https://doi.org/10.31489/2025Ped2/30-39
UDC: 544.42+519.242.7.
Received: 10.07.2024 | Accepted: 03.04.2025

T.M. Sadykov[1], G.T. Kokibasova[2*], A.S. Ospanova[3], M.R. Mkhitaryan[4]

[1, 2, 3, 4]Karaganda Buketov University, Karaganda, Kazakhstan
([*]Corresponding author's e-mail: kokibasova@mail.ru)

[1]ORCID 0000-0002-0678-4585
[2]ORCID 0000-0002-3418-731
[3]ORCID 0000-0002-0821-8448
[4]ORCID 0009-0007-2237-5793

Methodology of programmed chemistry lessons on the topic: "Hydrocarbons"

In modern education, the relevance of using innovative methods in the teaching of chemistry is significant. The complexity and volume of material that students need to master in chemistry lessons require new methods of delivery and comprehension. Programmed learning, using various technological tools and methods, makes it possible to individualise the learning process, taking into account the individual needs and learning pace of each student. This is particularly important given the different levels of students and the differences in their backgrounds and abilities. To date, there are few reliable and relevant developments on programmed learning in school education, especially in the field of chemistry. Therefore, the purpose of our work is to develop and evaluate a chemistry lesson on the topic: "Hydrocarbons". The development of the programmed lessons was carried out in 4 stages: in-depth study of the theory, selection of the topic of the lesson, development of the programmed lessons, and selection of the service to use in the classroom. The experimental group was class 10 "B" and the control group was class 10 "C". The experimental group was taught in the programmed learning format through the CopeApp website and the control group received the material in the traditional format using the explanatory-illustrative method and presentation. The points of the final test showed a significant increase of 12.5 % in the quality of knowledge in the experimental class. This suggests that programmed learning enhances students' ability to understand and master chemistry more effectively. A questionnaire survey was also carried out among the students in the experimental group, the results of which showed that the majority of the students evaluated the method of programmed learning positively.

Keywords: programmed learning, chemistry, 10th grade, questionnaire, test, hydrocarbons, secondary school.

Buketov University

Introduction

The modern educational system of the Republic of Kazakhstan has many tasks aimed at the development of students, contributing not only to their knowledge but also to the development of skills necessary for successful adaptation to the rapidly developing world. In contrast to traditional methods, programmed learning can develop each of these skills among students at an appropriate level.

The core of programmed learning in schools lies in its ability to focus on the individual needs of students, allowing everyone to progress at their own pace. This method provides a more personalised approach to the educational process, allowing students to master material in accordance with their level of knowledge and speed of learning. Programmed learning also promotes student independence, as students are allowed to take control of their learning and develop by following a structured learning programme [1].

The main value of computer-assisted learning in schools is that this method contributes to a deeper understanding of the material and teaches the ability to independently search for information and solve problems. It can also be an effective tool for individualising education and improving the educational process as a whole [2]. Programmed Learning (PL) is a teaching method based on the systematic delivery of structured information to master specific skills or knowledge. It is based on the principles of cognitive psychology and behavioural theory and can be used in a variety of contexts, from language learning to vocational training

Programmed learning is based on several key principles:

- Breaking down the material into small, digestible chunks to avoid information overload and improve learning.
- Active participation of students in the learning process by answering questions, solving problems and completing tasks, helps to consolidate learning and allows teachers to assess levels of understanding.
- Feedback: Students receive immediate feedback after each activity or answer, allowing them to correct their mistakes and improve their understanding of the material.

• Personalised: Learning is tailored to each student's individual needs and pace, providing an optimal learning experience and allowing students to absorb the material at their own level of understanding.

• Sequence: material is presented in a logical sequence from simple to complex, helping students to develop their knowledge and skills progressively.

• Progress tracking: Students can track their progress, which encourages continued learning. Teachers can also use this information to evaluate the effectiveness of learning and make changes if necessary [3].

Programmed learning is not only effective for standard curricula, but can also be used in corporate training, online courses, professional skills training and many other areas of education and training. It provides a systematic and structured approach to learning that makes the learning process more effective and accessible to a wide range of learners [4]. In addition, programmed learning can be adapted to suit different learning styles and student needs. Some learners may prefer visual materials, while others may prefer textual ones. Programmed learning allows you to choose the format of the material according to individual's preferences and needs.

One of the main advantages of programmed learning is its flexibility and accessibility. With the help of online platforms and digital technologies, learning material is easily distributed and available for learning at any time and from any location. This is particularly important in today's world where learning needs to be flexible and open to all types of learners. Finally, programmed learning increases the efficiency of the educational process and leads to better learning outcomes. It helps to assess students' progress and achievements more accurately and to tailor learning material to their needs and level of preparation. As a result, students can achieve better results and successfully apply their knowledge and skills in real life [5].

