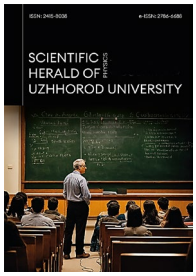
Scientific Herald of Uzhhorod University
Series "Physics"
Journal homepage: https://physics.uz.ua/en
Issue 55, 788–797
Received: 23.11.2023. Revised: 01.02.2024. Accepted: 28.02.2024



DOI: 10.54919/physics/55.2024.78ks8

Methodological basis for ecological knowledge development in future teachers in the chemistry education process at HEIs

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Abstract

Relevance. The relevance of this article lies in the fact that today's world changes rapidly, and the issue of the formation of a culture of ecological knowledge is becoming increasingly important, which allows a person to realise unity with the surrounding world, to educate a person in a rational attitude to nature. In such circumstances, every resident of the Republic of Kazakhstan should be ecologically educated in order to correctly understand the complexity of relations between man and nature. For this purpose, higher educational institutions are obliged to prepare qualified future teachers of chemistry with sufficient formation of ecological knowledge, so a teacher could bring to pupils of comprehensive schools the necessary information for them to understand the ecological situation in the world.

Purpose. The aim of this article is a theoretical substantiation of the formation of methodological bases of ecological knowledge in future chemistry teachers in the process of chemistry education in universities of Kazakhstan.

Methodology. Logical analysis, research of teachers' progressive experience, formalisation, and pedagogical experiments have been used as methods of research.

Results. This article highlights the issues of parsing the methodological foundations that will be able to satisfy the current demands of training chemistry teachers in the process of teaching in universities of the Republic of Kazakhstan.

Suggested Citation:
Zholdasbek B, Shokybayev Z, Ilyassova G, Akylbekova T, Kolushpayeva A. Methodological Basis for Ecological Knowledge Development in Future Teachers in the Chemistry Education Process at HEIs. *Sci Herald Uzhhorod Univ Ser Phys.* 2024;(55):788-797. DOI: 10.54919/physics/55.2024.78ks8

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Conclusions. The practical significance of the research on "Methodological bases for ecological knowledge development in future teachers in the chemistry education process at higher education institutions" is that the information analysed in the article can be applied by teachers and specialists of higher education institutions of the Republic of Kazakhstan when compiling manuals on natural science disciplines and methodological recommendations for future teachers of chemistry.

Keywords: learning process; chemistry; future teacher; ecological knowledge; methodology.

Introduction

Among current global issues, it is worth noting the growing environmental problem in the human environment. The growth of environmental pollution is evident and has been criticised by people. Often the main needs of the population are focused on chemistry. It is for this reason, in the current context, that it is necessary to objectively analyse the causes of increased pollution and the increasing frequency of natural disasters associated with the uncontrolled spread of chemical compounds of technical or biological origin. At present, there are two main aspects of the whole problem. The first concerns the chaotic and contradictory development of the economy, the second concerns people themselves, the extent to which they are prepared to consciously use modern advances in production and the family. It is particularly important to address the problem of chemical exposure to humans since today almost everyone is exposed to substances that can cause some kind of harm to humans [1]. In everyday life, people use various medicines, cosmetics, perfumes, dyes, fuels, plastics, and fertilisers. Thus, school educators are called upon to lay the foundation for the development of an individual with a new image and new behaviour in the environment. Environmental education as a modern system of education aims to meet the educational standards of the Republic of Kazakhstan and promotes the formation of disciplinary and meta-thematical knowledge, universal educational activities of future teachers, based on the understanding of environmental laws, the concept of sustainable development of the world, and increasing mental readiness to act safely in conditions of natural and social risk [2].

Ecological knowledge is the result of material and spiritual human social activity, an ideal conceptual description of unbiased processes and phenomena related to ecology. In any modern science, ecological knowledge is considered a special phenomenon, in which components are first preserved and formed in various fields of knowledge. The transition to ecological knowledge requires synthesis, and integration into the education system of the Republic of Kazakhstan. Therefore, the central methodological problem of ecological research is the problem of achieving holistic ecological knowledge, considering synthetic and systematic approaches to teaching chemistry. At all stages of its development, the human being has always been closely connected with the environment. But with the advent of chemical processes and the creation of artificial chemical compounds, our world has changed dramatically. This development raises the question of the impact of all these processes on the environment and human health. It is the formation of the population's ecological knowledge that will help to understand the process of studying the subjects of the natural sciences cycle, using the example of training future chemistry teachers in higher education institutions of the Republic of Kazakhstan. The peculiarity of chemistry classes is that practically all the lessons are devoted to the environment [3].

