SOME THEORETICAL DESCRIPTIONS OF COMPUTER ASSISTED LEARNING

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Abstract. Computer assisted learning on the tertiary level is discussed. The focus of the presentation is the discussion about the advantages and disadvantages of PC-assisted learning. A special part of the presentation is devoted to computer assisted laboratories at the period of diploma writing. Possible hybridisation of strategies in research laboratory and reciting classes is investigated.

Keywords: PC-learning, psychology disadvantages, new strategies, laboratory, reciting class.

Historical background

Computing machines were at first implemented in education shortly after the end of the World War II. Despite their usage was restricted, many faculties became familiarized with general concepts of new computing methods with assistance of these machines in the education strategy of several technical disciplines. That is why at the period of the first steps of education with PC-assistance many professors and instructors supported this new concept of learning. Yet there were a lot of faculties which were afraid of this new tool. As a result full implementing of PC-assistance in all possible fields of education technologies took one-two decades. The stages of this implementation were traditional: astonishment at first, partial resistance of any fraction of faculties, adaptation and widely spreading. The new generation of students is now familiar with PC at the preschool period. This is an accelerating agent affecting the implementation process. At present it is hardly possible to find somebody among faculties who does not use PC-assistance in his or her everyday practice. PC-assistance is employed in lecture halls, reciting classes, different laboratories and at the period of homework. Internet connections in distance education and so called PC-blogging are also known [1]. Both instructors and students feel comfortable with computer-assisted education. Students thrive to PCs because they are infinitely patient, never get tired, never get frustrated or angry, allowing students to work private without disturbance for making a mistake. All that allows students to experiment with correctness or praise, do not embarrass students who make mistakes, make it possible to experiment with different options, build proficiency in computer use, which will be valuable later in their life. In addition the students often prefer computer since in their opinion the PC testing is more objective than the instructors' one. Many instructors also prefer PCs because in their free time they can have more meaningful contact with students and the option to teach in small increments [2].

Over the last thirty years utilization of computer-assistance was described in many different articles and books. The positive behaviour of PC-assistant usage was carefully studied and discussed in all possible details. Many advantages of PC instructional practice are well known. There is no doubt PC in all types of classrooms are necessary and effective tools. It is evident that at over the first decades of PC implementing possible disadvantages of this process were neglected, although all misconceptions in PC instructional usage were stored in the memory of skilled instructors. It is reasonable by our opinion to have brief preliminary discussion devoted to detection of the sources of these disadvantages. This discussion is the main focus of the next section.

The main sources of disadvantages in PC assistance instructional practice

We can identify the fundamental sources of PC-assistance instructional disadvantages as connected with students and faculties psychology. The traditional instructional concept is to help the students in creating their content specific skills by dividing the studied content in small portions. It means the path through the new content consists on a set of steps which are under the PC control. That is why the typical computer guided manual is the step-by-step instruction. The student has to execute these steps without any doubt. All recommendations given in instructions are simple. One may be proposed to press a key or to read simple figures on the screen. This concept is realised when all students' mistakes are corrected by help of different hints which the students can read on the screen. All students' non correct operations are blocked by the managing program. It is very convenient for

students. If this idea is repeated frequently the students get accustomed to find the necessary help in their instructional practice. As a remote effect of this instructional technique the students lose the skills of independent actions in real situations.

PC-assisted learning of theoretical lectures avoids the students from practical independent searching for the necessary information. Different computer files, diverse recommendations which give information of pages in standard text-books and other available references suppress the skills of library literacy. This is the second widely spread disadvantage of implementing PC-assistance in the instructional practice.

PC-assistance in laboratory permits the students to study many different experimental situations on the screen. A principle obstacle of this strategy is the absence of handling and practical interaction with measuring instruments. If one wants to learn how to drive a car he or she will never limit his or her training in the theoretical and imitation area. An applicant needs hours of practical driving experience. A student also needs practical skills and abilities to have real achievements in experimental techniques. It is the third typical disadvantage of PC- instructional assistance.

An additional disadvantage of PC-assistant strategy is that it permits the students to repeat their exercises for many times. Weak students can work slowly. As a result many students loose the sense of real time expenditure. They cannot generate optimal schedule for their personal work. This is an additional weak point in students' skills and abilities which can generate different obstacles and problems in their future practice.

All these facts confirm our affirmation that computer assisted education aggregate many new concepts for the price of absence of independent work. An optimal education strategy should find a compromise between engaging of knowledge areas and independent manner of thinking.

