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THE IMPORTANCE OF ENVIRONMENTAL EDUCATION OF STUDENTS IN TEACHING CHEMISTRY

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This article presents insights into the pedagogical significance of environmental education for school students, organized through the teaching of two core scientific subjects—chemistry and ecology. The emphasis extends to the broad implementation of environmental education across various types of secondary schools nationwide, along with the proactive initiation of numerous projects to address environmental challenges, which are undeniably one of the most pressing issues of our time.

Many scholars remain dissatisfied with the current state of research on this topic. Therefore, a review of the works of prominent researchers who have studied environmental education within the school chemistry curriculum was conducted, along with an analysis of the methods and approaches tested in scientific studies. The article explores the ways in which the younger generation, starting from school age, can be instilled with habits of environmental protection and respect for the natural world. In the context of explaining the importance of the environment to students, the paper outlines strategies for preventing many pressing issues at both local and national levels through the development of environmental awareness and knowledge. Furthermore, the article presents a comprehensive analysis of research conducted among 8th-grade students at the A.Navoiy Gymnasium-School No.13. This investigation monitored students' active participation in general chemistry classes, assesses their individual abilities, and assigns tasks tailored to their specific skills. At the conclusion of the pedagogical experiment, students are asked to revisit the questionnaires they completed at the study's baseline, facilitating a thorough comparison of the pre- and post-study results.

Key words: *chemistry, research work, environmental protection, ecology, environmental education.*

ХИМИЯ ПӘНІН ОҚЫТУДА ОҚУШЫЛАРҒА ЭКОЛОГИЯЛЫҚ БІЛІМ БЕРУДІҢ МАҢЫЗЫ

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Мақалада жалпы білім беретін орта мектеп оқушыларына екі ірі ғылым – химия пәнін экологиямен байланыстыра отырып оқыту арқылы оқушыларға экологиялық білім берудің педагогикалық маңызы туралы ақпарат берілген. Еліміздің жалпы білім беретін барлық типтегі мектептерінде экологиялық білім беруге ерекше назар аударылып отыр. Сонымен бірге, экологиялық проблемалардың алдын алу мақсатында көптеген жобалар іске асырылып жатыр. Экологиялық проблема қазіргі күндегі өзекті мәселелердің бірі болып отырғандығы белгілі. Көптеген ғалымдарды да бұл тақырып толғандырмай қоймады. Сол себепті де, белгілі ғалымдардың мектепте химия курсында экологиялық білім беру туралы зерттеген еңбектеріне шолу жасалып, ғылыми-зерттеу барысында сынап көрген әдіс-тәсілдеріне талдау жасалды. Кейінгі ұрпақтың мектеп қабырғасынан бастап табиғатты қорғауға, өз ортасын құрметтеуге дағдыландыру жолдары қарастырылған. Мектеп оқушыларына қоршаған ортаның маңыздылығын түсіндіре отырып, бойларында экологиялық білім қалыптастыру арқылы қазіргі күндегі аудандық, мемлекеттік деңгейдегі көптеген актуалды мәселелердің түйінін шешу жолдары қарастырылған. Сонымен қатар, мақалада Ә.Науаи атындағы №13 мектеп-гимназиясының 8-шы сынып оушыларына жүргізілген зерттеулер нәтижелеріне талдау жасалынған. Зерттеуді оқушылардың жалпы химия сабағына қаншалықты белсене қатысуларына, жалпы тұлғалық қабілеттеріне бақылау жүргізуден бастап, әрі қарай білім алушылардың қабілетіне байланысты тапсырмалар ұсынылды. Педагогикалық эксперимент соңында оқушыларға зерттеу жүргізудің бастапқы кезеңінде берілген сауалнамалар екінші рет ұсынылып, зерттеуден бұрынғы және кейінгі нәтижелер салыстырылды.

