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Particularities of blended learning implementation in teaching physics by means of LMS Moodle

Particularidades de la implementación del aprendizaje combinado en la enseñanza de la física por medio de *LMS Moodle*

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Content

ABSTRACT:

Currently e-learning has become an integral part of university education. It is also an integral part of distant education, which is now rapidly developing. One of the most effective patterns of modern higher education is blended learning that combines traditional classroom activities with elements of distance training, and makes a wide use of modern information technology. The study covers the authors' experience in the implementation of blended learning in teaching physics through LMS Moodle to undergraduates who follow the Professional Education program "Energetics". It focuses on the structure of the distant education modules developed by the authors as well as on the methods of their use. While analyzing the results, the authors came to the conclusion about educational expediency of blended learning modules in the framework of undergraduate programs.

Keywords: physics education, learning process, distance learning, blended learning, e-learning course,

RESUMEN:

Actualmente el e-learning se ha convertido en parte integral de la educación universitaria. Es también una parte integral de la educación distante, que ahora se está desarrollando rápidamente. Uno de los patrones más efectivos de la educación superior moderna es la mezcla de aprendizaje que combina las actividades tradicionales de aula con elementos de formación a distancia, y hace un amplio uso de la tecnología de la información moderna. El estudio cubre la experiencia de los autores en la implementación de aprendizaje mixto en la enseñanza de la física a través de LMS moodle a los estudiantes universitarios que siguen el programa de educación profesional "energética". Se centra en la estructura de los módulos educativos distantes desarrollados por los autores así como en los métodos de su uso. Mientras analizaba los resultados, los autores llegaron a la conclusión acerca de la conveniencia educativa de los módulos de aprendizaje mixto en el marco de los programas de licenciatura.

Moodle

Palabras clave: educación física, proceso de aprendizaje, aprendizaje a distancia, aprendizaje mixto, curso de e-learning, moodle

1. Introduction

Currently, achieving a high level of educational process is impossible without an effective use of information and communication technology (ICT). Modern technologies (in particular, the Internet) provide teachers with many interesting tools that can be used to improve the teaching-learning process. These tools have proved its efficiency and demonstrated their advantages in many classroom situations (Ekici, Kara and Ekici, 2012). E-learning is now the most important element of distance learning (Embacher and Primetshofer, 2008).

Distance learning technologies are applied at various levels of education: at schools (Psycharis, Chalatzoglidis and Kalogiannakis, 2013; Udaya Sri and Vamsi Krishna, 2014), universities (Costello, 2013), within additional educational programs and refresher courses (Krasnova and Anisimova, 2013). The problems of distance learning elements implementation in teaching practice were considered by scientists in many countries (Bonk and Graham, 2006; Banados, 2006; Moore, 2012; Ekici, Kara and Ekici, 2012; Amandu, Muliira and Fronda, 2013; Titova and Talmo, 2014). They are also of significant importance in teaching physics as part of students' special training as well as the means of forming students' general culture and world outlook (Benito, et al., 2007; Gonen and Basaran, 2008; Cole and Foster, 2008; Martin-Blas and Serrano-Fernandez, 2009; Bednarova and Merickova, 2012).

Current researches on distant education leave many unresolved issues. At present it is urgent to determine the place of one of the distance learning models, i.e., to consider the integration of distance learning and traditional forms of learning, based on the direct personal contact of the teacher and the student. This model can be defined as blended learning: e-learning elements are used to address the specific educational tasks. This model can be effective in education, in particular, in the organization of the study of University course of physics.

2. Blended learning as an integrative model of traditional and e-education

E-learning, defined as a learning system using information and communication technologies (Moore, 2012), is now widely implemented in the educational process with the aim of improving its efficiency. The process of e-learning involves online delivery of information, mostly through the Internet and corporate networks of educational institutions or companies. At the initial stages of ICT development, e-learning was a superior form of distance education, which made use of various e-learning tools. It is at that time that the first training courses for different electronic environment found their elaboration. With globalization of the economy and with the use of ICT in various economic spheres, e-learning becomes a tool for corporate education. This was followed by the development of e-learning means, methods of distant learning, different models of e-learning management and approaches to teaching quality assessment. The following years are remarkable for the development of software aimed at comprehensive solution of e-learning problems. Systematization of this process has resulted in emerging of E-Learning Systems (Bonk & Graham, 2006), which include such components as training and content management, monitoring of learning outcomes, delivery of teaching material 'at the right time in the right quantity at the right place', testing systems and online support of learning environment.

