

**ХИМИЯ, БИОЛОГИЯ, ГЕОГРАФИЯ ЖӘНЕ
ЭКОЛОГИЯНЫ ОҚЫТУ ӘДІСТЕМЕСІ
МЕТОДИКА ПРЕПОДАВАНИЯ ХИМИИ, БИОЛОГИИ,
ГЕОГРАФИИ И ЭКОЛОГИИ
METHODS OF TEACHING CHEMISTRY, BIOLOGY,
GEOGRAPHY AND ECOLOGY**

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**PSYCHOLOGICAL AND PEDAGOGICAL FEATURES OF THE APPLICATION OF THE
ELECTIVE COURSE ‘CHEMISTRY AROUND US’ FOR NINTH GRADE STUDENTS**

Abstract

The study is relevant due to the need to modernise school education in the Republic of Kazakhstan, where specialised education plays a key role in developing students' personal qualities and meeting the demands of the state and labour markets. The introduction of state standards means that elective courses are becoming a tool not only for deepening knowledge and shaping professional interests, but also for overcoming the abstract nature of subjects such as chemistry. However, the lack of comprehensive chemistry courses and methodological recommendations limits their effectiveness. Therefore, studying the psychological and pedagogical aspects of these courses and applying them to increase student motivation and creativity is a pressing issue. This study aims to analyse the role of the pre-profile course and to develop and test an elective course called «Chemistry Around Us» for 9-grade students.

Research methods included a theoretical analysis of regulatory documents and scientific literature, developing a 34-hour course programme, and conducting a pedagogical experiment with an experimental group from General Education School № 52 named after E. A. Buketov in Karaganda. As part of the study, entrance and final tests were conducted, and psychological diagnostics were performed according to Jung's typology and Smirnov's psychodynamic properties. A questionnaire was also administered to assess interest in chemistry. The results showed positive dynamics: the percentage of correct answers in the tests increased by 19.3%, indicating an improvement in assimilation of the material. According to Jung's typology, the average score increased by three points, indicating an increase in emotional openness and activity. Smirnov's diagnostics confirmed the stability of psychodynamic properties, with a slight increase in extroversion and activity observed. The questionnaire revealed an increased interest in chemistry. The study confirms the potential of elective courses in bridging the gap between theory and practice and in developing the skills required for further education and careers.

Key words: elective course, chemistry, testing, questionnaires, 9-grade.

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ТОҒЫЗЫНШЫ СЫНЫП ОҚУШЫЛАРЫНА АРНАЛҒАН «АЙНАЛАМЫЗДАҒЫ ХИМИЯ» ЭЛЕКТИВТІК КУРСЫНЫҢ ПСИХОЛОГИЯЛЫҚ ЖӘНЕ ПЕДАГОГИКАЛЫҚ ЕРЕКШЕЛІКТЕРІ

Аңдатпа

Бұл зерттеудің өзектілігі Қазақстан Республикасында мектеп білімін жаңғырту қажеттілігінен туындайды, мұнда мамандандырылған білім беру оқушылардың жеке қасиеттерін дамытуда және мемлекет пен еңбек нарығының қажеттіліктерін қанағаттандыруда маңызды рөл атқарады. Мемлекеттік стандарттарды енгізу жағдайында элективті курстар білімді тереңдету, кәсіби қызығушылықты қалыптастыру құралы ғана емес, сонымен қатар химия сияқты пәндердің абстрактілігін жеңу құралына айналады. Алайда, химия бойынша кешенді курстардың және әдістемелік ұсыныстардың болмауы олардың тиімділігін шектейді, сондықтан курстардың психологиялық-педагогикалық аспектілерін зерттеу және оларды оқушылардың мотивациясы мен шығармашылығын арттыру үшін қолдану өзекті мәселе болып табылады. Зерттеудің мақсаты-профильге дейінгі курстың рөлін талдау, 9-сынып оқушыларына арналған "Айналамыздағы химия" элективті курсын әзірлеу және сынақтан өткізу.

