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The Methodology of Organizing Independent Work Based on a Credit – Modular System for the Study of Organic Chemistry

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Abstract: This study investigates the methodology of organizing independent work within a credit–modular system for teaching organic chemistry in higher education. While global adoption of the European Credit Transfer and Accumulation System (ECTS) has demonstrated success in promoting autonomy and competence-based learning, its application in Uzbekistan remains underexplored, especially in discipline-specific contexts like chemistry. Addressing this knowledge gap, the study develops and implements a modular educational program focused on hydrocarbons, integrating didactic goals, cognitive tasks, and self-assessment tools. The research method involves designing structured modules that include theoretical content, practical tasks, and guided self-study materials aligned with credit allocations. Findings reveal that modular instruction significantly enhances students' independent learning, critical thinking, and problem-solving skills. Results also show that systematic modularization supports gradual knowledge accumulation and improves educational outcomes through diversified assessment strategies. The implication of this work lies in demonstrating that the credit-modular system, when adapted effectively, can modernize chemistry education in Uzbekistan, foster academic mobility, and align with international standards. These insights support the need for teacher training, robust modular content, and culturally aware implementation strategies for sustainable educational reform.

Keywords: credit-modular system, credit, module, modular training, ESTS.

Introduction

Today, when fundamental changes are taking place in all spheres of the country's life, reforms in higher education are important. Among the most relevant is the transition of education to a credit-modular system. In the world, the credit-modular learning system (CMLS) is one of the most widespread. Many universities around the world are switching to the credit-modular learning system (KMS), as it promotes more effective learning, the development of independent work skills and adaptation to modern labor market requirements. The introduction of modular technologies for the formation of professional competence of future teachers, the provision of software in the world, the use of a value system in the development of professional competence, psychological and pedagogical mechanisms for the development of professional competence, including the improvement of the didactic system of modular technologies, are becoming increasingly relevant [1].

Decree of the President of the Republic of Uzbekistan No. PP-4805 of August 12, 2020 "On measures to improve the quality of continuing education and the effectiveness of science in the fields of chemistry and biology" it should be noted that the quality of teaching in the subjects of chemistry and biology does not meet modern requirements, the teaching methodology and

laboratories are outdated, and mechanisms for decent stimulating the work of teachers in secondary schools. The introduction of a credit-modular system is an important factor in teacher-student cooperation. In modular learning, the teacher organizes, manages, consults, and oversees the student's learning process. The student moves independently towards the directed object. The greatest emphasis is placed on students' independent learning [2].

Research and Methodology

The credit modular system is the process of organizing learning, which is a set of modular learning technologies and an assessment model based on credit measurement. Bringing it together is not only a fruitful process, but also a complex system process. In the credit module principle, importance is attached to two main issues: ensuring students' independent work; and assessing students' knowledge based on a rating [3]. The methodology of organizing independent work based on a credit – modular system for the study of organic chemistry involves dividing the material into small blocks, modules, each of which corresponds to a certain number of credits. Students can choose modules according to their individual interests and needs, which encourages them to study the subject independently. Each module includes theoretical material, practical tasks, self-examination tests and recommendations for further study. This learning system allows students to build up knowledge gradually, learn more deeply, and develop self-organization and independent work skills [4].