The ways to achieve the goals of environmental education can be different: ecological disciplines, creation of integrated courses, the introduction of them into the subject's educational practice, disclosure of ecology topics and environmental protection from pollution. When teaching chemistry, future teachers need to consider the problems of protecting the environment from chemical pollution; the biological interchangeability of chemical elements and the impact of these processes on organisms; the causes of disruption of biochemical cycles. To apply the ecological approach to the study of chemistry course, it is worth paying special attention to the issues of particular environmental interest [4]: global warming, stratospheric ozone depletion, acid rain, accumulation of toxic heavy metals and pesticides in soil, contamination of large areas with radionuclides, depletion of natural resources of the planet. Future teachers should also apply an ecological approach through tasks, practical work, and sectoral studies in chemistry.

One of the most effective methods of learning environmental knowledge is research activity, when students directly encounter nature, acquire scientific and experimental skills, and develop observation and interest in the study of specific environmental problems [5]. The aim of this article is a theoretical justification of methodological foundations development of ecological knowledge in future teachers of chemistry in the education chemistry process at higher education institutions of the Republic of Kazakhstan.

Materials and Methods

A variety of research methods were used to achieve the aim of the study and to address the identified objectives, including logical analysis of scientific information, research into the progressive experience of teachers, formalisation of information, and pedagogical experimentation. Within pedagogy, research is conducted using both universal and specific methods necessary to study specific pedagogical phenomena, and also to explore their interrelations and patterns. Theoretical methods help to identify problems, create hypotheses, and evaluate the collected research material, including monographs and scientific articles on pedagogy, historical, and pedagogical documents, textbooks and other materials related to pedagogy. By studying the literature on the chosen topic, it is possible to see which problems have already been solved and which still need to be solved. In the course of the research, the main concepts of this study, such as "ecology", "education process", "ecological knowledge", "methodological foundations" and many other judgments were analysed, as well as the structure and main positions of future teachers training in the process of chemistry education in universities of the Republic of Kazakhstan, which is reflected in the sections of the research paper.

The logical method of information research in this article is applied as a logical method of scientific reproduction of the formation of a complex object of study through theoretical analysis. The logical method involves reproducing the object under study as a system (i.e., in all its complexity and in all the structural and functional diversity of the phenomenon under study). Formalisation in this paper represents various objects that express and articulate their meaning and research structure in the form of symbols using a variety of "artificial" languages. The concept of "formalisation" is closely related to the concept of "abstraction", which is the process of mentally extracting the properties of the object under study according to its essential characteristics. According to scientists, formalisation as a research method has several advantages, in particular a complete description of a particular problem and a generalised approach to its solution; based on the use of special symbols that ensure accuracy and clarity of closing information; assigning certain values to individual symbols or their systems, which allows avoiding ambiguity of terms; allowing to teach and learn characteristic models of objects.

A pedagogical experiment in modern higher education is understood as one of the research methods aimed at determining the effectiveness of certain methods and tools in training future chemistry teachers in the process of learning in a higher education institution. A pedagogical experiment is characterised by the fact that the researcher actively participates in the development and elaboration of the phenomena under study. It tests its hypotheses not only on existing phenomena but also on those to be created. Unlike the usual study of learning phenomena in natural conditions, the experiment makes it possible to purposefully change the conditions of the learning impact on the subjects through direct observation. "Chemistry" subject is very varied and aware, so many characteristics, education, and skills of the students being taught, the qualities of the teacher, the social ideals, and the rapidly changing environmental situation in the world need to be taken into consideration in the experiment.

Results

By the end of the last century, ecology and environmental expectations had become firmly entrenched in the lives and minds of all people and were only becoming more relevant by the day. The language is full of such phrases as environmental products, clean air, clean water, environmental disaster or ecological crisis, environmental impact and many other words. Terms such as "ecological education", "ecological thinking", "ecological knowledge", "environmental law", and "environmental competence" have found their way into the modern vocabulary. The ecology of the relationship between man and nature is the subject of entire disciplines of education and science, such as human ecology and social ecology. The emergence of new scientific disciplines such as industrial and agricultural ecology, medical ecology, agroecology, engineering ecology, chemical ecology, geoecology, regional ecology, and, finally, global ecology.