Түйінді сөздер: *химия, ғылыми-зерттеу жұмысы, қоршаған ортаны қорғау, экология, экологиялық білім.*

ЗНАЧЕНИЕ ЭКОЛОГИЧЕСКОГО ОБРАЗОВАНИЯ УЧАЩИХСЯ В ПРЕПОДАВАНИИ ХИМИИ

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В данной статье представлена информация о педагогическом значении экологического образования школьников, организованного путем преподавания двух основных предметов науки – химии и экологии. Особое внимание уделяется экологическому образованию во всех видах общеобразовательных школ страны. Подчеркивается, что реализуется много проектов, направленных на предотвращение экологических проблем. Известно, что экологическая проблема – одна из актуальных тем на сегодняшний день. Многие ученые не удовлетворены исследованиями на данную тему. Поэтому был проведен обзор работ известных ученых, изучавших экологическое образование в школьном курсе химии, а также проанализированы методы и подходы, апробированные в ходе научных исследований. Рассматриваются способы, посредством которых подрастающее поколение, начиная со школьных лет, привыкает к охране природы, уважению к окружающей среде. В рамках объяснения значимости окружающей среды школьникам, приводятся пути предотвращения многих актуальных проблем на местном и государственном уровнях путем формирования экологических знаний. Более того, в статье были проанализированы результаты исследований, проведенных с учащимися 8-х классов школы-гимназии №13 имени А. Навои. Исследования начались с наблюдения за активностью учащихся на уроке химии, их общими личностными способностями. Далее были предложены задания, распределенные в соответствии с уровнем способностей учащихся. В конце педагогического эксперимента анкеты, выданные ученикам на началь-

ном этапе исследования, предъявлялись повторно, с целью сравнения результатов до и после исследования.

Ключевые слова: *химия, научно-исследовательская работа, охрана окружающей среды, экология, экологическое образование.*

Introduction. The intricate interdependence between humanity and the natural environment represents an intrinsic and inseparable system. Presently, human intellect has engendered a myriad of innovative advancements and novel processes, leading to the introduction of novel terminology within the global discourse. Nevertheless, it is evident that the advancement of these technologies must be undertaken with due diligence to prevent adverse impacts on the environment. The deleterious consequences borne by the natural world reverberate profoundly within the fabric of human existence. Environmental issues have transcended mere national borders, assuming a global prominence, thereby compelling international leaders to collaboratively address the manifold challenges arising from environmental calamities. Consequently, numerous nations have enacted comprehensive legislative measures and initiatives designed to safeguard the environment, encompassing the mitigation of deforestation, the establishment of robust recycling mechanisms, and the prudent management of waste disposal systems.

Several laws have been adopted in Kazakhstan because of many activities carried out while solving environmental problems. For example, in 2002, the law on environmental education was adopted into the state education program [1]. Furthermore, the “Ecology” segment has been seamlessly integrated into the Republic of Kazakhstan’s Code pertaining to the Special Protection of the Environment. This legal framework prioritizes environmental preservation, with a specific focus on ensuring an environment conducive to the well-being of the populace while concurrently safeguarding the diverse flora and fauna [2]. Article 181 of the Environmental Code explicitly underscores the paramount objective of environmental education and enlightenment, which is to cultivate an active civic disposition firmly grounded in the tenets of sustainable development and heightened ecological consciousness [3]. Consequently, the imperative of conserving our environment is firmly rooted at the individual level. Profound strides towards environmental preservation may be achieved through the conscientious execution of seemingly mundane daily practices, such as the judicious disposal of waste materials, abstaining from behaviors that engender environmental contamination, refraining from the destructive manipulation of arboreal vegetation, nurturing ornamental horticulture, and assiduously upholding personal hygiene and cleanliness. Within the contemporary academic milieu, the cultivation of an ardent affection for the environment, the inculcation of reverence for our surroundings, and the development of a profound reverence for the natural world constitute an overarching pedagogical imperative. One of the main tasks of the modern teacher community is to inculcate love, respect, respect for the environment among the younger generation at schools. Environmental education has yielded a discernible impact, catalyzing the emergence and development of pivotal concepts within the cognitive landscape of students. Specifically, this educational paradigm has engendered the cultivation of multifaceted constructs such as environmental literacy, environmental culture, and environmental consciousness within the intellectual purview of the learners.