Зерттеу әдістеріне нормативтік құжаттар мен ғылыми әдебиеттерді теориялық талдау, курс бағдарламасын әзірлеу (34 сағат), сондай-ақ Е.А. Бөкетов атындағы № 52 жалпы білім беретін орта мектебінің (Қарағанды қ.) оқушыларының эксперименттік тобымен педагогикалық эксперимент кірді. Зерттеу аясында кіріс және қорытынды тесттер, к. Юнг типологиясы және Б.Н. Смирновтың психодинамикалық қасиеттері бойынша психологиялық диагностика, сондай-ақ химияға қызығушылықты бағалау үшін сауалнама жүргізілді. Нәтижелер оң динамиканы көрсетті: сынақтардағы дұрыс жауаптардың пайызы 19,3%-ға өсті, бұл материалды игерудің жақсарғанын көрсетеді. Юнг типологиясы бойынша орташа балл 3 ұпайға өсті, бұл эмоционалды ашықтық пен белсенділіктің жоғарылауын көрсетеді. Нәтижелер оң динамиканы көрсетті: сынақтардағы дұрыс жауаптардың пайызы 19,3%-ға өсті, бұл материалды игерудің жақсарғанын көрсетеді. Юнг типологиясы бойынша орташа балл 3 ұпайға өсті, бұл эмоционалды ашықтық пен белсенділіктің жоғарылауын көрсетеді. Смирновтың диагностикасы экстраверсия мен белсенділіктің жеңіл өсуімен психодинамикалық қасиеттердің тұрақтылығын растады. Сауалнама химияға деген қызығушылықтың артқанын анықтады. Юнг типологиясы бойынша орташа балл 3 ұпайға өсті, бұл эмоционалды ашықтық пен белсенділіктің жоғарылауын көрсетеді. Смирновтың диагностикасы экстраверсия мен белсенділіктің жеңіл өсуімен психодинамикалық қасиеттердің тұрақтылығын растады. Сауалнама химияға деген қызығушылықтың артқанын анықтады. Зерттеу элективті курстардың теорияның практикадан алшақтығын жеңудегі әлеуетін растайды, әрі қарай оқу мен мансап үшін құзыреттілікті қалыптастыруға ықпал етеді.

Түйін сөздер: элективті курс, химия, тестілеу, сауалнамалар, 9-сынып.

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ПСИХОЛОГО-ПЕДАГОГИЧЕСКИЕ ОСОБЕННОСТИ ПРИМЕНЕНИЯ ЭЛЕКТИВНОГО КУРСА «ХИМИЯ ВОКРУГ НАС» ДЛЯ УЧАЩИХСЯ ДЕВЯТЫХ КЛАССОВ

Аннотация

Актуальность исследования обусловлена необходимостью модернизации школьного образования в Республике Казахстан, где профильное обучение играет ключевую роль в развитии личностных качеств учащихся, удовлетворении запросов государства и рынка труда. В условиях внедрения государственных стандартов элективные курсы становятся не только инструментом для углубления знаний, формирования профессиональных интересов, но и преодоления абстрактности предметов, таких как химия. Однако отсутствие комплексных курсов по химии и недостаток методических рекомендаций ограничивают их эффективность, поэтому изучение психолого-педагогических аспектов курсов и их применение для повышения мотивации и креативности школьников является актуальным вопросом. Цель исследования – проанализировать роль предпрофильного курса, разработать и апробировать элективный курс «Химия вокруг нас» для учащихся 9-х классов.

Методы исследования включали теоретический анализ нормативных документов и научной литературы, разработку программы курса (34 часа), а также педагогический эксперимент с экспериментальной группой учащихся Средней общеобразовательной школы № 52 имени Е.А. Букетова (г. Караганды). В рамках исследования были проведены входной и итоговый тесты, психологическая диагностика по типологии К. Юнга и психодинамическим свойствам Б.Н. Смирнова, а также анкетирование для оценки интереса к химии. Результаты показали положительную динамику: процент правильных ответов в тестах вырос на 19,3%, что свидетельствует об улучшении усвоения материала. По типологии Юнга средний балл увеличился на 3 балла, указывая на повышение эмоциональной открытости и активности. Диагностика по Смирнову подтвердила стабильность психодинамических свойств с легким ростом экстраверсии и активности. Анкетирование выявило рост интереса к химии. Исследование подтверждает потенциал элективных курсов в преодолении отрыва теории от практики, способствуя формированию компетенций для дальнейшего обучения и карьеры

Ключевые слова: элективный курс, химия, тестирование, анкетирования, 9 класс.

Introduction. General education schools have always been tasked with numerous important responsibilities, including providing a quality education, fostering spiritual and moral character, and encouraging creative thinking among students. Therefore, one area of modernisation in school education that is currently underway is the active development of specialised education. The system of elective courses as part of specialised education enables students to develop their professional interests [1]. Elective courses are an important step towards implementing the principles and objectives of specialised education, as they can make the educational process more interesting and varied. Building on this, this thesis studied the role of elective courses in specialised education and formed methodological recommendations for their development. To illustrate these

recommendations, an elective course entitled 'Chemistry Around Us' was developed to show the practical value of chemistry.

Elective courses are designed to meet the individual educational interests, needs and inclinations of each student. They play a crucial role in selecting a field of study or pursuing further education at higher education institutions, as well as in determining future employment opportunities. They also help to prepare schoolchildren for professional, cultural and social self-determination. However, not all schools currently offer elective courses, and there are few comprehensive courses in chemistry. Elective courses have great educational and creative potential in the learning process, as well as the ability to motivate schoolchildren to study chemistry. Implementing elective chemistry courses as part of the school curriculum will encourage schoolchildren to develop an interest in chemistry and other natural sciences [2].

