LOOK ACADEMIC PUBLISHERS

International Journal of Environmental & Science Education, 2016, **11**(8), 1743-1751

Electronic Learning Courses as A Means to Activate Students' Independent Work in Studying Physics

Viktor Yurjevich Shurygin & Lyubov Alekseevna Krasnova
Kasan (Volga region) Federal University, Elabuga Institute, RUSSIA

•*Received 24 September 2015* •*Revised 10 December 2015* •*Accepted 07 April 2016*

Currently, there are special requirements to the system of higher education, focused not only on imparting knowledge to students, but also on the formation of the continuous need for independent self-education, self-creative approach to getting knowledge throughout their active life. In this regard, the role of students' independent work with its potential to revitalize educational and research activities, to form general and professional competencies, self-education and self-promotion increases significantly. Currently, high-quality educational process is impossible without effective information and communication technologies. Particular importance is attached to the development and use of electronic educational courses which provides that all students of the academic group, without exception, will be involved into the process of learning. However, experience shows that students and teachers are not adequately trained to organize independent work effectively, and there are many issues that need to be addressed. The paper considers the problem of organization of students' independent work in the study of physics through the use of remote modules, and describes the experience of the development and application of electronic learning courses (ELC) for the major sections of physics at the Physics and Mathematics Department in Elabuga Institute of Kazan (Volga region) Federal University. The obtained results prove the importance and effectiveness of the developed electronic educational courses in the study of physics in the context of improving the efficiency of students' independent work when competency approach is used for training bachelors that enhances their competitiveness.

Keywords: physics, higher education, learning process, self-study, distance learning, e-learning course

INTRODUCTION

In accordance with the concept of education modernization the primary goal of higher school is the formation of the graduate's creative personality with a set of competencies that are manifested in the ability to solve problems and challenges in various spheres of human activity, a graduate who is capable of self-development, self-education, professional development, and possesses social and professional

Correspondence: Lyubov Alekseevna Krasnova
Kasan (Volga region) Federal University, Elabuga Institute, Elabuga, Kazan Street, 89
423600, Republic of Tatarstan, RUSSIA
E-mail: l.krasn@mail.ru
doi: 10.12973/ijese.2016.551a

Originally published by Look Academic Publishers in IJESE (ISSN: 1306-3065)

mobility and is capable of innovation activities. Specific role in the formation of the above mentioned qualities is assigned to students' independent work, representing not only a form of the educational process, but the foundation for training a competitive graduate. Today it is necessary to transform a student from a passive consumer of knowledge into an active creator who knows how to formulate the problem, analyse the ways to solve it and attain an optimal result. The degree of students' activity in learning, cognitive and creative process, as well as the effectiveness of the educational process is determined by a competent system and goal-oriented organization of all kinds of independent work. It is no secret that in reality this is far from being true. The results of the work indicate that the systemic nature of student's self-study only is observed in 23% of cases and 77% of students are engaged in self-study only occasionally. It can be explained primarily by the fact that at this stage, both students and teachers are not sufficiently prepared for the efficient organization of students' independent work.

In resolving this issue, emergence of new educational technologies as well as special computer programs offer a wide range of opportunities. For example, V.I. Andreev (Andreev, 2011) notes that in recent years there has been an understanding that good education in the twenty-first century is almost impossible without effective information and communication technologies use in students' training and education , such technologies cover a larger educational space and are given preferencein modern educational activities.

Thus, today, achieving a high level of educational process is impossible without the use of effective information and communication technologies. In this respect, a specific role is assigned to distant learning, which includes the following important aspects:

- appropriate level of modern teachers' training;
- introduction into the educational process of new information and communication technologies (ICT), best practices of domestic and foreign educational institutions in the use of distance education;
- creation of favorable conditions for educational and methodical activities of the teaching staff;
- increase in the proportion of students' independent work in the study of the discipline;
- electronic educational resource bank replenishment.

The problems of distance learning opportunities implementation in teaching practice are considered by many domestic and foreign scholars (Andreev, 2003; Polat, 2006; Sidenko and Khutorskoy, 2001; Burns, 2013; Stephens,, 2007, Shaidullin R.N. et al, 2014; Moore and Anderson, 2012; Soekartawi et al, 2002).

