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ბიოქიმიის სწავლების ხარისხის გაუმჯობესების რამდენიმე მეთოდი უმაღლეს
სასწავლებელში

აბსტრაქტი: ნაშრომი მოიცავს რვაწლიან კვლევასა და დაკვირვებას უმაღლეს სასწავლებლებში ბიოქიმიის სწავლების ხარისხის გაუმჯობესების საკითხებზე ზუგდიდის შოთა მესხიას სახელობის სახელმწიფო სასწავლო უნივერსიტეტის და გორის სახელმწიფო უნივერსიტეტის სტუდენტების სწავლების მაგალითზე. კერძოდ, აღწერილია მატერიალური, სმენითი და ემოციური მეხსიერების ვიზუალური დემონსტრირების შესაძლებლობების გაფართოების გზები, ტერმინებისა და რთული ფრაზების დამახსოვრება, მოსწავლეთა შემოქმედებითი შესაძლებლობების გამოვლენა, შეძენილი ცოდნის შეფასება სხვადასხვა ტიპის ტექნიკის გამოყენებით. დადასტურებულია, რომ შემოთავაზებული მეთოდების გამოყენება ხელს უწყობს სტუდენტების ცოდნის, უნარებისა და შესაძლებლობების დონის ამაღლებას.

საკვანძო სიტყვები: სტუდენტი, ამინომჟავა, შედეგის ანალიზი, უნარები.

Methodologies for Improving the Quality of Teaching Biochemistry in Higher Educational Institutions

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Abstract. The work includes eight years of research and observation on the issues of improving the quality of teaching biochemistry in higher educational institutions. On the example of teaching students of Zugdidi State University. Meskhia and Gori State University. In particular,

the ways of expanding the possibilities of visual demonstration of the material, auditory and emotional memory, memorizing terms and complex phrases, revealing the creative abilities of students, evaluating the acquired knowledge using various types of techniques are described. It is proved that the use of the proposed methods helps to increase the level of knowledge, skills and abilities of students.

Keywords: student, different methodological approaches, analysis of results, skills, amino acids.

Relevance. The problem is as follows: since the existing courses of academic disciplines have integrity, in order to include a methodological component in them, it is necessary to find a special integration mechanism that allows taking into account the specifics of the science under study and the peculiarities of its teaching at the university. Therefore, the relevance of the work is due to the need for improvement, the development of new techniques, the introduction of special teaching methods for memorizing complex material in the courses being studied. Teaching biochemistry in universities is one of the urgent problems of general training of physicians, pharmacists, biologists, chemists, and biotechnologists. The large amount of required professional knowledge and the limited possibilities for students to master it using traditional methods of the biochemistry course necessitated the development and implementation of special techniques for memorizing the material.

Aim and objectives. the purpose of the work was to present a number of author's technologies for teaching biochemistry, contributing to the development of students' creative abilities, interest in research activities, as well as the promotion of scientific knowledge. To achieve this goal, the following tasks were solved:

- creation of conditions necessary for the development of students' creative abilities;
- introduction of effective learning control technologies;
- development of students' interest in the discipline "Biochemistry";
- expansion of the general level of intellectual development of students;
- study of the influence of author's technologies of teaching biochemistry on the quality of students' education.

Introduction. The training of highly qualified personnel in universities is aimed, on the one hand, at raising the level of professional qualities, a culture of thinking, and on the other hand, at developing personal qualities and a number of specific abilities that can be fully and effectively formed as a result of a combination of various types of training.

At present, a contradiction has developed in higher education between the fundamental scientific and methodological training of students, which does not allow to fully realize the scientific potential in the professional activities of a specialist. The reason for this contradiction lies in the lack of study time to consider the methodology of teaching each topic of the subject within the framework of the corresponding university course, and in the absence of a methodological orientation of courses covering the basics of science. To resolve the contradiction that has arisen, it is necessary to combine in the educational process the special scientific and methodological knowledge and skills of future specialists.