As a global method, programmed learning is divided into many types. Each of them is used in one way or another depending on the needs of the teacher and the students [6]:

• Linear programmed learning. This represents the most fundamental form of programmed learning, where instructional material is delivered in a linear sequence, enabling students to progress step by step from simpler concepts to more complex ones. Linear programmed instruction usually involves text-based lessons with questions and answers [7].

• Branching programmed learning. This type of instruction gives learners choices in the learning process. By answering questions or completing tasks, learners are exposed to different areas of material, allowing them to tailor their learning to their individual needs and levels. Branching of programmed learning arguably allows for the most personalized approach possible, where the learner does not have to spend time on tasks that are too easy for them [8].

• Programmed learning through modelling and simulation. This method uses the modelling of real-life situations or learning tasks. Learners can interact with the virtual environment and practice skills in a safe and controlled environment, leading to a deeper understanding and better retention of the material [9].

Computer programs for programmed learning:

A) Faculty members at Karaganda Buketov University have created a programme called "Nentwig Chemical Simulator", which allows for the creation of lessons using programmed learning methodology. The programme is free, but it is not publicly available and it is still under development. The program uses the SQLiteStudio database, which contains all the material divided into volumes and sections. Each section is a separate page of the lesson (theoretical material, question, message about the correctness or incorrectness of the answer). The user fills the database according to his/her needs. What is particularly important for programmed learning in chemistry is the possibility to use and add pictures. "Nentwig's Chemistry Simulator" has such a possibility. The programme allows you to add images to both the question and answer boxes. This is useful, for example, in organic chemistry when you want to check how well the student understands the structural formula of a substance and its appearance in space. "Nentwig Chemical Simulator" has a very important advantage — the possibility to use it without going online. In summary, the programme is acceptable for use in school chemistry lessons, but not for permanent use [10]. Kokibasova et al. [11], based on the results of the experiment, concluded that the use of a simulator with elements of programmed learning in the study of individual topics of the basic course of chemistry increases the success of learning material by students. To achieve the goal of the experiment, the authors developed the content of the course for programmed learning of chemistry in secondary schools. Based on this material the interface of the application automating the study of the material was developed. A database of tasks was created. A working test version of the application, implementing the designed functionality, was developed. The application was tested in a school environment. The results of the analysis of the application logs and the questionnaires of the participants showed that the developed complex can be used in the study of chemistry at school.

Buketov University

B) Another example of a service that uses programmed learning is the CoreApp website. The site allows you to create any type of lesson by adding an unlimited amount of text, audio, video, quizzes, open-ended questions and programmed learning modules. The service supports the Russian language, which makes it easy to create lessons without language barriers. In addition, this site has a simple interface ensures accessibility even for individuals with minimal experience using computers.

The site also offers several advantages. One of these is the ability to import images into the questions. This plays an important role in the creation of chemistry lessons, as the display of structural formulae is the basis for some topics. Lessons on this service can be created from both a computer and a mobile phone. The mobile version of the site is well-designed and has no visible bugs. This service also allows you to assign a certain number of points to each question, which allows you to emphasise the difficulty/importance of a certain part of the lesson. Once the student has completed the task, the teacher can analyse the quality of the student's understanding of the topic and, if necessary, suggest additional study material. The learner will not be able to move freely through any module of the programmed lesson until he reaches it by answering the questions correctly. The learner will have to progress sequentially through the pre-designed modules, which can have either a direct or branched format of programmed learning. When designing a branched lesson, it is possible for a student to fail a section intentionally. The site provides the possibility to set a threshold number of points which, if not met, the student will receive an appropriate message about the lack of points. In such instances, the student will need to revisit the entire material to ensure a comprehensive understanding [12].

The purpose of our work is to develop and test programmed chemistry lessons on the topic: "Hydrocarbons" for 10th-grade students.

Methods and materials

Development of programmed lessons on the topic "Hydrocarbons":

1. *In-depth study of the theory.* It is necessary to study the topic of programmed learning in detail. Also, to facilitate further work, it was necessary to assume in advance what advantages and disadvantages both teachers and students can expect when working with such a method [13].

2. *Selected topics and classes.* Together with the teachers, we chose three topics from the "Hydrocarbons" section: "Alkanes", "Alkenes", and "Alkynes". They were chosen because they seemed to us to be the most relevant topics in the hydrocarbon section. They also lent themselves well to the format of programmed learning. Since we believe that programmed learning cannot be used as a stand-alone teaching method, but should be combined with other teaching methods, this factor also influenced the choice of topics. The students first studied an introduction to organic chemistry, Butlerov's theory, and had the basic concepts of this section. Then they moved on to the topics we had chosen in the programmed learning format. It was these topics that had to be thoroughly prepared and developed [14].

3. *Preparation of programmed lessons.* Before designing the lesson, we studied in detail the chemistry textbook by Ospanova M.K., Aukhadieva K.S., and Belousova T.G. [15] for the tenth grade to consolidate the material and prepare for its structuring. It was crucial for students to access the material as modular sections within the textbook. This ensured that examination content and test papers aligned perfectly with the freely accessible resources, maintaining consistency with the textbook material.