Distant learning is closely related to mobile learning, suggesting training regardless of the location and which is implemented using a variety of portable devices. Using mobile technology allows using various support mechanisms for e-learning in full.

Elements of adaptive learning technology in the form of pedagogical system of forms and methods are particularly important in the present period of distance education. This system involves the identification and registration of the initial level of students' training skills, instant tracking students' results of the current performance and designing individual learning paths.

Questions implementing mobile and adaptive learning presented in the works of scientists (Ivanchenko, 2014; Galeev, 2004; Brabazon, 2007; Attewell, 2005).

Despite the fairly large number of studies on the introduction of remote modules in the educational process, many issues need to be considered. In particular, one of the vital problems is activating students' independent work based on the use of the important elements of distance learning – electronic educational courses.

MAIN

In the face of new demands made to the level of graduates' training, their readiness for professional work,

students' independent work takes on a different status. Students' independent work is defined as a planned individual or collective classroom and extracurricular work carried out within the framework of the educational process under the guidance and supervision of a teacher.

The documentary bases for the organization of university students' independent work in Russia are:

- Federal State Educational Standard, basic professional educational program;
- Provision for the organization of students' independent work;
- Curriculum of students' independent work.

According to the requirements of the Federal State Educational Standard of Higher Professional Education of the third generation to the organization of educational process in the institutions of higher learning up to 50% of the total teaching hours is given to students' independent work. The effectiveness of independent work is achieved, providing it is one of the main coherent elements of the educational process, in which the student is an active participant, rather than a passive object, and on condition it is carried out systematically and regularly.

The Federal State Educational Standard of Higher Professional Education for bachelor's and master's degrees states: "The implementation of competence-based approach should include the widespread use in the educational process of active and interactive forms of training classes (computer simulations, business and role games, case studies, psychological and other training) combined with extracurricular activities with the purpose of formation and development of students' professional skills. Implementation of undergraduate and graduate programs can include e-learning and distance education technologies" (Federal State Educational Standard, 2009).

Thus, in the present conditions the educational process of high quality, involving students' active independent work, is inconceivable without the use of information and communication technologies, the main characteristic of which is the increased degree of interactivity, which is manifested in the use of computer network technology, activating teaching and learning process.

Interactive teaching methods, their opportunities and practical use in higher professional education are considered, in particular, in the studies of Y.V. Gushchin (Gushchin, 2012), N.V. Fisher (Fisher, 2010), E.A. Reutova (Reutova, 2012), R.N. Shaidullin (Shaidullin R.N. et al, 2014), and others. These papers highlight that the use of interactive teaching methods contributes to a more efficient organization of the educational process, in which the student becomes a competent, active participant.

Currently, the problem of using distance learning as a way to improve the efficiency of the educational process is actively discussed in Russian and foreign scientific and methodological literature (Andreev, 2003; Polat, 2006; Sidenko and Khutorskoy, 2001; Burns, 2013; Stephens, 2007). Particular importance in these works is given to the consideration of the features of distance learning, the identification of electronic educational course potential in enhancing students' independent work.

Considering e-learning courses, it should be noted that, on the one hand, they represent a certain set of data (graphics, text, digital, voice, music, video, photo, etc.), as well as printed user documentation. On the other hand, an e-learning course is a program-information component of the training system, the users of which are teachers, students and school administrators (Anisimova and Krasnova, 2015).

Regardless of the content and scope we can identify the following characteristics of e-learning courses:

1. Adequacy. Adequacy of the content refers to: compliance with state educational standards; completeness of educational material that is sufficient for the development of the discipline (section of discipline); support of various forms of learning (individual and collective); support of different types of activities (study of theoretical material, practical and laboratory work); support of different forms of knowledge (border-line, final, self-control); taking into consideration the latest trends in science and technology.

