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FORMATION OF INDICATORS OF STUDY THE EFFICIENCY AND EFFECTIVENESS OF THE E-LEARNING[1]

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Abstract: *E-learning is a process in which a lot of money is invested, so the question of its efficiency and effectiveness is essential. While efficiency is aimed at stimulating learning (students' work), the effectiveness is aimed at optimizing the work of teachers and reduce training costs.*

Keywords: *E-learning, efficiency, effectiveness.*

INTRODUCTION

The modern learning in the higher education has its own complex challenges. Its primary function aims at providing relevant knowledge and forming special skills as a prerequisite for creating competent professionals. Considering the rapid development of scientific fields and the need for continuous increase in the qualification such phenomena have appeared like 'lifelong learning', 'learning anytime and anywhere', 'informal learning', 'combining learning and employment' that naturally have created new forms of learning – 'distance learning', 'e-learning', 'blended learning'- (a combination of electronic and traditional learning) [3]. Because these forms serve the 'digital generation', they require the use of 'digital methods' that use dynamic and visual presentation of the educational content, maintaining high interactivity in the implementation of educational tasks, objective and immediate evaluation in a stage of the examination. *The E-learning is* able to meet these challenges. Because it is a process in which many resources are put essential is the question about testing its efficiency and effectiveness. While the efficiency aims at stimulating the learning (the student work), the effectiveness aims at optimizing the work of teachers and reducing the costs for teaching.

This study aims at determining the appropriate indicators able objectively to determine the efficiency and effectiveness of the implementation of e-learning in disciplines of the computer sciences cycle with students from specialty '*Pedagogy of The Teaching in Physics and Informatics'*.

EXPOSITION

There are in the different sources different formulations of the concept of 'E-learning':

1) 'A concept covering a wide range of applications and processes as web -based learning, computer-based learning, virtual classroom and digitized work together' [4];

2) 'A process of formal and informal activities, processes and events for learning and teaching through the use of electronic media' [5];

3) 'The e-learning is online education in a network which takes place in a formal context and uses a variety of multimedia technologies' [6].

On the bases of the said about the purposes of this study we can define the e-learning as a procedural and functional unity between the activities of teaching and learning through various electronic media and multimedia technology [3].

[1] Presented a plenary report of May 20, 2016 with the original title: ФОРМИРАНЕ НА ПОКАЗАТЕЛИ ЗА ИЗСЛЕДВАНЕ НА ЕФЕКТИВНОСТТА НА ЕЛЕКТРОННОТО ОБУЧЕНИЕ.

As for the time of conducting the e-learning it can be implemented synchronously and asynchronously.

In the synchronous training students and teacher are separated in space, but the training is carried out at the same time mainly through 'live courses via high-speed Internet connection' [7]. The main advantage of this type of training is the ability to contact the student with the teacher, but its main disadvantage – the dependence on the quality of the Internet connection.

The asynchronous training is carried out at different times, the teacher and the students are on different places. Its advantages are associated with the option for the students to learn at their own pace and in their own time, regardless of geographical location, and its main disadvantage - the inability to direct contact with the teacher [7].

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The optimal balance between the discussed advantages and disadvantages is expressed in 'the blended learning'. It shall combine the strengths of the electronic and traditional teaching. In this regard significant is the question of its efficiency

The efficiency is a concept that expresses the attitude of the achieved result towards the objective. As the achievement of a goal is higher, the more effective are the actions associated with it [8].

To identify the indicators of measuring the efficiency of the e-learning we should formulate its objectives.

The objectives of the training are decomposed in achieved knowledge, special skills and competencies. According to the European Qualification Framework of Lifelong Learning [9] 'the knowledge is the result of the assimilation of information through learning. It could be interpreted as a set of facts, principles, theories and practices related to a field of work or training.' 'Skills mean the ability to apply the knowledge and to use know-how to complete tasks and solve problems.' The transfer of knowledge and skills in new learning or work situations manifests itself as competences. 'The competence is a set of competences' [3].

Therefore related also to the e-learning, the efficiency is expressed in achieving higher knowledge, skills and competencies. Two approaches are used for their achievement:

1) Developed are web-based courses for certain subjects which are used for asynchronous training and to which the students in Informatics have access 'anytime' and 'anywhere';

2) A synchronous e-learning is performed in certain subjects.

Developed are web-based e-courses for training in the following subjects:

- Introduction into The Programming;
- Computer Networks and Communications;
- Methodology of Teaching in Informatics and Informational Technologies;
- The conducting of synchronous e-learning is done in the following subjects:
- Object-oriented Programming;
- Computer Graphics and Image Processing;
- Operating Systems.