There was only one small difficulty in designing the lessons: how to integrate the structural formulae of substances into them. And how to integrate them in such a way that the students would have to construct such formulas themselves and choose the correct answers. We studied the material and identified the points that needed to be presented to the students. We divided these points into separate modules and prepared questions for each of them. Three possible answers are the optimal format for such lessons, as the chance of guessing is only 33 %, but at the same time there are not so many options and it will be easier for the children to orientate themselves in the material.

4. *Choosing a service to use in the classroom and exporting prepared scenarios.* The choice was between two services: "Nentwig Chemical Simulator" and "the CoreApp website". The ability to use the site on mobile devices was the key factor as the chemistry classroom at the school is not equipped with computers and the students were to be taught using mobile devices only. We registered on the CoreApp site and then moved on to the lesson creation module. At this stage, you need to enter the name of the lesson, its description, if necessary, and add any modules from the menu on the left. In this case, the item called "Dialogue Simulator" is the module of programmed learning (Fig. 1).

Buketov University

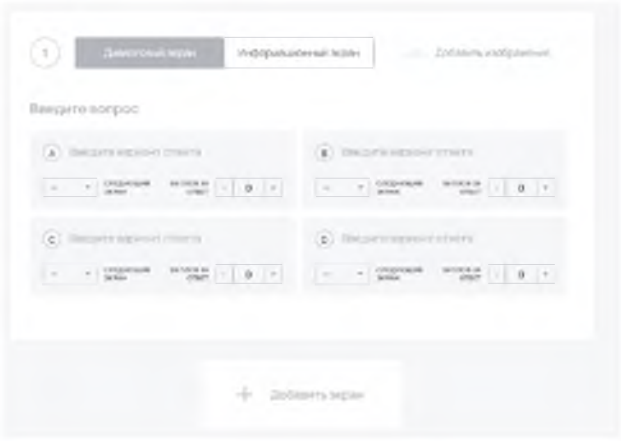

Figure 1. CoreApp site dialogue simulator

There are two module options here: a dialogue screen and an information screen. The dialogue screen is used to create questions directly (in the "Enter question" section). By default, the service offers four answer options, but you can remove unnecessary ones. In the image, you can see the "Add Image" option, which allows you to insert any image into the question field. The "Next page" option will take you to the next module. For example, a correct answer will take the student to Module 2 and an incorrect answer will take the student to Module 3. The Tutor will mark the answer at their discretion or leave this field blank. "Information Screen" — a module that does not contain a question but provides information and / or pictures. After reading the Information screen the student will also be redirected to the module selected by the tutor. In this way, each item from the prepared scenarios is entered. The student does not see the whole list of modules, but only one, and moves sequentially between them (Fig. 2).

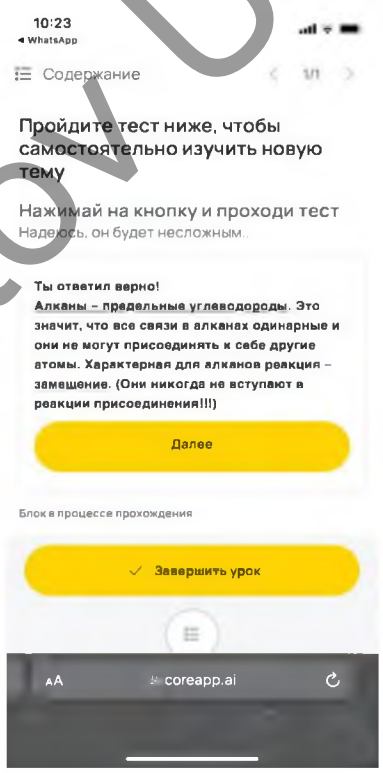

Figure 2. An example of a programmed lesson from a mobile device

Once the lesson script is fully entered into the service, the lesson should be published. You can share the lesson with your students either through a link or by giving them a lesson code that they will enter on the site. After the students have completed the lesson, the teacher will see the number of points they have scored

Buketov University

(provided the students have registered on the site before the lesson). All that remains is to send the link to the students and the lesson can begin.

Results

The 10 “B” and 10 “C” grades were chosen for the programme lessons. The tenth grades were chosen because the students already had general knowledge of the section “Hydrocarbons” from the previous year, and now there was an opportunity to use this as a basis for entrance testing in addition to the final testing. Three lessons from the section: “Alkanes. Products of combustion of alkanes”, “Alkenes. Alkene addition reactions”, “Alkynes”.