Including everyday life topics in the course will help students see specific examples of how chemistry is applied, making learning more meaningful and engaging. This is important for overcoming the subject's abstract nature, which often prevents students from grasping its essence. Methods for creating elective courses provide teachers with recommendations for organising and implementing them. Using this methodology, teachers can develop their elective courses in chemistry and other subjects. Teachers need to constantly improve their skills and learn new teaching methods. The introduction and use of elective courses will contribute to their professional growth, renew their teaching tools and improve their qualifications [3].

The issue of organising and developing specialised education at the secondary level began to be studied in the Republic of Kazakhstan in the early 1990s. Following independence, it became possible to move away from the uniformity and standardisation of education that had characterised Soviet schools. Kazakhstan needed its own updated educational model based on variability to contribute to the country's successful establishment as a competitive member of the global community. To this end, reforms aimed at organising specialised education in Kazakhstani schools were implemented. In 1996, the Republic of Kazakhstan developed a number of conceptual documents that reflected the nature of international educational systems and the theoretical constructs for creating a new, socially demanded, personality-oriented school. These documents are: "Concept for the development of general education schools in the Republic of Kazakhstan (1996)" and "Concept for the content of general secondary education (1996)".

According to the Concept for the Development of general education schools, secondary education is completed at the upper level of education. Students are taught according to their cognitive interests and organised into three areas: natural sciences and mathematics; social sciences and humanities; and vocational and technical education [4].

A key part of implementing the principles of profile-based education involves introducing the Republic of Kazakhstan's state-compulsory standards for secondary general education: "Basic Provisions (State Mandatory Standard of Education 2.003-2002)". These standards define the content and procedural aspects of profile-based education. Subject programmes have been developed in two areas of education based on SMSE: natural sciences and mathematics; and social sciences and humanities. One of the main modernisation initiatives in general secondary education in the Republic of Kazakhstan is the transition to a 12-year education system, as set out in the state programme 'Kazakhstan 2005–2010'. The next stage in the development of specialised education in the Republic of Kazakhstan was the adoption of Law No. 319-III of 27 July 2007 "On Education". This law became a key document, defining the legal, organisational, and economic foundations of the country's entire education system [5].

A significant development was the approval of new mandatory state education standards, as set out in Order № 406 of the Minister of Education of the Republic of Kazakhstan, dated 23 September 2022. These standards regulate the content and structure of education at all levels, from pre-school to post-secondary. For general secondary education in particular, the standards highlight specialised education as a key component of upper secondary school. The document outlines the objectives of specialised education, which are the development of competencies necessary for

professional self-determination, an in-depth study of specialised subjects and the formation of applied skills relevant to future professional activities. Additional regulatory support for specialised education is provided in two key orders of the Ministry of Education of the Republic of Kazakhstan. For example, Order № 399 of 16 September 2022, “On the approval of model curricula for general education subjects and elective courses at primary, basic secondary, and general secondary education levels”, ensures flexibility in the implementation of educational content, allowing the interests, inclinations, and abilities of students to be taken into account. The elective courses included in these programmes promote interdisciplinary integration and in-depth study of core subjects, including chemistry. Order № 365 of 12 August 2022, “On the approval of model curricula for primary, basic secondary and general secondary education in the Republic of Kazakhstan”, in turn, defined the structure of model curricula in which the compulsory and variable components are clearly distinguished [6].

In recent years, particular attention has been paid to the professional competence of teachers delivering specialised education. To this effect, the Concept for the development of teacher education in the Republic of Kazakhstan (Abai KazNPU) was approved by Protocol № 1 on 21 June 2024. The document emphasises that training a new generation of teachers must align with the requirements of specialised education. The adoption of Order № 31 of the Minister of Education of the Republic of Kazakhstan, dated 24 February 2025, “On the approval of professional standards for teachers of educational organisations” was significant in this context. This document clearly defines the professional competencies that teachers must possess.

The recent Order № 90 of the Ministry of Science and Higher Education of the Republic of Kazakhstan, dated 4 March 2025, “On amendments and additions to the order of the Minister of Science and Higher Education of the Republic of Kazakhstan № 2, dated 20 July 2022, “On the approval of State General Education Standards for Higher and Postgraduate Education”, introduced changes that further strengthen the continuity between levels of education, ensuring the continuity of students' professional development from general secondary education to higher education institutions [7].

There are three main types of courses: compulsory, optional and elective.

- Comprehensive courses are compulsory for all students. Attendance and performance are strictly monitored. These courses form the core of the curriculum and comply with state educational standards. Successful completion of these courses is necessary to continue studying. Examples of compulsory courses include chemistry courses in secondary schools and standard general education and specialised chemistry courses in specialist schools.

- Facultative courses are those needed to build a student's programme of study. Students can choose one or more electives from the offered list, but this is not mandatory — they may choose none. As a rule, there is no final assessment for elective courses.

- Elective courses are chosen by students based on their interests and needs from a set of proposed courses. However, once a course has been chosen, it becomes compulsory to attend and complete, just like standard courses. Elective courses play an important role in specialised and pre-specialised education [8].

