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THE DEVELOPMENT OF INTERACTIVE CHEMISTRY LESSONS ON THE TOPIC: «MINERAL FERTILIZERS»

The main methodological innovations today are the use of interactive learning technologies, involving each student in the learning process, i.e. in the process of cognition. The introduction of modern interactive learning technologies creates conditions for improving the quality of the training session, as well as methods of teaching chemistry. Each teacher uses new learning technologies to ensure that classes are systematic, high-quality, interesting, and effective. It is known that students have different ways of thinking and when conducting lessons, performing tasks with the help of illustrations, video materials, animation, and games increases interest in the subject.

In this paper, interactive apps identified and described that contribute to increasing the activity of students and the effectiveness of the learning process in lower secondary school, as well as interactive chemistry lessons on the topic «Mineral fertilizers» are developed. In implementing the developed interactive lessons, such teaching methods as interactive lectures, interactive exercises, and didactic games were used.

A relatively small sample size limited this study, but the results obtained have essential data for the professional development of teachers and the development of modern interactive lessons using ICT.

The results obtained after a survey of students, in which 100 students participated, indicate that interactive lessons support learning and increase students' motivation, and this has a positive effect on their attitude to the subject.

Keywords: teaching, chemistry, interactive lessons, application of ICT, questionnaire.

Introduction

Nowadays, the modern education system solves problems related to the definition of new values to improve the quality of education, and personal

development of students, as well as the use of innovative teaching methods that will develop students' knowledge and skills in natural sciences [1].

Karpov stated [2], that school does not develop research abilities such as the ability to find a problem, comprehend it and highlight the subject of study. The formation of research competencies and creativity in the field of modern science requires a long time, so it should begin in the school years. According to Fialho and Matos [3], when teaching subjects of the natural science cycle using traditional methods, it is very difficult to achieve a connection with the real life of students. At the same time, Cizkova and Ctrnactova in their study [4] point to similar problems associated with motivation to study chemistry and biology in secondary school, noted in Eastern Europe: students consider these subjects too «academic», «theoretical», «complex», complain about a large amount of educational material and the «impossibility» to apply this kind of «theoretical knowledge» in practice.

The modern technical level of interactive web technologies, and the flexible nature of ICT open up wide opportunities for both teachers and students to engage work with them in the educational process. For the teacher, this is a way of modernizing the content and course of the lesson, for example, computer modelling and animation have already firmly taken their place in the description, explanation and prediction of natural processes [5].

The ICT literacy model proposed by Peres and Murray [6] is based on the principle of generativity, i.e. the ability to acquire new skills and knowledge that form the basis for innovation and creativity. In our opinion, a promising resource for activating students can be the use of mobile devices (smartphones, computers, tablets) in the educational process, which have already become part of everyday life for the modern generation of schoolchildren.

Koc [7] emphasizes that with adequate use of ICT, students better assimilate educational material, and as a rule, they are more motivated to overcome the difficulties encountered. Much attention is paid to conducting student research in a virtual computer environment, which can be organized as an environment of collaboration and educational cooperation [8]. The works of Blasco-Arcas L. et.al. [9], Koch and Vogt [10] provide evidence that students in an interactive environment increase the accuracy of perception (memory), as well as intellectual and emotional personality traits, such as the amount of attention, the ability to distribute attention, the ability to analyze the activities of a partner.

Avinash and Shailja in their study [11] showed that from the point of view of assessing the progress of students in chemistry, an ICT-based curriculum is more effective than the traditional method. In the studies of Cerghit [12] and Manak [13], interactive methods are analyzed for the ability to interact or be in dialogue with someone (for example, with a person) or with something (for example, with

a computer) in the learning process. Such methods include an active educational and cognitive activity of students, exchange of knowledge, ideas, and experience for the joint solution of a problem situation in a group.

Sadykov's article [14] highlights the following advantages of interactive lessons:

– improving the quality of knowledge as a result of the active participation of students in the educational process;

– increased motivation and cognitive activity of students, especially when learning new material;

– providing flexibility and convenience in learning.

Currently, some experience has been accumulated in creating interactive programs and Internet portals in chemistry. Table 1 shows the programs to support the teaching of chemistry in secondary school. Currently, some experience has been accumulated in creating interactive programs and internet portals in chemistry.