Although recently the efforts to introduce a new education system in our country were started by representatives of the region, including B.S.Usmonov, R.A.Khabibullaev, V.Urinov, A.Umarov, S.Mustafakulov, M.Sultonov analyzed the main differences between the credit module system and the current education system, the achievements and disadvantages of the new system. The credit-modular system of the educational process organization is a model of the educational process organization, which is based on the combination of modular learning technologies and credits or credits of educational units [5]. The organization and execution of the educational process is a multifaceted and complex system of action and interaction. The attention in the credit module system is focused on two of its characteristics: - on the independent work of students; - on the management of a credit-modular system for organizing the educational process and a rating system for evaluating students' academic achievements. Many people believe that Uzbekistan's education system was formed in conditions of information scarcity and limited access to information. Therefore, the activity of a teacher in universities was primarily limited to informational, or better to say, informing, functions [6]. The teacher played the role of the most important source of information. Since the student is the object of the educational process and at the same time the object of perception and assimilation of information, the planning of the educational process was carried out in such a way that the bulk of the work fell on classroom instruction. The current state of information security development opens up wide opportunities for access to information sources and therefore partially mixes accents in the planning of the educational process towards independent work. The question arose how to determine the weight of the unit of measurement for the complexity of studying a discipline – according to the tradition existing in European higher education, this unit was called an "academic credit"[7]. It was stated that the academic year in European universities, on average, lasts about 40 weeks. Based on the study of a fairly extensive previous experience of using academic loans in different countries, it was decided that the total workload of a student's academic load per year would be equal to 60 credits. Based on this, a student can earn exactly 30 credits per semester, and 20 credits per trimester. Bachelor's degree program. Given that it is usually 4 years, a student can earn this degree with only 240 credits to complete and 120 credits to complete the master's program will have to be collected. With proper quality control of the educational process, a student will not be able to receive more than 60 credits in academic year 2 [8]. Such attempts will only mean that he is underloading on the basic curriculum, that the university is underworking, trying to accrue lightweight credits. Loans are not just numbers. Each loan that a student had to complete had a certain reading load and the student as a result of a certain reading got the results. That is, the credit-modular ECTS composition system consists of two necessary

elements: a) reading the load and b) reading the results. Only when the student completes these elements in the same subject can he receive a certain amount of credit [9].

MODULAR PROGRAM OF EDUCATIONAL TECHNOLOGIES FOR STUDENTS' SELF-CONTROL The didactic purpose of the module program: You can work independently with the help of a modular program, the use of modular learning technologies in the process of teaching organic chemistry, the features of these technologies, the differences and advantages of modular lessons from traditional lessons, and the cognitive activity of students. to get acquainted with the ways of organization and management, to develop their methodological knowledge, skills, professional skills, culture of speech and communication. We have developed a modular program "Hydrocarbons" in organic chemistry with elements of generalization. The modular program "Hydrocarbons" has the following structure: Module 0. "Comprehensive goal".

Module 1. "Unity and interrelation of the structure of inorganic and organic substances".

Module 2. Generalization of knowledge about carbon compounds in the study of marginal hydrocarbons.

Module 3. "Development of knowledge about chemical bonding and isomerism in unsaturated hydrocarbons of a number of alkenes and alkadienes".

Module 4. "Generalization of knowledge about unsaturated hydrocarbons of the aliphatic series in the process of studying alkyls".

Module 5. "The relationship of aromatic hydrocarbons with marginal and unsaturated hydrocarbons. The specifics of their structure and properties."

Module 6. "Generalization of knowledge about the structure and properties of hydrocarbons of different homologous series".

Generalization is a complex mental activity technique that involves the ability to analyze, highlight, abstract, and compare. Therefore, for the development of these mental operations, specially selected tasks are included in the modules, during which these abilities are developed [10].

For example:

1) what chemical properties can be assumed for a substance with a structure? H3C-C≡C-CH2-CH3. Explain the answer by writing down two or three equations of chemical reactions;

2) compare the electronic and spatial structure of cyclohexane and benzene molecules;

3) Establish a match: Starting materials Reaction products 1. propylene + hydrogen a) polypropylene 2. propylene + hydrogen bromide b) propane 3.propylene + oxygen c) 2-bromopropane 4. propylene + bromine g) 1-bromopropane 5. Propylene ------→e) 1,2-dibromopropane e) 1,3-dibromopropane g) carbon dioxide + water

4) write the reaction equations with which you can perform the transformations according to the scheme: C2H5OH → C2H4 → C2H5Br → C4H10, etc.

The modules provide for solving chemical problems for the derivation of chemical formulas of organic compounds, non-theoretical product yield, and others, which also involves productive mental activity, the use of various mental operations, and the transfer of knowledge to new objects [11].

A certain role in the process of generalization and systematization is played by laboratory and practical exercises, which are provided in module 2 "Gorenje alkanes", "Qualitative determination of carbon, hydrogen and chlorine in organic compounds" and module 3 "Production of ethylene and study of its properties", during which students perform actions of varying depth, breadth and independence. One of the important means of generalization is the independent work of students with a textbook and a printed modular program both in the

classroom and at home. At the same time, various methods of working with the text can be used: reading and drawing up a plan, theses, summaries, comparing processes, concepts, completing tasks, answering questions, filling out tables, etc. In the process of generalization and systematization, it is of great importance to prevent errors in students' knowledge and correct them in a timely manner, therefore, intermediate control is provided in each module [12].

