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E-test with physics video demonstrations

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Abstract: Preparation of a comprehensive, engaging, thematic, problem- based learning model of physics should be contribute the mental strategy “Understanding vs. memorizing”. This article presents e-multimedia test, integrated in the LMS “Moodle”. All questions are constructed on a basis of video clips and correspond with the form and the matter of the physics curriculum in engineering courses for machine subjects. The test generator called “Hot Potatoes” has been used for preparation of the test questions. The created e-multimedia test can be used by students to make connections between concrete, real-life phenomena and the abstract ideas and models of physics, understand basic principles and concepts. In so far as learning is structuring and restructuring memory, the students have to explore the real physics world and organize, represent and link received knowledge. Students have to learn not only the applications of laws, principles and facts but also, the most important, they have to learn to think, to understand and explain the phenomena. Presumably, applying instructional model “engage, explore, explain, elaborate and evaluate” should increase the student’s interest of study physics and achieve the educational goals. The distant learners, who have often null opportunity to access to observe the real experiments in the university, can also use it for self- learning and self-assessment.

Introduction

One problem of learning physics is that students have no opportunity to repeat experiments whenever they need or would like to. This lack of concrete experimental experience is first of all caused by practical boundaries: a considerable cost due to very costly equipment and infrastructure, as well as the cost of highly qualified personnel, rather than by educational reasons. The problem can be solved with using the modern information and communication technologies and in particular with using video activity running on a Web browser instead of requiring hands-on experiments [1]. Education has never had as good possibilities of development as now through the use of computers. Computer aided learning introduces new trends in teaching and learning and can enhance the quality of physics education. The innovation of the education process with implementation of multimedia didactic means make demands not only on teachers’ professionalism but also on time and new activity managing. With respect to further development of various forms of education, e.g. extramural studies, distant learning, e-learning and their combination, multimedia in teaching-learning process will be more and more demanded. The main advantage of e-learning is independence of both location and time. It is indeed one of the challenges in e-learning and e-teaching is to create balanced combination of experiment and theory as found in natural and engineering science labs. Modern e-learning needs to be flexible, “just in time” and cost effective, whilst harnessing the most appropriate technological “channels” to provide learning opportunities and to help manage learning.

Assessment is an integral component of the learning process, an ongoing process aimed at understanding and improving student learning. It involves making our expectations explicit and public; setting appropriate criteria and high standard for learning quality; systematically

gathering, analyzing, and interpreting evidence to determine how well performance matches those expectations and standards; and using the resulting information to document, explain, and improve performance. To overcome some of the problems associated with assessing individual contribution of students, it was necessary to involve the students in the assessment process through the use of self-assessment. Self-assessment involves two key elements: the development of knowledge and capacity to make judgments. Self-assessment allows the student to develop metacognitive skills – “the capacity to learn, the capacity to know how to learn, and the capacity to know what he has learned” [2].

In this paper we present the development of a concept of self- learning with e-multimedia tests, integrated in the LMS “Moodle”. All questions are constructed on a basis of video clips and correspond with the form and the matter of the physics curriculum for the students from the mechanical engineering courses at University of Rouse.

Reasons to create the e- multimedia physics tests

Physics is more than knowledge about facts, laws and principles. The most important aspect of physics is the possibility to gain experimentally the knowledge and also to generate and verify these. Therefore, one of the important objectives of laboratory work in physics education is that students acquire skills and concepts about how to do a scientific investigation. Doing investigations is an interaction between doing observations, making predictions, formulating hypotheses, looking for experimental methods to verify ideas, interpreting data and analyzing results. The notion that concept formation [3] is not only directed from phenomena to theory but that it actually takes the form of a cyclic process, means that the every physical concept is intimately associated with a process, where experimentality and theory are joined together [4, 5]. Experiments where this process of "doing physics" is a main objective have to be open ended. In this type of so-called process - lab the human factor has a crucial role in coaching students. In our conception, the most important role of the assistant is to put the problems, to incite permanent the students in order to explain the results and to observe the changes in the phenomenon following the modification of initial conditions. In all these experiments, the determinism principle is demonstrate and students learn not only the applications of laws, principles and facts but, the most important, they learn to think, to find the true way to understand and explain the phenomena.