Table 1 – Interactive programs to support chemistry education in secondary school [15]:

Program name	*Description*
1.ACD /Chemsketch	designed specifically to support the teaching of chemistry, it contains many graphical options that facilitate the creation and editing of various chemical structures. Students can drag and rotate 3D models.
2.Periodic Table and databases apps	digital applications that are more focused on studying the properties of chemical elements in general or inorganic chemistry.
3. Mobile Reagents	provides access to a database of 11 million chemicals for searching by name and formula or using a camera.
4. Reaction101	It is used as a chemical reaction editor with chemical reaction equalization functions.
5. ChemLab	This is a virtual chemical laboratory necessary to create your own virtual laboratory experiment.
6. Interactive Environment Project «PhET» https://phet.colorado.edu/en/	This is a website containing free interactive and scientific simulations using a game environment.

7.«Waterloo» https://open.science.uwaterloo.ca/7	contains free online lessons and exercises in general chemistry, covering topics from the Canadian curricula of the 11th and 12th grades.
8. Learningapps.org	an interactive application that allows the teacher to create personal interactive tasks and exercises. This program contains about 20 interactive templates that also allow students to use their mobile devices for learning.
9. Kahoot	Ian interactive platform based on games. It can be used on any school subject, on any mobile devices. The platform also allows you to publish and share your own tests, as well as edit tests created by other users.
10. Bilimland https://bilimland.kz/ru	educational website containing educational materials in Kazakh and Russian languages, interactive exercises, tests.

The presented special programs and educational websites on chemistry can help students to create clearer ideas about the structure and properties of various chemical compounds.

In recent years, many didactic programs have appeared in the world designed for teaching chemistry, focused on various thematic areas, but we do not often encounter their use in chemistry lessons. There are two main obstacles to the introduction of new technologies in the educational process:

– fear or anxiety of a teacher associated with low knowledge in the field of ICT;

– low-quality assignments that do not meet the modern goals of teaching chemistry [15].

At the moment, there is a huge gap in the introduction of information and communication technologies in the educational process in Kazakh schools, only some of the studies indicates how teachers use these tools to transfer knowledge to students and what impact the use of ICT has on the learning process [16].

The article by Kokibasova et.al. [17] presents the results of using mathematical methods to determine the impact of programmed learning on the quality of students' knowledge in chemistry. In the course of this study, a test version of the application «Nentwig» was developed that implements the intended functionality. The results of the analysis of the application and the questionnaires of the participants showed that the developed complex can be used in the study of chemistry at school.

Ospanova A.S. et al. in their work [18] consider the methodology of compiling a programmed course in inorganic chemistry on the topic: «Energy in chemistry» for 10th grade students. The chemical simulator was used during distance learning, and its effectiveness was studied in the classroom for the diagnosis (slice) of the results in the control and test groups. The final cross-section showed that the academic performance of the control group students remained almost unchanged, increased by 2%, and the academic performance of the students of the test group increased significantly, improved by 9 %.

The point may also be that so far there is no such «universal» interactive resource that a teacher could use in the classroom – to set a task, assimilate and consolidate educational material, evaluate students' knowledge and skills. The analysis of professional literature, including the sources listed above, allows us to identify one of the important reasons for such a «discrepancy». The point, in our opinion, is that educational materials provide students with knowledge as fragments of illustrated or animated information to be memorized «ready-made».

The goal of our research is to present created and tested interactive lessons for lower secondary schools based on the characteristics of interactive ICT-supported education. Interactive lessons developed by us for use in the following ways of organizing education:

– An interactive lecture is an immersion in the presentation of the material in close contact with the audience. In this case, various interactive technologies are used, and students can discuss issues of a problematic nature. An interactive lecture with ICT can be implemented, for example, as a computer presentation with tasks and samples of their solution. The interactive lecture is based on the idea of generativity as an active principle that encourages cognition, the creation of new knowledge and its application.

– An interactive exercise engages students in the learning process, provides them with information about their success, increases their interest and stimulates their intellectual abilities. Practical interactive exercise allows students to be active, and creative, generally providing an opportunity to find the answer on their own. Such exercises give students immediate feedback in the form of messages about whether the given answer was correct, as well as an overall assessment of the work in the form of a percentage of correctly completed tasks.

– A didactic game as a means of purposeful personal development of the child. A successful experience here is the online service Kahoot, which allows you to create online surveys, discussions and quizzes for the audience. Interactive games with quiz forms provide an opportunity to develop strategic thinking. Quizzes can help strengthen knowledge and act as a knowledge-testing tool in many areas of chemistry [14].

Materials and methods

In developing the content of interactive lessons, we took into account the content of chemistry curricula and their corresponding teaching methods in schools in the Czech Republic and Kazakhstan, where the developed electronic resources were tested. The possibility of concurrent use of educational programs in the education of schoolchildren of these two countries gives them a meaningful and structural similarity, as well as the proximity of the foundations of the fundamental reforms carried out to date, which open up a certain prospect of introducing ICT innovations into educational practice.