It is well-established that environmental catastrophes serve as catalysts for alterations in natural phenomena and the hastening of various processes [4, p. 1685]. For instance, the rapid thawing of colossal glaciers is attributed to the annual escalation of global mean temperatures, signifying the acceleration of the global warming phenomenon. These processes, in turn, precipitate profound climatic transformations within the natural world. The pertinence of environmental education is intrinsically intertwined with the existence of ecological disaster zones within the country. To illustrate, West Kazakhstan residents are deeply concerned about the predicament of the Aral Sea, while other regions grapple with the environmental transgressions associated with military installations and industrial enterprises failing to adhere to environmental stipulations. Simultaneously, major urban centers such as Almaty, Karaganda, and Shymkent contend with a contemporary predicament characterized by an overabundance of toxic gases in the atmosphere, largely attributable to the phenomenon of artificial fog [5]. Ecological knowledge represents a vehicle for the augmentation of human consciousness, the broadening of perspectives on life, and the augmentation of curiosity and inquiry regarding the natural world and its intricate phenomena [6, p. 93]. Given the salience of this subject matter, elucidating to students the genesis of prevailing environmental issues and the pivotal role played by chemical science in their resolution stands as a paramount objective of this research endeavor. Consequently, the overarching aim is to scrutinize the most efficacious pedagogical methods for instructing students about the preservation of the natural environment, promoting its cleanliness, and ensuring its welfare for the benefit of all.

Chemical education plays an important role in the development of mankind. By connecting chemical education to a more complete understanding of the world, people will be able to solve environmental problems more effectively [7, p. 2910].

Environmental education has a rich historical lineage, with its origins traceable back to antiquity, spanning from the 9th to the 15th centuries. Visionaries such as Makhmud Kashkari, al-Farabi, Zhusip Balasaguni, and Akhmet Yassawi, among others, were early luminaries who exhibited a deep concern for the

dynamics and forces governing the natural world. Notably, scientists like Zh. Aymautov and A. Baitursynov, as well as the architects of national education, contemplated the imperative of environmental education in their respective eras. However, the course of history witnessed a shift in human actions, where the detrimental impacts on the natural environment prompted the emergence of concepts like “ecology” and “ecological problems” [8, p. 22]. Both foreign scholars, such as Usova A.P., Vinogradova N.F., Poddyakov N.N., and domestic luminaries like Zh. Yanbayev, A. Beisenova, and E. Mambetovna, have offered valuable insights into the realm of environmental education. Additionally, educational institutions draw inspiration from the invaluable works and methodologies crafted by scholars affiliated with the Ybyray Altynsarin Kazakh Academy of Education, in the domain of environmental education for students [9, p. 75]. G. Kokibassova, in her comprehensive exploration of environmental education for schoolchildren, has delved into the contemporary significance of this field. She has proposed a pedagogical framework encompassing multiple instructional approaches, with the culmination of this educational process culminating in the assessment of substantial positive outcomes achieved by students [10, p.110]. At its core, ecological education seeks to elucidate the most efficacious pathways for harmonizing society, nature, and the environment, thereby imparting these insights to the younger generation. Through the incorporation of environmental education within the chemistry curriculum, students gain a profound appreciation for the pivotal role of chemistry in human existence. This educational endeavor underscores the imperative of responsible resource utilization and sustainable practices, equipping students with the knowledge to wield their understanding judiciously.

Non-stop chemical and environmental education encompasses several fundamental directions, which are as follows:

– Based on chemistry, exposing the harm caused by dead and living nature and the phenomena that occur between them.

