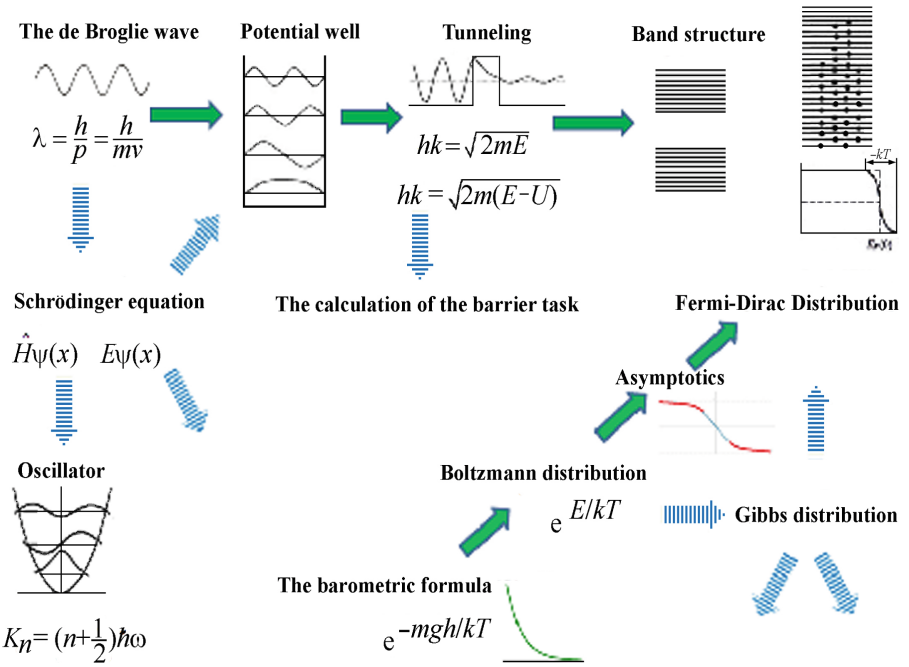

Fig. 1. The electronic structure of solids

6 Conclusions

The computer brings a new life in teaching, at least in three different senses: (1) it provides powerful tools, (2) it changes the teaching process, and (3) it changes the human mind. Everywhere there are pros and contras. Anyway, we all must adapt to a rapidly changing world, including in high school, and the educative techniques must also adapt to the total computerization. We have suggested here some approaches to such adaptation, based on a rigorous selection of primary elements and drawing up a multilevel set of links between them. The already obtained results make us believe that this approach is very promising.

Acknowledgment. This research was sponsored by the Russian Foundation for Basic Research under the projects: 16-04-00494 "Research of functioning of rhodopsin as the canonical representative of the class A receptors, which are the G-protein, by the methods of the local selective NMR, optical spectroscopy and numerical simulation", 16-07-01113 "Virtual supercomputer as a tool for solving complex problems", and 17-03-01372 "Investigation of energy conversion processes in nanoscale structures by vibrational spectroscopy, luminescence, and computer simulation".