An example of an interactive lesson developed by us on the topic «Mineral fertilizers».

The main goal of the lesson: to name the classification of mineral fertilizers and the nutrients that make up them.

Fertilizers are complex substances containing substances that are necessary for plant growth. Fertilizer separation: 1) Natural (Figure 1).

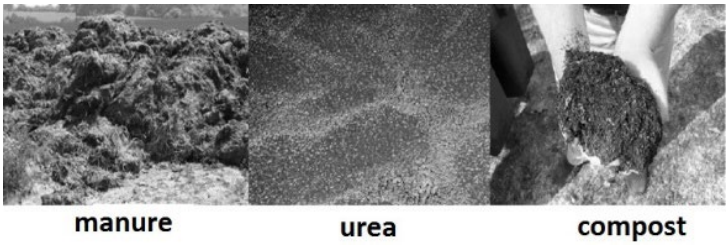


Figure 1 – Types of natural fertilizer.

Task 1. Choose the advantages and disadvantages of organic fertilizers (Figure 2): https://learningapps.org/watch?v=pkm09qc6k18

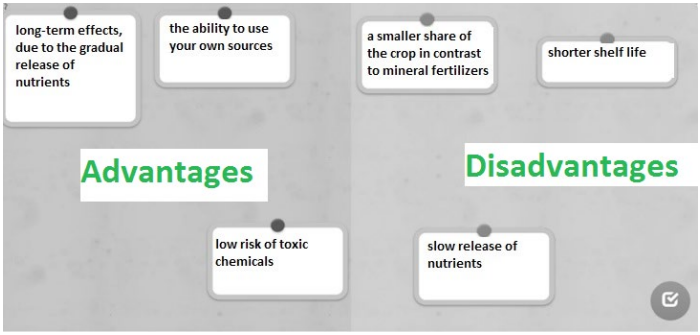


Figure 2 – Interactive task № 1

2) Mineral

Task 2. Compare the concepts that are related to each other (Figure 3): https://learningapps.org/watch?v=phvfa3uct18

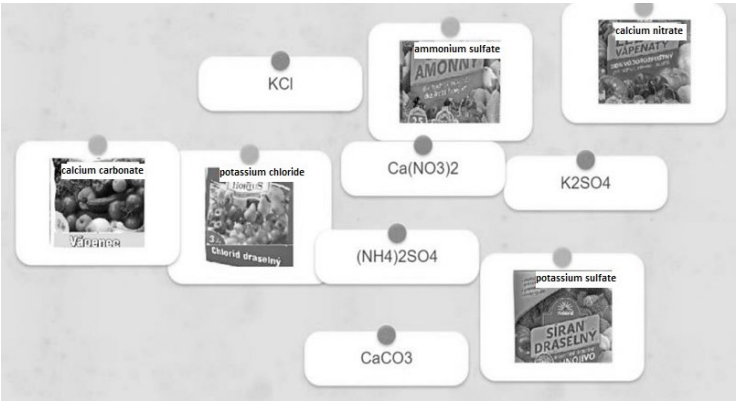


Figure 3 – Interactive task №. 2

Task 3. Divide mineral fertilizers into nitrogen, phosphorus, potassium, calcium (Figure 4): https://learningapps.org/watch?v=phvfa3uct18

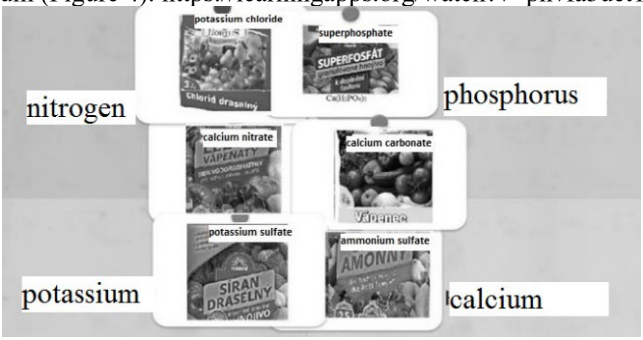


Figure 4 – Interactive task № 3

Task 4. Make words from the following letters to learn certain functions of fertilizers.

1. N G E N O T R I – promote protein production and, consequently, plant growth.
2) I C R P H S P O O - support the formation of flowers and fruits.
3) P T S S M I M O A U - contribute to the formation of carbohydrates.
4) C U M I C A C L- used to reduce the acidity of some soils.