There is also known an additional disadvantage of PC-assistant practical strategy which is a result of instructors' faults. It is the main educational concept to check the students' achievements by help of testing procedures. PC is an excellent tool for realisation of this strategy. That is why at the checking period the students seldom are in touch with their instructors face to face. It is usually forgotten that this situation sometimes can be wrong. The merit of this concept can implement only if the students have the standard type of thinking. Some creative and non standard thinking students can find unexpected answers to the testing questions. PC programs usually estimate these non standard answers as mistakes. That is why without instructors' additional verbal discussion the most perspective students can get undesirable low grades. This disadvantage is usually out of the field of different discussions.

All disadvantages enumerated above are not critical. The ways of their compensation are clearly known. In all cases the real advantages of different PC-assistant instructional strategies are very high. Their profits exceed all the disadvantages described in this section.

Some new achievements in PC-assisted educational strategies

One of the main concepts of computer assistant education is the usage of the so called computer-enriched instructions (CEI). CEI is usually defined as a learning activity in which computers generate data at the students' request to illustrate relationships in models of social or physical reality, execute programs developed by the students, or provide general enrichment in relatively unstructured exercises designed to stimulate and motivate the students. CEI is applied in all types of classrooms and especially in the laboratories of new type in which a traditional direct experiment is frequently eliminated. The CEI fundamental merit is the multiple choices of challenges. The student carries his or her one-to-one instruction. In the imitation laboratory the instrumental circuit can be built individually for each student. All quantities and other conditions are accidental. The imitation computer experiment applies different strategies. The first strategy exactly repeats on the screen all instrumental tools which are known for the traditional experiment. This strategy is widely spread in the case of distance education and self-guided exercises. The second strategy is based on the arbitrary building of instrumental circuit from any standard set of details. It is beneficial for a large set of possible circuits. Using this strategy, the students train in building and breaking of virtual circuits. Understanding some basic laws of the instrumental technique is an additional advantage of this strategy. At last, the third strategy acquaints students with a situation that can not be realised in a common laboratory room. This

strategy is more effective in compound with all-class verbal discussions in the reciting room. The main goal of this strategy is to help the students be familiar with situations they will meet in the post-university practice.

An additional advantage of CEI is the possibility to write all instructions and data on the single CD, DVD or on the memory stick. It is possible to connect all computers in the classroom to single data storage. This means that different disciplines can be studied in a single classroom full of computers. Variability of the available material is a serious advantage of this strategy. It permits to easily manage a large number of students. Yet the possibility of regular students-instructor discussions is still limited. The visual and simulation capabilities of computer assisted teaching materials and inherent flexibility in their use introduce an additional advantage to computer simulation experiments. An additional profit of computer simulation is the possibility of generating different demonstrations on the large screen at the time of theoretical lectures or in the reciting classes. In the latter case these demonstrations can help the teacher during his or her discussions with the students' group. PC-assistance in the lecture hall permits to present all theoretical content by help of power-point prepared images [3].

Computer-assistance allows the teacher to store much information about each of the students. Processing of the stored data permits the teacher to built an intellectual profile of each student and describe many average behaviours of different student groups. The analysis of students' answers gives a possibility to evaluate the quality of tests and other teaching tools. It is the way for optimisation the content of theoretical and practical paper printed materials, and different guide books.

Towards new laboratory scenarios on basis of combine traditional exercises and computer simulations

Although laboratory simulations are attractive, it is not easy to replace all laboratory work with computer simulations. New educational administration is an answer based on combination of different instructional laboratory strategies. Implementation of these compound strategies demands to build a special cluster introduced into the curriculum. The sketch of this cluster is the following: on the first laboratory day an experiment on the base of the traditional strategy is performed. On the next day the experiment is repeated in a computer aided laboratory. On the third day discussion about the studied concepts and experimental results follows. It takes 5-6 hours to apply this strategy. The average duration of the laboratory setting does not allow introducing more than two clusters with combined strategy per one semester. Therefore, the time point of this strategy realisation has to be chosen carefully [4].

Correction of all mistakes in the traditional laboratory strategy usually takes plenty of time because students must pay attention to different problems that are difficult to detect. This tiresome work is frequently difficult for the students. To help them the new strategy can be recommended. The concept of this strategy is introducing the second measuring system which transforms the independent results to digits and records these results into the computer. There is a special comparing program preliminary implemented in this computer, too. This program compares independently measured variables with those measured by the students. There is an admitted value of discrepancy between these two sets of values. If this admitted value is exceeded then the student is given corresponding information and additional recommendations from the computer. This program not only checks the variable values, but inspects all calculated values, too [5].