Elective courses complement the content of specialised education programmes and are an element of the curriculum offered to schoolchildren. Unlike optional courses, which are merely available for study and not compulsory, elective courses must be included in the curricula of all specialised classes. Students do not take any official examinations on their programmes. Elective courses focus on deepening knowledge and improving learning effectiveness, so they have a minimum class size of 3–15 students. The number of elective courses offered as part of a programme must exceed the number that students are required to choose [9].

Teaching aids for elective courses can also be developed in the form of a set of modules. This allows the programme content for these courses to be determined with student participation. Elective course modules should consist of 17–34 hours. Consequently, during the academic year,

students will be able to study three to five topics in depth, in addition to their specialised course [10].

For an elective course to be an effective teaching method for a subject such as chemistry, it must possess several key qualities: systematicity, comprehensiveness, integrity, scientificity, structure and substance. The presence and degree to which each of these qualities is manifested determines the ability of chemistry electives to fulfil the tasks set by society for general education schools. Elective courses are an important component of specialised education and are of great importance in the system of specialised training. Elective chemistry courses focused on research and practical activities can provide schoolchildren with a solid foundation for their future studies in higher education institutions specialising in natural sciences. These courses are designed to improve students' knowledge and develop their interest in chemistry, fostering a positive attitude towards continuing education [11].

Methods and materials. The elective course programme is designed for secondary school students for 9 grade and is scheduled for 34 hours per year, once a week. It is primarily aimed at students with a keen interest in chemistry who intend to continue their education at institutions specialising in natural sciences [12].

The elective course “Chemistry around us” implements the principles of profile-based education. This teaching material introduces students to a wide range of chemical knowledge, prepares them for choosing their future field of study and supplements and deepens the content of basic chemistry lessons. The course also aims to satisfy the cognitive interests of individual schoolchildren and contribute to the development of their creative and professional abilities.

Main objectives of the course:

- increase students' cognitive interest in chemistry;
- broaden their knowledge of chemistry;
- create conditions for the development of students' general knowledge and creative abilities.

Expected results:

- work independently with reagents and chemical equipment;
- explain chemical processes occurring in the environment;
- research the chemical composition of food, cleaning products and medicines;
- effectively and safely apply chemical knowledge in everyday life;

Forms of organisation: frontal, individual, group.

Forms of lesson: lecture, workshops, laboratory work, seminar, independent work.

Teaching methods: explanatory-illustrative, reproductive, research, interactive.

Programme content: Introduction (1 hour), Chemistry in everyday life (6 hours), Environmental chemistry (6 hours), Chemistry and medicine (6 hours), Food chemistry (8 hours), Chemistry of the future (5 hours), Final lessons (2 hours).

Description of the experiment

The elective course “Chemistry around us” was designed for ninth-grade students. As part of the programme, eight lessons were conducted on chapter IV, “Food chemistry”, as well as one introductory lesson and one final lesson. The experimental group consisted of 10 students from Academician E. A. Buketov General Education School № 52. An entrance test consisting of 15 closed questions with one correct answer was conducted as part of the introductory lesson. The content of the questions was based on the topics covered in the course. After completing the elective course, a final test consisting of 25 closed questions with one correct answer was conducted as part of the final lesson.

Before and after starting the elective course, the experimental group underwent a psychological and pedagogical assessment of students in terms of group interaction and personality:

- Psychological personality typology (C. Jung). Personality types are determined by identifying the predominant trait of either extroversion or introversion [13].

• Diagnosis of psychodynamic personality traits by B. N. Smirnov is necessary to determine the psychodynamic personality traits that determine the specificity of the personality-group style [14].

• Degree of interest in chemistry. This diagnosis is necessary to determine the degree of interest in chemistry. This questionnaire is intended for students in 9 grade and is designed to determine the specifics of the personality group style. The questions in the questionnaire were compiled based on the scientific works of Sadykov et al. [15] and Salta et al. [16].

All questionnaires were conducted anonymously, as it is believed that only anonymous research yields the most reliable results.

Results

1. Results of testing:

Before starting the elective course, the results of the testing in the experimental group are as follows: one student scored 4 points (10%), seven students scored 5 points (70%), one student scored 6 points (10%), and one student scored 7 points (10%). Thus, the average score for the entire experimental group was 5.2. The percentage of correct answers was 34.7%.

Final test results in the experimental group: one student scored 10 points (10%); two students scored 11 points (20%); two students scored 12 points (20%); one student scored 13 points (10%); one student scored 14 points (10%); one student scored 16 points (10%); two students scored 18 points (20%).

Based on the analysis of the points scored by the students, the average score for the experimental group on the final test was 13.5, The percentage of correct answers was 54 %. (diagram 1).

