INVESTIGATING THE ROLE OF COMPUTER AIDED LEARNING/eLEARNING IN TEACHING PHYSICS IN TERMS OF STUDENT

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Abstract. Computer use in training activities leads to the development of forms of training organizing which are not possible by traditional methods and means. Computer Aided Learning/eLearning (CAI) is a teaching strategy that capitalizes the principles of modeling and cybernetic analysis of training activity in the context of new information and communication technologies. Thus, teaching-learning physics can be successfully performed through this interactive didactic strategy. The present material is trying to express the impact of this educational strategy on learning, on students and on their perception of the necessitiy and utility of diverse educational software.

Key words: eLearning, Computer Aided Learning, educational software.

1. INTRODUCTION

Modern teaching conceives the educative process as an activity of teaching – learning – assessing, curricularly designed by focusing on educational goals and achievement of objectives and content of correspondence, on the one hand, and the methodology and evaluation, on the other. It focuses on teaching and learning strategies, assessment, in which the student is not just a receiver of information but an active participant of knowledge and action. Amid rapid changes and technological progress and the trend globalizing education, new perspectives opened for educational practice. Thus, this was completed with modern methods of teaching, learning and evaluation, methods specific to an information society.

The intervention of science in grounding the educational process has grown so much that it managed to make it an area that successfully applies the latest information and communication technologies. Converting the training and education strategies of high technology emerges as one of the major trends characterizing the evolution of education at the beginning of the century, the greatest impact on growth and increased quality in schools.

Using the computer in training activities leads to the development of organizational forms of training which are not possible using traditional methods and means. Possibilities of computer processing, recording and retrieval of information triggers the situations in which the student acquires knowledge and skills independently, in accordance with their interests and aspirations. Most experts consider that, at present, research efforts have focused on the potential it offers education and training, in general, computers and virtual environments created by them: the accuracy of operations performed, the ability to provide multiple presentations and dynamic phenomena, interactivity in general, but also the possibility to interact in a consistent and differentiated way with each student (user), in part.

One of the major changes brought by the intervention of computers in education is the paradigm shift from teacher-centering to student-centering. By spreading and diversifying eLearning, the role of teacher changes. Progressively, the teacher exempts routine activities, but his task is amplified by the fact that we must develop and implement small programs tailored to the discipline taught and adapted to, however, the requirements of the educational process [2].

In this way, there are already elements of decentralization, the teacher is no longer "the center" of information irradiating the educational process is moving its dominant focus from teaching to learning. Learning emphasizes the active student participation in building its own system of knowledge at their own pace and on their own strategies. Individualization of learning process becomes dominant, giving up more and more on standardization (UNESCO, 2002, p. 59).

Student-centered learning associates learning focused on individual characteristics (heredity, experience, perspectives, backgrounds, talents, abilities and needs) with the focus on teaching understood as a new way of sharing knowledge (selecting the best and latest information, stimulating the motivation to ensure accumulation of knowledge by all students). In the new learning environments, all students have access to the same sources of information that can be expected to ensure equal opportunities for education.

2. COMPUTER AIDED- INTERACTIVE TEACHING STRATEGY

Computer Aided / eLearning (CAI) is a way of individually training students through computer programs (called educational software), which guide the student step by step from ignorance to knowledge through its own efforts and pace of learning [3].

Computer Aided / eLearning (CAI) is a teaching strategy that leverages the principles of modeling cyber and analysis of training activity in the context of new information and communication technologies. The synthesis of educational resources of of programmed training and the technological abilities of computers

(information processing system) provides this method of learning important qualities regarding: the computerization the teaching-learning-evaluation activity to improve learning through action-of query management and documentation; interactive automated simulation of knowledge and skills involved in education, according to official documents of planning education [1].

Via the computer we use different educational software with various contents that can perform varied teaching tasks and thus they may serve to different functions within the teaching in all disciplines. The teaching / learning software computer is a program designed specifically to carry out tasks or problems teaching / education by exploiting the specific eLearning technologies.

The educational software is presented in a package that includes: the product-program, its documentation (methodical instructions and description of the type of computer that can be implemented on), other material resources [4].