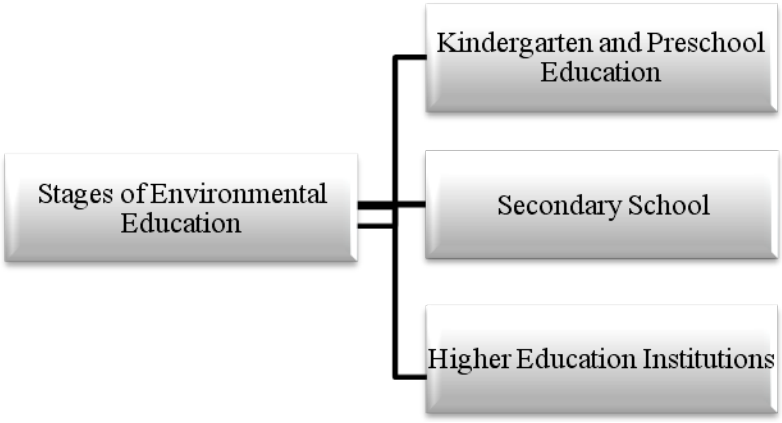
– Combining chemical and ecological concepts with the system of other natural sciences with the help of environmental aspects of chemical science.

– Detailed disclosure of harmful and useful aspects of substances obtained because of chemical experiments.

– The use of materials in the formation of chemical and environmental concepts in the region.

These multifaceted directions in non-stop chemical and environmental education collectively serve to cultivate a comprehensive and well-rounded understanding of the interplay between chemistry and the environment, thereby empowering learners to make informed decisions that contribute to the preservation and sustainable management of our natural world.

The primary objective of chemical and ecological education for young children is to impart an understanding of the detrimental consequences arising from scientific and technological advancements, as well as natural phenomena, on living organisms. This educational endeavor strives to nurture an awareness of strategies for mitigating such harms, devising preventive measures, and fostering a commitment to lead a healthy lifestyle that safeguards both personal well-being and the environment [11, p. 6]. The acquisition of ecological knowledge during the formative years exerts a profound and enduring influence on the cognitive development of students. Consequently, it is imperative to recognize that the knowledge assimilated by the younger generation is not rigidly fixed but rather dynamic and subject to ongoing growth and refinement. This pedagogical journey is characterized by distinct stages, as elucidated in the table below: (Figure 1).



Picture 1. Stages of Environmental Education

Goal and objectives. The purpose of the study is to provide environmental education and upbringing for students by effectively organizing extracurricular activities in chemistry at a secondary school and developing environmental literacy.

The main tasks:

– as a result of effective organization of extracurricular activities in chemistry, to teach students to save time and work productively;

– to develop respect for the environment through teaching chemistry related to ecology;

– to comprehensively explain to students current environmental situation, its causes and consequences, and ways to prevent it, and to motivate each student to save nature.

Scientific novelty.

– Improving the teaching of chemistry in secondary by providing students with effective material and differentiating the best methods for quality education during the research process;

– Increasing students' interest in chemistry by organizing extracurricular activities and helping them understand the importance of chemistry in our lives.

Materials and methods. Throughout the course of the investigation, a diverse array of educational resources was made available to the school's students. The selection of these materials was intricately tailored, considering the outcomes of previous assessments, as well as the individual characteristics and learning capacities of each student. Furthermore, a stringent commitment was upheld to source materials exclusively from authoritative and reputable outlets of information, ensuring strict adherence to textbooks sanctioned in alignment with the state's educational framework.

It is a well-recognized fact that the realm of educational pedagogy encompasses a multitude of diverse approaches. However, the caliber of knowledge imparted to students is intrinsically linked to the judicious selection of teaching methodologies and the way classes are conducted. In the context of this study involving schoolchildren, a methodical approach was employed, involving the careful grouping of students. This approach facilitated individual students' opportunities to showcase their knowledge, engage in independent work, collaborate within small groups, and foster closer interaction among peers. Concurrently, clear directives were provided, accompanied by illustrative examples of problematic scenarios. The integration of information technologies played a pivotal role in this pedagogical framework, notably with video presentations. These videos effectively harnessed modern technology to elucidate pressing environmental concerns, areas afflicted by disasters, and the resultant impact on the natural world. To stimulate the logical development of students' cognitive faculties, various activities such as environmental reports and related tasks were thoughtfully incorporated into the instructional process.