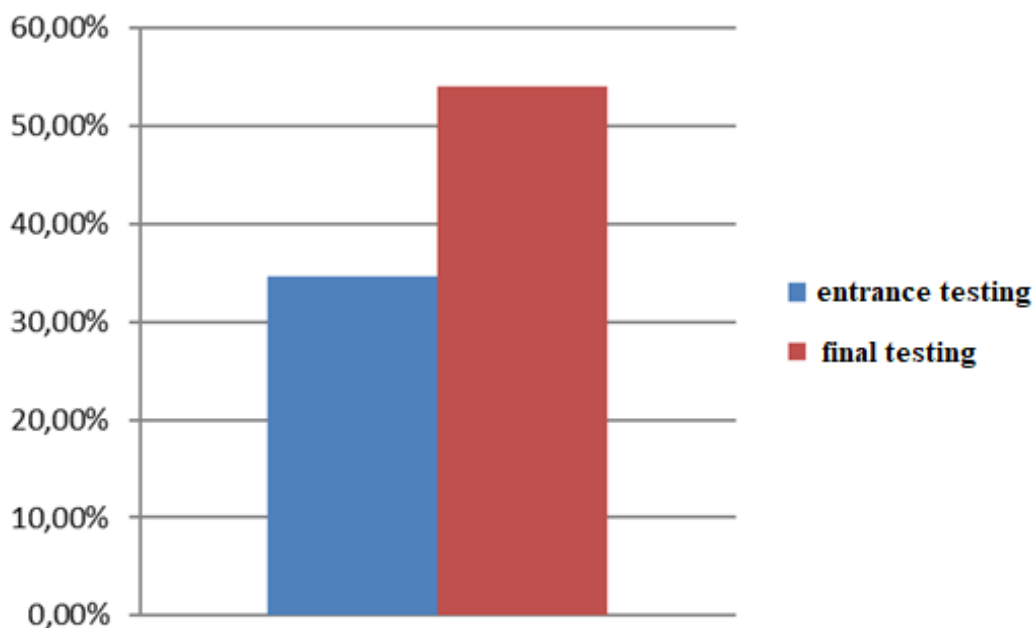


Diagram – 1 The results of the testing

The test results show that the percentage of correct answers increased from 34.7% to 54% before and after studying the elective course. This represents a change of 19.3%. This indicates that implementing the elective course had a positive effect, significantly influencing the students in the experimental group's assimilation of the educational material.

2. Analysis of the results of psychological and pedagogical diagnostics

A) The results of Jung's personality assessment before the experiment are presented in table 1.

Table 1. Jung's personality assessment before the experiment

Full name	Score	Personality type	Average score
1. student	35	Introvert	56.5 - ambiverts
2. student	65	Ambivert	
3. student	65	Ambivert	
4. student	45	Ambivert	
5. student	55	Ambivert	
6. student	40	Ambivert	
7. student	70	Extrovert	
8. student	75	Extrovert	
9. student	35	Introvert	
10. student	80	Extrovert	

According to these results, the average score for Jung's personality typology in 9th grade was 56.5 points, which corresponds to ambiversion: a personality type that has traits of both types. Ambiverses have traits of both extroversion and introversion. They are sociable and reserved, passive and active. It all depends on the place and time of action. They have a fairly stable psychological orientation towards the world of external objects (extroversion) and the internal subjective world (introversion).

It was noted that the elective course group would include: 5 ambiverts (mixed type), 3 extroverts, and 2 introverts. After the elective course, table 2 shows slightly different results of the psychological and pedagogical diagnoses of 9th-grade students.

Table 2. Jung's personality assessment after the experiment

Full name	Score	Personality type	Average score
1. student	45	Ambivert	59.5 - ambiverts
2. student	70	Extrovert	
3. student	65	Ambivert	
4. student	40	Ambivert	
5. student	65	Ambivert	
6. student	45	Ambivert	
7. student	65	Ambivert	
8. student	80	Extrovert	
9. student	50	Ambivert	
10. student	70	Extrovert	

The average personality type score was 59.5, corresponding to the ambivert personality type, which has traits of both introversion and extroversion. The breakdown of personality types among the students was as follows: 7 ambiverts and 3 extroverts. Compared to the beginning of the experiment, there were two more ambiverts; the number of extroverts remained unchanged; and there were no introverts. This is because the students became more emotional, lively and open in their communication. Homework assignments helped students to find additional information on various topics.

Diagram 2 shows a comparative analysis of the results of Jung's psychological personality typology before and after the elective course.