Today, every project and every new production is subject to environmental expertise. Ecology is fully connected to nature and is therefore combined with a wide range of other sciences. Modern researchers argue that the word science is not quite appropriate for ecology, but rather is meant for an understanding that encompasses all sciences and all fields of activity. Thus, ecology is not just a scientific system, but an entire worldview [6]. The main difference between ecology and the other sciences is that it integrates human interests, and improves living conditions as relationships become more complex, from determining the impact of human activities on the environment to investigating the motives and patterns of these activities and evaluation. Ecology differs from the natural sciences in that it becomes a normative natural science, that is, it is responsible for the validity of the results obtained in research and also for their application in practice. Classical science is neutral with respect to humans, and it also guarantees the optimality of society's transformative activities. The knowledge about nature and its laws, obtained in classical natural science, makes it possible to create powerful means of solving many environmental problems of the modern world.

Scientists of all disciplines can and should contribute to the development of pupils' environmental attitudes. The world around us is filled with a multitude of events, local and global environmental problems. On the one hand, this reflects the uniqueness of environmental phenomena and hence the complexity of approaches to solving environmental problems. On the other hand, it allows to use of the potential of all environmental sciences (social and natural) to solve environmental problems of different scales, types, and complexity, combining the efforts of specialists from different fields and knowledge. Today, people's attitude towards nature is changing dramatically and everyone understands that nature should not always be a source of unused raw materials and minerals. It is not a laboratory where experiments are allowed. In order to get rid of many outdated ideologies about the understanding of nature, a lot of work needs to be done to restore people's consciousness and improve it.

Upper secondary school students will be able to effectively develop their ecological knowledge as part of traditional subjects, including biology, chemistry, and geography. And while it is easier to discuss traditional biological ecology in biology lessons, there is great scope in chemistry lessons to explain knowledge of modern global ecology and human ecology. Chemistry lessons at school can reveal as much as possible about the negative aspects of human intervention in the environment and the potential for anthropogenic impact on the environment. Visual examples illustrating the chemical side of the interaction between society and nature can be found in various popular science textbooks examining environmental issues and attempts to improve the world's environmental situation [7]. However, the effective use of ecological knowledge in chemistry lessons requires the teacher to work diligently with the literature and adapt it to the school's contemporary curriculum. Work on the problem of ecological studies of chemistry in schools in the Republic of Kazakhstan is relevant and requires special attention since the ecological information system is traditionally formed not only in biology but also in the process of studying chemistry.

The essence of ecological education can be understood through the specification of its main objectives, namely the development of environmental awareness and thinking in

the population, the environmental culture of the individual and society, the responsible attitude of people to nature; training in the practical experience of environmental management and competent processes of environmental decision-making (each at its own level), promotion of a healthy lifestyle, sustainable social and economic development, environmental safety in the country and the world. Modern ecology is great interdisciplinary science. In addition to traditional ecology, which studies the relationship between organisms and environmental conditions at the level of individuals, populations, and ecosystems, it also includes applied ecology (industrial, urban, agricultural, forestry, etc.) and social ecology (nature and society relations). Due to such a wide range of environmental problems, there was no separate subject "Ecology" in schools, and teachers' experience was not expanded and integrated into the context of environmental education. Moreover, practically all subjects constitute a single platform for environmental education.

Chemistry lessons are best used to explore the problems of chemical pollution, methods of pollution control, and ways of reducing the harmful effects on living organisms, including humans. The chemistry teacher can professionally discuss new low-waste production technologies and processes with the treatment of liquid effluents and gas emissions, and waste management issues; consider the cycle of substances in the biosphere and its impact on anthropogenic effects (increasing the greenhouse effect, depletion of the ozone layer, transboundary transport of pollutants, acid rain), chemical substances, carbon and hydrogen problems [8]. Some of these subjects are also included in courses in other school subjects related to environmental education, including biology, geography, and physics. But these repetitions are also useful since they allow students to look at the same problem from different angles. It is worth considering the relationship of environmental problems caused by chemistry. The problems of general ecology are considered only when studying chemical processes and energy flows in the ecosystem, the natural cycle of substances in the biosphere, and social ecology when discussing the impact of chemical factors on human health.