Computer assisted instructional strategies at last semester period before graduation

Educational strategies vary systematically at the way through the university curriculum. These changes transform the goals of education strategies. Senior students' educational outcomes converse from development of the basic KSA to product familiarity with the experimental and industrial technique and creating knowledge and skills of a higher hierarchical level. Highly automated modern instrumental tools demand special knowledge and long time training. That is why at the senior period the instructional strategies transform themselves to the long-term exercises and to work with special sources of information. The laboratory strategies for senior students forced to implement in the curriculum different complex clusters consisted of tailored reciting classes, imitation rooms and

processing laboratories of traditional type. The imitation laboratories have varied content and similar computer tools.

The main objectives at senior students' education are:

- to be familiar with the necessary minimum of information data;
- to be familiar with modern methods of information searching;
- to be familiar with the main methods of representation results of different observations:
- to be familiar with the instrumental technique of real-world behaviours;
- to study modern methods of describing real situations;
- to make judgements in formulating conclusions about real-world problems;
- to get skills in building and assembling parts and products or whole systems;
- to develop his or her abilities to collect, analyse and interpret data, and to form and support conclusions;
- to get abilities to choose the necessary materials and equipment;
- to be familiar with developing new system specifications;
- to create methodologies of meeting the client requirements;
- to generate abilities of choosing the optimal tools for answers on environment challenges.

In many specific areas these general objectives are complemented. In fact, for the students of medical and veterinary faculties the students alternate between traditional practice use animals and real diseased people and computer simulations. Consequently, computer programs can substitute for the less critical simulations. The simulation programs help with many diverse topics in physiology and nursing. A variety of manipulations can also be performed during one laboratory session. Without computer simulation, some medical experiments might take days or weeks, require considerable technical prowess, and require expensive laboratory support. Computer-aided laboratory instruction means that experiments can be done any time the computer is accessible. In addition, no instructional help is required to set up the imitation laboratory, and the experiment will not fail due to technical inexperience on the part of the students. The advantage of medical and veterinary computer imitation is in a possibility of repeating all exercises if necessary. The experiments can be changed for different students. By running through a procedure before using simulation, students can be better prepared as to the signs to be looked for when the live procedure is done.

Some new computer assisted strategies for senior students in machinery

Computer imitation laboratories can help the students imagine properties and dimensions of complex parts of different machines (see Fig.1and Fig. 2).

