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## Scientific and methodological features of the development of quantum-text tasks in chemical and environmental disciplines

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### Abstract

**Relevance.** The relevance of the study is conditioned by the improvement of the qualitative component of methodological foundations for the development of evaluation material in chemical and environmental disciplines.

**Purpose.** The purpose of the study is to develop methodological foundations of quantum-text tasks in chemical and environmental subjects.

**Methodology.** The leading approach to the investigation of this issue was a diagnostic survey of students on the subject of influencing factors on the assimilation and understanding of the material by solving text tasks that would allow them not only to check the degree of their knowledge but also to activate their mental activity, deepen cognitive processes.

**Results.** The study presents a model of methodological foundations for the development of functional quantum-text tasks in the framework of chemical disciplines with an ecological orientation, which includes the factors of the selection and compilation of text tasks in the sustained parameters of the presentation of the basics of concepts in a short and simple form, excluding philosophical and literary statements, and logic, which is expressed by one semantic component in the factor of the establishment of a unit of text tasks at the level of cognition in response to many questions.

**Conclusions.** The study results assist with forming a base of scientific information on the development of text tasks with a semantic structure within their quantum text section based on the details of the influence of the field of chemical

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disciplines on the overall ecological balance, which will be of practical importance for the field of education and the well-being of society.

**Keywords:** ecological orientation; ecological chemistry; analytical and evaluative activity; development of thinking; education.

## **Introduction**

In modern society, the education system shows the relevance of focusing on the basics of environmental education, which would allow the establishment of a stable internal aspiration of ecological thinking to activate everyday and professional processes that would contribute to the development of programmes to restore the ecological balance [1]. It is the factors of the educational environment that should take on the most important role in this, as a system that educates both the younger generation and highly qualified professionals on whom the state of life on earth as a whole depends, and at this stage one of the leading regions, which at the present stage of the development of the environmental education system introduces it into different environments of the educational environment is the Republic of Kazakhstan.

One of the important disciplines in this study is the field of chemistry [2]. Currently, it has acquired an important socially sustainable value on the way of greening all its industries, which in a detailed consideration should proceed from the level of training of various knowledge factors for their impact on various components of the biosphere, considering their environmental safety. Such an approach introduced into the system of higher professional education in Kazakhstan identifies a number of criteria that would form the basis for the education of an ecological worldview at the level of its understanding, as a norm from the position of self-manifestation of each individual, both in their domestic and professional life [3].

Nowadays, the educational system in Kazakhstan is built in such a way that it has become a distributor of important environmental knowledge, emphasising their relevance by introducing the study of subject areas in which chemical disciplines play a leading role in reflecting the impact on various components of ecology, both chemical technologies and in a detailed investigation of all its areas. Technologies of environmental education in combination with integrated learning affect all spheres of influence of chemistry on human life.

The teaching activity of chemical and environmental disciplines is built at a high level within the framework of the application of various innovative pedagogical models in its study and acquisition of various practical skills and abilities in this field. The progress of the greening of the chemical industry in Kazakhstan is manifested in the introduction of an ecological structure into all educational systems in the process of their globalisation everywhere in any factors related to the educational environment in the world, considering the fact that the parameters of ecology can only be considered in its total study at the level of globalisation as a whole, and the overall prosperous component of life will depend on this [4].

The environmental aspects of applying knowledge in chemistry courses are currently being examined within various pedagogical systems. These systems include integrated learning, problem-based learning, interactive methods, visual aids, project-based learning, analytical

approaches, communicative techniques, and the use of information and communication technologies. Emphasizing the significance of these diverse components in the study of environmental chemistry, these methods aim to foster a high level of student interest and engagement [5]. Thus, considering the existing methods of teaching chemical and environmental disciplines, the importance of applying an up-to-date quantisation system is highlighted by developing text tasks that would reflect all aspects of the current stage of the development of pedagogical science.