The role of chemistry as a subject in ecological education lies in the fact that this science is related to the knowledge of the laws of nature, the chemical form of substance movement, and its significance for the material life of society. The future teacher of chemistry in the educational process has the following objectives [9]: to recognise the unity of the inorganic and organic worlds, the impact of human activity on the environment and education based on the belief in the need to respect nature; to reveal the dual role of the chemical industry in nature; to teach students practical skills and abilities that allow them to participate in environmental protection activities.

Industry, transport, agriculture and its structural elements affect nature in different ways:

1. Natural consumption of chemical products in nature.
2. Pollution of the environment by human waste.
3. The emergence in nature, and especially in the biosphere, of new highly active chemical compounds isolated from natural sources or synthesised by humans.

The first course is characterised by organic and inorganic chemistry course content, which looks at natural materials as raw materials for chemical and other industries based on chemical processes. The use of natural substances such as fertilisers and pesticides is discussed. To develop and teach knowledge about environmental pollution, concepts such as pollutants, sources of pollutants, natural and anthropogenic pollution, standards of hygiene, and maximum allowable concentrations of substances need to be introduced. It is necessary to take into consideration the sources of pollution in nature. It is important to show students that solving and developing pollution problems is about improving and developing new equipment and technology, increasing productivity and reducing industrial waste production, and creating a water recycling system that reduces water consumption.

Water pollution, development of waste management systems, and transition to closed technological cycles. The use of protected areas should also be characterised to illustrate the importance of plants in expressing the atmosphere. Knowledge of safety measures in industrial activities should be further developed, demonstrating to a large extent the basic ecological principles of modern production. In the study of environmental problems, chemical experiments play a special role as an important part of the education in the school of chemistry. Ways must be found to get rid of chemical experiments with school waste and to include the recycling phase as an integral and indispensable part of all school experiments. Recycling in this case means the destruction of substances, their subsequent disposal in the environment, or their recycling (direct or indirect reuse in the learning process). Only this approach will allow students to develop ecological thinking and to develop a certain "ecological cleansing" in each of their actions.

Regarding environmental issues, students can be asked questions on chemical and environmental issues. When formulating it, it is recommended to be guided by the following methodological requirements [10]:

- information related to the practice should be included in the terms of reference and the outcome of the decision;
- the information should be closely linked to the programme content and current environmental issues;
- assignments should be available to students in the classroom;
- problem-solving should be based on skills based on knowledge of multiple topics;
- tasks are used to check, explain, apply, and improve knowledge.

Chemical, environmental, and containment problems can be divided into several types: problems with chemical properties of natural objects; tasks on sources of pollution, types of environmental pollutants; measures for environmental protection and elimination of pollution consequences. The tasks performed should not be a single solution, they are designed to solve problems, discuss, and find a rational way of solving real educational and cognitive problems. Environmental education has characteristics such as the idea of renewing the inseparable connection between human physical and spiritual life and nature; solving environmental problems in today's global problem system; focusing on conservation goals.

To ensure the integrity of environmental education in chemistry education, a concentric structure of the content

of the environmental component is more appropriate. The ecological component course is developed systematically in the teaching of chemistry in secondary schools, and the same ecological problem can always pass-through different sections of chemistry due to the constant deepening and broadening of the discipline. Any new approach to a problem is based on updating previously acquired knowledge. Pupils may be interested in information about formulas that illustrate the relationship in a system of constructive properties using examples of toxicity of materials. In homogeneous sequences, the drug activity concentration and toxicity of substances increase with the number of carbon atoms in the molecule. The presence of many compounds increases the chemical activity of organic compounds, which not only increases the activity and toxicity of the drug but can also change the nature of the substance; for example, the composition causes a reaction in the form of irritation in humans [11]. Knowledge of all these laws will help students to definitively and conclusively analyse the structure of organic compounds and, if possible, predict their properties based on their effects on living organisms in nature.

Discussion

The ecological crisis in the country and the world draws attention to the problem of environmental education of the younger generation, this problem requires high-quality training of future chemistry teachers to work with children and young people. Such education should develop and promote the formation of ecological culture as a key factor in the change of sustainable development of civilisation [12]. If society still has its attitude to environmental management and value politics, then there is social apathy towards solving environmental problems. In general, a low level of culture leads to an irresponsible policy of exploitation of nature. It is possible to overcome this contradiction between the needs of the world and reality by forming an ecological culture of the population based on a new system of values based on the ideas of the unity of man and nature. The priority basis of knowledge in the process of training future chemistry teachers in higher education institutions of the Republic of Kazakhstan is the concept of ecological development sustainable development and integration of these issues.