The work was carried out in grades 8 "A" and 8 "B" of the A.Navoiy Gymnasium School No.13 in Turkestan. The knowledge of pre-school students was tested using test results and reports. According to the results of the study, 8 "A" classes were taken as a group of experiments. For 8th-grade students, a range of environmental topics was introduced, distinct from the subjects delineated by the state's educational standards. The objective of incorporating these topics was twofold: first, to furnish students with fresh insights during their lessons, and secondly, to cultivate a broader perspective and heightened awareness. Consequently, by presenting captivating and relevant information, students' innate curiosity is piqued, rendering the study of natural phenomena engaging and problem-solving regarding environmental issues becomes an intuitive process. Below, a table has been compiled featuring select headings along with accompanying illustrative examples (Table 1).

Table 1. Additional subheadings recommended for 8thgraders

№	Fixed subject of the lesson	Subheadings with ecological content
1.	Chemical reactions.	The effect of combustion reactions on oxygen gas in the air.
2.	Oxygen use. Oxygen circulation in nature.	Chemical reports of ecological content.
3.	Ozone. Allotropic oxygen changes.	The importance of the ozone layer in our life, its current state.
4.	Air. Air composition. Air pollution.	The main sources of air pollution in the country.
5.	Sources of water pollution. Cleaning methods.	Water pollutants in the city are factors.
6.	The concept of gases.	The effect of gases on nature.

Results and discussion. The research project was undertaken at the A.Navoiy Gymnasium School No.13 in Turkestan. For the study, the 8 "A" class was defined as the experimental group, and the 8 "D" class was defined as the control group. Prior to the commencement of the study, these students had demonstrated a keen interest in their chemistry classes, actively engaging in the learning process. A pedagogical study was conducted on the stages of identification, formation, and control. To establish a foundational understanding of the students' perspectives on chemistry, an initial survey was administered to gauge their attitudes toward the subject. Subsequently, research materials were thoughtfully discussed in relation to the insights gleaned from the survey. The students were presented with a series of questionnaires, each tailored to elicit specific information relevant to the study's objectives as follows:

1. Do you like chemistry lessons?
2. Are you interested in the chemical processes that are happening in nature, in the environment?
3. Do you think you need a chemistry lesson?
4. How often do you use your theoretical knowledge of chemistry in life?
5. How actively participate in chemistry classes?

The result of the survey is shown in the chart below. (Chart 1)

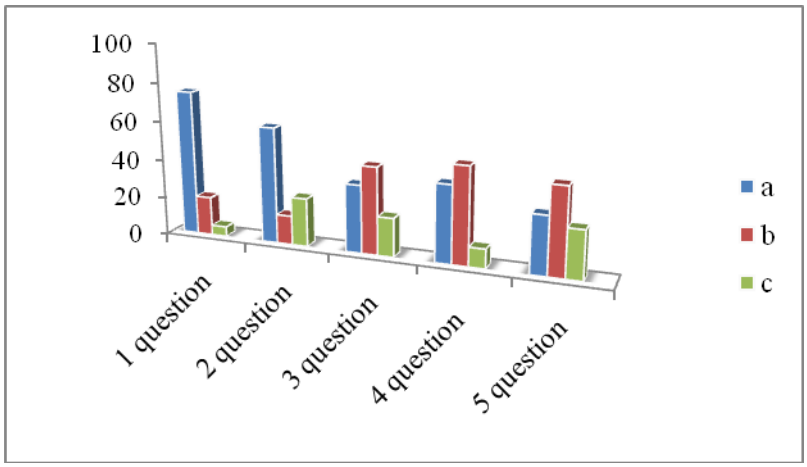


Chart 1. The results of the survey were conducted to monitor the interest of students in chemistry. (% indicated)

Chart 2 below shows the results of the control and experimental groups based on the questionnaire survey. According to the conducted health improvement and testing, it can be observed that the students' environmental knowledge is not high enough. Nevertheless, there is a high level of interest in environmental education and upbringing. In addition, the test revealed difficulties with questions that required an explanation of the chemistry of natural processes, the effects of certain compounds on the human body, and the use of basic concepts in water purification, natural gas, etc.