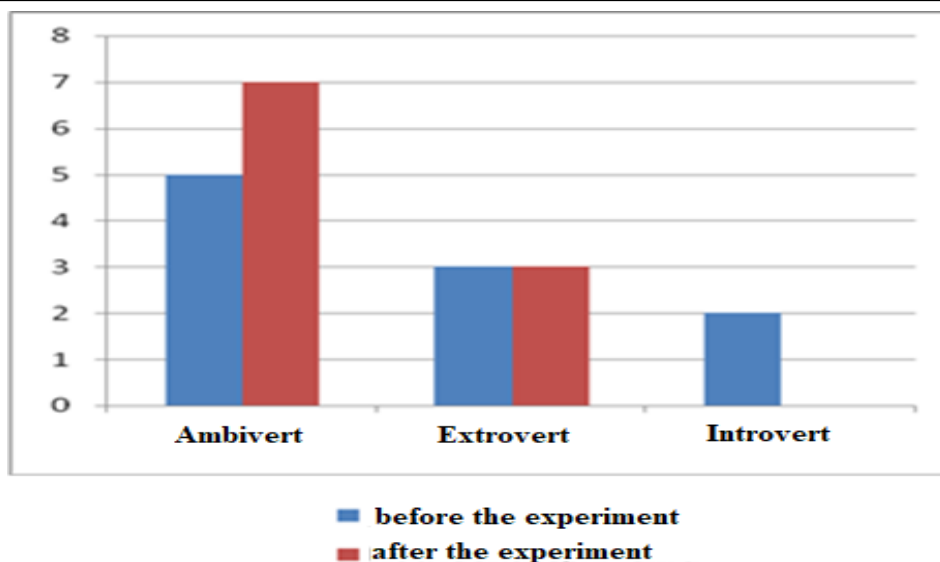


Diagram – 2 Comparative analysis of the results of Jung's psychological personality typology before and after the experiment

B) Diagnosis of the psychodynamic properties of N.I. Smirnov's personality. It all began with determining the reliability of the subject's answers based on the sincerity indicator. For this purpose, the number of matchings "yes" answers to the questions asked is counted (the count is made line by line according to the sincerity indicator in the questionnaire key). The results of N.I. Smirnov's diagnosis before the experiment is presented in Table 3.

Table 3. Diagnosis of psychodynamic personality traits N.I. Smirnov's before the experiment

№	Scales				
	Extroversion	Rigidity	Emotional excitability	Reaction speed	Activity
S-1	10	14	8	12	10
S-2	12	8	9	10	12
S-3	21	14	8	8	10
S-4	12	9	16	9	13
S-5	9	10	8	10	5
S-6	12	12	10	7	6
S-7	12	15	12	8	14
S-8	10	10	7	14	10
S-9	15	15	14	15	5
S-10	18	12	7	9	7

The average score for the group on the “Extraversion” scale is 13.1, indicating average extraversion.

On the “Rigidity” scale, the group's average score is 11.9, indicating an average expression of this trait. The group scored 9.9 points on the “Emotional excitability” scale, indicating average emotional excitability. The average score for the group on the “Reaction speed” scale was 10.3, indicating average reaction speed. The group scored 9.2 points on the “Activity” scale, meaning that the psychodynamic trait of activity is expressed very weakly in this sample. These results are consistent with those obtained by other methods. Table 4 shows the data obtained after the elective course.

Table 4. Diagnosis of psychodynamic personality traits N.I. Smirnov's after the experiment

№	Scales				
	Extroversion	Rigidity	Emotional excitability	Reaction speed	Activity
S-1	8	10	6	12	11
S-2	14	10	7	10	12
S-3	18	14	8	9	10
S-4	14	11	9	9	12
S-5	11	12	7	12	8
S-6	13	10	11	9	8
S-7	12	12	12	8	12
S-8	10	11	8	14	10
S-9	15	14	7	15	7
S-10	18	17	7	11	9

On the «Extroversion» scale, the group's average score is 13.3, indicating average extroversion. On the «Rigidity» scale, the group's average score is 12.1, indicating a high degree of rigidity. On the «Emotional Excitability» scale, the group scored 8.2, indicating average emotional excitability. On the «Reaction Speed» scale, the group's average score is 10.9, indicating average reaction speed. On the «Activity» scale, the group scored 9.9, meaning that the psychodynamic property of activity is very weakly expressed in this sample.

A comparative analysis of the results of this methodology is presented in Diagram 3.

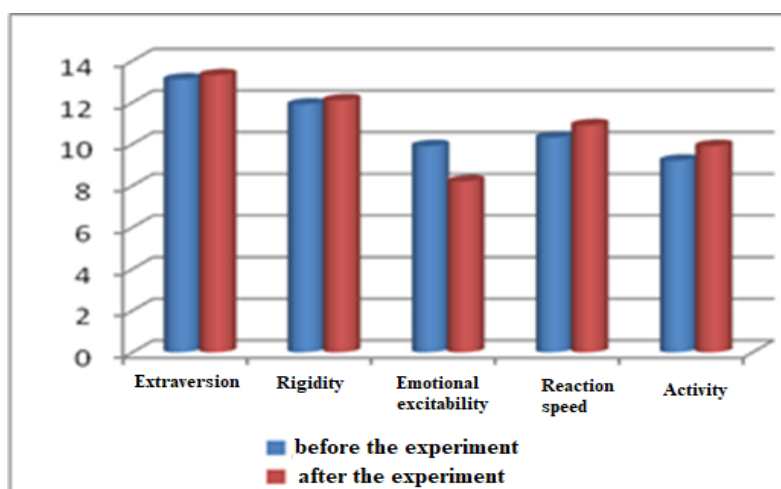


Diagram – 3 Comparative analysis of the results of the psychodynamic properties of N.I. Smirnov's personality before and after the experiment

Thus, the results of the two methods used to determine the psychodynamic properties of personality are consistent. The number of ambiverts increased slightly after the elective course, while the average psychodynamic property level according to N.I. Smirnov remained unchanged.