References

1. Popova, A.V., Brylina, I.V.: Temporal aspects of education. Siberian J. Sci. **3**(18), 1–10 (2015). (in Russian)
2. Santopaolo, L.: From a gloss to a hypertext. Advantages and disadvantages of dynamic communication. In: Runov, S.A. (ed.) Russia and WTO: New Challenges and Perspectives: International Scientific and Practical Conference, pp. 367–375. Znanie, Novokuznetsk (2013)
3. Bukina, M.N., Barmasov, A.V., Lisachenko, D.A., Ivanov, A.S.: Modular design of general physics course for students in natural sciences. In: Modern Educational Technology in the Teaching Natural Sciences and the Humanities: Proceedings of the III International Scientific-Methodical Conference, 7–8 April 2016, pp. 814, 350–355. Mining University, St. Petersburg (2016). (in Russian)
4. Barmasov, A.V., Barmasova, A.M., Bukina, M.N., Zinkevich, E.R.: Modern trends in teaching of physics for medical students (Prepared for publication)
5. Lisachenko, D.A.: Quantum mechanics as a foreign language: interaction of educative methods. In: Innovative Educational Technologies: Proceedings of II International Scientific Conference (Kazan, May 2015), Kazan, Buk, pp. 189–192 (2015)
6. Lisachenko, D.A.: Teaching of foreign languages to students in science and engineering. In: Fokin, S.N. (ed.) Roman Collegium. Interdisciplinary Collection of Scientific Papers. St. Petersburg Economical University (2016)
7. Lisachenko, D.A.: French language. A view of a physicist, p. 198. Logos, St. Petersburg (2003)
8. Lisachenko, D.A.: Le français par la science: une langue étrangère enseignée par un scientifique aux scientifiques. Le français de spécialité. Enjeux culturels et linguistiques. Bertrand, O., Schaffner, I. (eds.), pp. 141–150. Editions de l'Ecole Polytechnique, Paris (2008). (in French)
9. Popov, E.A.: Approaches to the study of hypertext. Vestnik of Pushkin LSU **7**(1), 167–171 (2015). (in Russian)
10. Sivukhin, D.V.: The general course of physics. In. FIZMATLIT, Moscow, vol. 5 (2002–2005). (in Russian)
11. Barmasov, A.V., Kholmogorov, V.E.: Course of general physics for nature managers. Mechanics, Chirtsov, A.S. (ed.), p. 416. BHV-St. Petersburg, St. Petersburg (2008, 2012). (in Russian)
12. Barmasov, A.V. Kholmogorov, V.E.: Course of general physics for nature managers. Oscillations Waves, Bobrovsky, A.P. (ed.), p. 256. BHV-St. Petersburg, St. Petersburg (2009, 2012). (in Russian)
13. Barmasov, A.V. Kholmogorov, V.E.: Course of general physics for nature managers. Mol. Phys. Thermodyn., Bobrovsky, A.P. (ed.), p. 512. BHV-St. Petersburg, St. Petersburg (2009, 2012). (in Russian)
14. Barmasov, A.V. Kholmogorov, V.E.: Course of general physics for nature managers. Electricity, Bobrovsky, A.P. (ed.), p. 448. BHV-St. Petersburg, St. Petersburg (2010, 2013). (in Russian)
15. Barmasov, A.V., Barmasova, A.M., Struts, A.V., Yakovleva, T.Yu.: Dynamics of rigid body. Elements of the theory and the collection of tasks, p. 28. Publishing house of St. Petersburg State Pediatric Medical University, St. Petersburg (2012). (in Russian)
16. Barmasov, A.V., Barmasova, A.M., Struts, A.V., Yakovleva, T.Yu.: Processing of results of measurements of physical quantities, p. 92. Publishing house of St. Petersburg State Pediatric Medical University, St. Petersburg (2012). (in Russian)