Currently, the value of e-learning in higher education is constantly increasing due to the fact that it most fully meets the needs of today's students who are living in the information space. In addition, it stimulates pedagogical innovations and contributes to knowledge exchange and cooperation between universities; it expands the possibilities of distance learning and facilitates the access to education for various categories of trainees (Starichenko, Semenova and

Slepukhin, 2014).

Continual use of e-learning has made it an alternative to traditional face-to-face training. Broadband access to the Internet, which is now available in the most remote areas, allows the teacher to conduct online classes. It supplies the student with textual and graphical information and affords an opportunity to attend and participate in the actual training sessions in real time mode.

The development of ICT allows using e-learning in combination with traditional face-to-face form at all levels of education: school, university, retraining of personnel. It is only natural that this combination must take into account the advantages of each form of learning. The strengths of e-learning include flexibility, individualization, interactivity, the possibility of organizing the educational process for students with different abilities and requests, etc. The strengths of the traditional classroom tuition include an emotional component of personal contact, the spontaneity in the formation of a chain of associative ideas and discoveries. The combination of the advantages of each form laid the foundations for blended learning (Shaidullin, et al., 2014).

Thus, blended learning is a modern educational technology, which is based on the concept of uniting the traditional face-to-face technologies and e-learning technologies based on new didactic opportunities of ICT and modern teaching means.

In all cases, blended learning involves at least three components.

1. Traditional interaction between the participants of education process.

2. Interaction between the participants of education process, mediated by telecom technologies and internet-resources.

3. Self-education component.

3. Blended Learning Management Systems

The basis of e-learning in the modern university is the use of Course Management Systems (CMSs) or Learning Management Systems (LMSs), which are a set of software and hardware based on Internet technology, teaching methods and organizational measures. Currently, there are many LMSs in the world, for example, BlackBoard, WebCT, Top-Class, Claroline, ILIAS, Desire2Learn, Moodle, etc.

In Kazan Federal University (KFU), just like in most leading universities in Russia, the foundation of e-learning is the use of LMS Moodle. Currently, this system is translated into dozens of languages, including Russian, and is widely used in more than two hundred countries. An important advantage of this system is the possibility of free use, which does not provide for licensing, but provides free upgrading and receiving programs. Its programming code is open so you can make your adjustments, and allows managing the entire educational process. One of LMS Moodle advantages is ample opportunities for communication and provision of active feedback. These benefits give a reasonable basis for the creation of e-learning courses including a university course of physics.

In Elabuga Institute of KFU, LMS Moodle is used in the study of individual disciplines by the students of full-time and part-time departments (Ljubimova, Galimullina and Ibatullin, 2015; Shurygin and Krasnova, 2016), in the course of the implementation of advanced training programs for teachers (Krasnova and Anisimova, 2013), the organization of students' and pupils' research work (Samedov, et al., 2015).

4. Materials and methods

The study on the use of blended learning in teaching physics was carried out within the Professional Education program "Energetics" during the first term of 2016-2017 academic year at Elabuga Institute of Kazan Federal University. The number of students involved in the study was 49. Classroom training that was held once a week concerned the main theoretical data and ways to solve physics' problems, and tasks and assignments that the students were to solve

during the following week when doing the e-learning course (ELC). Total amount of hours on the subject is 180, including lectures – 36 hours, practical work – 36 hours, laboratory work – 18 hours, students' independent work – 90 hours; means of control are a credit test, and an exam. Table 1 shows the distribution of teaching hours between types and forms of lessons.

Table 1. Distribution of teaching hours between lesson type and form

	Theme	Lectures		Practical classes		Laboratory work (classroom hours)	Student's independent work, including ELC
		Classroom hours	in ELC	Classroom hours	in ELC		
1	Kinematics	4	4	6	6	4	24
2	Dynamics	8	8	6	6	6	36
3	Mechanical Waves	4	4	4	4	8	20
4.	Fundamentals of special theory of relativity	2	2	2	2	-	10
	Total	18	18	18	18	18	90

5. E-learning course structure and content

E-learning course has a structure containing introductory and thematic part. Introductory part of the course contains an introductory video, the curriculum, schedule, issues for the exam, as well as general guidelines for the study of the subject, both for students and teachers.

