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USE OF VIRTUAL LABORATORIES IN ORGANIZING PRACTICAL AND LABORATORY LESSONS IN CHEMISTRY EDUCATION

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ABSTRACT

This article describes the use of a virtual laboratory in the teaching of chemistry in general secondary schools, as well as integrated web-based learning for simulating chemical experiments, summarizes its advantages and gives recommendations.

Keywords: Chemistry teaching methodology, Virtual laboratory, ChemCollective, Crocodile Chemistry, animations.

INRODUCTION

In the field of education, interactive boards and panels are used, which not only ease the teacher's work, but also create opportunities for obtaining sufficient knowledge. Modern information technology tools make it possible to use and store information of any size and content to a practically unlimited extent.

Virtual laboratories are used in general education schools that are not sufficiently equipped with reagents and equipment in order to achieve the acquisition of knowledge and skills in accordance with the requirements of DTS. In this regard, in our country, in practical and laboratory classes in chemistry, scientific work is being conducted on the mechanism and conditions of chemical processes, as well as methodological aspects of conducting physical and chemical realities in a virtual way.

LITERATURE ANALYSIS AND METHODS

It is known that teaching chemistry in general education schools, in turn, requires in-depth theoretical knowledge in explaining chemical phenomena and processes, as well as the ability to perform practical laboratory experiments. However, many of the laboratory and practical exercises that must be carried out in educational institutions are important due to the fact that the safety requirements in the laboratory are not up to the required level, the necessary modern equipment is not enough, the required reagents and substances have expired or they are not available. it causes the results obtained in the experiments to be wrong or the practical training not to be performed as expected. Nevertheless, laboratory and practical exercises are an integral part of chemical education in explaining the essence of theoretical processes in chemistry education and in acquiring various skills and qualifications of students. In addition, it may require a specially equipped laboratory and a long time for students to study the physico-chemical properties of substances. Accordingly, solving the problems listed above requires an alternative educational approach, i.e., virtual laboratory programs that allow predicting

properties, and this in turn is an additional supplement for students or in situations such as during a pandemic. It also serves as a convenient distance learning resource for students to strengthen their theoretical knowledge. In addition, virtual labs offer new ways to develop simulation-based exercises for learning and motivation. Interactive exercises allow students to learn and reinforce key concepts in increasingly complex, realistic, and engaging contexts, creating a flexible, interactive learning environment where they can approach chemistry more like practicing scientists.

Currently, multimedia e-learning literature, lectures, virtual laboratory and other special programs are necessary in the educational system. There are many such programs. For example, there are opportunities to create multimedia educational tools in the Macromedia Flash program, and virtual laboratory exercises using educational programs such as ChemCollective and Crocodile Chemistry.

The multimedia laboratory works created by us include animations and videos. This multimedia Macromedia Flash, ChemCollective and Crocodile Chemistry virtual laboratory programs provide an opportunity to create text, animation, sound laboratory works that meet the requirements of today. The procedure for using the laboratory work conducted on the basis of these programs was tested during the training, and positive results were obtained in the experimental classes. Because there are many invisible microprocesses, dynamic movements, interactions between atoms and elementary particles in chemistry, when performing and explaining laboratory and practical exercises in the 7th grade chemistry textbook, often o teachers have to verbally explain effects and physico-chemical phenomena, experiments, and imagine them mentally.

Take The ChemCollective, a program devoted to the study of chemistry. It contains many thematic materials in English. One of its most interesting departments is a virtual laboratory called IrYdium Chemistry Lab. Its device is significantly different from other virtual programs. The fact is that concrete experiments with their tasks are not offered here. Instead, the user is given almost complete freedom of movement.

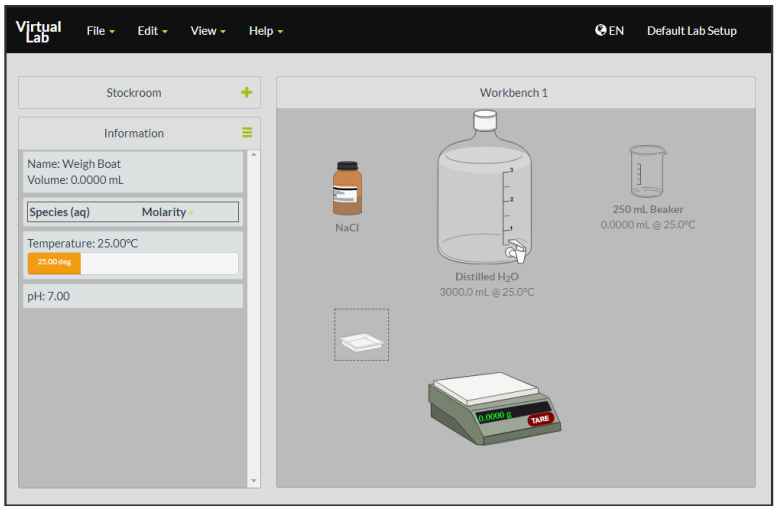

Figure 1. ChemCollective virtual lab software desktop.

About the Crocodile Chemistry program.

Using the Crocodile Chemistry program, you can study the chemical and physical properties of all the elements in Mendeleev's table. Usually, during chemical reactions, it is not possible to observe the process of transformation of molecules participating in the reaction into other molecules. However, through this program, it will be possible to observe the dynamics of molecules during the reaction of a chemical substance with other substances.