Task 5. Select the advantages and disadvantages of mineral fertilizers (Figure 5): https://learningapps.org/watch?v=pdx1u8hrt18

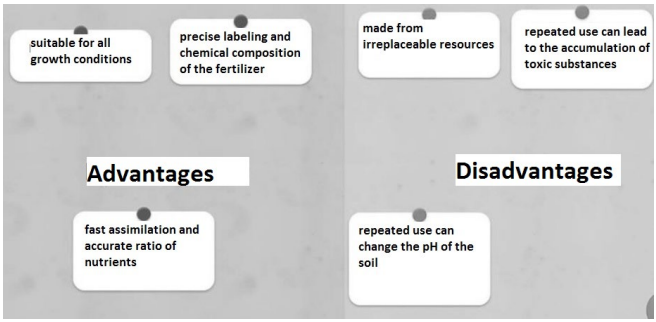


Figure 5 – Interactive task № 4

Pesticides are chemicals used to protect against pests and plant diseases. When using pesticides, we follow the manufacturer's instructions, do everything with care and monitor the exact dilution of the product or its dosage.

Division of pesticides:

1. Fungicides – means against mold and fungi (Figure 6).

Figure 6 – Examples of different types of fungicides

2. Herbicides – means for the destruction of weeds and invasive plants (Figure 7).

Figure 7 – Examples of different types of herbicides

3. Insecticides are products designed to control insects (Figure 8).

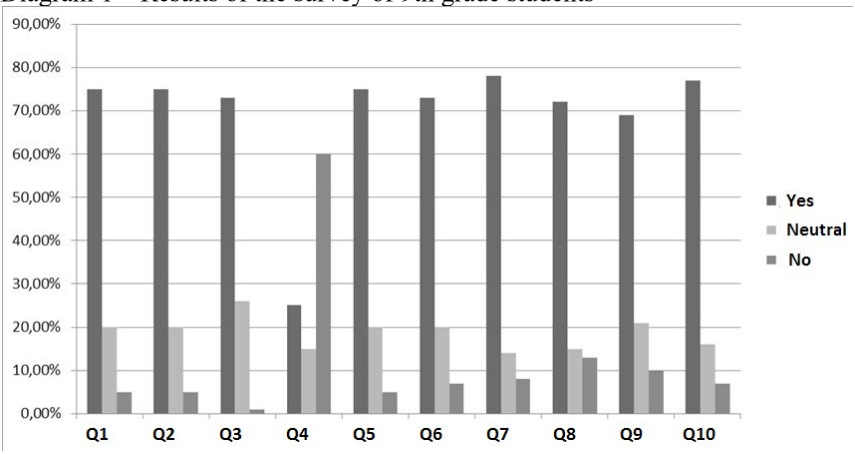
Figure 8 – Examples of different types of insecticides

Task 6. Play the game Kahoot : https://play.kahoot.it/#/k/69f19337-10db-4180-8f98-543939a116c7.

Results and discussion

The experiment was carried out on the specialized school of Information Technology (Karaganda), Secondary School No. 44 (Karaganda), as well as two Czech schools: First Private Language Gymnasium (Hradec-Kralove), gymnasium in Prague (Prague) in the period from 15.11.2018 to 10.05.2021. Students of the 9th grade took part in the approbation of the developed lessons. At the end of a series of interactive lessons, a survey was conducted. The questionnaire was answered by 100 students - 49 girls and 51 boys aged 14-15 years (the results of the survey are shown in Diagram 1). The questionnaire developed for this study consisted of ten questions. We used a three-point response scale: «yes» (1), «neutral» (2) and «no» (3).

Diagram 1 – Results of the survey of 9th grade students



As the results of the survey show, more than 75 % of students believe that interactive lessons are more interesting than traditional classes. The students liked (70 %) the opportunity to use mobile phones or tablets in the lesson: 8 %, respectively, answered «no» to this question. More than 75 % of students would like interactive lessons using computer presentations and various types of interactive applications to be conducted more often, and only 8 % of students chose the answer «no». 69 % of students preferred interactive problem-solving to traditional. It is interesting to note that more than half of the surveyed students do not believe that interactive lessons contain too much information, diagrams and images, although there are much more of them used than in traditional lessons. In addition, approximately 75 % of students are confident that the knowledge gained in an interactive chemistry lesson can be applied in real life.

Conclusions

In this article, we identified the role of ICT in teaching chemistry and described interactive chemistry programs that contribute to improving the effectiveness of the learning process in secondary school. The purpose of our research was to create and test interactive lessons for lower secondary schools based on the characteristics of interactive ICT-supported education. A review of the scientific and methodological literature of previous studies has shown that mobile applications used in secondary school increase student academic performance and engagement. During the testing of interactive lessons, we are faced with the willingness of teachers to use tablets and mobile phones. Interactive lessons developed by us for use in the following ways of organizing education: an interactive lecture, an interactive exercise, and a didactic game. This study was limited by a relatively small sample size, but the results obtained have important data for the professional development of teachers and the development of modern interactive lessons using ICT.