The following indicators were identified when determining the psychodynamic properties of the personality: attitude to study; general style of behaviour and activity; qualities characterising educational and organisational skills; and attitude to classmates and oneself.

C) The results of the entrance questionnaire are presented in Diagram 4. This shows the number of 'yes', 'no' and 'neutral' responses to each question.

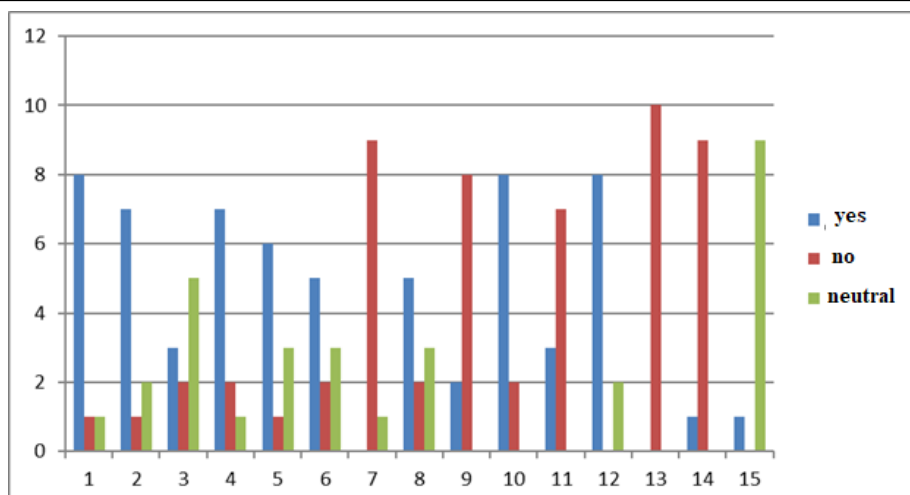


Diagram – 4 The results of the survey before the experiment

Based on the results of the questionnaire analysis, the following conclusions were drawn: Seven students (70%) consider chemistry to be an important science, while three students (30%) are unsure of its significance or do not recognise it as such, indicating the need to emphasise the applied role of chemistry. Only three students want to pursue a career in chemistry, while five students (50%) are undecided. This suggests an insufficient understanding of the career prospects in chemistry. Seven students (70%) expressed an interest in solving chemical problems, indicating developed logical thinking. However, five students (50%) find it difficult to apply their chemistry knowledge in everyday life, suggesting a gap between theory and practice. Only five students (50%) consider chemistry knowledge useful for the future, while the rest are unsure or do not see any prospects. Eight students (80%) are not interested in studying chemistry beyond the school curriculum, and eight students (80%) consider chemistry to be a challenging subject that requires adjustments to teaching methods. Nine students (90%) are not interested in taking courses outside of the school curriculum, and nine students (90%) have no experience of attending additional classes, making it difficult to assess their usefulness objectively.

The survey revealed moderate interest in the subject, as well as significant gaps in motivation for independent chemistry study and a weak connection between the school curriculum and real life. A more practice-oriented approach is required, along with the introduction of project-based learning and the expansion of the extracurricular educational environment. Diagram 5 presents the results of the survey, which were obtained after the students had studied the elective course.