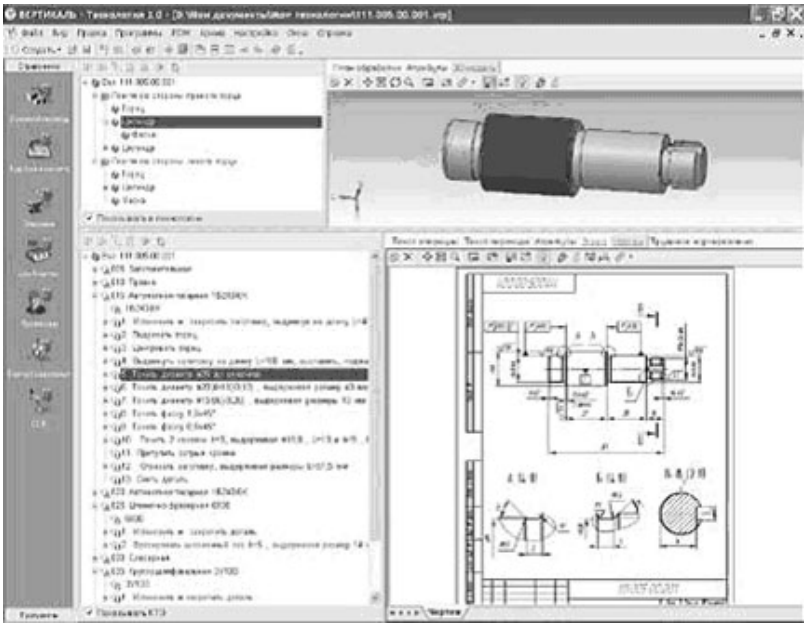

Fig. 1. **Example of standard detail image on the screen**

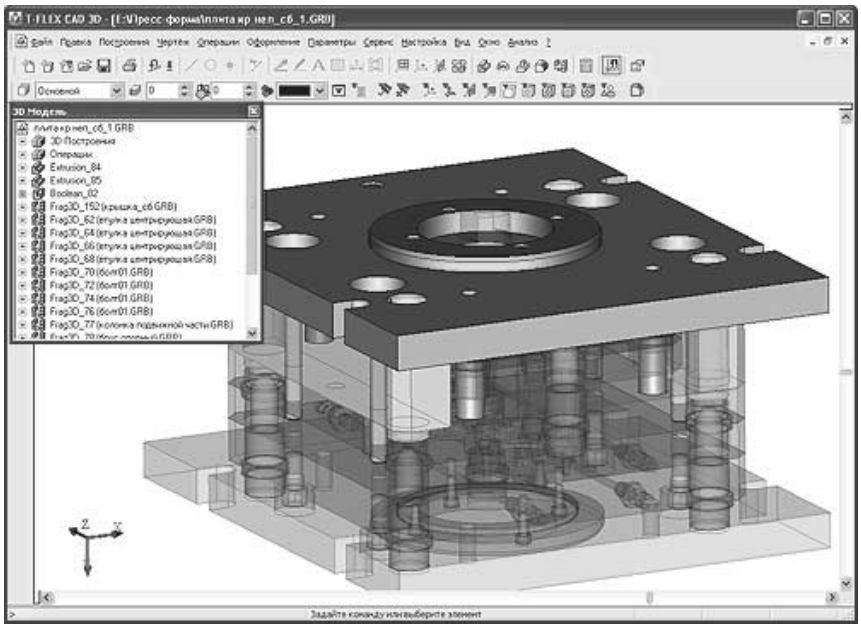

Fig. 2. **Example of real view of complex part of any machine**

It is possible to rotate the image on Fig. 2 and observe the part under appropriate angles if necessary. The student can study all possible dimensions of this part. He or she can simultaneously find and observe different possible technologies of its production, get information of its price ant other interesting data. In fact, instructional imitation technology accepted for several terms creates students' competence and adaptability in the application of design, build, or assemble a part, product, or system, including application of specific methodologies, equipment, or materials; meeting the client requirements; developing system specifications from the requirements; and testing and debugging a prototype, system, or process using appropriate tools to satisfy the requirements. This strategy includes quizzes to discus the basic tenets of the engineering enterprise and fundamental design and analysis techniques [6].

Optimisation of computer-assisted instructional strategies

Optimisation of instructional strategy in computer assisted laboratory settings can be constitute on the numerical index — *S* [7]. Let us assume that the whole amount of instructional steps on any computer aided manual is *L*. The amount of independent steps we denote as *l*. Then:

$$S=l/L$$

Historical full independent strategy is characterized with $S=1$ (or 100 %). Computer aided strategy without any independent steps assigned with $S=0$ (0 %). What is the optimal amount of *S*? According to Skinner theory [8] individuals achieve success after he or she produce no less than 95 % correct operations. The probability to find a correct answer is 50 %. It means to feel him or herself comfortable the student can treat no less than 10 % independently solved problems. The remainder problems the student can find with CAI given hints. The maximum allowed amount of *S* one can find from the next arguing. Each independent operation can be checked after the nearest operation in the order. It is the self-control point. The chain of two choice points in order is undesirable because of the possibility that two wrong solutions create too high deviation from the necessary way of experimental steps. It means $S=0.5$ (or 50 %) is the maximum acceptable value of *S*. That is why the desirable *S* value lies in the range $10\ \%<S<50\ \%$. It may be expected that real values of *S* can be find between 25-40 %.

The optimal *S* values found above are very approximate certainly. Despite of this we studied paper printed manuals in laboratory of the introductory course of physics for five Russian universities. Computer assistance in physical laboratories of these universities confined the pre and post experimental testing and data recording. In the four universities the values of the independence index lie in the range that was found above. A very high value for the case of the fifth university can be

probably explained by too small amount of steps in the manuals. That may be the source of large errors in the value we have found. Manuals in modern computer assisted laboratories with a traditional style of experiments include much more steps. These developed strategies encourage students to be more independent.

Conclusions

Computer assisted strategies transform traditional strategies into more effective. These strategies tailored with traditional ones foster the students' activity and generate new KSA. The advantages of implementing computer assisted education are excellently known. Creation of new strategies enhanced effectiveness of the educational technologies. Nevertheless, there are some negative behaviours of widely spread computer assisted instructions, too. Lack of students' independence and practice to wait for different hints are traditional disadvantages of computer aided learning. These disadvantages are not critical. Yet, it is necessary to discuss them more detailed in future. Constant control for the independence indexes can compensate some discussed disadvantages without any problem.

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