The results obtained after the survey indicate that interactive lessons support learning and increase the motivation of students, and this has a positive effect on their attitude to the subject. Moreover, we believe that the combination of mobile phones and tablets allows multiple students to complete tasks at the same time, and this encourages them to interact with each other. Therefore, in the following studies, we will focus on testing the use of interactive applications, as well as the development of interactive lessons for teaching chemistry in other schools both in Kazakhstan and other countries.

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«МИНЕРАЛДЫ ТЫҢАЙТҚЫШТАР» ТАҚЫРЫБЫ БОЙЫНША ХИМИЯДАН ИНТЕРАКТИВТІ САБАҚТАР ӘЗІРЛЕУ

Бүгінгі таңда әрбір оқушыны оқу процесіне, яғни таным процесіне тартуды көздейтін интерактивті оқыту технологияларын пайдалану негізгі әдістемелік инновациялар болып табылады. Оқытудың қазіргі заманғы интерактивті тәсілдерін енгізу оқу сабағының сапасын, сондай-ақ химияны оқыту әдістерін жақсарту үшін жағдай жасайды. Әр оқытушы сабақтың жүйелі, сапалы, қызықты, эффектілі болу үшін оқытудың жаңа технологияларын қолданады. Оқушылардың қазіргі таңда ойлау қабылеттері әртүрлі болуына байланысты жаңа сабақты, тапсырманы орындауда иллюстрация, бейнематериал, анимация, ойын ретінде көрсету оқушының пәнге деген қызығушылығын арттырады.

Бұл жұмыста оқушылардың белсенділігі мен орта мектептегі оқу процесінің тиімділігін арттыруға ықпал ететін интерактивті қосымшалар анықталып, сипатталған, сонымен қатар «Минералды тыңайтқыштар»тақырыбы бойынша химиялан интерактивті сабақтар әзірленген. Әзірлеген интерактивті сабақтарды жүзеге асыру кезінде интерактивті дәріс, интерактивті жаттығу, дидактикалық ойын сияқты оқыту әдістері қолданылды. Бұл зерттеу

салыстырмалы түрде шағын үлгі өлшемімен шектелді, бірақ алынған нәтижелер мұғалімдердің кәсіби дамуы және АКТ көмегімен заманауи интерактивті сабақтарды дамыту үшін маңызды деректерге ие. 100 оқушы қатысқан оқушылардың сауалнамасынан кейін алынған нәтижелер интерактивті сабақтар оқуды қолдайтынын және оқушылардың мотивациясын арттыратынын көрсетеді және бұл олардың пәнге деген көзқарасына оң әсер етеді.

Кілтті сөздер: оқыту, химия, интерактивті сабақтар, АКТ қолдану, сауалнама

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РАЗРАБОТКА ИНТЕРАКТИВНЫХ УРОКОВ ПО ХИМИИ ПО ТЕМЕ: «МИНЕРАЛЬНЫЕ УДОБРЕНИЯ»

Основными методическими инновациями сегодня является использование интерактивных технологий обучения, предполагающих вовлечение каждого студента в учебный процесс т.е. в процесс познания. Внедрение современных интерактивных технологий обучения создают условия для улучшения качества учебного занятия, а также методов преподавания химии. Каждый преподаватель использует новые технологии обучения для того, чтобы занятия были системными, качественными, интересными, эффективными. Известно, что у учащихся разные способы мышления и при проведении уроков, выполнение заданий с помощью иллюстрации, видиоматериалов, анимации, игры повышают интерес к предмету.

В данной работе, определены и описаны интерактивные приложения, способствующие повышению активности учащихся и эффективности процесса обучения в средней школе, а также разработаны интерактивные уроки по химии по теме «Минеральные удобрения». При реализации разработанных нами интерактивных уроков использовались такие методы обучения как: интерактивная лекция, интерактивное упражнение, дидактическая игра. Это исследование было ограничено относительно небольшим размером выборки, однако полученные результаты имеют важные данные для

профессионального развития учителей и разработки современных интерактивных уроков с применением ИКТ.

Приведенные результаты, полученные после анкетирования учащихся, в котором участвовали 100 учеников, говорят о том, что интерактивные уроки поддерживают обучение и повышают мотивацию учащихся, и это положительно влияет на их отношение к предмету.

Ключевые слова: обучение, химия, интерактивные уроки, применение ИКТ, анкетирование.

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