The experiment was, is and will continue to play a central role in physics education. Visualization of physical phenomena has always been important components for the deeper understanding of physics concepts. Visualization of phenomena through such techniques as demonstrations, simulations, models and video can contribute to students` understanding of physics concepts by attaching mental images to these concepts. The digital video activities and tools could be used from students to make connections between concrete, real- life phenomena and the abstract ideas and models of physics [1].

Strategy of the e- multimedia physics test

The goal of prepared e- multimedia physics test is to achieve productive self- learning and self-assessment, respectively by Problem-Based Learning. PBL is an instructional method that

challenges students to “learn to learn”, to seek solutions to real world problems. PBL prepares students to think critically and analytically, and to find and use appropriate learning resources. Learning is initiated by a problem. Problems are based on complex, real-world situations. Students identify, find and use appropriate resources [6]. This strategy was followed:

- Students are presented with a physics problem- they watch the video clip in which some physics experiment is shown.
- They are demanded to “solve problem”- explain phenomenon, find answer to question by analyzing the video information that they have observed. Students have to organize ideas and previous knowledge, find and use appropriate resources.
- In some cases for help students the test system gives the students possibility to use prompt and keys, but it costs them points. In other cases additional illustrative animation [7, 8] has been given.

Creation and design of the questions

For preparation of the test questions with integrated video clips the test generator called “Hot Potatoes” has been used. This suite software includes five applications that can create exercises for the World Wide Web. The applications are JCloze, JCross, JMatch, JMix and JQuiz. A new Insert Object wizard allows creates nested XHTML object tags to embed common media players into exercises (“Hot Potatoes” support four players- Windows Media Player, Quick Time Player, RealPlayer and Flash Player) [9].

In the last years the preparation of e-learning content is produced in Learning Management Systems (LMS). One of the most popular of them is “Moodle” [10]. The “Hot Potatoes” is an activity in the LMS (Learning Management System) “Moodle”. This system gives educators tools to create a course web site and to provide access control so only enrolled students can view it. Aside from access control, “Moodle” offers a wide variety of tools that can make course more effective and provides an easy way to upload and share materials, holds online discussions and chats, gives quizzes and surveys, gathers and reviews assignments, and records grades. “Moodle” has modular suite design that makes it easy to create new courses, adding content that will engage learners. This modular object- oriented dynamic learning environment possess intuitive interface that makes it easy for teacher to create courses. Teachers and students require only basic early acquired from Internet browser skills to begin learning, which makes last one very simple and user- friendly platform. For our aim JQuiz- have been used to create multiple- choice questions (Fig.2) and JCloze- to create fill- gap exercise (Fig.3 and Fig.4).

Because the interface of “Hot Potatoes” is written in English, students with limited knowledge of the English language might have problems understanding the controls and instructions. For our purpose some of the text of the question interface has been translated in Bulgarian. Some of the exciting video clips [11] have been extracted from our video collection to create the reinforcement and provocative questions.

Examples presented e- multimedia physics tests

The teacher has possibility to create tests on the PC with installed “Hot Potatoes” in the local set and the students can work offline or create activity and put the questions in the LMS (Fig.1), then students can work online.