2. The effectiveness of the presentation of information is determined by: the availability of educational resources, simplicity and ease of use and navigation, ergonomics, the presence of tutors - teachers, coordinating students' actions, monitoring and supporting students' activity, providing communication with teachers and fellow students, giving advice, protecting data and providing an opportunity for the data recovery.

3. Cost-effectiveness is determined by the following indicators: long service life, the ability to upgrade in the process, low cost and price, reasonable configuration of the necessary technical and system-wide resources.

The innovative qualities of the ELC include:

- Maintenance of the components of the educational process;
- Receiving information;
- Feedback availability;
- Interactivity;
- Possibility to organize a variety of learning activities;
- Certification (control of educational achievements);
- Remote (distance) full training.

Thus, the use of distance electronic learning courses fits into the framework of a new paradigm of higher education, which is characterized by the following features:

- education accessible from anywhere in the world;
- education throughout life;
- training on the job. (Belyakov, 2004).

METHODS

In recent years, Elabuga Institute of Kazan Federal University (EI KFU) developed e-learning courses in various disciplines in the framework of learning process optimization through remote modules design and their implementation in the process of learning. These resources are available to all students.

LMS MOODLE features and capabilities in the context of remote modules implementation

For the introduction of electronic educational courses aimed at increasing the effectiveness of students' independent work, the most widespread is learning management system (Learning Management System) (LMS) Modular Object-Oriented Dynamic Learning Environment (MOODLE) (Cole J. and H. Foster, 2008). This system allows creating distance learning courses (online courses) including all necessary training, support and control materials (or links to them), as well as procedural instructions in accordance with the discipline curriculum.

The main features of LMS MOODLE include:

- opportunities for placement and updating training and methodological support of the educational course;
- tools for remote consultation of students through forums;

- possibility of regular monitoring of students by reviewing the statistics of logs-in;
- active feedback;
- possibility to be used for remote, as well as full-time study (Ustyugova, 2011).

One of the greatest advantages of LMS MOODLE is its ample opportunity for communication. The system supports exchanging files of all formats between teachers and students, teachers and students sharing their files, andexchanging files among students themselves. Mailing service allows instant informing all participants of the course or selected groups of current events. The Forum provides an opportunity to organize an educational problem discussion that can be carried out in groups. The teacher can attach files of any format to the reports on the forum, the students' answers to the task and his reviews. There is a function of report evaluation – by both teachers and students. The Chat allows organizing educational discussion of individual problems in real time. Communication capabilities of this system allow the teacher to receive students' works instantaneously, check them, correct errors and send back for revision. Such features as a high level of interactive learning, diversity of methods and forms of presenting educational materials, the possibility of a modular structuring of the content, the presence of constitutively active help system, the ability to create an individual education plan, comfort and privacy of study contribute to a significant increase in interest in the subject under study, skills development and activate students' independent work. In addition, the teacher gets an opportunity to quickly and effectively manage these processes. The teacher's role also changes. Rejecting the dominant role in the learning process, the teacher largely fulfills only the function of a mentor, one of the sources of information, an assistant in the process of students' self-development. It should be noted that today's students are psychologically ready for this form of work, and are eager to be engaged in it.

In Elabuga Institute of Kazan Federal University LMS MOODLE is used in the study of individual disciplines by the students of full-time and part-time departments, in the course of the implementation of advanced training programs for teachers, the organization of students' and pupils' research work. The experience in organizing and carrying out remote-service teacher training through e-learning courses is described in the article by Krasnova and Anisimova (Krasnova and Anisimova, 2013) which identifies and develops goals, objectives and structure of distance learning courses in detail. The paper by Timerbaev and Shurygin (Timerbaev and Shurygin, 2014) examines the pedagogical conditions and methodological aspects of the intensification of the educational process and enhancing students' independent work in the study of the course "Theoretical Mechanics" which is based on the use of the ELC

E-learning courses in physics and students' independent work

Let us discuss the experience of the development and use of e-learning courses for the Bachelor of professional training on an example of discipline "Physics". The authors have developed e-learning courses in the following areas of physics: "Mechanics", "Molecular Physics. Thermodynamics", "Electrodynamics" to prepare bachelors in 051000.62 Professional training (for branches of industry). E-courses are located on the Kazan Federal University platform "Tulpar". The introductory parts of the courses contain an introductory video, the curricula of the disciplines, schedules, issues for the exam, as well as general guidelines for the study of the course, both for students and for teachers. It also has links to the open electronic and educational resources in the relevant sections of physics of other universities, news forum and forum for discussing common problems related to work in the system.