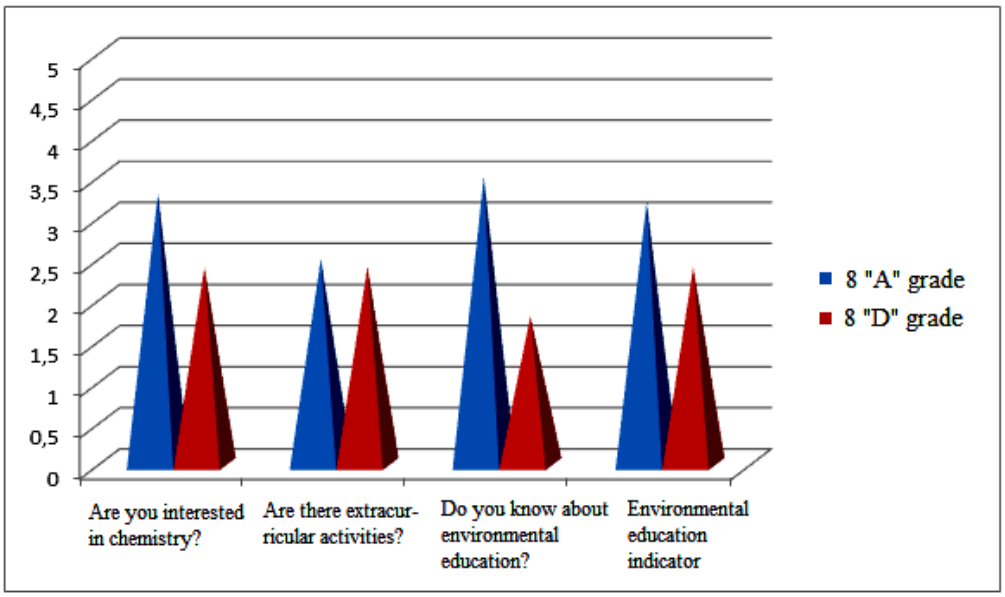


Chart 2. Questionnaire indicator of 8 classes "A" and "D" (rating scale of answers up to 5)

The chart unmistakably reflects a pronounced level of enthusiasm among the students enrolled in the investigated classes when it comes to the subject of chemistry. Right from the inception of the study, these students exhibited remarkable levels of engagement in the classroom, actively initiating interactions with their teachers and dutifully adhering to instructions. To underscore the paramount importance of the environment in the context of human existence and the intimate interdependence between nature and mankind, a series of tasks were thoughtfully presented to the students. These tasks, framed within an ecological context, revolved around the utilization of chemical compounds and their ramifications on both the human body and the broader environment. The execution of reports centered on ecological content plays a

pivotal role in reinforcing the retention of chemical knowledge, its practical applicability in real-life scenarios, and the visualization of intricate processes transpiring within the natural world. Furthermore, such reports serve as a conduit for addressing pertinent environmental issues. It becomes evident that reports infused with ecological content occupy a distinctive and pivotal position within the realm of chemistry education, firmly tethered to the overarching field of ecology. The overarching objective of this project lies in cultivating the students' capacity for independent learning, nurtured through practical reporting, and in fostering an in-depth exploration of environmental dynamics, substantiated by theoretical underpinnings.

In pursuit of this overarching objective, students were assigned a series of tasks designed to elucidate the paramount significance of the environment in the context of human existence. These tasks were meticulously crafted to underscore the intricate interrelationship between nature and humanity, emphasizing the inseparable bond that exists between the two. Through these assignments, students were prompted to explore and appreciate the fundamental role that the environment plays in sustaining and enriching human life.