Providing school education with qualified chemistry teachers in achieving sustainable development is the key to solving this problem. The problem of formation of ecological culture among students is the search for theoretical and methodological basis, and specific methods, which correspond to the state standard of general education, the concept of intellectual and moral development, individual education of citizens of the Republic of Kazakhstan, as well as international standards, connected with realisation of international innovative projects in the sphere of ecology. Environmental values define an optimal connection between people and nature in connection with the idea of sustainable development, management measures for the implementation of planned decision-making measures in relations between people and nature; they also serve as strategic goals, encouraging people to participate in joint efforts on nature creation; they are the connection between the environmental culture of society and individual, basis of social solidarity and cultural identification of individual and society, an essential part of environmental security, criterion of longevity and stability of society as a system [13-17].

In the conditions of formation of post-industrial society, characterised by uncertainty, crisis, and multidimensionality of existence of different cultures, ecological values lead the development of ecoculture on kindness, responsibility, protection of a safe environment for health, which is the basis of the concept of sustainable development. In the culturological approach, the solution to problems of ecological knowledge is interpreted as a qualitative state of general culture, and the current ecological crisis allows defining ecological culture as a kind of spiritual culture. In contrast to the ideology of struggle, conquest and exploitation of nature, the cultural approach leads people to an active dialogue with nature [18; 19]. From this point of view, an educational centre is a cultural object that creates it, capable of cultural development and survival. The implementation of the culturological approach aims to overcome the alienation of students from the subjects, personal values of the ecological culture to form, based on immersion of students in the study of real natural objects, cultural events, works of art, harmonious relationship between man and nature.

The method of applying the cultural and biological approach in environmental education is an eco-cultural identification, i.e., establishing spiritual unity with the whole ecosystem and national traditions of the country, activities to preserve and enrich the natural and cultural heritage. The essence of the personality-active approach is that the model includes the idea of a human being as a subject of the action. This approach is based on the principles of humanism, responsible behaviour, and the implementation of the ideology of sustainable development. This approach is expressed in the acquisition of special experiences by students during learning and teaching. Self-education, self-realisation in solving real educational and environmental situations through creative action on the ground.

The coevolutionary approach introduces into the model a system of values, including human participation in harmony with nature [20-22]: awareness of human participation as a special ecological phenomenon in the natural system; a partnership in the human-nature system, tolerance, search for compromises for sustainable development; human perception of management functions and criteria for achieving sustainable development of the territory; the advantage of ecology over the economy, expressed in the moral and ecological imperative; an internal value of man and nature as subjects of equal relations with each other. These concepts are the basis for the formation of a new worldview focused on harmony in the relationship between man and nature. Co-evolution is a long-term process of proportional and coordinated coexistence and joint development of man, society as a whole, and the environment [23]. It is about a radical change in values in the worldview of society. The core of the educational model of an ecological education is the ecological and cultural approach, as it unites all its elements and determines the vector of ecological culture development. The reasons, essence, and application of the

eco-cultural approach in education are revealed in several scientific publications of modern researchers [24].

It should be noted, however, that the source for the content of environmental education should be those areas of knowledge that explore interrelationships with human participation. The structure of education content should correspond to all ideas and structures of ecological culture building. The process of its creation should reflect the process of cultural assimilation of reality in a creative and constructive direction. Theoretical and methodological bases for the construction of the coevolutionary model of students' ecological knowledge formation are complex of principles, reflecting complex influence on all spheres of personality's consciousness. The cultural and creative principle is one of the main principles of modelling and implies the development of creative thinking in solving environmental problems under the requirements of cultural heritage and nature management. This principle changes the idea of basic values of ecological education as purely cognitive, eliminates narrow scientific orientation of its content in the development of curricula for students, expands cultural bases and values of education, and categories of its efficiency. The principle of semantic values also plays an important role in the formation of ecological knowledge of modern man, as ecological values perform these functions concerning people and the environment [25; 26]. The principle guarantees the connection of scientific knowledge with the spiritual and moral development of environmental education in the Republic of Kazakhstan; determines the new personal axiological perception of natural phenomena as inner value, a human being as a part of the whole nature; reaches ideals of eco-humanism and environmental ethics; promotes evaluation and reassessment of students' experience with the environment in the context of sustainable ecological development. The principle of eco-humanism embodies the general principles of nature and culture. The principle is based on the idea of the co-development of man and nature, on unity, and is designed to understand students' need to live with nature in harmony, to take responsibility for the preservation of the social and natural environment [27; 28].