Each Learning Module includes the following elements: the necessary theoretical material, didactic materials for practical training, a number of tasks for students' independent work, links to recommended educational publications available in the University library, hyperlinks to external electronic information sources, as well as test items to the organization of intermediate and final control. The study of e-learning material is in parallel with the full-time training.

The theoretical course material is represented in the form of the element "Lesson", where each block of theoretical information is punctuated by test questions, where,in case the answer is wrong, the system returns the student to re-study of the theory. In addition, the unit includes presentations, animations and videos useful in the study of specific issues.

It should be noted that LMS MOODLE provides a wide range of opportunities for the development and use of tests. The system allows creating a wide variety of test items, often of unique types. The most motivating and useful in the study of physics are, in our opinion, such types of tasks as "calculated", "embedded questions" and others. The specific test is formed from the teacher's bank of test items. The test can be configured both in a learning mode and the control mode.

An integral part of the successful assimilation of the course of physics is the ability to solve specific problems. Solving problems requires systematization and consolidation of knowledge gained in the study of theoretical material and an ability to use additional and reference books. Therefore, each module of the course contains a description of the methodology and examples of problem solving on the subject. To monitor mastering the relevant skills and abilities it is supposed that students perform individual independent work. This is done by means of assignments with answers in the form of a file that is sent to the teacher. Communication capabilities of LMS MOODLE allow the teacher to receive students' works instantaneously, check them, correct errors and send back for revision. The results of the work help to evaluate the level of practical mastery of the theoretical course of the subject.

Laboratory work, according to the curriculum, is performed in specialized laboratories. The student can do all preliminary work remotely: to study the work description, to prepare the necessary tables for the measurement results, to undergo appropriate testing and gain admission to the fulfillment of work.

There are also tasks in the structure of courses with elements of the biographical method, the content and significance of which are described in the article by F.M. Sabirova (Sabirova, 2013). This is the database "Outstanding scientists". Students completing this task, study the biographies of scientists who made significant contributions to the relevant section of physics, the history of scientific thought. This leads to a deeper understanding of the subject, allows making the process of learning physics closer to humanities, as endowing the study with information of a biographical character allows revealing the context of a physical discovery of the law or phenomenon. In addition, students are encouraged to write a paper on one of the suggested topics related to the history of physics. Moreover, the system makes it possible to involve students in the process of verification and evaluation of abstracts. Experience shows that the use of elements of the biographical method in the self-study promotes interest in the subject, improves the quality of bachelor training.

It should be noted that each course is self-developing, for such its features as "wiki", "database" and interactive

glossar assume that they are filled in jointly by all students under the teacher's supervision. This leads to the improvement and enrichment of the course content, after every student group has studied it and made theircontribution into the content. The feedback is provided by a large number of evaluation elements, which allows active using of score-rating system, as well as forums and chat rooms.

Services "Messaging" and "Comment" are intended for individual teacher - student communication, reviewing students' papers and discussing current learning problems.

An important feature of e-learning course in LMS MOODLE is that the system creates and stores portfolio for each student: the submitted works, students' ratings and teacher's comments on the works, and forum messages. The final statement of all students' results when working with distance courses can be converted, for example, into a document Microsoft Office Excel.

A very useful component of LMS MOODLE in terms of research, analysis of the results and effectiveness of this form of learning is an element of "survey". This element suggests that for every question there are offered several answers from which the student is to choose one. Such elements have been built in by us in every e-course. We used such questions that allow determining the effectiveness of e-learning courses and types of students' independent work in the context of motivation, self-development, and formation of certain qualities and competences. It is significant that the system retains all the answers in the form that is suitable for subsequent statistical processing.