Thus, this study involved 10 “B” classes as the experimental group and 10 “C” classes as the control group. The experimental group was taught in the format of programmed learning through the CopeApp website, and the control group — received the material in the traditional format using the explanatory-illustrative method and demonstration of presentation. Entrance and final tests were given to the students. Both the entrance and final tests were based on the three-unit topics selected and listed above. The tests consisted of fifteen questions and a student received one point for each correct answer. All the students in class 10 “B” (experimental) — 16 students — and class 10 “C” (control) — 15 students — took part in the entrance test.

1. Points for correct answers in the entrance test:

- In the experimental class (10 “B”): 2–4 points were obtained by 3 students, i.e., 18.75 % of the total number of students; 5-6 points were obtained by 6 students, i.e., 37.5 % of the total number of students; 7 and more points were obtained by 7 students, i.e., 43.75 % of the students. Accordingly, the quality of knowledge was 43.75 %.
- In the control class (10 “C”): 2–4 points were obtained by 3 students, i.e., 20% of the class; 5-6 points were obtained by 5 students, i.e., 33.3% of the class; 7–10 points were obtained by 7 students, i.e., 46.7% of the class.

In summary, the percentage of students with the same scores is about the same in both the control and the experimental classes. However, in the control class, the average grade is slightly lower. After the entrance test, the control class (10 “C”) continued to study in the usual mode; the experimental class (10 “B”) received knowledge in the format of programmed learning (Fig. 3).

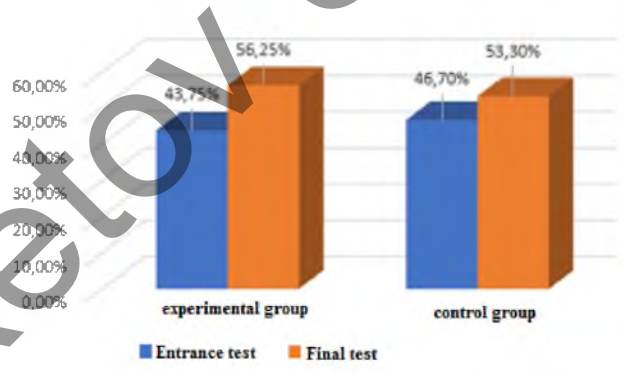

Figure 3. Results of entrance and final testing

2. Points for correct answers in the final test:

- In the experimental class (10 “B”): 2–4 points were obtained by 3 students, i.e., 20 % of the class; 5-6 points were obtained by 5 students, i.e., 33.3 % of the class; 7–10 points were obtained by 7 students, i.e., 46.7 % of the class were obtained by 5 students, i.e., 31.25 % of the class; 7–10 marks were obtained by 9 students, i.e., 56.25 % of the class.
- In the control class (10 “C”) that 3 students scored 2–4 points, accounting for 20% of the class; 4 students scored 5-6 points, representing 25% of the class; and 8 students scored 7–10 points, comprising 53.3% of the class.

In the experimental class (10 “B”) increased the quality of knowledge from 43.75 % to 56.25 %, while the control class increased the quality of knowledge from 46.7 % to 53.3 %. The experimental class increased the quality of knowledge by 12.5 %, while the control class increased the quality of knowledge by 6.6 %.

Buketov University

In addition, a seven-question survey was carried out in the experimental class to determine the general attitude of the students towards the programmed learning method.

Questions for the survey:

1. Did you like the lessons in the programmed learning format?
2. Would you like to have such lessons regularly?
3. Was it difficult to learn the material on your own?
4. Is programmed learning more difficult than traditional teaching?
5. Do you find it convenient to use electronic resources in class?
6. Would you like to use electronic resources more often, but in a different format?
7. Do you find it easier to absorb the material in programmed learning rather than when it is explained by the teacher?

The questionnaire was distributed to 16 students of experimental class 10 "B". Figure 4 shows the number of "yes", "no" and "neutral" responses to each question on the questionnaire.

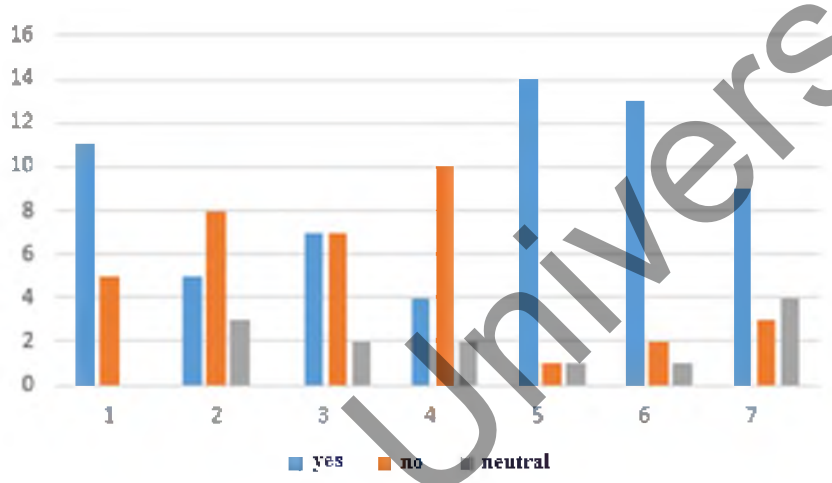

Figure 4. Results of the questionnaire in the experimental class

Eleven students answered "yes" to the first question and 5 students answered "no". This indicates that more than half of the students liked this teaching method. The second question was answered "yes" by 10 students, "no" by 5 students and only one pupil doubted his answer. From this, we can conclude that the majority of the learners would like to participate in the "programmed learning" format again, but not regularly. Perhaps in alternation with other methods.