## **Materials and Methods**

A diagnostic survey method was used to identify important components that help students assimilate material. This method ensures clarity in the semantic characteristics of text utterances. It is based on various components that create interest in a more in-depth study of environmental and chemical disciplines, along with an understanding of the importance of this area. These prerequisites influence the establishment of an ecological worldview and various perspectives. They are relevant both in the study of chemistry and its ecologisation, as well as in the future professional activities of students. The survey focused on identifying elements that influence the activation of students' independent work, both during and outside of class time. It included pedagogical observation and expert evaluation of the results of the developed model of methodological foundations. This evaluation was based on a scientific framework within their quantum representation. The survey also examined the actual areas of use of chemical discipline details, particularly how these are presented in the form of tasks using quantum texts [6]. The survey of students included the task of understanding features that strengthen their psychological engagement with chemical disciplines. This was based on the parameters of incorporating environmental aspects within these disciplines. The survey examined the influence of various chemical components and the overall impact of ecology. It also considered individual details within the mechanism of quantizing components, assessing their level of environmental safety in different contexts. In addition, considering the quantisation of small details, which, in generalising the overall presentation of the testing material, will create an image of a whole science of chemical disciplines within the framework of their environmental friendliness in quantum consideration. This will have a functional component of understanding individual concepts and their impact on the environment within the framework of both the evaluating result when implementing testing of quantum text tasks, and equally activating the mental activity of students in a given area of the text part in its semantic form.

Thus, a detailed analysis of the survey results, along with pedagogical observation, clarifications, and further expert evaluation, helped establish ecological thinking and an understanding of the importance of incorporating

environmental aspects into professional chemical activities. This process determined the criteria necessary for creating a model of scientific and methodological foundations for quantum text tasks in environmental areas within chemical disciplines. A standard method of mathematical calculation and a graphical representation of the results were used when calculating the obtained research data.

The pedagogical research was conducted at the bases of the Abai Kazakh National Pedagogical University and Sh. Ualikhanov Kokshetau State University. As part of this study, diagnostic testing was conducted among 120 students of the 2nd-4th years of study, in the age category of 18 to 24 years.

The experimental study of the highlighted problem was carried out in three stages. At the first stage, analytical and theoretical investigation of the literature on the types of establishments of scientific and methodological foundations of quantum text tasks was carried out, during which the actual problem, purpose, research methods were determined and a work plan was drawn up. At the second stage, a diagnostic survey was conducted with pedagogical clarifications of the necessary parameters and factors for students studying at the experimental bases of selected universities, then an analysis of the results was made and conclusions were formulated. At the third stage, the obtained results and conclusions were clarified, and the results obtained were systematised.

## Results and Discussion

The data obtained in the course of the study were analysed based on an analytical and systematic approach, and on the personal prerequisites, which would reflect the depth of understanding of knowledge with a factor that increases interest in the study of subject information in the framework of environmental chemistry in its various forms. This is important in considering the establishment of an ecological worldview and approach to the application and studied factors in the framework of personal life at the level of environmental safety, which will be reflected in the scientific component in the approach to the selection of topics affected and implemented in the quantum approach of drafting text assignments in chemical and environmental disciplines.

Thus, in the general understanding, when performing test tasks, aspects will manifest themselves that, at the formative level within the framework of mental activity, will reflect motivational, targeted, productive, evaluative, active components of the influence of chemical knowledge as a result of their practical application. This is also reflected in the theory of memorisation and implementation at the practical level, considering the creation of targets and aspirations, which at the present stage are considered in the framework of the greening of education, which emphasises the importance of this process for the creation and restoration of the ecological component in the world for the prosperous development and continuation of life in general [7].

The scientific component in the methodological consideration dictates the allocation of the basics of knowledge within the framework of their importance on the part of environmental friendliness. Thus, it is necessary to determine the scope of questions in a given topic, which

will reflect an understanding of the whole essence of the environmental component in the study of the chemical discipline. The questions that need to be asked should show the areas of mental activity, which, when developed within the framework of quantisation of the knowledge allocated within the meaning of the information part, in its detailed consideration will show the essence of chemistry as a discipline with its impact on the environment, and thus a system with direct and reverse action will be created based on the development of testing material. According to the selected parameters, zones related to ecology will be determined and they should be considered in the conditions of their quantisation, as subjects for consideration in the form of text tasks based on the allocation of the smallest details and their parts, showing the importance of their influence in the factor on the restoration and maintenance of ecological balance [8].

The reverse side of this will manifest itself in the knowledge of students who, when reading quantum sections of texts, will get acquainted with problematic areas of environmental safety, which would also affect the development of their thinking and in the factor of deepening cognitive activity by applying the knowledge gained in their future professional activities. Together, when developing testing, the text quantisation mechanism will play an important role in determining the smallest details of chemical disciplines in its various existing disciplines [9; 10]. This will also strengthen the scientific side of the consideration of the problem, since aspects will be identified, which in turn need further study of all components in their influence in the factor of life based on environmental safety.