Tasks related to the consequences of environmental disasters:

In the 1950s, he took the 4th place in the world in terms of volume. The current name is "Aral" due to the fact that the water of the sea is drawn, and small islands are visible from the surface of the water. It will be flooded by the rivers of Amudariya and Syrdarya. Currently, it has decreased by 8 times (8303 thousand km2) from its previous volume (68 thousand km2).

1. What is the reason for this?
2. Why is birch not hot in the heat? [12]
3. What is the reason why the wolf is called "The Sanitary of the Steppe?"

Within the framework of the special state educational program designed for 8th-grade "A" classes, a curated selection of concise video presentations has been incorporated, intended to foster the development of ecological knowledge. These short videos, encompassing themes such as "First Chemical Concepts", "Hydrogen", "Oxygen" "Acids and Salts" and "Water: Basics and Solutions" have been thoughtfully introduced.

Of particular interest in this context is the thematic exploration of "Acids and Salts". While acquainting students with this subject matter, an emphasis has been placed on elucidating the pivotal roles and significance of acids and salts within the human body. The discourse extends to underscore how the acidification of the human body can precipitate premature and accelerated aging, thus shedding light on a crucial health-related aspect. Furthermore, the instructional materials also broach the topic of acid rain, providing comprehensive information to enrich students' understanding.

To assess the influence of these video presentations, students were prompted to articulate their reflections and insights following the viewing experience. Presented below are selected excerpts that provide a glimpse into the content that was presented to the students, thereby cultivating an interactive and immersive learning environment (Picture 2).

Picture 2. Screenshots from video about acid rains

The students showed their knowledge by actively carrying out the tasks. At the end of the lesson, he expressed his opinion on the following questions.

1. What do you know about the environmental problem?
2. Which areas of the country are subject to ecological lysis?
3. Compare the ecological situation of the city and the village.

4. Tell us what you know about the conditions that lead to ecological disasters.
5. Does the area where you live belong to the ecologically unscathed zone?
6. What work is being done to solve environmental problems?
7. What should be done to prevent environmental problems, what suggestion would you make?
8. What do you know about the damage caused by industrial sites to nature?
9. What do you know about toxic gases?
10. Do ultraviolet rays benefit?

Throughout the course of their studies, students actively shared captivating and noteworthy information that they had independently researched in relation to the subject matter. This process not only enriched their understanding but also fostered the acquisition of a myriad of new skills. To further invigorate scientific inquiry and gauge the students' sustained interest in chemistry, a secondary survey was conducted. The results of this subsequent survey are graphically depicted in the chart below, providing valuable insights into the evolving dynamics of the students' engagement with the subject (Chart 3).

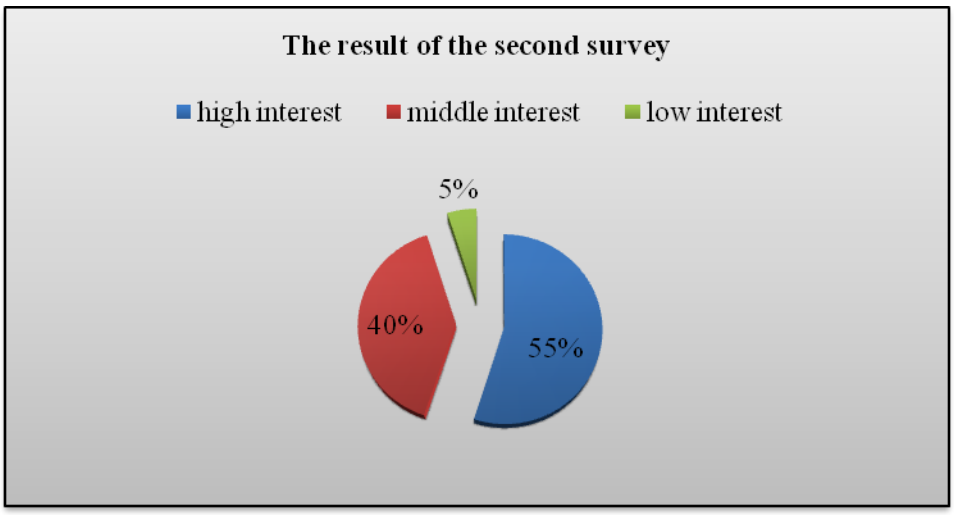
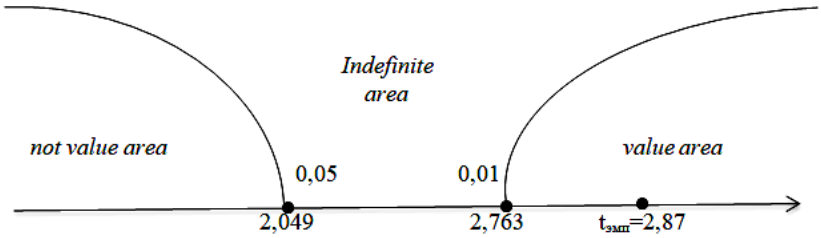