When studying the topic “Amino acids”, it is necessary to remember 8 essential amino acids that cannot be synthesized in the human body and therefore must be supplied with food. These are valine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine and tryptophan. As work experience shows, these amino acids are easy with the help of the phrase: “Vano invented a watering can, Liza a broom, Felo cracks three times”, according to the first three letters from the name of the corresponding amino acids. When considering the nomenclature of amino acids, it must be remembered that proteins are built from L-amino acids. From the point of view of the absolute R,S-stereochemical nomenclature, the side radical always has a lower precedence than the carboxyl and amino groups, all L-amino acids have the S-configuration at the α -atom. It is easy to remember which of the forms S or R are right- or left-handed, given the spelling of these letter designations 9. S - we start writing from top to bottom, moving counterclockwise, which means these are left-handed connections; R - we begin to write, moving clockwise, therefore, these are dextrorotatory joints (Fig. 1).



Fig. 1. Mnemonic for remembering the configuration of isomers

When studying the topic "Nucleic acids", confusion is possible in the complementarity of nitrogenous bases (Fig. 2)

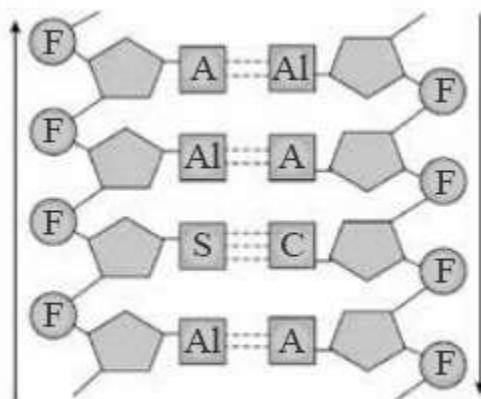


Fig. 2. Complementarity of nitrogenous bases

You can give them different phrases (the more ridiculous, the better). For example, the G-C and A-T pairs stand for Silly Chicken and Anxious Alligator, or Blue Heron and Scarlet Tulip. The hard part of the class is writing metabolic processes in formulas. For example, when studying the Krebs cycle, it is necessary to remember the following sequence of reactions (Fig. 3).

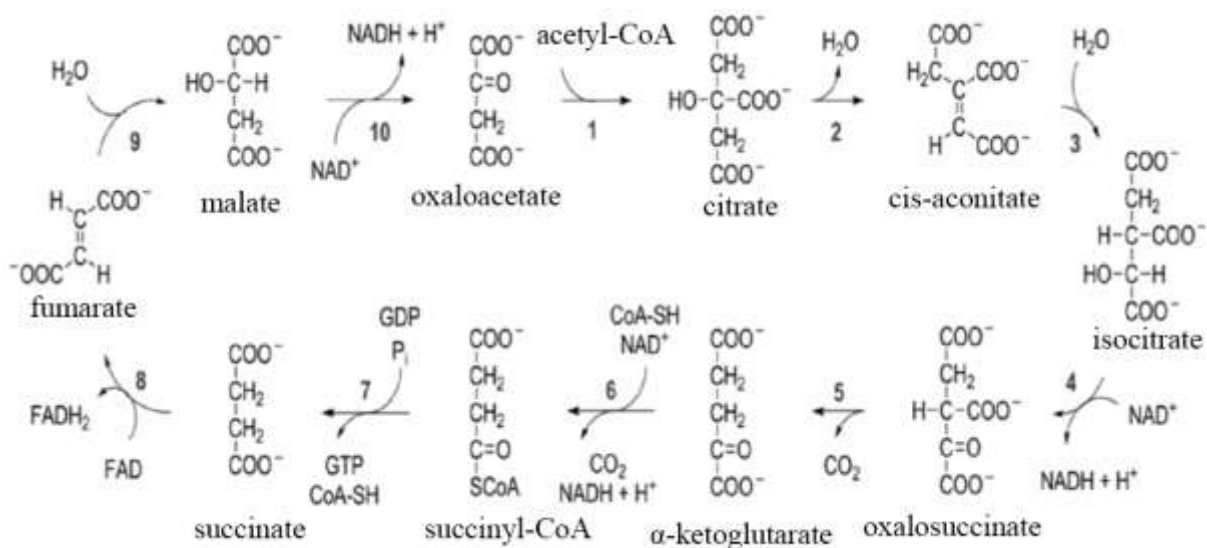


Fig. 3. Krebs cycle

However, the cycle is easy to remember with the following mnemonic phrase: "A Whole Pineapple And A Slice Of Soufflé Today Is Actually My Lunch", which corresponds to the series - citrate, (cis-) aconitate, isocitrate, alpha-ketoglutarate, succinyl-CoA, succinate, fumarate, malate, oxaloacetate. Cis- and trans-isomers are easy to remember in the direction of the lines in the initial letters of their names, written with a double line, symbolizing a double bond (Fig. 4) (in C, substituents or chain continuation on one side, in T - on opposite sides).