This area can also strengthen scientific research, which will receive many topics for study and further experimental work, which will allow students to choose topics for deeper investigation with an understanding of the importance of highlighting environmental components in areas that will be indirectly and directly reflected in the textual part of the testing control of quantum evaluation materials [11]. After all, it is known that when studying many components of the discipline, one can realise the general essence, but skip its details and elements on which everything rests, and considering the peculiarities of the chemical discipline, which, after considering it from the side of the impact on the environment, will be reflected in the form of the influence of each of its smallest elements in different industries, technologies, studies of all components. This, in fact, today leaves all the material surrounding, and so detailing with the help of a modern and up-to-date mechanism that was developed within the framework of studies by V. S. Avanesov, will solve many existing problems facing modern society in the factor of detection of various chemical parameters that need correction of their application within the framework of the developed environmental safety systems [12].

Thus, the evaluation material of quantum text assignments in chemical and environmental disciplines will form the ways of the future chemical science, educating future specialists studying chemical disciplines and gaining professional knowledge in this field. Thus, students will already realise the importance of studying all the details and all the texts that are available in monographs, manuals, scientific publications, based on

their deep quantisation of the elements of impact based on the environmental component and human activity with factors influencing all components of their prosperous life [13-15].

The educational element of the study of quantum text tasks in the form of students' answers will consist in selective fragmentation reflecting the influence of the smallest elements of chemical science of all existing knowledge in this field. It will also affect the development of psychological properties, qualities and characteristics of students' personalities, given that under the influence of the received fragments of quantisation of knowledge in environmental chemistry, they will form an ecological attitude to the parameter of preserving their well-being to society.

In the described context, their self-determination of personal significance will also be determined based on the use of chemical knowledge in the future and their impact on the life of society as a whole, based on their value concepts of social relations and their essence in students' understanding of intellectual, behavioural and emotional properties, on which the final semantic result with motivational action will depend on the received quantum piece of information, which plays a large role in the spectrum of understanding the importance of preserving environmental safety through the use of chemistry in any of its branches and forms [16; 17]. This will be reflected in the understandable actual text of the task with a sample of quantisation of these areas of existing knowledge in chemical science, disciplines, industry in the form of production, which is also studied as part of the acquisition of a chemical speciality and for the development of practical skills and abilities.

The above will be indirectly determined by the indicators of the establishment of a value-based and oriented motivational order of a person undergoing an ecology-oriented quantum text test by performing these tasks, as a future specialist with functional effectiveness from their personal activities, which will be strengthened with personal independent work in the area of studying the influence of composite chemical objects on ecology. Further, this factor will also reveal an emphasis on strengthening environmental self-activity within the framework of education at a higher educational institution [18]. After all, in generalisation, professional activity in the chemical industry is a very multidimensional and multilevel system and it is more influenced by both personal qualities and acquired motivation, which are enhanced by the personal properties of the future specialist and, in fact, it is their deepening and strengthening of these qualities that are directed to activation and any independent work, both of a student and any other person. And in this consideration, it is the quantisation system that will play a decisive role in highlighting the constituent elements in the again highlighted format of their impact on the environment.

Thus, it is in the study and evaluation activity, which will also allow determining the criteria of correctional work to strengthen and form ecological thinking, it will be possible to consider chemical disciplines within the framework of the application of an innovative quantisation system, which implies the smallest detail without factors of reflection and philosophical conclusions that lead

students towards a different thought process. Thus, within this framework, it will be difficult to grasp the components of the semantic process in terms of their impact on the environment, and within the framework of environmental safety of the practical application of all factors [19; 20]. And it is only the quantum text processing system that would determine aspects related to ecology at a deep and qualitative level within the framework of a multi-level system of applying chemical knowledge in all existing aspects at the theoretical and practical level, which as a result would create an important system of ecological chemistry with its effects on the restoration of ecological balance.

Thus, at the practical and theoretical level, which carries an important task in terms of determining the cognitive system and educational character within the framework of the influence of the educational process on the establishment of the ecological orientation of the individual [21]. Also important in this consideration are the methodological prerequisites for visualisation and perception of the textual part of quantum tasks, which allow the survey to identify the constituent elements of the presentation of quantum texts and to determine important criteria for the perception of the evaluation material by students when systematising the results [22; 23].