It also includes links to open e-learning resources on the relevant sections of physics of other universities, news forum and a forum to discuss common problems associated with work in the system.

Each Learning Module in the thematic part includes the following elements: the necessary theoretical material, didactic materials for practical classes, tasks for students' independent work, links to recommended educational publications available in the university library, hyperlinks to external electronic information sources, and test tasks for the organization of intermediate and final control. The study of e-learning material is synchronized in time and is done in parallel with the traditional forms of full-time study.

The theoretical material of the course is represented in the form of such elements as "lecture", where each block of theoretical information is interspersed with test questions, at the wrong response to which the system returns the student to re-studying the theoretical material. In addition, there are presentations, animations, videos, useful in the study of specific questions of the course of physics.

Notable are the LMS Moodle wide opportunities for the development and use of testing tasks. The system allows creating a wide variety of test items, often of unique types. They include both traditional types of tasks (with an open or close form of response, conformity, etc.), and those that are more complex in structure and content. The latest version of Moodle allows creating 32 task types.

Particularly interesting and useful in the study of physics are, in our view, such types of tasks as "Calculation", "Embedded answers" and "Essays".

In "Calculation" type assignments, the system itself generates for every student a new numerical

data of the test task from the interval given by the originator. The system calculates the correct answer according to the input physical formula. This ensures that every tested student will receive a unique version of the task. Figure 1 shows an example of tasks that three different students will get.

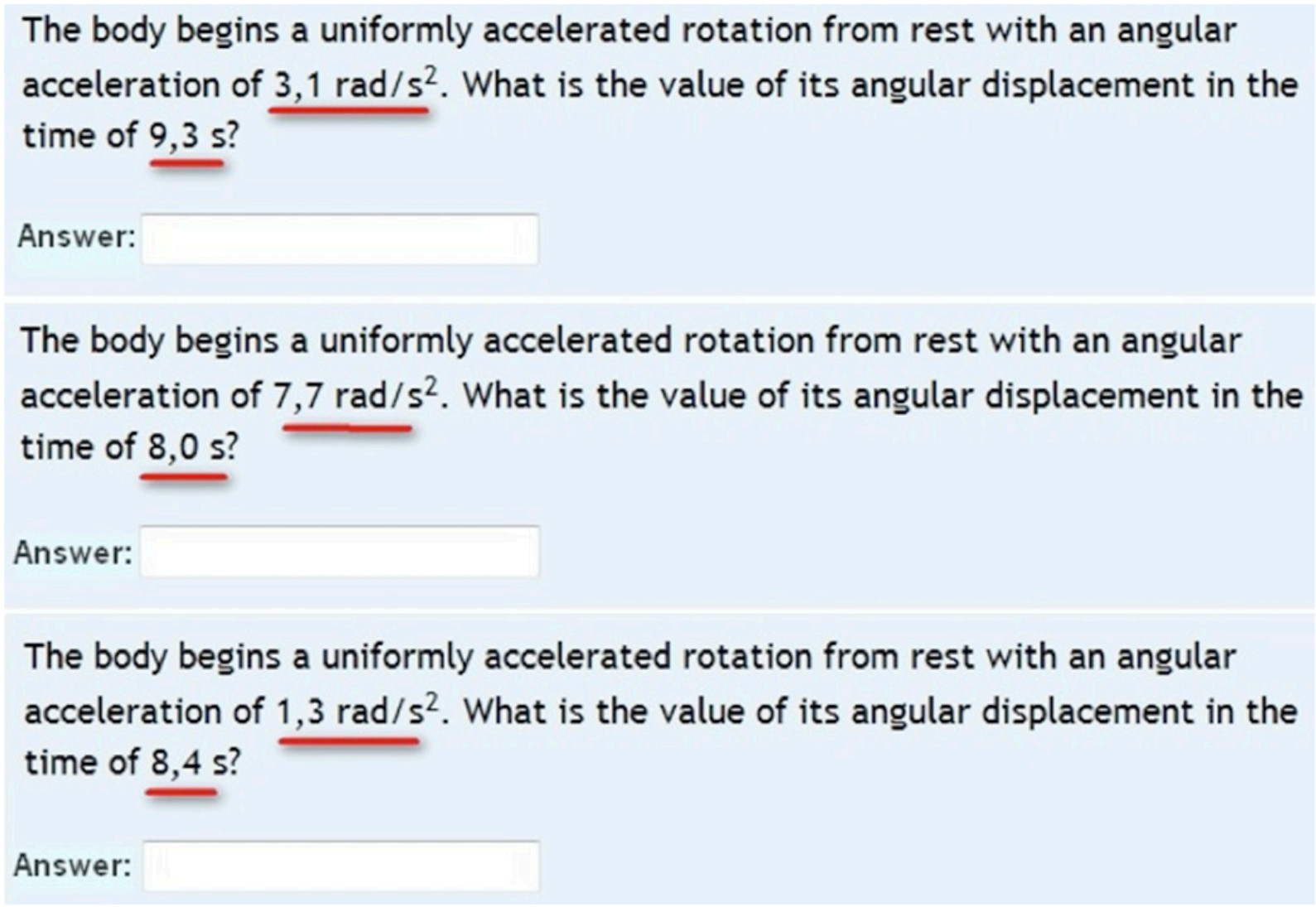
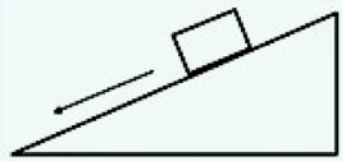