The principle of affirmation and communication is linked to the acquisition of co-evolutionary values in society and the establishment of a subjective relationship with the environment. This contributes to the development of environmentally sound skills in students, based on human and social security. Focusing on genuinely important environmental issues means integrating them into the curriculum of other school subjects as a special form of interdisciplinary knowledge. This principle supports the development of subjective decision-making experiences in environmental situations. It creates a link between the study of sensory and logical, theoretical, and practical environmental problems of today. The principle of uniqueness of the territory expresses a local history approach to the formation of ecological culture: the territory of the country is a universal value for those who consider it their homeland [29; 30]. The study of natural, cultural, social, and economic features of the country. Representations of the territories and their connection in the previous and subsequent generations (through heredity and creativity) become an important prerequisite for the formation of the ecological culture of the personality, the ability to broaden the outlook of the subject through the knowledge of natural and cultural objects.

The principle of universal unity means shaping environmental knowledge within the ideas of globalism, developing such a specific feature of global thinking as self-awareness as part of humanity; perceiving the modern world as a whole in all its aspects; focusing on humanistic values to solve environmental problems; critical thinking, ability to learn from the past, reflection on own experience; the sense of justice, intolerance to war and violence [31-33].

The pedagogical level of the coevolutionary model of students' eco-cultural creativity is represented by the block of goals, content, procedures, and assessment components. Currently, there is a general misunderstanding of the content of organic culture in the scientific literature. Its components, according to different authors, do not always correspond to its properties. In this context, we have tried to compile a list of our key elements of human ecological knowledge to ensure the sustainable development of modern society [34]. It is worth noting that ecological knowledge includes the following components: cognitive and ecological competence, ecological thinking, awareness of the environment, progress from perception to understanding, awareness and use of resources; assessment of attitude towards environmental values, experience related to this process, emotional response; normative and moral, environmental component, environmental responsibility of citizens of Kazakhstan; creative activity, which is based on the experience of creative activity, design, environmentally friendly activity and thinking; behaviour similar to the rational and natural use of environmental resources, mental and physical health activities [35-37].

Hence, human ecological knowledge is a holistic system whose function is based on the harmonious interaction of all spheres of human life. In today's context, as noted earlier, harmonised policies and values are particularly important, which are part of each other and facilitate the transition from a deep perspective to a natural and scientific, and cultural one. A new holistic worldview is characterised by a creative emphasis on knowledge, and understanding of nature. There are three stages in the process of building environmental knowledge in students [38; 39]: an emotional attitude, an adapted culture, and an experience of environmental issues. This experience can take the form of different images, cultural symbols and identifications of a person to the social environment; cultural and semantic, when a person understands and appreciates environmental knowledge and values, which become the property of the individual; cultural and creative when students are involved in creative activities in varying degrees to solve real environmental problems.

At this stage, it is possible to acquire a variety of creative abilities: explicit, productive, innovative and so on. The assessment component contains selected analytical tools, learning criteria and methods for assessing the stage of development of ecological knowledge. Pre-Environmental Culture is an analytical tool as a strategic goal of environmental education in the school discipline system to maintain stability in the noosphere to determine levels (high, medium, low) and culture. To sum up, it is

worth mentioning that the main aim of environmental education in the process of teaching chemistry is the development of an international system of environmental conservation, with the right skill to dispose of the knowledge acquired during the course of chemistry. Specialised environmental education aims to prepare qualified specialists for the future who can actively influence the state of nature and the various forms of human activity to reconcile the interests of human society with the environment.

The most urgent need and the key to the success of the development of environmental education today is a complete sociological study and analysis of the situation with environmental education. That is the creation of a unified knowledge base, giving a complete picture of the state of environmental education in the Republic of Kazakhstan. In most cases, very little time and attention are given to environmental issues in schools. This shows that the implementation of school education is obliged to actively develop, and due to the emergence of several new programmes and environmental problems, competent specialists are required to be able to convey the necessary information to students [40].

