# E-MULTIMEDIA PHYSICS TEST FOR DISTANT LEARNER'S SELF-TEACHING

Aleksandrija Aleksandrova, Nadezhda Nancheva

*Abstract: Preparation of e-learning content in physics education is based on the novel concept of teaching, connected with visualization of physics phenomena through such techniques as demonstrations, simulations, models, video clips and movies. It can contribute to students` understanding of physics concepts by attaching mental images to these concepts. This article presents e-multimedia test, integrated in the LMS "Moodle". For preparation of the test questions with integrated video clips the test generator called "Hot Potatoes" has been used. 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, allow students to explore the real physics world and teach and train themselves. The distant learners, who have often null opportunity to access observe the real experiments in the university, can also use it.*

*Keywords: physics, e-learning, e-multimedia test, self- teaching, engineering education, LMS, test generator*

*ACM Classification Keywords: K.3.1 Computers and education – Distance learning*

## Introduction

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. 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 aim is to improve the quality of current education methods and will take part in upgrading the teaching-learning process in future. The physics demonstration experiments are inseparable part of the curriculum of physics education. At the same time organizing classically these constitute a considerable cost due to very costly equipment and infrastructure, as well as the cost of highly qualified personnel. This places strong demands on an efficient organization of the physics courses and available equipment, which unfortunately often inflicts a corresponding reduction in didactic quality. In many situations, however, it is impossible for all students to be able to perform every experiment that the teacher would like. In such circumstances considerable pedagogical gain can be achieved by playing a recorded video of an experiment. One way to overcome these difficulties is to use video activity running on a Web browser instead of requiring hands-on experiments [1].

In this paper we present the development of a novel concept of teaching - self- teaching - with e-multimedia tests, created for the students from the mechanical engineering courses at University of Rousse. The tests questions are from three parts of physics - "Oscillations and waves", "Optics" and "Atomic and nuclear physics". Other parts of physics are still under construction.

As the visualization of physical phenomena have always been important components for the reinforcement and understanding of physics concepts, some of the video clips have been included in test questions for creation to self- teaching e-multimedia test. Presumably, that should increase the interest of study physics.

## 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.

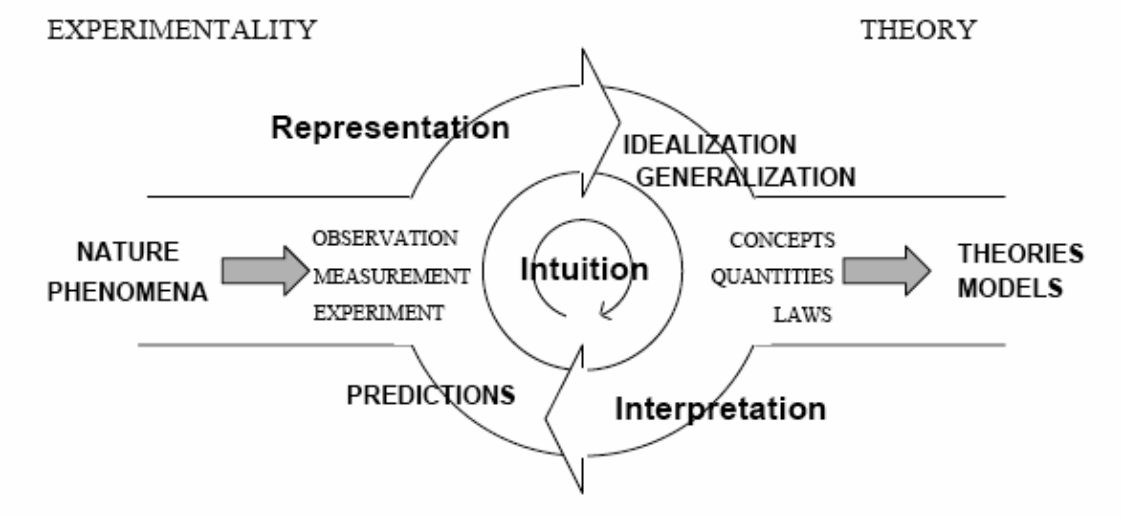


Fig.1. Cycle of concept formation. The process is directed from phenomena to theory

The notion that concept formation [2], as presented in Fig. 1 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 [3, 4]. 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 lows, 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 [1]. In terms of didactics, by adding multimedia in the ordinary e- test allow putting the students in dynamic problematic physics situation, it is some kind of virtual frontal experiment.

In engineering education the links between the theory/model world and the object/event world is important to make explicit in education. Interactive video clips and movies are logical step in the progression of creating useful visualizations for students. 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]. That is why the knowledge and use of physics structures, including the analytical and synthesis methods, is extremely useful and efficient.