The credit system in Uzbekistan. The first steps were taken in the higher education system of Uzbekistan based on the decree of the President of 2019. Development of higher education is one of the urgent issues facing the country. It was decided that it is necessary to change the education system in order to train competitive personnel in the world labor market and to place the country among the developed countries.

As the head of our state said, "Education is our future, a matter of life and death." Therefore, we have no right to delay reforms in this area. …. because we have lost a lot of time"[13]. In fact, the reform of education and the transition to a new stage (system) started half a century ago in developed countries and achieved high results and led to the prosperity of various sectors of the state. Uzbekistan chose the European ECTS credit-module system after researching world credit education models. This can be caused by:

- ECTS credit-module system is recognized by many foreign countries;
- The establishment of this system in Uzbekistan and neighboring countries (it will be much easier to ensure the exchange of professors and teachers and students);
- Similarity of educational stages;
- This system shows effective results in education.

Although it was not long ago that the efforts to implement a new education system in our country began, representatives of the field, including B. Sh. Usmonov,

R. A. Khabibullaev, V. Urinov, A. Umarov, Sh. Mustafakulov, M. Sultonov analyzed the major differences between the credit-module system and the current educational system, the achievements and shortcomings of the new system [14].

The number of credits and study loads at higher education levels are the same as the ECTS system. In the bachelor's program, 30 credits per semester and 60 credits per academic year are set, and it is desirable to accumulate a total of 240 credits to obtain a bachelor's degree. 1 ECTS credit is equivalent to 25-30 hours of study. A student spends a total of 6000-7200 hours to obtain a bachelor's degree. In our HEIs, 1 ECTS credit is defined as a study load of 30 hours, of which 12 hours are class hours, and the remaining 18 hours are divided into independent study hours, that is, in the ratio of 1/1.5. So, for 4 years, 2880 hours of classroom hours and 4320 hours of independent study are spent in the Bachelor's program. The distribution of credits within subjects is defined as 3-7 credits on average, depending on the number of subjects covered in one semester [15].

Results and Discussion

So, the credit-modular educational process management system (ESTS) accumulates advantages for higher education institutions:

1. Promotes the development of autonomy and responsibility;
2. Opens up new opportunities for cooperation;
3. Promotes the development of communication links between higher education institutions;
4. Stimulates the improvement of the quality of the educational process and organizational and administrative activities;
5. Improves the quality of student mobility, improves the content of curricula, as well as the quality of the educational process and its results.

6. For research and teaching staff, ECTS provides and supports: autonomy and diversification;
7. Communication skills; decision-making on academic recognition.
8. For students, ECTS expands the choice for studying abroad;
9. Allows them to form a study program; provides certification of the learning process at an educational institution abroad and guarantees academic recognition.
10. Recently, modular chemistry programs have been created both in higher education institutions and in higher education institutions. Most teachers at institutes find it advisable to use modular learning in the educational process, but they experience a number of difficulties.
11. This is due, firstly, to the insufficient quality of methodological developments on the use of modular chemistry programs in the educational process and their shortage. Secondly, teachers underestimate the diversity of modular learning functions. Thirdly, the lack of preparation of chemistry teachers for the organization of educational activities of students to work with modular programs.
12. It is based on independent education;
13. Transparent implementation of educational activities;
14. Availability of higher education platforms (for example, HEMIS,

MOODLE, GOOGLE, AIS, BLACKBOARD);

Conclusion

When one education system moves to another, it requires a gradual introduction, and that in turn is a long-term process. Similar aspects of credit models are the availability of elective subjects, the importance of learning outcomes, increased student mobility, etc. When learning about the education system of foreign countries in our country, it is necessary to take into account our national and cultural characteristics, our views on education. Because the developed countries are reforming after studying their national and cultural characteristics, human qualities and problems in national education in building their systems. So it is well known that the direct introduction of the European system of education credits will not produce good results. For example, the full introduction of student selectivity in the new system into our education system, the reduction of staff units of professors and teachers in the creation of educational programs, some disparities in their distribution or the use of our students without a full understanding of the selectivity will create some problems. In addition, it should be noted that the ECTS introduced in Uzbekistan's universities will bring education to a higher level in the future. This alone requires research, training, implementation and collaboration.

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