Fig. 4. Alpha and beta glucose

If there are difficulties with writing down the cyclic structural formula of α - and β -glucose, then it is easy to remember them, given how we begin to write the corresponding letters of the Greek alphabet. α is the tail at the top, the circle is below, which means the -OH group is below, β is the tail below, the circles are above, which means the -OH group is above (Fig. 5).

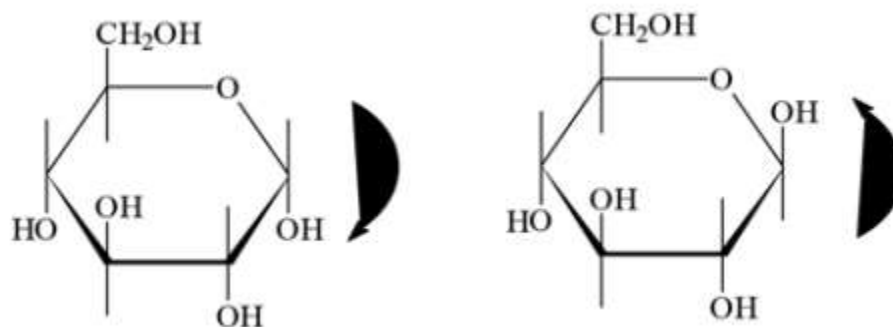


Fig. 5. Alpha and beta glucose

When studying the topic "Lipids", you can associate the names of fatty acids with the number of carbon atoms to memorize empirical formulas. The formula of stearic acid is $\text{C}_{17}\text{H}_{35}\text{COOH}$ - the words "seventeen" and "stearic" begin with the letter "C". Palmitic acid $\text{C}_{15}\text{H}_{31}\text{COOH}$ - contains fifteen carbon atoms (palmitic, fifteen) 16.

At lectures, students themselves sometimes show a creative approach, forming easily remembered images when writing complex formulas. For example, when studying the topic “Carbohydrate Metabolism”, it is necessary to memorize the UDP-glucose formula (Fig. 6). One of the students noticed that she resembled a peacock, with a tuft, beak, torso on legs and a long tail. Each time, now giving this example to other courses of students, they note the similarity with pleasure and begin to look for similar associations in other formulas.

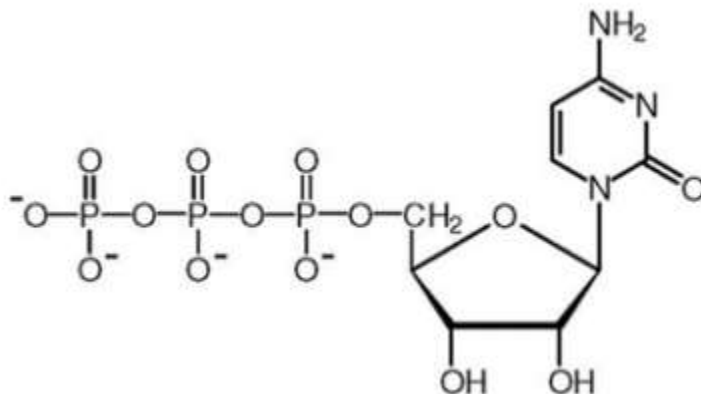


Fig. 6. UDP-glucose

We have accumulated pedagogical experience in conducting student Olympiads in biochemistry. The Olympiad makes it possible to attract a wide range of young people who are interested in biochemistry, identify gifted youth and form human resources for research and professional activities. A month before the start of the full-time round of the Olympiad, students received test tasks that were completed online for a certain time. In the full-time round, the tasks of the theoretical and practical stages were solved, allowing students to show erudition and additional knowledge in the subject. All assignments were original, educational in nature and based on the biochemistry curriculum.

To improve the quality of education, the authors of the article developed and put into practice electronic textbooks on biochemistry, allowing students to learn additional material that was not included in the lecture course, and independently replenish knowledge about the functions, significance and distribution of the main classes of substances in wildlife.