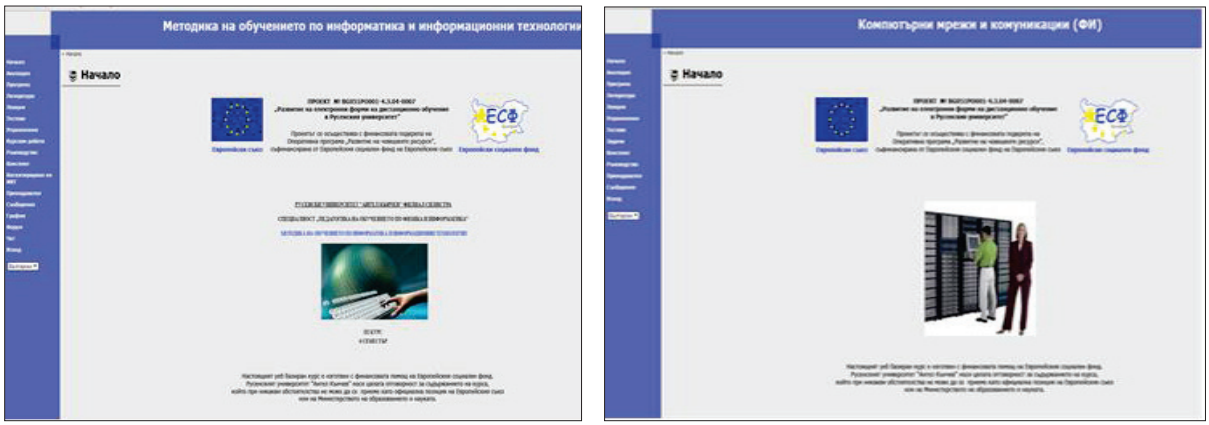

Fig. 1 Web-based courses in The Specialty 'Physics and Informatics'

Because the e-learning is done on a computer (or other mobile devices), the implementation of the standards of Human-Computer interface (HCI) [10] is required.

The term **Human-Computer Interface** covers all aspects of interaction between hardware, software, workplace organization and others. The main goal of HCI is to create safe systems with 'good user interface and good functionality'. So in its design the achievements of different disciplines are used - mostly of *The Informatics*, *The Ergonomics* and The *Cognitive Psychology*, as the functionality is determined by the terms '***technical and pedagogical usability'***.

The international standard that regulates the ergonomic requirements for hardware and software when working with visual display terminals (VDTs) is the standard ISO 9241-11 (International Organization of Standardization 9241-11). According to it, the usability is the 'extent (of convenience) with which the product can be used by specified users to achieve specified goals with the necessary efficiency, productivity and satisfaction in the specified conditions (context)' [11].

The most relevant indexes of usability, which can be used to determine the efficiency of the e-learning, are the following: [4; 12; 13; 14].

(1) ***Visibility*** of the opportunities for interaction with the educational objects;

(2) ***Aesthetics*** and ***minimalism*** of information;

(3) ***Awareness*** of the used concepts;

(4) ***Feeling of control*** of attending the educational objects;

(5) ***Uniformity*** and ***standard type*** of the symbols;

(6) ***Recognition*** by clear designations and descriptive links;

(7) ***Flexibility***, which allows users to reach different paths to the desired information;

(8) ***Meaningfulness*** of the displayed information with emphases on the important, the new and the searched one;

(9) ***Readable*** text for quick assimilation;

(10) ***Images*** that are recorded in an unobtrusive and economical manner;

(11) ***Connections*** - recognizable and easy to follow;

(12) ***Minimizing the memory*** load and providing information in **meaningful portions**;

(13) **The practical reference** and **problematic nature** of educational material;

(14) ***Transfer*** of knowledge and skills;

(15) The environment - providing ***more learning opportunities*** in comparison to the traditional training through various media - ***text, audio, video***;

(16) Educational stuff - ***adapted*** to the ***style of learning*** of the learners;

(17) ***Feedback*** - precise and adaptive toward the responses of the learner.

The effectiveness in its turn shows the attitude of the achieved result toward the input [8] (time, knowledge, competence and financial resources). The effectiveness is related to the economy of the action. The more competent the available resources are used, the more efficient are the costs of achieving the results.

The effectiveness of the e-learning is expressed in:

1) use of appropriate platforms for deploying the web-based training courses [2];

2) use of the most appropriate copyright tools for creating e-learning content [3];

3) creating learning objects for electronic courses which to replicate the most common web browsers and simultaneously to maintain its high interactivity playback [1].

CONCLUSION

On the base of the said, the study on the efficiency of the e-learning can be done by checking the extent of its achieved goals that are decomposed into ***knowledge***, ***formed special skills*** and mastered ***competencies***. Suitable tools are the *electronic tests* and the *tasks for independent solving*. The matrix of their objectives most often is formed by Benjamin Bloom's taxonomy - knowledge, comprehension, application, analysis, synthesis and evaluation.

Second instrument to measure the commented ***ergonomic indexes of usability*** of the electronic didactic materials would be a *poll* among the trained students.

A third tool that would give information on the effectiveness of the e-learning would be an administered *expert assessment* which to be formed by the weighing units of the developers of the course, teachers who apply it, the system administrator who maintains it and the opinion of a representative of the educational institution. The indicators towards which the opinion of experts is sought are focused on: the ***reliability of the platform*** for training; the ability of the used ***author's tools*** to create e-learning content and the ***added value*** of their interactivity to the success of the students.

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