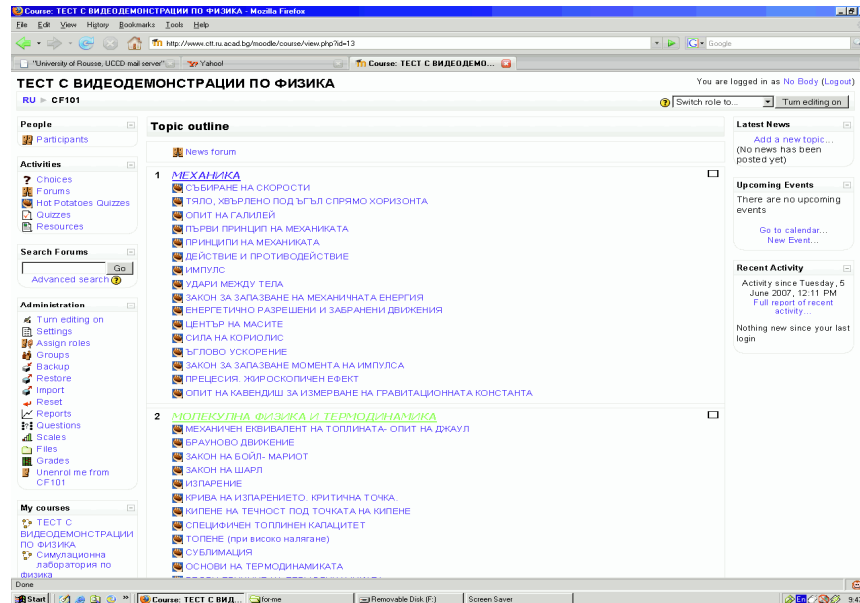


Fig.1. Main page “Physics video test” (<http://cdo.ru.acad.bg/moodle/>)

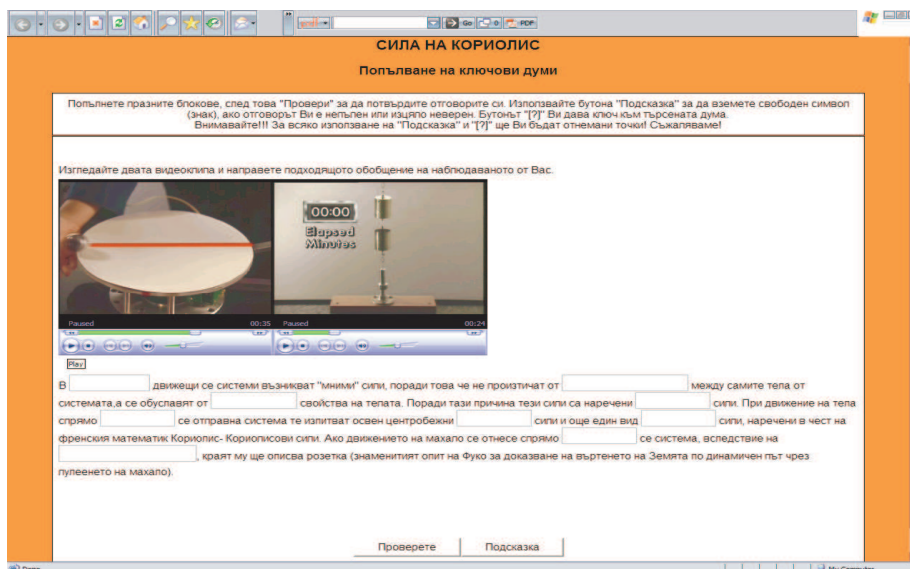


Fig.2. “Coriolis Force” - JCloze- fill- gap exercise from the part “Mechanics”