The analysis of the results of the survey and indicators of students' performance suggests that the introduction of e-learning in the educational process is an important component of modern educational process

RESULTS

The introduction of electronic learning courses in physics into the educational process within the full-time study increases the efficiency of students' independent work. Systematized material blocks of electronic learning courses, easy navigation within the course contribute to regularity and strict compliance with the tasks of independent work under the supervision of a teacher during all the semester. At the same time in case of necessity assistance is provided both in the mode of on-line work and through forums and private messages. Every student's involvement into work, the real marks for the different types of learning activities allow to measurethe quality and quantity of students' independent work. At the same time, the constant feedback, availability of both educational information and work results discipline the students and motivate them for more productive self-study.

The use of e-learning courses in the study of the relevant sections of physics allows the teacher to effectively organize the students' independent work outside the classroom, to help to navigate among the various sources of information, to get to observewho of the students is engaged in distant study, how successfully the students study the material, how much time they devote to the study of a particular topic. All these data are recorded in the log of student performance, which is generated automatically, without teacher's additional efforts.

The designed courses have been successfully used as separate remote modules in the study of physics sectionsand in the preparation of students to a centralized online testing of basic knowledge in physics.

DISCUSSIONS

In August 2014 Kazan Federal University was attended by representatives of the Open University of Great Britain, who praised the university experience in the field of e-learning, in particular, the created open electronic catalogue of e-learning courses developed by KFU teachers which is used in support of full-time and extramural learning programs in higher professional education and retraining.

The delegation noted that Kazan Federal University successfully uses learning management system LMS MOODLE as the basis of the educational process. This

system allows creating rich methodically complete e-learning courses, including several dozen of specialized components such as object "Lecture", assignments and tests of various types, forums, chats, glossaries, objects "Hot Potatoes", etc., which provides a high degree of interactivity in learning, enables the teacher to monitor the students' educational trajectories, to realize various methods of instructional design).

CONCLUSIONS

As practice shows, the organization of educational process and independent work on the basis of electronic learning courses increases the students' enthusiasm. In the students' opinion, independent work on the basis of e-learning courses in physics is an important complement to traditional forms of learning. Work in the on-line mode is natural for today's students. This form of education is useful and convenient, it helps to make self-study more active, allows monitoring the results, participating in the discussion of problematic issues, working closely with both the teacher and group mates. E-learning courses allow each student to build individual trajectories of development and learning, ensure optimal formation of professionally important qualities and competencies.

Moreover, the development and use of electronic learning courses by the teacher benefit to the process of the teacher's self-development. Designing e-learning courses, selection, development of material, placing it in LMS MOODLE, organization of work with students in a virtual learning space on-line, are no easy. Despite all the difficulties, each teacher receives valuable information and experience in his/her professional luggage. In addition, to ensure prompt resolution of issues on the design, methodological and learning material placement, introduction of the designed e-learning course in the learning process, the control of students' independent work the Department of Educational Resources of Kazan Federal University conducts remote 24-hour teacher training program "Theory and practice of using LMS MOODLE in learning", which is an important factor in the further productive activity in this area.

Thus, in the present conditions properly planned, organized and controlled students' independent work is of great importance in the professional formation of future specialists. It is not only a prerequisite for students' achieving high learning results, but it also reveals their interests and motives, promotes the formation of professional and personal qualities, teaches self-control, self-esteem and lays the foundation for further self-development. In this regard, e-learning courses as one of the main tools of the educational process in different forms of training are a powerful means for managing and monitoring students' independent work.

In our view, the issues raised in the article are relevant and require further study. In particular, the question of remote modules application in the organization of various types of independent work in preparing the Master is still to be considered.

ACKNOWLEDGEMENT

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

REFERENCES

Andreev, A.A., (2003). Distance Education in the System of Continuous Professional Training. Innovations in Education, 4.

Andreev, V.I., (2011). Resource approach to foster innovation and self-development of the individual in terms of higher pedagogical education. *Education and self-development*, 1(23): 3-7.

Anisimova T.I., Krasnova L.A., (2015). Interactive Technologies in Electronic Educational Resources. *International Education Studies*; Vol. 8, No. 2: 186-194.