Conclusions

This article presents a modern methodology of ecological knowledge development in the training of future chemistry teachers in higher education institutions of the Republic of Kazakhstan. The necessity to solve the problem of training future chemistry teachers in Kazakhstan is caused by the almost complete absence of professional methodology of ecological knowledge in higher education institutions while training specialists in natural sciences. Underdevelopment of this mechanism of training future chemistry teachers for secondary schools and the limited opportunities of a traditional system of training of chemistry teachers allowed to consider in detail the available form of training future teachers of chemistry within the educational programme of professional training of future teachers of chemistry and allowed developing a relevant methodological basis for the formation of ecological knowledge. The implementation of this methodology of ecological knowledge formation was justified by taking into consideration the social and economic, educational features of the Republic of Kazakhstan, based on which this study was carried out.

Modern teachers are obliged to be specialists of a broader profile, for whom there is no tipping point between impenetrable knowledge of the humanities and the sciences, in related disciplines and, conversely, completely unrelated. They are those who easily understand different professional languages, who can engage in interdisciplinary interaction, solve very complex problems and easily advance professionally in different areas of teaching practice. Such professionals should be trained in secondary and higher education, so new requirements for the training of teachers of the 21st century are emerging. Modern time is a time of reflective forms of knowledge when it is not enough to immerse oneself only in one subject of specialisation; he or she needs to know the features of the structure, areas of the progress of development, and methods of adjustment with other types of knowledge.

Concerning ecological knowledge in the preparation of future chemistry teachers, specially organised training of future specialists is necessary. For the qualitative and relevant introduction of modern ecological knowledge, special organisational techniques are needed to gradually identify and incorporate elements of ecological knowledge into chemistry teaching. Future chemistry teachers should be able to identify the main educational objects related to ecological issues, which should be given time to prepare the curriculum and to be able to plan appropriate educational activities and conduct an initial diagnosis of students' readiness to deal with these issues.

The study considered the principles and methods of development of ecological foundations in the preparation of future chemistry teachers to work in a general education school, which will allow the development of basic skills of a teacher necessary for work in modern conditions. The analysis of scientific information has shown that the introduction of ecological knowledge into the training programme for future teachers of natural sciences in the Republic of Kazakhstan is at the initial stage of development.

Acknowledgements

None.

Conflict of Interest

None.

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Методологічні засади формування екологічних знань у майбутніх учителів у процесі навчання хімії у ВНЗ

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Анотація

Актуальність. Актуальність даної статті полягає в тому, що сучасний світ стрімко змінюється, і все більшого значення набуває питання формування культури екологічних знань, що дозволяє людині усвідомити єдність з навколишнім світом, виховувати в людині раціональне ставлення до природи. У таких умовах кожен житель Республіки Казахстан повинен бути екологічно освіченим, щоб правильно розуміти всю складність взаємовідносин між людиною і природою. З цією метою вищі навчальні заклади зобов'язані готувати кваліфікованих майбутніх вчителів хімії з достатньою сформованістю екологічних знань, щоб вчитель міг донести до учнів загальноосвітніх шкіл необхідну інформацію для розуміння ними екологічної ситуації в світі.

Мета. Метою даної статті є теоретичне обґрунтування формування методологічних основ екологічних знань у майбутніх учителів хімії в процесі хімічної освіти в університетах Казахстану.

Методи дослідження. Методи дослідження - логічний аналіз, вивчення передового досвіду вчителів, формалізація, педагогічний експеримент.

Результати. У статті висвітлено питання аналізу методологічних засад, які зможуть задовольнити сучасні вимоги підготовки вчителів хімії в процесі викладання у вищих навчальних закладах Республіки Казахстан.

Висновки. Практична значущість дослідження "Методичні основи формування екологічних знань у майбутніх учителів у процесі навчання хімії у вищих навчальних закладах" полягає в тому, що проаналізована в статті інформація може бути застосована викладачами і фахівцями вищих навчальних закладів Республіки Казахстан при складанні навчальних посібників з природничо-наукових дисциплін та методичних рекомендацій для майбутніх учителів хімії.

Ключові слова: процес навчання; хімія; майбутній учитель; екологічні знання; методика.