Following the specific pedagogical function that it can perform within the activity of educational training the software is classified as: software for interactive presentation of new knowledge, practice software, demonstrative software, presentation software of models of real phenomena (simulation) computerized models of laboratory work, software to test your knowledge.

Under that diverse range of software, CAI takes a variety of functions, which make an important contribution to successful learning. Thus, software for interactive presentation of new knowledge are used successfully in the teaching, in order to obtain an interdisciplinary content. The computer is a real active Encyclopedia able to make useful for teachers and students a great repertoire of data, rigorously structured, predetermined, with strict control of assimilations. The computer comes thus to support teaching, helping the teacher to carry out in better conditions his best teaching basic function. New interactive content is presented interactively and manages to engage students actively in a climate of questioning, to be involved in formulation of responses, to use the advantages of immediate feedback.

However, the computer constitutes in a good support for learning, designed to facilitate the learning of subjects and even to accelerate the assimilation of knowledge and training habits. The tutorial software helps students with good results to progress more quickly and helps those with poor results in school. Comparative studies show the superiority of cognitive and affective results obtained within CAI, to traditional training.

There is software that provides an excellent basis of demonstrations, and dynamic multiple representations of phenomena, of realizing the fundamental knowledge either by taking laboratory tasks in sense of imitating some experience or completing them on them and others allow simulations, with great effect, of processes, situations, complex physical and social phenomena. The simulation exercises of this type offer great possibilities in presenting and analysing, issue of assumptions, of imaginary solutions in exploring other ways of collecting hidden data.

The dominant component of programs for CAI is the individualized nature of knowledge, the focus on the needs and capacities of individual students on individualizing tasks. Thus, it supports flexible programs, organization and guidance of independent learning, promoting their own learning pace.

With the entering CAI class significant changes operate slowly, in teaching practices, modes of teaching and learning are renewed, strategies to work with students change, teachers roles change. A new pedagogy is developped, which operates by different rules.

Assuming such roles and functions, the computer can be regarded as the third actorwhich, together with the teacher and students, contributes to searching and finding better solutions to specific training.

3. INVESTIGATION CONCERNING THE IMPACT OF USING CAI IN PHYSICS LESSONS

In designing this investigative approach the following assumptions were followed the concern of specialists and practitioners of education for the computerization of education, promoting new paradigms in the field of education science theory and of the instructive and educational practice, which emphasize the learning. It's about shifting focus from educational activities focused on teachers, on teaching, to student-centered activity, on learning.

The investigation was primarily aimed at highlighting the impact that the computer use produces on the educational process, especially in what concerns its main actors - students and resources involved in this process, paying particular attention to paradigm changes in teaching-learning-assessment plan. Thus, this investigation aims: to present arguments in support of implementation of CAI in physics classes, highlighting the possibilities offered by the use of appropriate educational software, in terms of effective regulation of the learning activities of students, identifying types of software to ensure effectiveness of the educational process to physical discipline.

The sample included in the investigation was selected from 10 pre-university education institutions in Vrancea County and included subjects on secondary and highschool level.

The investigation, which was to conduct a questionnaire-based survey, aimed at obtaining relevant data to outline a picture of the impact of CAI in educational activities conducted in the hours of physics and thus to highlight the usefulness and effectiveness of different types of educational software that can be used in physics classes.

The hypothesis in this research was: CAI involvement in teaching - learning - evaluation of high school and middle school teaching of physics helps to optimize the instructive and educational activity, to a better understanding and learning by

students, of the concepts, laws and definitions of the field of physics, to forming specific skills of this discipline.

