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THE EFFECTIVENESS OF A VIRTUAL LABORATORY IN TEACHING CHEMISTRY

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Abstract
An important progress in computer technology and software has been realized in recent years and using of the computer in education increased as well as. The computer-based education (CBE) has been enriched using simulation and animation. The aim of this study is to carry out the effect of computer simulation and animation on the students' success on chemistry subject and attitudes of students into chemistry. A computer-based learning packet concerning solutions is prepared for this purpose. Traditional teaching does not often allow very active involvement of pupils in class. In chemistry and natural sciences in general experimental and laboratory work is one of the most effective methods for acquiring knowledge. This article will represent the effectiveness of virtual laboratory in pupils' knowledge.

Keywords: Virtual laboratory, science, chemical and visual literacy, knowledge, simulation, animation, Computer Based Learning, Student Success.

Introduction

Nowadays, computer animation and simulation is an important tool for science education. Studies show that animated images transform abstract idea into concrete images, thus improving the student's perception, understanding and attention. This also enhances and stimulates the cognitive thinking of learners and at the same time relates the basic concept of science in their real life experiences. Visual materials are needed in science education for students to better comprehend the subjects since science classes have theoretical natures and include abstract concepts. Computer-aided instruction plays an important role in presenting science subjects to students in a more concretized manner and presents active learning opportunities to teachers and

students through computer Traditional teaching does not often allow very active involvement of pupils in class. In chemistry and natural sciences in general experimental and laboratory work is one of the most effective methods for acquiring knowledge. Experimental work can also be exercised using virtual world. Virtual laboratory offers some important advantages. Understanding chemistry involves the ability of cognitive comprehension on three levels: the macroscopic level, the symbolic level and the level of particles where the virtual laboratory can be an effective tool. On this basis a didactic experiment was performed in order to verify the effectiveness of virtual laboratory from pupils' knowledge point of view. Furthermore, I tried to answer the question whether the learning results of pupils, according to the experimental design of classes using a virtual laboratory, are better than results gained through teaching classical science classes without visualization tools. The researches of the didactic experiments have shown that acquiring knowledge is more effective when using the virtual laboratory instead of classical teaching (in the case when classical approach does not include visualization elements crucial for learning and understanding chemistry).

Main Part

In teaching science teachers often proceed from the fact that nature is the best source of information. The basic and at the same time the most effective method in gaining chemistry related knowledge is experimental and laboratory work. Basic science concepts are introduced by experiments. In a dynamic social environment like today's traditional forms of education and training do not suffice. Information and communication technology (ICT) opens up a new world of creativity for students and teachers. The understanding of chemical concepts and processes can be increased if we provide the development of chemical visual literacy. Key elements of chemical visual literacy are perception and the ability to describe changes at the macroscopic level and the correct perception of the natural partition structure of matter at the submicroscopic level. We use molecular and crystal models. In school laboratory experiments can be carried out in a realistic or virtual manner. With virtual experiments the experiments are carried out using computer simulations or animations. One of the advantages of virtual laboratory, among other things, is that it allows the portrayal of matter's model structure which is a prerequisite for proper understanding of the natural partition structure of matter[1].

Teaching scientific concepts should be firstly based on the observation of a particular science process which means that the natural process is perceived through perception or senses. At the second stage it is necessary to explain the observations with theories

based on the partition structure of matter that are at a given time and on a certain level of education scientifically indisputable. At the third level is the understanding of a chemical concept. The submicroscopic level is translated into the appropriate symbols which include chemical symbols, formulas and equations, mathematical equations, different, schematic and graphical presentations and more. This level permits an easier interpretation of the situation and mutual communication between those who are acquainted with the symbolic language. Science education particularly seen from the symbolic level without integrating it with the previous two, can lead to the creation or strengthening of already established misunderstandings if these symbols are not correctly interpreted and integrated into the existing network of knowledge In chemistry and natural sciences in general, the experimental and laboratory work is one of the most effective methods for acquiring knowledge. The detection of concept world of matter, phenomena and processes is characteristic for chemistry at the macroscopic level[2]. For interpreting and forecasting we must use the language of the submicroscopic world. While learning chemistry it is important that students understand and can connect concepts on all three conceptual levels (macroscopic, submicroscopic and symbolic) which is difficult for many of them. The gap between the three conceptual levels can be, to the great extent, overcome by the use of visualization elements. Thus the ability to use models in teaching and learning chemistry is among the key chemical elements of visual literacy

Virtual labs are one of the technological innovations among the modern educational methods. In virtual labs, the computer is used to provide a 3D virtual environment for the science lab, enabling the student to coexist and interact and deal with it, so that the student feels as he/she coexists, interacts, and deals with a real science lab in all its dimensions. Consequently, the student can use the Internet and computer in any place and time to perform experiments. Also, he will be able to access information in various materials and disciplines, which develops his skills and helps him to keep abreast of daily developments in the field of education. Even the radical change in the educational techniques and methods around the world and the use of digital devices in a wide range within the educational system, it became necessary that educational institutions keep pace with this transformation and seek to obtain the greatest benefit from virtual labs to help students to compete in the labor market and research fields. It is clear to us that the digital age will make room only for those who can keep up with it, which enables them to adapt to its applications in all aspects of life. The way to benefit from virtual labs in modern education is by linking the theoretical aspect in the lecture, to the practical aspect in the laboratory. And the best way to achieve the most benefit is to use them in teaching analytical thinking skills, in addition to using

them in assessing student performance and achievement, which is significantly reflected in the improvement of the learning process[3].