Seven students responded positively to the third question, while an equal number answered negatively, and two expressed uncertainty. These responses indicate that independent study of the material poses challenges for some students but is manageable for others. The fourth question received positive responses from four students, negative responses from ten students, and uncertain responses from two students. These results suggest that the students did not view programmed learning as a method more complex than traditional teaching.

Fourteen students responded positively to the fifth question, while one student answered "no" and another provided a "neutral" response. This indicates that students enjoy using electronic resources in class, as they find it to be a familiar and comfortable learning environment. The sixth question revealed that 13 students expressed a desire to combine electronic resources with other teaching methods, while two students opposed this approach, and one was uncertain. These responses suggest that the majority of students are open to incorporating electronic resources into alternative learning methods. For the final, seventh question, nine students answered "yes", three responded negatively, and four expressed uncertainty. The majority of students believe that this presentation style facilitates better understanding and retention of material compared to traditional teaching methods.

To summarise the results of this questionnaire, the majority of the students of class 10 "B" evaluate the method of programmed learning positively. They like this format; it is not difficult or incomprehensible for them. They also expressed their interest in the use of electronic resources and, in general, in the idea of inde-

Buketov University

pendent acquisition and analysis of knowledge. Students agree to use this method often, but not regularly. They prefer to combine it with other equally interesting teaching methods, which may also require the use of electronic resources.

Discussion

Programmed learning is an effective teaching method, but like any other educational approach, it has its limitations and drawbacks [16]:

1. *Transfer of knowledge and skills.* Knowledge that requires creativity or active interaction can be difficult to transfer through unit-based curricula. This is particularly true in areas where the development of critical thinking, analytical or problem-solving skills is essential.

2. *Lack of individualisation of learning.* Curricula can be structured to accommodate different learning styles, but they cannot always be adapted to the individual needs of each student. Materials need to be adapted so that they are accessible to both less and more capable students. This requires the creation of a variety of materials and tasks that meet the individual needs and ability levels of each student.

3. *Limited interaction with the teacher.* Limited opportunity for teacher-student interaction to solve complex problems or to ask for additional explanations of difficult concepts. Preparing a lesson involves developing a clear structure, and identifying key concepts and the steps that need to be followed to understand the material. This requires a thorough understanding of the subject and the ability to organise information in a way that is accessible and understandable to learners.

4. *Technical constraints.* Lack of access to the necessary equipment or internet connection can make it difficult or impossible for some learners to use software-based learning programmes, as not everyone has a computer and/or even a smartphone with internet access. Evaluating the effectiveness of programme-based learning can also be challenging because of difficulties with assessment. Not all services provide sufficient data to assess student performance.

The practical part of the work also showed the need to combine programmed learning with other interactive methods — this will give students not only practical but also theoretical skills. It is important to emphasise that programmed learning can be a very useful tool, but its use as the only method of learning can lead to the omission of important aspects of education, such as social interaction, creative thinking and the development of social skills. It is therefore important to find a balance between programmed learning and other learning methods to ensure a comprehensive and effective educational process [17].

Conclusion

Based on the results obtained it is possible to conclude about the positive impact of programmed learning on the learning process and the ability to interest students. The results of the final test showed a significant increase in the quality of knowledge in the experimental class from 43.75 % to 56.25 %. This indicates that programmed teaching allows students to better assimilate the chemistry material.

A questionnaire survey was carried out among the students in the experimental group, according to which 68 % of the students rated the method of programmed learning positively and liked it. According to the students, this method should be alternated with other methods. At the same time, almost 63 % of the students would like to use this method more often.

There are several reasons for these results:

Firstly, the increased interest of the students in this method of teaching, the comfortable pace of work — all this ensured the interest of the students.

Secondly, the division of the material into small modules made it easier for the students to understand the subject and the topics. A small amount of information is much easier to comprehend than, for example, a whole paragraph of a textbook.

Thirdly, it is simply more interesting for students to use mobile devices in class because it is a familiar environment for them. All these factors increase the quality of knowledge and general interest in the subject, which are undoubtedly important advantages of programmed learning.

However, it is important to note that such a small number of respondents (n=16) cannot guarantee the validity of the survey results. For a better understanding and more accurate results, many more students should be interviewed.