3.1. PROCESSING, ANALYSIS AND INTERPRETATION OF DATA

*1. Do you think that computers are useful in the educational process?*

Yes	No
82%	18%
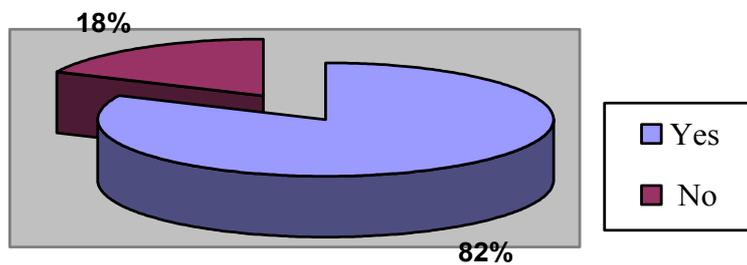
The answers to this question show that, according to many students, the computer finds utility in educational activities. The high percentage of students who are considering the premise of usefulness reveals the opening of students to new, accepting the challenge, but also the use of a tool that they use frequently for other purposes, in educational space.

2. How would you like to run physics classes?

In the classroom	In the classroom with a computer and a videoprojector	In the IT/Media lab
23%	30%	47%
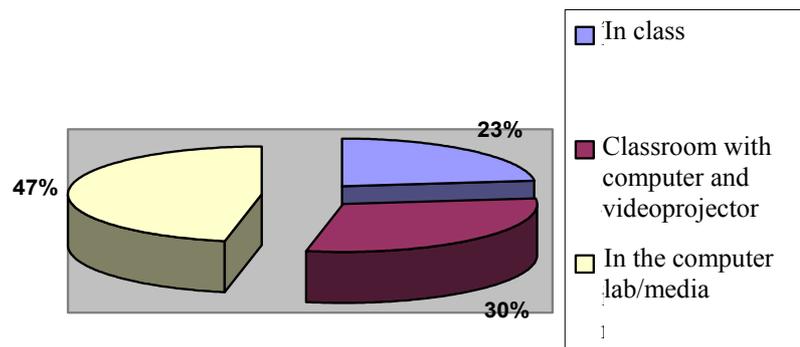
Students want to be involved in computer-assisted activities. Thus, a significant percentage of them (47%) would like physics classes be carried out in the computer lab, arguing that choice (in discussions with them) in that there can have access to more information, varied examples may be presented, and some physical phenomena and processes, hard to reach, can be made, observed through simulations. A considerable proportion of students (23%) opted to conduct physics lessons in the classroom, being aware of the impossibility of their programming in the computer lab, in circumstances where there is only one in school or because the school does not have yet have such equipment, and some of them (30%) want to be in class at least one computer and a projector that can be used in lesson.

3. *How often are you involved in CAI activities at classes of physics?*
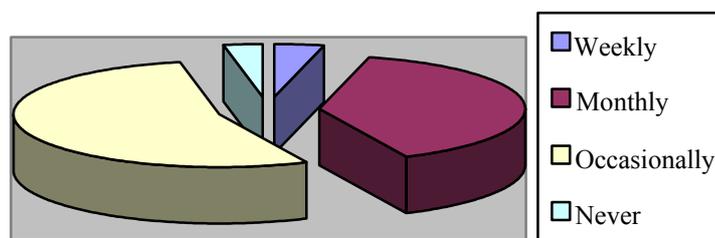
The subjects interviewed sustain that this strategy is applied in physics classes weekly in only 4%, 39% – monthly, 54% – occasionally, and a small percentage, 3% say that no lesson uses this strategy. The reasons why in most situations physics classes are performed in this manner can be related to the lack of adequate facilities to allow teachers use this strategy or, in some cases, teachers' lack of time to prepare the lesson or the lack of appropriate software.

4. *What effect will CAI have on your school, in your opinion?*

Most interviewed students associate use of computers in lessons with a good efficiency, because in their view, more information can be presented *via* electronic interface on their level of understanding, there are programs that allow recovery of the issues that were not understood or allowing reinforcement depending on how they performed tasks. The learning content, as organized and structured information support teaching is an essential tool in skills training and development for students. The integration of modern technologies in lessons facilitates a better understanding of content, which leads to better academic performance.