## Strategy of the e- multimedia physics tests

The aim of our e- multimedia test is student's self- teaching and self-evaluation and this strategy was followed:

- Students watch the video clips in which the different experiments are shown. The video clips present and correspond with basic physics concepts that they should connect with the physics theoretical knowledge.
- They are asked to find answers to questions by analyzing the video information that they have observed.
- The test system gives the students possibility to use prompt and keys, if they have some problems. It costs them points but it is better than nothing.

## 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). There is also a sixth application called The Masher, that will compile all the "Hot Potatoes" exercises into one unit. "Hot Potatoes" is not freeware, but it is free of charge for publicly funded, non-profit, educational users who make their pages available on the web. Other users must pay for a licence.[ 5]

The "Hot Potatoes" is an activity in the LMS (Learning Menagment System) "Moodle". 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" [6]. 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 have been used only JCloze- to create fill- gap exercise (Fig.3) and JQuiz- to create multiple- choice questions (Fig.4 and Fig.5). 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 [7] have been extracted from our video collection to create the reinforcement and provocative questions. Before embedding in the test question, video clips have been converted from VOB in the WMV format. "Power Video Converter" has been used.

## 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.2), then students can work online. As questions examples are presented "Resonance" from the part "Oscillations and waves" (Fig.3), "Light polarization" from the part "Optics" (Fig.4) and "Heat emission" from the part "Atomic and nuclear physics" (Fig.5).

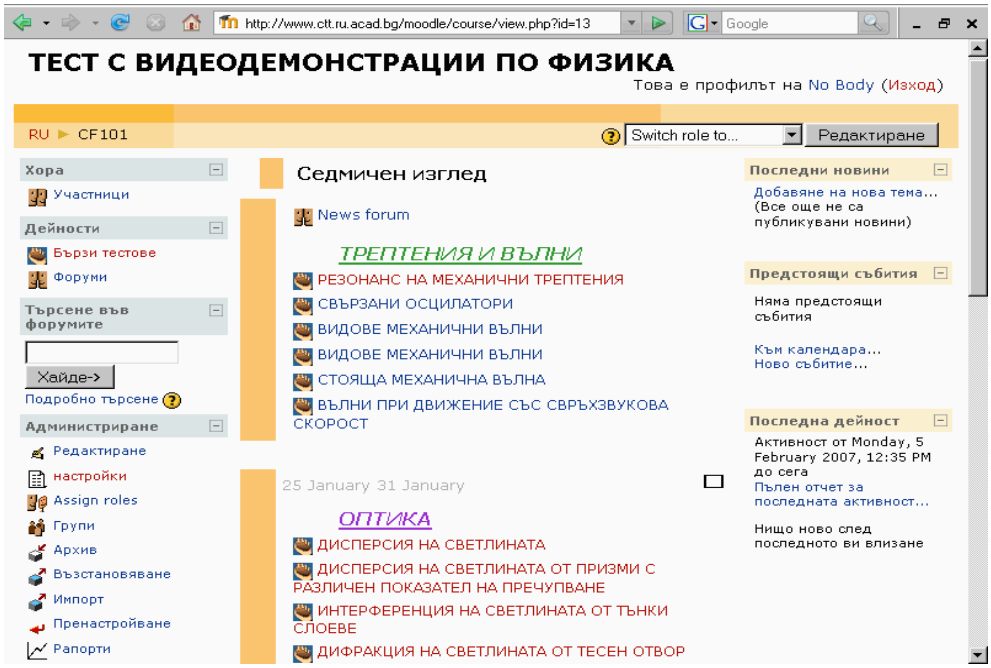


Fig.2. Main page - “Physics video test’

(http://www.ctt.ru.acad.bg/moodle)