Through this program, you can model chemical processes, carry out various reactions, and most importantly, do it safely.

This program can be widely used in teaching chemistry in secondary and higher educational institutions.

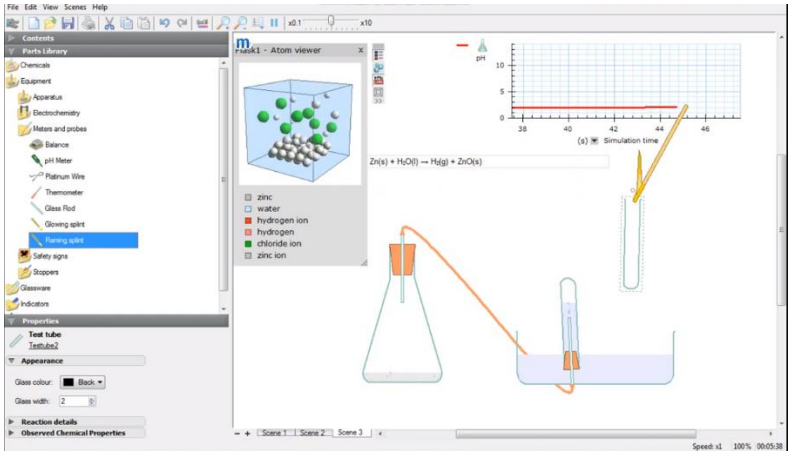

Figure 2. Corocodile Chemistry virtual lab software desktop.

Through the program, using containers of any shape, it is possible to observe a chemical reaction by mixing different reagents. During a chemical reaction, the ability to see the color of reactants, the proportion of substances, chemical reaction formulas in a special window makes it possible to use the program as a powerful pedagogical tool. These capabilities of the Crocodile Chemistry program have caused a revolutionary change in the teaching of chemistry.

Using Macromedia Flash, ChemCollective and Crocodile Chemistry virtual laboratory programs, experiments were carried out in a general secondary school in order to coordinate students' theoretical knowledge with practical and laboratory work.

DISCUSSION AND RESULTS

Experimental testing consists of two stages. The first stage is the preparation of animations in the Macromedia Flash program and the development of methods for creating virtual laboratories and using them in Virtual Chemistry Laboratory, Crocodile Chemistry programs. Second stage: use of prepared animations and virtual laboratories in the educational process.

During the 2022-2023 academic year, animations related to the implementation of existing laboratory and practical exercises in the 7th grade Chemistry textbook were carried out on the basis of Macromedia Flash and virtual laboratories Chemistry Laboratory, Crocodile Chemistry programs. In the second stage, 7th grade students were taken, who needed to be tested. The

students' chemical knowledge, skills and qualifications were determined using test questions and oral questions and answers.

In order to ensure the accuracy of the experimental results, 7th "A" and 7th "B" classes, whose chemical knowledge is almost equal to each other, were selected (as experimental and comparison classes). Multimedia and virtual laboratory lesson plans were prepared for the experimental class based on the existing 6 laboratories and practical exercises in the 7th grade Chemistry textbook. For the pedagogical experiment of the 7th grade Chemistry textbook, "Working with a laboratory tripod, alcohol lamp, gas burners, electric heater", "Separation of a pure substance from the composition of mixtures (purification of contaminated table salt)", "Flame structure and combustion of substances in oxygen", "Hydrogen extraction" and testing its properties", a virtual laboratory was conducted on the topics of "Preparation and properties of acids" and "Interaction of acids with metals" and existing animations were used.

In the experimental class, students performed laboratory and practical exercises using virtual laboratories. In the comparison classes, the students were taught the lessons in a traditional way, according to the textbook. After that, the students of both classes were evaluated by means of test control using the same control tasks.

The results of the students' mastery of the laboratory and practical exercises given in the 7th grade chemistry curriculum during the experiment are presented in Table 1.

Table 1 Changes in the level of knowledge of students in the laboratory and practical training provided in the 2022-2023 curriculum

Classes	Number of students	Preliminary test results			Experimental results		
		"5" price	"4" price	"3" price	"5" price	"4" price	"3" price
Experimental class	30	2	16	12	6	20	4
Comparison class	30	3	17	10	3	18	9

In the experimental classes, the "excellent" grade increased by 13%, and the "good" grade increased by almost 13%. In the comparison classes, such positive results were not beyond the margin of experimental error.

The results of the control test show that the number of "satisfactory" and "unsatisfactory" grades in the experimental classes decreased by almost 2 times compared to the comparison classes.

Table 2 Variation lines according to the evaluation results

Level of students' mastery	In experimental classes		In control classes	
	Number of students	%	Number of students	%
"5" – price	6	20	3	10
"4" – price	20	66.7	18	60
"3" – price	4	13.3	9	30
Total	30		30	
Appropriation		86.7		70
Quality indicator		20		10

CONCLUSION

Therefore, teaching the laboratory and practical exercises presented in the 7th grade chemistry curriculum using virtual software and demonstration tools has a better result than conducting traditional laboratory and practical exercises (16.7% higher). it can be clearly seen from the results of students of the experimental class.

It can be seen that if virtual laboratories are used in practical training for the proper organization of students' learning, students' interest in training will increase and they will have a conscious approach to education, as a result, their thinking will expand. and strive to get more independent knowledge.

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