17. Bukina, M.N., Barmasov, A.V., Ivanov, A.S.: Modern teaching methods for the teaching general physics and mathematical processing of results of measurements of physical quantities. In: Modern Educational Technology in the Teaching Natural Sciences and the Humanities: Proceedings of the International Scientific-Methodical Conference 27–29 May 2014, pp. 562, 408–414. Mining University, St. Petersburg (2014). (in Russian)
18. Bukina, M.N., Barmasov, A.V., Lisachenko, D.A., Ivanov, A.S.: Modern methods of teaching physics and the concepts of modern natural science. In: Proceedings of the II International Scientific-Methodical Conference on Modern Educational Technologies in Teaching Natural-Scientific and Humane Disciplines, 09–10 April 2015, pp. 732, 516–520. Mining University, St. Petersburg (2015). (in Russian)
19. Barmasova, A.M., Yakovleva, T.Yu., Barmasov, A.V., et al.: Multimedia lecture course on processing of results of measurements of physical quantities for students users. In: Spirin, G. G. (ed.) Abstracts of Scientific-Methodical Workshop on "The Physics in the Engineering Education System of the EurAsEC Member States" and The Meeting of Heads of Physics Departments of Technical Universities of Russia. The Scientific Seminar was Held from, 25–27 June 2007, p. 344, p. 42. Zhukovsky Air Force Engineering Academy, Moscow (2007). (in Russian)
20. Nordling, C.; Österman, J.: Physics Handbook for Science and Engineering. Authorized translation from the English language edition by Barmasov, A.V., p. 528. BHV-St. Petersburg, St. Petersburg (2011). (in Russian)
21. Stankova, E.N., Barmasov, A.V., Dyachenko, N.V., Bukina, M.N., Barmasova, A.M., Yakovleva, T.Yu.: The use of computer technology as a way to increase efficiency of teaching physics and other natural sciences. In: Gervasi, O., et al. (eds.) ICCSA 2016. LNCS, vol. 9789, pp. 581–594. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-42089-9_41
22. Blackboard Learn. www.blackboard.com/platforms/learn/overview.aspx
23. Moodle. https://moodle.org
24. Barmasova, A.M., Barmasov, A.V., Skoblikova, A.L., et al.: Features of teaching general physics to the students-ecologists. In: The Problems of Theoretical and Applied Ecology, pp. 267, 15, 226–241. Publishing house RSHU, St. Petersburg (2005). (in Russian)
25. Barmasova, A.M., Barmasov, A.V., Bobrovsky, A.P., Yakovleva, T.Yu.: To the question about teaching general physics to the students-ecologists. In: Abstracts. Meeting of the Heads of Departments of Physics of Technical Universities in Russia. AVIAIZDAT, Moscow, pp. 46–48 (2006). (in Russian)
26. Barmasova, A.M., Yakovleva, T.Yu., Barmasov, A.V., et al.: An integrated approach to the teaching physics to students-nature managers. In: Spirin, G.G. (ed.) Abstracts of Scientific-Methodical Workshop on "The Physics in the Engineering Education System of the EurAsEC Member States" and the Meeting of Heads of Physics Departments of Technical Universities of Russia. The Scientific Seminar was Held from 25–27 June 2007, pp. 344, 40–41. Zhukovsky Air Force Engineering Academy, Moscow (2007). (in Russian)
27. Yakovleva, T.Yu., Barmasova, A.M., Barmasov, A.V.: Interdisciplinary connections in teaching General Physics to students of science and engineering. In: Spirin, G.G. (ed.) Abstracts of Scientific-Methodical Workshop on "The Physics in the System of Engineering and Pedagogical Education of the EurAsEC Member States". The scientific seminar was held in 2008, Moscow, pp. 364, 355–357. Zhukovsky Air Force Engineering Academy, Moscow (2008). (in Russian)
28. Bukina, M.N., Barmasov, A.V., Ivanov, A.S.: Some aspects of teaching physics in high school. In: VIII St. Petersburg Congress "Education, Science, Innovation in the Twenty-First Century". Collection of Works, 24–25 October 2014, pp. 414, 47–49. Mining University, St. Petersburg (2014). (in Russian)