In chemistry and natural sciences in general the experimental laboratory work is one of the most effective methods for acquiring knowledge. From a didactic point of view, the experimental work is of the most importance because it sometimes discontinues the monotonous teaching of theory with practical work. Experimental work can be divided into real and virtual. Classical experimental work is the best known method of practical work and is most commonly used in teaching science and chemistry in elementary school. For students who choose the subject. Experiments in chemistry are a fundamental and predominant form of work. Students train their manual skills, develop the ability to describe chemical changes, learn about physical and chemical properties of matter, develop safety at work abilities in the school laboratory, they strengthen and complement knowledge, abilities and skills, develop an experimental approach as a form of research work. The experimental work allows them to develop and deepen their science literacy, basics of scientific work, complex thinking and linking theory with practice. As proved, the students want to elevate the frequency of laboratory work covered in traditional classes. Virtual laboratory exercises are held in the virtual world. Virtual lab brings many advantages. We can perform dangerous experiments without endangering ourselves or others. Simulations are affordable. Once developed, they can be done at no extra costs as many times as we want. The results are always the same. The main disadvantage of a virtual laboratory is the alienation from nature and from what is real. Therefore simulations are mostly a good supplement and not a substitute for practical experimental work. Virtual laboratories reproduce the conditions of a real chemical laboratory and enable learning through an interactive simulation and are a valuable tool for distance learning and lifelong learning of chemistry. Virtual laboratories allow the execution of experiments without teacher's presence; therefore students have a major role in their learning process. Studies have shown that virtual laboratory is an appropriate tool with which chemistry students prepare for practical work[4-6].

Advantage of Virtual Labs

1.Help solve the problem of limited resources and funding for experiments.

2.Protect students from the dangers they face while conducting some dangerous laboratory experiments. It eliminates the need to deal with toxic or radioactive chemicals and other hazards such as electrical connections, etc. Subsequently, it is an effective way to avoid laboratory accidents.

3.Ability to display very accurate phenomena and results that may not be measurable using simple laboratory tools and that require complex and expensive equipment.
4.Help the teacher cover all aspects of the course curriculum with practical applications and help the student understand all the points of the course curriculum; which is difficult to provide in the case of limited equipment and funding.
5.Provide the synchronization between the process of explaining the theoretical ideas and practical application, just as real laboratory experiments are linked to theoretical lectures.
6.Help students and teachers study and prepare laboratory experiments at any time and place.
7.The student is able to conduct the same experiment several times according his/her ability to absorb the information. This is generally difficult to provide in a real laboratory in the case of limited material and the lack of equipment in proportion to the numbers of students.
8.The student is given the opportunity to control the inputs of the experiment, change the different transactions, and observe the changes in the results without the existence of a supervisor and without being exposed to any risks.
9.Provide cooperation and interaction between the students and between the teachers and students.
10.The ability to record all the results electronically, which helps in analyzing them using the latest software programs and sharing the results and analysis with others.
11.Help the teacher to evaluate students electronically and easily to guide them and follow their progress in conducting experiments.
12.Save time and effort for researchers by eliminating the need to move between different laboratories.
13.Provide a comprehensive overview for the learner about the hazardous experiments which are not safe in the real world, thus providing him/her with a greater absorption of the course.
14.Help educational institutions save money.
15.Add entertainment while conducting the experiment, which helps attract the students' attention.
16.Motivate students to conduct laboratory experiments.
17.They satisfy the scientific passion of students, allowing them to access the various experiments easily regardless of time or place.
18.Increase the understanding of scientific courses in physics, chemistry and biology; and Increase student achievement.
19.Eliminate boredom, as it provides fun during the experiments.

20.The virtual labs will increase the scientific research rates because it saves time and effort and enables researchers to use their time more effectively.
21.The virtual labs will enable students to use modern technology and enable them to follow the tremendous progress of the information revolution.
22.Students will be able to use the scientific method of problem-solving.
23.Developing teaching and learning methods that will lead to the effectiveness of the educational process.
24.Increased communication between students and each other on the Internet, which helps with the exchange of ideas and experiences.

Impediments to Use Virtual Labs

1.They require computer devices with high specifications in order to simulate the exact phenomena with full details and create a three-dimensional virtual lab.
2.They require professional programmers with strong skills in different programming languages. They also require a team of experts in the scientific material, teachers, and experts in psychology.
3.One of the negative effects of Virtual Labs is that it reduces the direct interaction between students and each other, and between students and teachers, given that the communication between them is electronically most of the time.

Conclusion

We can change reaction conditions and examine the course of the reaction on the submicroscopic level by virtual lab's tools. With this we included visualization elements that are crucial for learning and understanding chemistry. The effectiveness of lessons carried out with a virtual laboratory was examined from knowledge's point of view at three levels: knowledge, comprehension and application of knowledge. We identified statistically significant positive impact on science and knowledge at a higher level of knowledge of the experimental group which was taught the themes Substances, their properties and changes and Pure substances and mixtures using a virtual laboratory. With the reproduction of knowledge, the difference between the adjusted arithmetic mean of the students' test scores of experimental and control group was not statistically significant. In measuring the comprehension of knowledge we found the experimental group students' performance was better than of control group students' performance. Virtual laboratory facilitates laboratory work which sometimes cannot be implemented due to physical or other reasons. Using ICT makes science popular among young people. Retaining knowledge through virtual laboratory has proved to be effective in comparison to traditional lessons in terms of knowledge.

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