Chart 3. Results of a secondary survey of students in the class



At the culmination of the experiment, a hypothesis was formulated and tested to ascertain the reliability of any differences between the results obtained from the control group and the experimental group. The empirical value of the studentəs t-test for independent selected samples yielded a value of 2.87. Therefore, this analysis has substantiated the proposed hypothesis, affirming the presence of statistically significant differences between the outcomes obtained at the conclusion of the experiment.

Conclusion. This subject, extensively explored by numerous scientists, remains highly pertinent today. Commencing at the school level, addressing environmental issues through the provision of ecological education to young learners holds the potential to engender lasting solutions. Present-day students, who have been nurtured with a profound appreciation for the interconnectedness of nature and society, are poised to innovate novel approaches for environmental conservation. In the future, they will evolve into conscientious citizens who ardently cherish and respect their homeland and the natural world.

While a plethora of methods and techniques for ecological education are available within the school's chemistry curriculum, it remains imperative to continually introduce students to the most efficacious and engaging approaches. Throughout the course of this study, students' responses to questionnaires revealed their keen interest in future classes, evincing a positive outlook on the instructional methods employed.

Furthermore, as the study unfolded, students exhibited genuine empathy for nature and initiated actions to protect the environment. They began by actively participating in cleaning up litter within their surroundings, maintaining personal hygiene, responsibly disposing of used items in designated bins, and conserving vital natural resources such as water and electricity. Notably, there was also a discernible uptick

in ecological literacy among the students. In essence, the objectives of this study have been realized, with students demonstrating a heightened environmental consciousness and actively contributing to the protection of the natural world.

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METHODOLOGY FOR STUDYING TRANSBOUNDARY RIVERS OF KAZAKHSTAN AND CENTRAL ASIA AS AN OBJECT OF GEOCONFLICTOLOGICAL RESEARCH

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This article discusses a methodology for the study of geoconflicts as an object of geoconflictology using the example of transboundary rivers in Kazakhstan and Central Asia. The aim of the study is to develop and test a methodology for studying transboundary rivers in Kazakhstan and Central Asia within the educational process as an object of geoconflictological analysis, aimed at fostering students' professional competencies in identifying, analyzing, and modeling geoecological conflicts related to the use of water resources in transboundary regions. The research objectives include analysis of international agreements and legal norms regulating the use of transboundary water resources; development of practical tasks for students focused on identifying the causes and consequences of geoconflicts; implementation of a pedagogical experiment aimed at forming students' skills in analyzing, synthesizing, and evaluating information using innovative teaching methods. The study presents the results of the pedagogical experiment and identifies the key factors influencing the development of students' professional competencies in geoconflictology. The research highlights the importance of integrating theoretical knowledge with practical application in geoecology, as well as the need for further development of methodologies and technologies aimed at analysis and resolution of transboundary geoecological conflicts. The paper also underscores the significance of using international legal regulations and predictive models in the formation of sustainable water resources management systems in Central Asia.

Key words: *geoconflictology, geoecological conflict, professional competence, transboundary rivers, innovative teaching methods.*