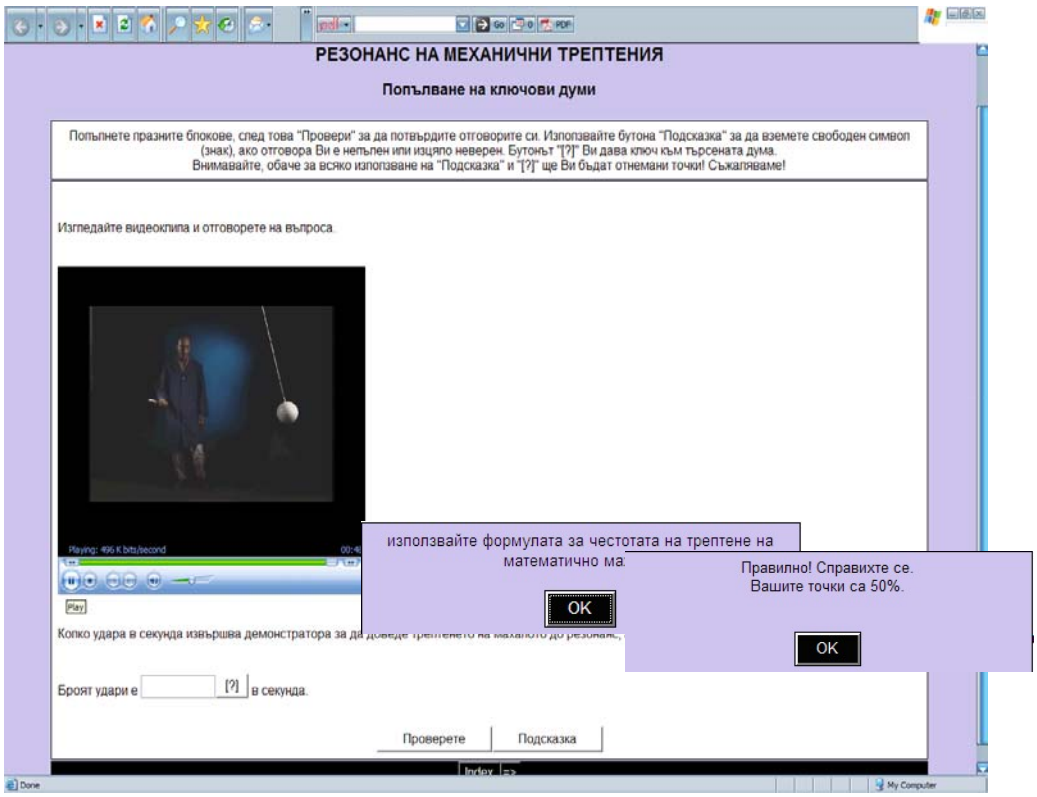


Fig.3. “Resonance” - JCloze- fill- gap exercise from the part “Oscillations and waves”

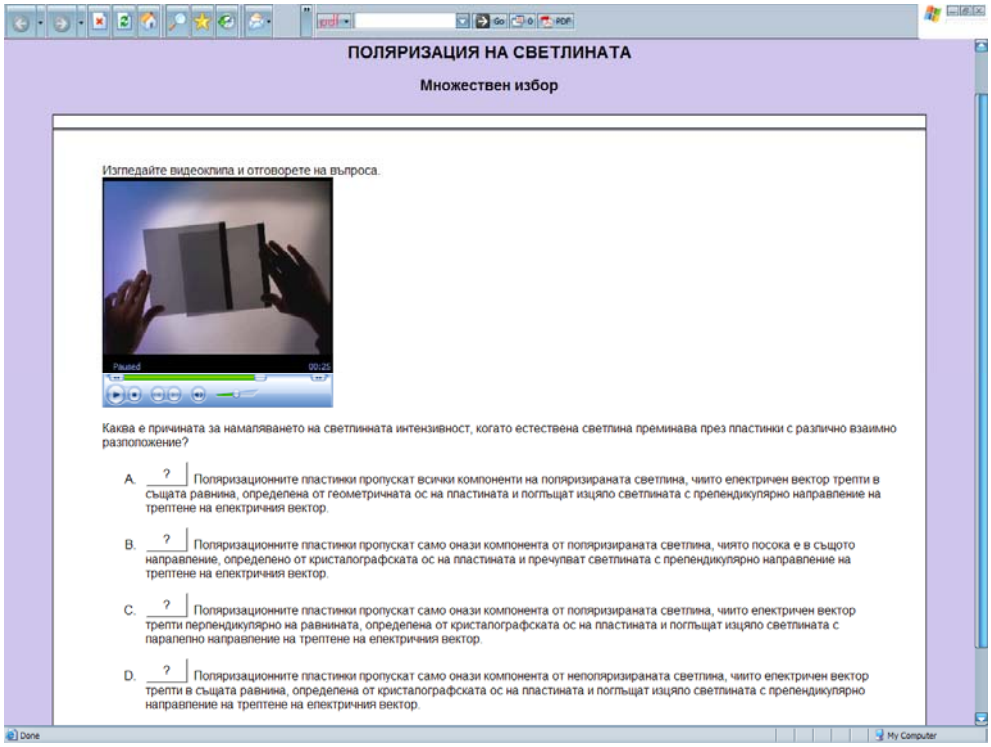


Fig.4. “Light polarization” - JQuiz- multiple- choice questions from the part “Optics”