29. Bukina, M.N., Barmasov, A.V., Ivanov, A.S.: Features of general physics teaching to students of natural science specialties in modern conditions. In: The Physics in the System of Modern Education (FSSO-2015): Proceedings of the XIII International Conference, St. Petersburg, 1–4 June 2015, vol. 2, pp. 393, 3–6 (2015). (in Russian)
30. Barmasov, A.V., Barmasova, A.M., Klikunova, K.A., Struts, A.V. Medical electronics. Physical methods in medicine. SPb: Publishing house of SPbGPMU (2019, Prepared for publication). (in Russian)
31. Dyachenko, N.V., Barmasov, A.V., Stankova, E.N., Struts, A.V., Barmasova, A.M., Yakovleva, T.Yu.: prototype of informational infrastructure of a program instrumentation complex for carrying out a laboratory practicum on physics in a university. In: Gervasi, O., Murgante, B., Misra, S., Borruso, G., Torre, C.M., Rocha, A.M.A.C., Taniar, D., Apduhan, B.O., Stankova, E., Cuzzocrea, A. (eds.) ICCSA 2017. LNCS, vol. 10408, pp. 412–427. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-62404-4_30
32. Bobrovsky A.P., Dyachenko N.V., Barmasov A.V., et al.: Electronic lab for laboratory workshop on physics at the university. In: Istomin E.P. (ed.) Interuniversity collection of scientific works "Information Technologies and Systems: Management, Economics, Transport, Law", vol. 2, no. 20, pp. 150, 36–48. SPb: Andreevsky Publishing House LLC (2017). (in Russian)
33. Stankova, E.N., Dyachenko, N.V., Tibilova, G.S.: Virtual laboratories: prospects for the development of techniques and methods of work. In: Gervasi, O., et al. (eds.) ICCSA 2018. LNCS, vol. 10963, pp. 3–11. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-95171-3_1
34. Lisachenko, D.A., Barmasov, A.V., Bukina, M.N., Stankova, E.N., Vysotskaya, S.O., Zarochentseva, E.P.: Best practices combining traditional and digital technologies in education. In: Gervasi, O., et al. (eds.) ICCSA 2017. LNCS, vol. 10408, pp. 483–494. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-62404-4_36
35. Kholmogorov, V.Y., Barmasov, A.V.: The biosphere and physical factors. Electromagnetic fields and life. In: The Problems of Theoretical and Applied Ecology, RSHMU, St. Petersburg, pp. 267, 27–47 (2005). (in Russian)
36. Barmasov, A.V., Barmasova, A.M., Yakovleva, T.Yu.: The biosphere and the physical factors. Light pollution of the environment. In: Proceedings of the Russian State Hydrometeorological University, vol. 33, pp. 84–101 (2014). (in Russian)
37. Yakovleva, T.Yu., Barmasova, A.M., Barmasov, A.V.: The biosphere and the physical factors. Possible hazards of wide application of white LEDs. In: The World Science and Education in Contemporary Society: Collection of Scientific Works on Materials of the International Scientific-Practical Conference, 30 October 2014, Part III. OOO "AR-Consult", Moscow, pp. 42–50 (2014). (in Russian)
38. Barmasov, A.V., Barmasova, A.M., Yakovleva, T.Yu.: The biosphere and physical factors. The geomagnetic field. In: Modern Trends in the Development of Science and Technology, vol. 3–4, pp. 127–131 (2015). (in Russian)
39. Barmasov, A.V., Korotkov, V.I., Kholmogorov, V.Y.: Model photosynthetic system with charge transfer for transforming solar energy. Biophysics **39**(2), 227–231 (1994)
40. Struts, A.V., Barmasov, A.V., Brown, M.F.: Methods for studying photoreceptors and photoactive molecules in biological and model systems: rhodopsin as a canonical representative of the seven-transmembrane helix receptors. Bulletin of St. Petersburg University. Series 4. Physics, Chemistry, vol. 2, pp. 191–202 (2014). (in Russian)
41. Struts, A.V., Barmasov, A.V., Brown, M.F.: Spectral methods for study of the G-protein-coupled receptor rhodopsin. I. Vibrational and electronic spectroscopy. Opt. Spectrosc. **118** (5), 711–717 (2015)

42. Struts, A.V., Barmasov, A.V., Brown, M.F.: Spectral methods for study of the G-protein-coupled receptor rhodopsin. II. Magnetic resonance methods. Opt. Spectrosc. **120**(2), 286–293 (2016)
43. Bukina, M.N., Bakulev, V.M., Barmasov, A.V., et al.: Luminescence diagnostics of conformational changes of the Hsp70 protein in the course of thermal denaturation. Opt. Spectrosc. **118**(6), 899–901 (2015)
44. Lisachenko, D.A., Kuzmin, Yu.I., Sokolov, A.I., et al.: Quantum mechanics and statistical physics. Sokolov, A.I. (ed.), SPb: St. Petersburg Electrotechnical University LETI (1999)
45. Landau, L.D.; Lifshitz, E.M. (eds.): Quantum Mechanics Non-Relativistic Theory (Course of Theoretical Physics), 3rd edn., vol. 3, . Pergamon Press (1977)