Buketov University

References

1 Sadykov T. A systematic review of programmed learning approach in science education [Electronic resource] / T. Sadykov, G. Kokibasova, Y. Minayeva, A. Ospanova, M. Kasymova // Cogent Education. — 2023. — No. 10 (1). — Access mode: https://doi.org/10.1080/ 2331186X.2023.2189889

2 Hošková-Mayerová S. Programmed learning / S. Hošková-Mayerová, Z. Rosická // Procedia — Social and Behavioral Sciences. — 2012. — No. 31. — P. 782–787. https://doi.org/10.1016/j.sbspro.2011.12.141

3 Талызина Н.Ф. Теоретические проблемы программированного обучения / Н.Ф. Талызина. — Москва: Издательство МГУ, 1969. — 288 с.

4 Kurbanoglu I. Programmed instruction revisited: A study on teaching stereochemistry / I. Kurbanoglu, Y. Taskesenligil, M. Sozbllir // Chemistry Education Research Practice. — 2006. — No. 7 (1). — P.13–21. https://doi.org/10.1080 /03075079512331381605

5 Zalazar-Jaime M.F. Evaluation of an academic satisfaction model in E-learning education contexts / M.F. Zalazar-Jaime, L.S. Moretti, Z.E. García-Batista, L.A. Medrano // Interactive Learning Environments. — 2023. — No. 31 (7). — P. 4687–4697. — Access mode: https://doi.org/10.1080/10494820.2021.1979047

6 Oginni O.I. Integration of programmed instruction into mathematics and science teaching: a panacea to students dwindling interest in mathematics and science in Nigerian schools / O.I. Oginni, O.O. Owolab // European Journal of Educational Research. — 2012. — No. 3(1). — P. 199–209.

7 McDonald J.K. Learning from programmed instruction: Examining implications for modern instructional technology / J.K. McDonald, S.C. Yanchar, R.T. Osguthorpe // Educational Technology Research & Development. — 2005. — No. 53(2). — P. 84–98.

8 Lee V.S. Teaching and Learning through Inquiry / V.S. Lee. — Sterling: V.A. Stylus Publishing, 2004. — 288 p.

9 Aboagye E. COVID-19 and e-learning: The challenges of students in tertiary institutions / E. Aboagye, J.A. Yawson, K.N. Appiah // Social Education Research. — 2020. — No. 2. — P. 1–20. https://doi.org/10.37256 /ser.212021422

10 Нентвиг И. Программированное пособие для средней школы: [в 2-х ч.] / И. Нентвиг, М. Кройдер, К. Моргенштерн. — Москва: Мир, 1986. — Ч. 1. — 470 с.

11 Кокибасова Г.Т. Разработка контента и интерфейса программного тренажера по курсу «Неорганическая химия» и исследование его эффективности / Г.Т. Кокибасова, В.Н. Фомин, Д.С. Токмагамбетов, Т.М. Садыков // Вестник Карагандинского университета. Серия педагогика. — 2023. — № 1(109). — С. 169–175. DOI 10.31489/2023Ped1/169-175.

12 Coreapp — создавай свои курсы — 2023. — [Электронный ресурс]. — Режим доступа: https://coreapp.ai/

13 Martin F. A Systematic Review of Research on Online Teaching and Learning from 2009 to 2018 / F. Martin, T. Sun, C.D. Westine // Computers & Education. — 2020. — No. 159. https://doi.org/10.1016/j.compedu.2020.104009

14 Sadykov T. Application interactive methods and technologies of teaching chemistry [Electronic resource] / T. Sadykov, H. Ctrnactova // Chemistry Teacher International. — 2019. — No. 1(2). — Access mode: https://doi.org/10.1515/cti-2018-0031

15 Оспанова К. Химия. Учебник для 10 кл. естеств.-матем. направления общеобразоват. шк. / М.К. Оспанова, К.С. Аухадиева, Т.Г. Белоусова. — Алматы: Мектеп, 2019. — Ч. 1. — 200 с.

16 Camacho D.J. Pivoting to Online Learning — the future of learning and work / D.J. Camacho, J.M. Legare // The Journal of Competency-Based. Education. — 2021. — No. 6(1). — P. 1–8. https://doi.org/10.1002/ cbe2.1239

17 Gopal R. Impact of online classes on the satisfaction and performance of students during the pandemic period of COVID-19 / R. Gopal, V. Singh, A. Aggarwal // Education and Information Technologies. — 2021. — No. 26(6). — P. 6923–6947. https://doi.org/10.1007/s10639-021-10523-1

Т.М. Садыков, Г.Т. Кокибасова, А.С. Оспанова, М.Р. Мхитарян

«Көмірсутектер» тақырыбы бойынша бағдарламалық химия сабақтарын өткізу әдістемесі