In the instructive – educational process, CAI is necessary because:

The computer allows easier communication of ideas	Computer promote cooperative learning	Computers make learning more effective	Computer facilitates individualized learning	Computers make teacher's work easier
19%	12%	35%	30%	14%

19% of respondents say CAI enables easier communication of their ideas and opinions. This can be justified by the ease with which students could transpose the message in this form, as well as the ability to work with computers. However, CAI promotes cooperative learning in the opinion of 12% of respondents, their involvement in group projects, carried out not only in classroom space, allowed them to support the need for CAI from this perspective. It is important that new technologies create the opportunity of involving students in various collaborative activities. For 35% of the students involvement of computers in the educational-instructive process lead to more effective learning, CAI is an active, participatory teaching strategy, and in this lesson the student is actively involved in solving the learning tasks. The approach of curriculum through this strategy is a key tool in enhancing student's skills. 30% of students say that the use of CAI in lesson tasks were differentiated according to their learning potential, and individualizing the training according to the learning characteristics of each student is a major concern for every teacher, concerned about the effectiveness of own work, to find solutions to adapt to different learning styles of students. According to 14% of respondents computers are used in educational activities to facilitate the work of teachers.

5. *In what ways educational software proves its usefulness to you?*
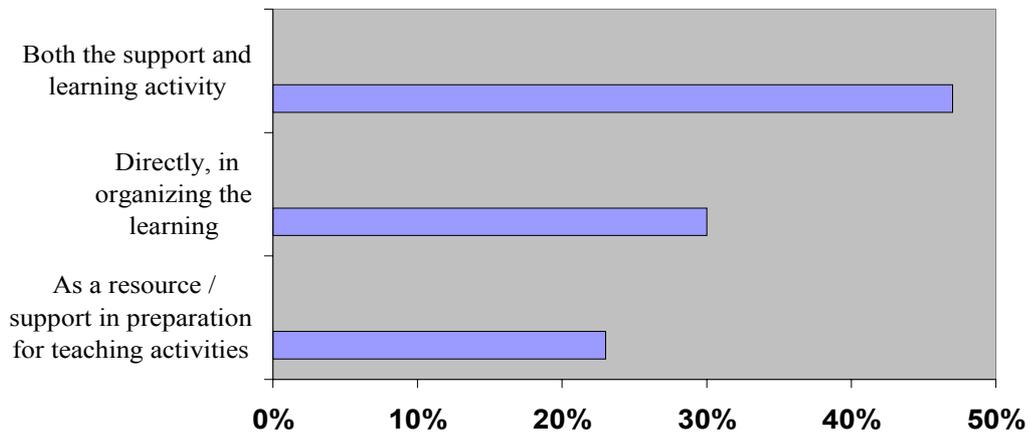
The computer has become a useful tool used not only in the classroom, 23% of students say they use it as a resource / support in preparation for teaching activities or homework to prepare at home or in libraries or in resource centers.

30% of respondents indicated that they use it directly, in organizing their learning, and 47% of them use it both as a support but also in learning activities.

6. *List some reasons why you believe it is useful to use CAI in physics lessons?*

The utility of computers in educational process in physics lessons was motivated by students as follows: shortens time of learning of understanding the presented concepts, for making calculations, graphs and tables, lessons become more attractive, difficult experiments can be performed in laboratory, evaluation becomes more objective, it develops creativity, thinking, collaborative spirit, allows working at own pace.

7. *Which programs / software that you have worked in physics did you like most? Please list them in descending order.*
AeL, Moodle, Virtual Physics, Intuitext

The preference for AEL (67%) is justified by the fact that it is a completely integrated platform for computer-assisted instruction and content management, providing support for teaching and learning, testing and evaluation, content management, monitoring of education and curriculum design. AEL platform was made available for most schools and high schools in Romania through a government project. AEL can be used for teacher-led learning or independent learning it is built on the principles of constructivist and student centered learning approaches. Each learning unit helps students explore, discover, find solutions, to build his knowledge base and formulate their own conclusions. AEL places particular emphasis on operational knowledge, of learning by doing and active development of cognitive structures. The digital content enhances the understanding of phenomena, their collaboration with peers and teacher, their cooperation in solving problems, expressing their views and in developping their reasoning capacity.