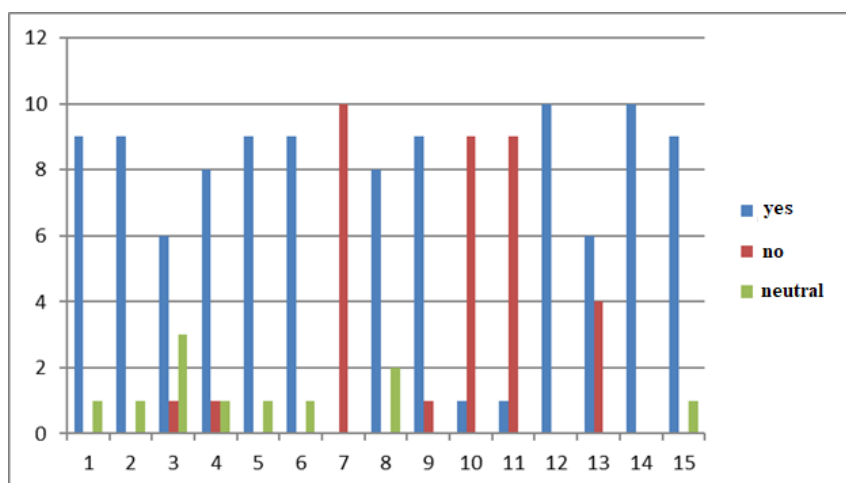


Diagram – 5 The results of the survey after the experiment

The 30% increase in responses to question 3 ('Would you like to choose a career related to chemistry?') suggests a growing professional interest in the natural sciences, highlighting the influence of education on career choices. Furthermore, interest in problem solving (Question 4) increased by 10%, demonstrating a parallel development. Similarly, the increases in awareness of the role of chemistry in the world around us (question 5) and in everyday life (question 6) reflect the successful implementation of interdisciplinary connections and a practice-oriented approach: awareness of the role of chemistry in the world around us increased from 60% to 90%, and awareness of its role in everyday life increased by 40%. Finally, the number of students who recognise the value of individual and additional classes (question 12) increased by 20%.

Conclusion and discussion. According to Dadonova [10] and Martin et al. [11], including elective courses in the general education curriculum is an important step towards implementing the principles and objectives of specialised education. Elective courses can make the educational process more interesting and varied. Building on this approach, during the research period, we developed various materials, including methodological recommendations, lesson plans, interactive presentations, teaching materials, digital learning tasks, entrance and final tests, and a questionnaire for elective courses

To demonstrate the positive impact of the elective chemistry, course on students' assimilation of educational material, a pedagogical experiment was conducted involving an experimental group of ten students. Due to the specific content of the elective course 'Chemistry Around Us,' the group included 9th-grade students from the Academician E.A. Buketov Secondary School № 52. Ten teaching hours from the entire programme were selected for teaching.

Before the start of the course, the experimental group of students took an entrance test consisting of fifteen questions on topics from Section VI- "Food Chemistry". The entrance test scores of the 9 grade students were as follows: One student scored 4 points, six students scored 5 points, one student scored 6 points, and one student scored 7 points. The percentage of correct answers was 34.7%. This result can be attributed to the students' limited knowledge of these topics.

After completing the elective course, the experimental group took a final test consisting of 25 questions on the topics covered. Their scores on the final test were as follows: One student scored 10 points; two students scored 11 points; two students scored 12 points; one student scored 13 points; one student scored 14 points; one student scored 16 points; and two students scored 18 points. The percentage of correct answers was 54%. The test results show that the percentage of correct answers increased by 19.3% before and after the course. This indicates that implementing the "Chemistry Around Us" elective course has a positive effect, significantly influencing the students' assimilation of the educational material.

There are several reasons for the increase in the percentage of correct answers. Firstly, the course content went beyond the basic curriculum and focused on practical applications. Students were eager to learn about subjects such as chemistry from a new perspective and acquire knowledge that would be useful in everyday life. Secondly, laboratory work and practical workshops unlocked the students' creative and educational potential. They were keen to acquire new knowledge through non-standard tasks. Thirdly, the relaxed atmosphere and small group size enabled each student to participate fully in the educational process and ask questions that interested them. All these factors contributed to activating cognitive activity and general interest in chemistry.

After the experiment, the students completed a final psychological and pedagogical assessment to study their personalities and their interest in learning. The results were then compared with those of the initial assessment. The personality assessment results show that the number of ambiverts increased slightly after the elective course, while the average psychodynamic characteristic score remained the same. The questionnaire results demonstrate a significant increase in students' interest in, awareness of, and activity relating to chemistry. Notable positive changes include attitudes towards chemistry-related professions, readiness for independent learning, and the desire to study the subject in depth, as well as reduced anxiety about the complexity of chemistry.

According to Ikram et al. [17] and Ayanbode et al. [18], elective courses have great potential, but successfully implementing them requires considerable effort. Teachers must develop an elective programme that reflects the course objectives in the context of the subject being studied, provide students with the necessary teaching materials, and select effective teaching methods. Thus, our study revealed that elective chemistry courses positively impact the educational and cognitive processes.

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PEDAGOGICAL FOUNDATIONS OF USING MODULAR TECHNOLOGY IN THE TEACHING OF INORGANIC CHEMISTRY

Abstract

This article comprehensively examines the pedagogical foundations of applying modular technology in the process of teaching inorganic chemistry in higher education institutions. In modern education, modular technology is considered one of the effective methods that enables students to master learning material step by step, while improving the quality of knowledge through the interconnection of theory and practice.

The purpose of the study is to identify the pedagogical prerequisites for the application of modular technology in teaching the inorganic chemistry course, to determine its features, and to prove its effectiveness on a practical level. For this purpose, research was carried out with an academic group of 12 first-year chemistry students. At the initial stage, students' opinions about modular learning were identified. The survey results showed that 8 out of 12 students had heard this term for the first time, while only 4 students were able to provide a general understanding of its content.

During the study, the course "Theoretical Foundations of Inorganic Chemistry" was divided into 8 modules, and a 15-week lesson plan was developed. Each module included not only