Attewell, J., (2005) *Mobile technologies and learning: A technology update and m-learning project summary*. London: Learning and Skills Development Agency. URL: http://www.m-learning.org/docs/The%20m-learning%20project%20-%20technology%20update%20and%20project%20summary.pdf

Belyakov V.S., (2004). Distributed University as a form of increased access to modern higher education.*University Management: Practice and Analysis,* 5-6(33): 173-178.

Brabazon, T., (2007) *Mobile Learning: the iPodification of Universities.* URL:

Burns, M., (2013). *Distance Education for Teacher Training: Modes, Models and Methods*. URL:

Cole J. and H. Foster, (2008).*Using Moodle. Teaching with the Popular Open Source Course Management System, Sebastopol*, CA: O'Reilly Media, Inc., 266 p.

Federal state educational standard of higher education in the direction of training 051000 "Vocational training" with the qualification (degree) "bachelor". Ministry of Education and Science of Russian Federation. 22.12.2009 # 781.

Fisher, N.V., (2010). Innovative technologies in professional education. *Vestnik of Adygei State University. Series 3: Pedagogy and Psychology*, 1: 113-118.

Galeev, I. H. (2004). The development of adaptive learning technologies. *Bulletin of the Voronezh State University,* 4: 76-83.

Gushchin, Y.V., (2012). Interactive teaching methods in higher education.*Psychological Journal of International University of Nature, Society and Man "Dubna"*, 2: 1–18

http://edutechdebate.org/distance-education-for-teachers/distance-education-for-teacher-training-modes-models-and-methods/

http://www.iiav.nl/ezines/IAV_607294/IAV_607294_2010_3/Brabazon.pdf

Ivanchenko, D.A., (2014) Management of mobile technologies in the information space of the modern university, *Higher education in Russia*, 7: 93-100.

Krasnova L.A., Anisimova T.I., (2013). Particularities of Remote-Acting Courses to Upgrade Teaching Qualification. *World Applied Sciences Journal 27 (Education, Law, Economics, Language and Communication):* 158-161. URL: http://www.idosi.org/wasj/wasj27(elelc)13/33.pdf. doi: 10.5829/idosi.wasj.2013.27.elelc.33

Moore, M.G. and Anderson W. (2nd ed. 2012). *Handbook of Distance Education.Psychology Press.*Taylor and Francis.

Polat, E.S., Moiseeva, M.V., Petrov, A.E., (2006). *Educational technology of distance learning.* Moscow, Academia. 400 p.

Reutova, E.A., (2012). *The use of active and interactive teaching methods in the educational process*. Novosibirsk, NSAU Publishing House. 58 p.

Sabirova F.M., (2013). Opportunities of Biographic Method in Improvement of Physics Teacher Training. *World Applied Sciences Journal,* 27: 294-298.

Shaidullin R.N., Safiullin L.N., Gafurov I.R., SafiullinN.Z., (2014). *Blended Learning: Leading Modern Educational TechnologiesProcedia - Social and Behavioral Sciences*, Volume 131, 15 May 2014, Pages 105-110. doi: 10.1016/j.sbspro.2014.04.087.

Sidenko, A., Khutorskoy, A., (2001). Remote advanced training. *Public education*, 5: 79-86.

Soekartawi, Haryono, A. & Librero, F. (2002). Greater Learning Opportunities Through Distance Education: Experiences in Indonesia and the Philippines. *Journal of Southeast Asian Education*, Vol. 3, No. 2, pp. 283-320.

Stephens D., 2007. (July 2007). *Quality issues in distance learning*. Data Views 06.09.2013 www.aacsb.edu/publications/whitepapers/quality-issues-distance-learning.pdf.

Timerbaev R.M., ShuryginV.Yu., (2014). Pedagogic Condition and Methodological Aspects of Education Intensification on the Course "Theoretical Mechanics". .*Life Science Journal*, 11(12): 405-408.

Ustyugova, V.N., (2011). *Work of the student in distance learning system MOODLE: a tutorial.* Kazan, TSHPU, 59 p.

◈⊙◈