Figure 1. Example of "Calculation" type test task

In the second case, the test task can contain an unlimited number of "sub-questions" of various types. This allows you to control the whole system of the student’s knowledge; abilities and skills by means of one test task (see Figure 2).



A bar with a mass m=1 kg slides down an inclined plane with friction 0.2, placed at an angle of 30 degrees to the horizon. (Accept g=10m/s^2)

The bar is affected by the following forces:

Gravity

Ground reaction force

The force of friction

The rolling force

The force of inertia

In this problem for the inertial force we can take any reference system rigidly connected with .

Under the influence of such system of forces the bar will move with uniform .

Does the acceleration of the bar depend on its mass?

Acceleration of the bar is equal to m/s^2 .

During 2 seconds, the bar will cover a path equal to m.

The ultimate mechanical energy of the bar is the initial one.

What will the acceleration of the bar be, if the surface is absolutely smooth? m/s^2.

In these conditions the ultimate mechanical energy of the bar is the initial one.

Figure 2. Example of "Embedded answers" type test task

The tasks of "Essay" type can use a text or graphic material, or any audio or video file as the content of the question. An example of such task is shown in Figure 3. Such assignments are used by the teacher not only as a means of control, but also as the means of developing students’ skills in explaining the processes and phenomena of nature and technology.

Figure 3. Example of "Essay" type test task

Every particular test is formed from the bank of test items created by the teacher. The test can be set in a learning mode and a control mode.

An integral part of the successful assimilation of physics is the ability to solve specific problems. Solving problems requires systematization and consolidation of knowledge gained in the study of theoretical material, the ability to use additional and reference books. Therefore, each course module contains a description of the methodology and examples of problem solving on the topic. For control of mastering the relevant skills and abilities, the students are expected to 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. LMS Moodle communications capabilities allow the teacher to receive students' work instantly, check them, correct errors and send back for revision. The results of the work determine the degree of practical mastery of the theoretical course of the subject.

Laboratory work, according to the curriculum, is performed in specialized laboratories. Using LMS Moodle allows the students to do all the preliminary work on their own remotely: to study the work description, to prepare the necessary tables for the measurement results, to go through the appropriate testing and get access to laboratory work fulfillment.

It should be noted that each e-learning course is self-developing, as such its features as "Vicky", "Database", an interactive glossary presuppose their joint filling by all the trainees under the teacher's supervision. This activates the students' independent work, and also leads to the improvement and enrichment of the content of each course after being studied by many students.

Feedback is provided by a large number of evaluated items (that allows an actively use of the score-rating system), as well as forums and chat rooms. All the students results obtained in the course of working with distance learning course are recorded in the final list, which is generated automatically and can be converted, for example, in Microsoft Office Excel document and used by the teacher for further processing or debriefing.