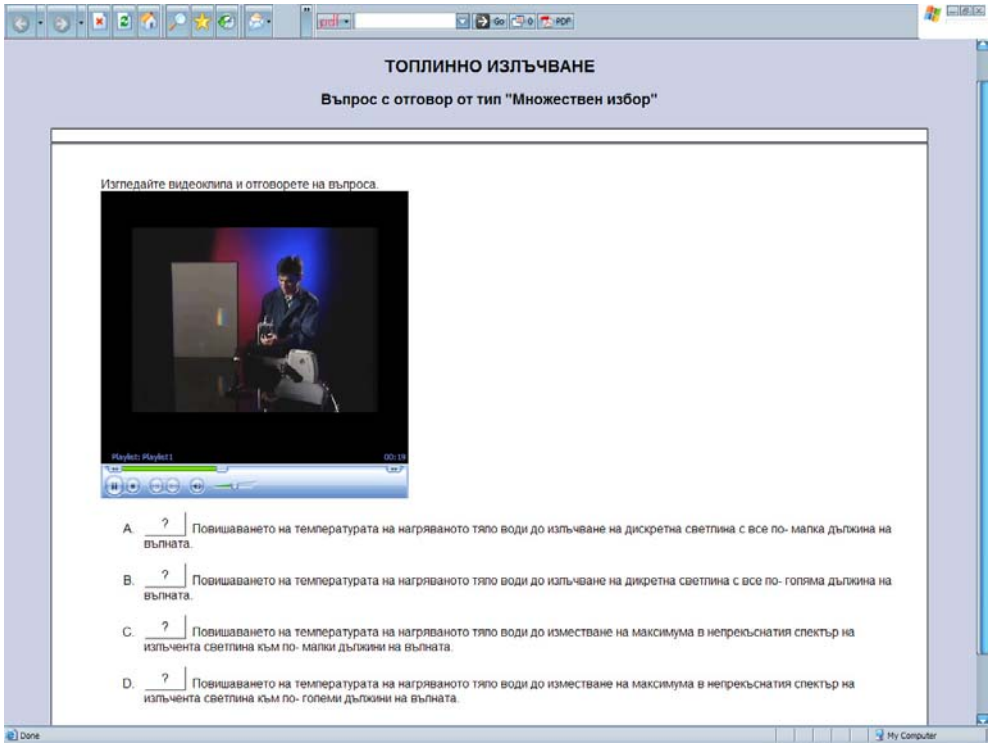


Fig.5. “Heat emission” - JQuiz- multiple- choice questions from the part “Atomic and nuclear physics”

Created JCloze- fill- gap exercises include the simple phenomena in provocative situations. In JQuiz- multiple-choice questions require to found the connection between the more complicate phenomenon and basic physics principle. The test system gives the students possibility to use prompt and keys but it costs them points (Fig.3).

By watching the video demonstration students receive a basic knowledge on the physics phenomena. It effects on the motivation of students and stimulating their interest in physics. The experience of student's physics exams in the last years suggests that students haven't great interest to study physics and any theoretical physics knowledge in the most cases. Preparation of such attractive educational materials should be change this hopeless situation.

## Conclusion

The fundamental formation of the licensed engineers follows up the well knowledge of the physics phenomena. At the same time, in many universities the traditional introductory physics course - General Physics – for non-physicists is rapidly becoming less and less popular. The solution of these problems is creation of a Web based interactive materials of physics for engineering students. As the visualization of physical phenomena and laboratory experiences have always been important components for the reinforcement and understanding of physics concepts, some of the video clips have been included in test questions for creation to self- teaching e-multimedia test.

In this paper we present the development of a novel concept of teaching- self- teaching with e-multimedia test. The created e-multimedia test could be used from students to make connections between concrete, real-life phenomena and the abstract ideas and physics models, students could explore the real physics phenomena, teach and train themselves. The distant learners, who have often null opportunity to access observe the real experiments in the university, can use it. From didactic point of view advantages of the usage of multimedia to create the attractive e-tests in teaching-learning process of physics are evident. Presumably, that should increase the interest of study physics.

## Bibliography

[1] L.T.Escalada, R. Grabhorn, D.A.Zollman. Application of Interactive Digital Video in a Physics Classroom, Journal of Educational Multimedia and Hypermedia, 5, 1, pp.73-97, 1996

[2] T.Pieska, L.Ilkko, Students' demonstrations, Physics Teaching in Engineering Education PTEE 2005, Brno University of Technology, June 29 – July 1, 2005, Brno, Czech Republic The distant learners, who have often null opportunity to access observe the real experiments in the university, can also use it.

[3] Kurki-Suonio, Kaarle and Riitta, Fysiikan merkitykset ja rakenteet (Meanings and Structures in Physics), Limes, Helsinki (1998).

[4] Koponen, I. T., The Role of Experimentality in Concept Formation in Physics: Quantifying Experiments and Invariances, PHYTEB, Barcelona (2000).

[5] http://hotpot.uvic.ca/.

[6] http://docs.moodle.org/en/Using_Moodle_book

[7] "Physics demos"- DVD collection

## Authors' Information

Aleksandrija Aleksandrova – PhD student, University of Rousse, Department of Physics, Rousse-7017, Bulgaria; e-mail: aalexandrova@ru.acad.bg

Nadezhda Nancheva – Assoc. Prof., University of Rousse, Department of Physics, Rousse-7017, Bulgaria;

e-mail: nancheva@ru.acad.bg