20% of respondents opted for Physics INTUITEXT Interactive lessons, an educational software that plays the basic phenomena and processes in the study of physics, which are difficult or impossible to explain using conventional teaching materials (*e.g.* gravity or seismic wave propagation). The product is based on numerical modeling and virtual simulation techniques. The interactive lessons Physics INTUITEXT emphasize the practical side of physics and skills training, such processes and physical phenomena can be visualized using virtual simulation techniques. They include multimedia animations and interactive games for learning in a funny way.

5% of students questioned stated Physics Virtual Collection, a collection of programs simulating physical phenomena that can be used as demonstrative tools at school or for home study.
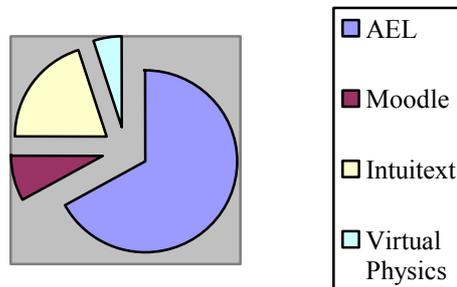
For Moodle e-learning platform have opted 8% of subjects. This is an innovative tool to support the educational process users in terms of enhancing and developing their individual skills and key skills. The system supports distance learning so that users can access relevant training materials when they want, their progress being monitored by hte teacher to verify their fulfillment of indicators, as well as for training support.

8. *Please specify which software you find has the most appropriate graphic content?*
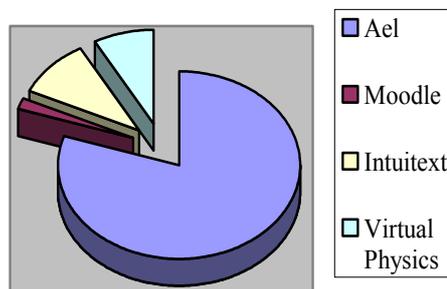
80% have chosen AeL. Among the general characteristics of the platform that explain students' preference, it must be mentioned the friendly interface, adaptable, differentiated according to type of user. AEL has a coherent structure, the interactive animations, texts, assessments, and film presentation with a well-established place on screen. Supplementary information and icons are also properly positioned to facilitate access and avoid duplication.

4. CONCLUSIONS

Computer and educational software use in classes shows that students are drawn to study this discipline, increasing their interest in this, given their great

passion for the computer. Students enjoy therefore much more attractive interactive lessons that help them better understand the concepts, stimulates the developpment of personal opinions, encourages individual self-paced work, as well as the team spirit, contributing to forming longlasting skills and attitudes.

Use of educational software, of CAI, in lessons contributes to the efficiency of training allows a more performative learning because it enables the possibility of diversifying the teaching strategy facilitating student's access to more detailed information, more logically organized, varied structured presented in different ways of visualization, as well as the simulation of physical phenomena and processes, which with traditional resources are difficult to obtain. The lessons held in this system suppose individual exploration of information and operating on it, information exchange and cooperation in solving tasks, involving all pupils in the teaching according to learning ability of each of them as well as permanent feedback that contributes to supporting and increasing motivation of the interest in learning.

REFERENCES

1. Adăscălitei, Adrian, *Computer assisted instruction*, Publishing Polirom, Iaşi, 2007, p. 54, 55.
2. Cerghit, Ioan, *Alternative and complementary training systems. Structures, styles and strategies*, Publishing Aramis, Bucharest, 2002, p. 121, 122.
3. Chicioreanu, Teodora, *Computer assisted instruction*, 2003, p. 477.
4. Malinovschi, V., *Teaching physics*, Edit. Didactică şi Pedagogică, Bucharest, 2003.
5. Toma Steliana, Găbureanu Simona, Făt Silvia, Novak Cornelia, *Training in the knowledge society: The impact of Intel Teach program in Romania*, Publishing Agata, Bucharest, 2009.
6. Ştefănescu Valeriu, *Laboratory experiments and interactive models of physical training lessons*, The 6th International Conference on Virtual Learning *Virtual Learning–Virtual Reality*, Publishing University of Bucharest, 2011, p. 335.
7. Ael, *Physics lessons,* Siveco România SA, 2008.