For the individual teacher – student communication, such services are provided as "Exchanging Messages", "Comment", in which work review is done, current educational problems are discussed.

The Moodle platform allows a teacher to organize students' research activities which consist in collecting material for a glossary of a particular section of physics, or in selection of different interactive elements for filling the content. Of great interest for students is selection and systematization of historical or biographical information relating to any physical law or phenomenon, and writing essays on the history of physics (Sabirova, 2013). To achieve better results, it is convenient to involve the students in the assessment work and discussions, followed by the final verdict of the teacher.

6. Results

Important components of LMS Moodle in terms of research, analysis of results and the effectiveness of this form of learning are the poll and the questionnaire. The poll offers several answers to every question from which the student must choose one. The questionnaire may contain several questions of different types.

The questions are used to determine the effectiveness of e-learning courses and types of self-employment in the context of students' motivation, self-development, formation of certain qualities and competencies. To obtain objective information, "polls" were conducted after the students have completed training and have taken the exam. The results are shown in Table 2.

Table 2. Students' poll results after e-learning course completion

Using e-learning course…		Fully agree	Agree	Doubt it	Disagree	Entirely disagree
1	contributes to better assimilation of educational material	17	23	6	3	-
2	motivates an active independent work	20	23	4	2	-
3	allows individualizing educational process	23	21	3	2	-
4	develops skills of planning activities	17	20	8	4	-
5	gives an opportunity to gain additional knowledge of the studied subject	26	23	-	-	-
6	increases interest in the studied subject	19	22	6	1	-
7	generates self-evaluation skills	16	19	10	4	-
8	makes knowledge testing most objective	28	20	1	-	-
9	contributes to performance improvement	18	21	7	3	-

7. Discussion and conclusion

The analysis of the results of questionnaire, as well as the comparison of academic performance of students learning with and without the use of the e-learning course, strongly suggest that the introduction of e-learning courses in physics in the educational process in the framework of full-time training improves the quality of the educational process. The use of e-learning courses in the study of the relevant sections of physics allows the teacher to effectively organize the learning process and help students to find their way among the various sources of information, receive information on how well every student studies the content of the course, how much time the student spends to study this or that topic. All these data are recorded in the journal of students' performance, which is generated automatically, without any additional effort of the teacher.

The study of physics based on e-learning courses is an important complement to traditional forms of learning. Electronic modules provide the delivery of learning content to the students; they implement control of knowledge (through the responses to the tasks, intermediate and final testing and other forms of feedback in the learning process).

The use of blended learning for the study of physics in the university has expanded educational opportunities for students by increasing the availability and flexibility of education, by taking into account their individual educational needs and by the rapidity of acquisition.

This was facilitated by the fact that the entire volume of the studied material was in front of them, as a result, the students had the most complete and clear representation of the training material for self study at their own pace. E-learning courses allow every student to construct individual trajectories of development and education, ensure optimum formation of professionally important qualities and competencies necessary for the teacher's professional activity. The students develop such skills as independence, responsibility for learning outcomes, and the ability for feedback. In addition, the teacher changes his/her work style, which develops from mere imparting his/her knowledge into the teamwork with the students. In its turn, it may result in formation of professionally important qualities and competencies required for future professional activity.

The experience of blended learning proved, that the successful implementation and use of e-learning courses in physics should begin with a deep analysis of the learning objectives, the didactic potential of the new training information technology transfer, requirements for blended learning in terms of teaching physics. Moreover, the planning and development of e-learning courses must take into account the basic components of teacher's activities: presentation of educational material, practice, feedback. At the same time, designing e-learning requires taking into account peculiarities of the content of the subject. In particular, a number of physical phenomena can be observed only in scientific laboratories with special equipment, which is not always possible in full-time training. Many micro and macro processes are impossible to visualize without the involvement of electronic resources. Furthermore, it is expedient to use such courses for experiments using computer models and interactive virtual labs.

Thus, e-learning courses in physics, used in teaching, are an important part of the educational process in the blended form of training; they can intensify the learning process, enhance students' independent work, increase students' interest in the studied subject, and are an important means of learning management and monitoring the results.

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