Қазіргі білім беруде инновациялық әдістерді қолданудың өзектілігі химияны оқытуда ерекше маңызды болып отыр, себебі химия сабақтарында оқитын материалдың күрделілігі мен көлемі оқушыларға оны жақсы игерудің жаңа тәсілдерін қажет етеді. Бағдарламаланған оқыту әр түрлі технологиялық құралдар мен әдістер арқылы әр оқушының жеке қажеттіліктері мен оқу қарқынын ескере отырып, оқу процесін жекелендіруге мүмкіндік береді. Бұл әсіресе сынып оқушыларының әртүрлі деңгейлерін және оқушылардың дайындығы мен қабілеттеріндегі айырмашылықтарды ескеруі өте маңызды. Бүгінгі таңда мектеп білімі шеңберінде, әсіресе химия саласында бағдарламаланған оқыту бойынша қажетті және өзекті әзірлемелер аз. Сондықтан, біздің жұмысымыздың мақсаты — «Көмірсутектер» тақырыбында химия сабақтарын әзірлеу және сынақтан өткізу. Бағдарламаланған сабақтарды әзірлеу 4 кезеңде жүргізілді: теорияны терең зерттеу, сабақ тақырыбын таңдау, бағдарламаланған сабақтарды әзірлеу, оны сабақта қолдану үшін сервис таңдау. Экспериментке 10 «Б» — эксперименттік сынып, 10 «С» — бақылау сыныбы ретінде қатысты. Эксперименттік топ

Buketov University

CopeApp веб-сайты арқылы бағдарламаланған оқыту форматында, ал бақылау тобы түсіндірме — иллюстрациялық әдіс пен презентацияны қолдана отырып, материалды дәстүрлі форматта оқыды. Қорытынды тестілеу нәтижелері эксперименттік сыныптағы білім сапасының 12,5 %-ға айтарлықтай өскенін көрсетті. Бұл бағдарламаланған оқыту оқушылардың химия материалын жақсы меңгеруге мүмкіндік бергенін көрсетеді. Қосымша эксперименттік топ оқушылары арасында сауалнама жүргізілді, оның нәтижелері бойынша білім алушылардың көпшілігі бағдарламаланған оқыту әдісін оң бағалады.

Кілт сөздер: бағдарламаланған оқыту, химия, 10-сынып, сауалнама, тестілеу, көмірсутектер, орта мектеп.

Т.М. Садыков, Г.Т. Кокибасова, А.С. Оспанова, М.Р. Мхитарян

Методика проведения программных уроков химии по теме: «Углеводороды»

В современном образовании актуальность использования инновационных методов на уроках химии становится особенно важным в обучении. Сложность и объем материала, который необходимо усвоить учащимся на уроках химии, требует новых способов его подачи и усвоения. Программированное обучение с помощью разнообразных технологических средств и методов позволяет индивидуализировать процесс обучения с учетом индивидуальных потребностей и темпа обучения каждого ученика. Это особенно важно, учитывая разный уровень учеников классов и различия в подготовке и способностях учащихся. На сегодняшний день имеется недостаточно достоверных и актуальных разработок по программированному обучению в рамках школьного образования, особенно в области химии. Поэтому, целью нашей работы является разработка и апробация уроков по химии на тему: «Углеводороды». Разработка программированных уроков проводилась в 4 этапа: углубленное изучение теории, выбор темы занятия, разработка программированных уроков, выбор сервиса для использования его в классе. В эксперименте приняли участие 10 «Б» — экспериментальный класс, 10 «С» — контрольный класс. Экспериментальная группа обучалась в формате программированного обучения через веб-сайт *CopeApp*, а контрольная группа получала материал в традиционном формате с использованием объяснительно-иллюстративного метода и презентации. Результаты итогового тестирования показали значительное повышение качества знаний в экспериментальном классе на 12,5 %. Это свидетельствует о том, что программированное обучение позволяет учащимся лучше усваивать материал по химии. Среди учащихся экспериментальной группы также было проведено анкетирование, по результатам которого, большинство обучающихся положительно оценили метод программированного обучения.

Ключевые слова: программированное обучение, химия, 10 класс, анкетирование, тестирование, углеводороды, средняя школа.

Buketov University

References

1 Sadykov, T., Kokibasova, G., Minayeva, Y., Ospanova, A., & Kasymova, M. (2023). A systematic review of programmed learning approach in science education. *Cogent Education,* 10, 1. Retrieved from https://doi.org/10.1080/2331186X. 2023.2189889.

2 Hošková-Mayerová, S., & Rosická, Z. (2012). Programmed learning. *Procedia — Social and Behavioral Sciences,* 31, 782–787. https://doi.org/10.1016/j.sbspro.2011.12.141.

3 Talyzina, N.F. (1969). *Teoreticheskie problemy programmirovannogo obucheniia [Theoretical problems of software training].* Moscow: Izdatelstvo Moscovskogo Gosudarstvennogo Universiteta [in Russian].

4 Kurbanoglu, I., Taskesenligil, Y., & Sozbilir, M. (2006). Programmed instruction revisited: A study on teaching stereochemistry. *Chemistry Education Research Practice,* 7, 1, 13–21. https://doi.org/10.1080 /03075095123313816O5.