The material presented in the electronic textbook has a theoretical and practical orientation, includes photo and video elements. Students keep in memory: 10% of what they read; 20% of what

they hear; 30% of what they see; 50% of what they hear and see, therefore, the developed video workshop expands the possibilities of using visual and demonstration educational material with the involvement of auditory and emotional memory in the learning process. The ability to see three-dimensional models of the DNA and RNA helix significantly increases the efficiency of material assimilation.

Computer animations and videos are excellent means of visualizing complex molecular processes.

To control the studied material, various forms of tests were developed and introduced into the educational process. Text tasks are especially useful for organizing independent work. They are given fragments of the text, which describe the keywords. Those who have studied the text will be able to fill in the missing word, the rest will have to study the text again - until the text is learned. Instead of a task with the choice of one correct answer from several, in some cases it makes sense to move on to tasks with the choice of several correct answers from a larger number of answers. You can use tasks in a dual form, which allow you to enlarge a proven didactic unit of knowledge.

Materials and methods. At various stages of the study, depending on the tasks to be solved, various methods were used:

- analysis and comparison of programs and textbooks in biochemistry;
- monitoring the educational and methodological activities of students in the process of studying the course of biochemistry;
- interviewing and questioning students in order to find out their opinion or attitude to certain issues of interest;
- analysis of results, processing of received data.

The study was carried out in three stages.

At the first stage (2013 / 2015), the goals and objectives of the study were determined, the analysis of biochemical, pedagogical and methodological literature on the research problem was carried out.

At the second stage (2016/2018), a model of the biochemistry teaching system was formed, methodological approaches to teaching were developed.

At the third stage (2019 / 2021), the influence of the methods used on students' mastering the content of the biochemistry course was studied.

3rd and 4th year students of the specialty "Medical Biochemistry", 3rd year students of the specialty "Biology", 2nd and 3rd year students of the specialty "Pharmacy" and 1st year students of the specialty "Physical Culture" participated in the testing of didactic techniques and techniques.

Biochemistry is a rather complex subject, which is explained by the large amount of material studied, the abundance of formulas necessary for memorization. For example, one lesson on the topic "Amino acids" includes the study of at least 20 basic amino acids, for each amino acid it is necessary to memorize 5–7 biochemical reactions, as a result, students must memorize over 100 reactions and metabolisms in just one lesson.

One of the alternative forms of learning is the use of mnemonic techniques to memorize the material. Consider the techniques that can be applied in the study of biochemistry.

We have developed a number of tasks in a dual form: The authors of the theory of the ornithine cycle: A. Braunstein and M. Kritzman, H. Krebs and W. Johnson, D. Watson and F. Crick. In their opinion, this cycle produces: A) starch, B) glycogen, C) carbon dioxide, E) urea development of interest in the subject. Students can use test tasks in preparation for classes, tests and exams in self-control mode. Another area of work with students that goes beyond the regular program is the development and implementation of additional education courses that can ensure active participation in the work of both prepared and unprepared students. We have introduced and successfully implemented the following courses: "Actual Problems and Modern Achievements in Biochemistry", "Biochemistry of Medicinal and Biologically Active Substances". The course participants were students of different specialties and courses from the first to the sixth. Additional education courses contribute to the systematization of theoretical knowledge and the improvement of professional skills and abilities, the training of qualified specialists who are capable and ready for independent activity in the field of biochemistry.

Results and discussion. The approbation of various didactic techniques and the use of educational and methodological materials in the study of biochemistry made it possible to conduct a comparative analysis of the degree of mastering biochemical knowledge and skills by students in the control and experimental groups.

The completeness of mastering the knowledge of biochemistry by students was assessed by the results of control points within the framework of the module-rating system, which were carried out after studying two biochemical topics. At the same time, the control and experimental groups of students had approximately the same academic performance, equivalent learning conditions and the volume of the study load.

The content of the biochemistry course was mastered by students at a sufficient level in both the control and experimental groups. But at the same time, the results of the evaluation of control points, on average, in groups where didactic techniques were used in the classroom and educational and methodological materials were used, exceeded the results in groups where classes were conducted in the traditional form. So, the average score in the experimental groups was 4.00 points, and in the groups with the traditional form of training - 3.75 points.