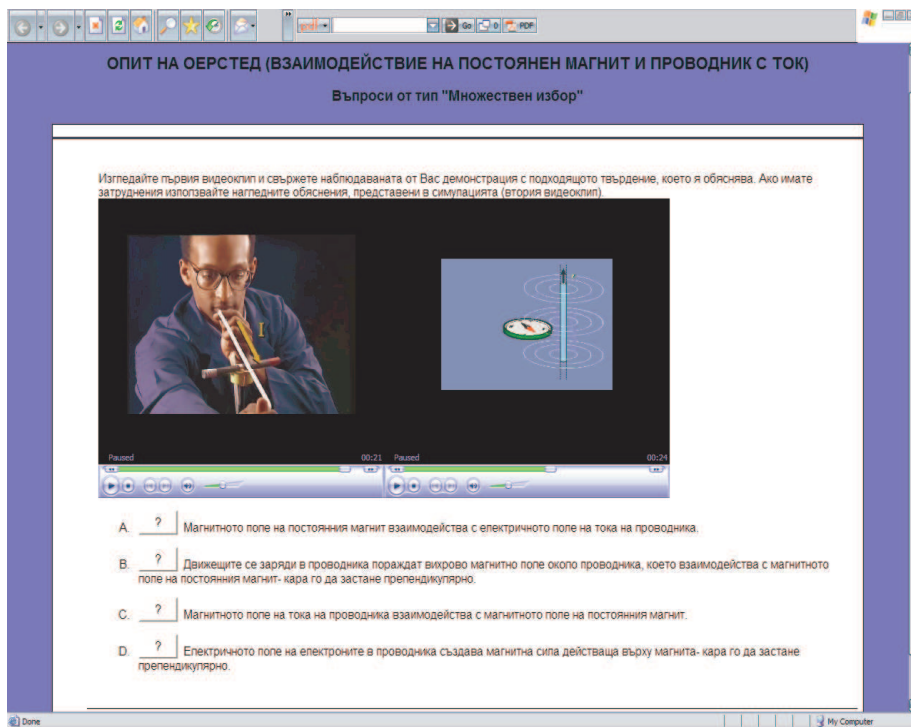


Fig.3. “JQuiz- multiple- choice” question example from the part “Electricity and Magnetism”.

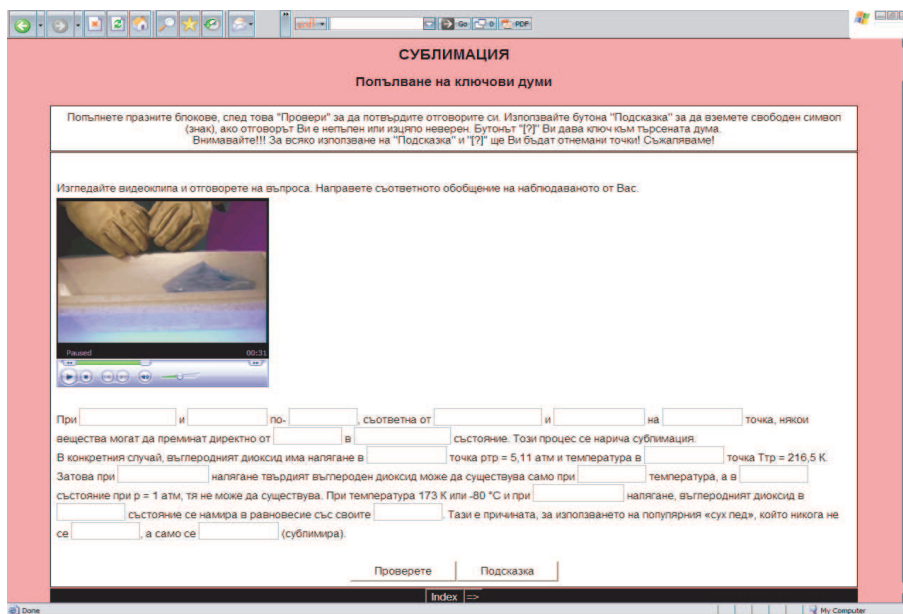


Fig.4. “JCloze- fill- gap exercise” question example from the part “Thermodynamics and Statistical physics”

As questions examples are presented “Coriolis Force” - JCloze- fill- gap exercise from the part “Mechanics” (Fig.2), “Oersted experiment” from “Electricity and Magnetism” (Fig.3) –in this case additional illustrative animation help student to “solve problem” and “Sublimation” from “Thermodynamics and Statistical physics” (Fig.4).

The experience of student’s physics exams in the last years suggests that students haven’t great interests to study physics and any theoretical physics knowledge in the most cases. Preparation of such attractive educational materials should be change this hopeless situation

by included the simple phenomena in provocative situations or require to found the connection between the more complicate phenomenon and basic physics principle.

Conclusion

At this moment around 80 tests questions from all parts of physics has been constructed. The goal of prepared e- multimedia physics test is to achieve productive self- learning and self- assessment, respectively by Problem-Based Learning. We hope that students using physics video demonstrations and experiments will acquire skills and concepts about how to do a scientific investigation. In so far as learning is structuring and restructuring memory, the students have to explore the real physics world and organize, represent and link received knowledge. Generate productive thinking in the classroom by engaging students with some problem and provoke students to doing observations, making predictions, formulating hypotheses and verify ideas. The distant learners, who have often null opportunity to access to observe the real experiments in the university, can also use it for self- learning and self- assessment.

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