5 Zalazar-Jaime, M.F., Moretti, L.S., García-Batista, Z.E., & Medrano, L.A. (2023). Evaluation of an academic satisfaction model in E-learning education contexts. *Interactive Learning Environments, 31*, 7, 4687–4697. Retrieved form https://doi.org/10.1080/10494820.2021.1979047.

6 Oginni, O.I., & Owolab, O.O. (2012). Integration of programmed instruction into mathematics and science teaching: a panacea to students dwindling interest in mathematics and science in Nigerian schools. *European Journal of Educational Research,* 3,1, 199–209.

7 McDonald, J.K., Yanchar, S.C., & Osguthorpe, R.T. (2005). Learning from programmed instruction: Examining implications for modern instructional technology. *Educational Technology Research & Development,* 53, 2, 84–98.

8 Lee, V.S. (2004). *Teaching and Learning through Inquiry.* Sterling: V.A. Stylus Publishing.

9 Aboagye, E., Yawson, J.A., & Appiah, K.N. (2020). COVID-19 and e-learning: The challenges of students in tertiary institutions. *Social Education Research,* 2, 1–20. https://doi.org/10.37256/ser.212021422.

10 Nentwig, I., Kroider, M., & Morgenstern, K. (1986). *Programmirovannoe posobie dlia srednei shkoly [A programmed manual for secondary schools].* (Vols. 1-2; Vol. 2). Moscow: Mir [in Russian].

11 Kokibasova, G.T., Fomin, V.N., Tokmagambetov, D.S., & Sadykov, T.M. (2023). Razrabotka kontenta i interfeisa programmnogo trenazhera po kursu "Neorganicheskaia khimiia" i issledovanie ego effektivnosti [Development of the content and interface of the software simulator for the course "Inorganic Chemistry" and the study of its effectiveness]. *Vestnik Karagandinskogo universiteta. Seriia pedagogika — Bulletin of Karaganda University. Pedagogy series,* 1(109), 169–175. DOI 10.31489/2023Ped1/169-175 [in Russian].

12 (2023). Coreapp — sozdavai svoi kursy [Coreapp create your own courses]. *coreapp.ai.* Retrieved from https://coreapp.ai/.

13 Martin, F., Sun, T., & Westine, C.D. (2020). A Systematic Review of Research on Online Teaching and Learning from 2009 to 2018. *Computers & Education,* 159. Retrieved from https://doi.org/10.1016/j.compedu.2020.104009.

14 Sadykov, T., & Ctrnactova, H. (2019). Application interactive methods and technologies of teaching chemistry. *Chemistry Teacher International,* 1(2). Retrieved from https://doi.org/10.1515/cti-2018-0031.

15 Ospanova, M.K., Aukhadieva, K.S., & Belousova, T.G. (2019). *Khimiia. Uchebnik dlia 10 klassov estestvenno-matematicheskogo napravleniia obshcheobrazovatelnykh shkol [Chemistry. A textbook for grades 10 the natural-mathematical direction of secondary schools].* (Vol. 1). Almaty: Mektep [in Russian].

16 Camach, D.J., & Legare, J.M. (2021). Pivoting to Online Learning — the future of learning and work. *The Journal of Competency-Based. Education,* 6(1), 1–8. https://doi.org/10.1002/cbe2.1239.

17 Gopal, R., Singh, V., & Aggarwal, A. (2021). Impact of online classes on the satisfaction and performance of students during the pandemic period of COVID 19. *Education and Information Technologies,* 26, 6, 6923–6947. https://doi.org/10.1007/s10639-021-10523-1.

Information about the authors

Sadykov, T.M. — PhD, Assistant Professor of the Department of Inorganic and Technical Chemistry, Karaganda Buketov University, Karaganda, Kazakhstan; e-mail: *sadastayer@mail.ru*, https://orcid.org/0000-0002-0678-4585, Scopus Auhtor ID: 57300063900

Kokibasova, G.T. — Candidate of Chemical Sciences, Professor of the Department of Inorganic and Technical Chemistry, Karaganda Buketov University, Karaganda, Kazakhstan; e-mail: *kokibasova@mail.ru*, https://orcid.org/0000-0002-3418-7315, Scopus Author ID: 6603504145

Ospanova, A.S. — Candidate of Chemical Sciences, Associate Professor of the Department of Inorganic and Technical Chemistry, Karaganda Buketov University, Karaganda, Kazakhstan; e-mail: *ospanova_as@mail.ru*, https://orcid.org/0000-0002-0821-8448, Scopus Author ID: 7801330011

Mkhitaryan, M.R. — 4th year Student of the Faculty of Chemistry, Karaganda Buketov University, Karaganda, Kazakhstan; e-mail: *karustudent587@gmail.com*, https://orcid.org/0009-0007-2237-5793

Buketov University