At the end of the semester, after studying the course of biochemistry, students are asked to conduct a questionnaire to identify difficult and interesting ways of learning. Of the students surveyed, for approximately 50% of people, the most difficult way of learning was problem solving. The most interesting, according to the students surveyed, were active forms of learning (36%) and test tasks (29%) requiring elements of creativity. The study of lecture materials was considered a more interesting way of learning by 27% of students, and the study of textbook materials by only 8% of students.

It is advisable to use mnemonic techniques when studying the elements of biochemistry that require “memorization” of the material, since such memorization methods allow you to create vivid images for concepts and definitions in your imagination. In the course of interviewing students from the control groups who completed the course of biological chemistry, 85% of the students surveyed expressed the opinion that the use of mnemonic techniques contributed to easier understanding and better memorization of the subject.

A survey of participants in Biochemistry Olympiads shows that this event is remembered by all participants, including jury members, as a good, kind, interesting, bright, fun and educational event. This improves the quality of education and makes the life of the student body and teaching staff more interesting and varied.

It is advisable to use adaptive testing, the essence of which is that when answering a task of an average level of difficulty, the test person receives a task of a higher level, and, conversely, with an unsatisfactory answer, a task of a lower level of difficulty is provided. The use of this form of knowledge control will reduce the likelihood of a situation in which all the proposed tasks for testing will be complex or simple. In this case, testing will be more objective. The use of tasks that are too difficult can reduce learning motivation, and the use of tasks that are too simple can lead to the fact that almost all students will receive approximately the same scores, and, therefore, the measurement will not take place due to a discrepancy between the level of difficulty of the tasks and the level of preparedness of the students being tested.

In the process of implementing electronic textbooks, students acquire the following skills and abilities: to observe and study the properties of biologically active substances; describe the results of observations; select the necessary equipment for the experiment; perform calculations; present measurement results in the form of tables and graphs; interpret the results of the experiment; draw conclusions; discuss the results of the experiment, participate in the discussion. Many years of experience in using the author's laboratory video practice allows us to conclude that the possibility of using visual demonstration educational material is expanding, involving auditory and emotional memory in the learning process, which contribute to deepening knowledge of biochemistry.

Conducting additional education courses emphasizes the scientific orientation of biochemistry, contributing to the expansion and deepening of students' knowledge in their chosen direction for further professional activities. When analyzing the results of exams in biochemistry for 2016/2017 academic year. year, it was revealed that students who took additional education courses along with traditional education received higher marks in the exam than students who used only traditional forms of education.

Thus, the use of a variety of teaching methods makes it possible to make the learning process not only interesting for students, but also effective. The effectiveness of training depends on how ready the teacher is for creativity, the ability to reveal the importance of the topic being studied, to build the presentation of the material so that learning does not turn into cramming, but is a process of active search for solving professional problems.

Conclusion. The theoretical significance of the study lies in the fact that the developed methods and materials for teaching biochemistry can be used as the basis for methodological systems for the professionally oriented study of other scientific disciplines. This material is of interest to students, undergraduates, university professors and professional teachers who are interested in the problems of science education, in the system of advanced training, in the training of teachers, in the framework of additional education courses or elective courses and in the preparation of educational and methodological complexes. The practical significance of the work performed is that:

- the developed didactic techniques and teaching materials allow, simultaneously with the assimilation of the biochemical content, to develop the creative abilities of students;
- changing requirements for learning outcomes leads to the need to create means of monitoring and evaluating educational achievements; adaptive testing can become one of the assessment technologies;
- the annual holding of the Biochemistry Olympiad makes it possible to attract a wide range of young people who show an increased interest in biochemistry among students of higher educational institutions of the natural sciences, medical-pharmaceutical and biotechnological fields;
- in the course of the pedagogical experiment, it was proved that the integration of methodological training into the process of teaching biochemistry contributes to an increase in the level of assimilation of biochemical knowledge and skills.

Thus, the use of the proposed active teaching methods contributes, on the one hand, to the formation of knowledge, skills and abilities of students, and on the other hand, to the fact that educational information turns into personal knowledge of students. The presented materials are introduced into the practice of work in the relevant departments of the Zugdidi State Educational University. S. Meskhia at Gori State University.

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