Thus, all of the above allows identifying methodological and scientific patterns and constituent elements necessary for the development of a model based on the identified important criteria for the students themselves, to maintain their personal high interest, which will, among other things, activate their independent work in the direction of greening chemical knowledge, and scientific and methodological parameters for the establishment of quantum text tasks for chemical and environmental disciplines.

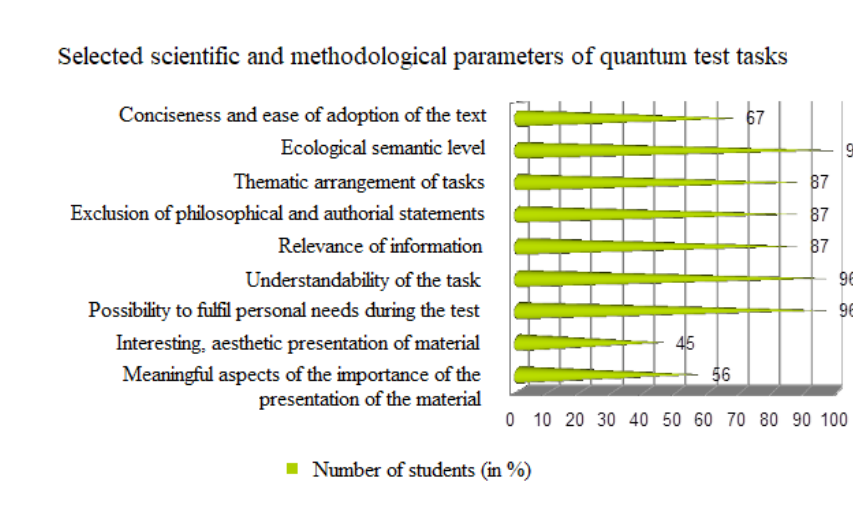
The result of the functioning of the study under consideration is understood as a formed model for the development of quantum text tasks in chemical and environmental disciplines that will allow not only to assess the level of knowledge of students, but also to create conditions for the establishment of ecological culture. Thus, this model was introduced into the educational process in several stages, which included the identification of important components at the personal level of students for a better perception of the testing semantic order and positions that would determine the scientific component of the quantisation of chemical knowledge as a result of the development of the testing quantum material, and pedagogical observation, refinement, and final statistical processing of the results obtained. In the subsequent stage, the development and implementation of a model of scientific and methodological foundations for the development of quantum text tasks in environmental chemistry and chemical ecology took place.

In total, the survey covered 120 students of a higher institution studying chemical and environmental disciplines. The analysis of the results of the diagnostic survey allowed for the conclusion about the indicators and criteria that will be reflected in the factor of interest, the susceptibility of evaluative and cognitive testing material. Thus, it was revealed that certain criteria, based on psycho-emotional interest indicators such as high attentiveness to text tasks, are crucial. These criteria include personal

aspirations (56%) to understand the importance of environmentalisation, which should be reflected in small quantum sections of the text. An interesting form of material presentation was noted by 45% of respondents. A significant 96% emphasized the importance of the visual aspect. Knowledge competency and its relevance were highlighted by 87%. An understandable form of task presentation, without distractions, was important for 76%, as it simplifies the placement of test tasks depending on the topic (87%) or chosen aspect, allowing students to focus deeply on one direction. Additionally, semantic order

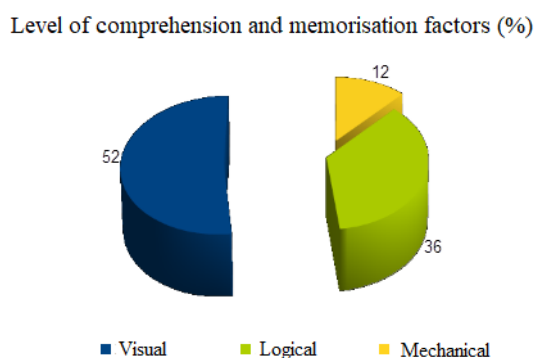
factors that reflect environmental ideological criteria, helping to form environmental values, were important to 98% of respondents. Finally, brevity and ease of text perception were valued by 67%.

Thus, the main concepts of criteria expressed by students for passing quantum-text tasks within the discipline with an environmental orientation were highlighted based on an understanding of its essence and importance, which is reflected in Figure 1.



In addition, the parameters based on the susceptibility of knowledge and effective methods of memorising various factors were clarified for students based on the criteria: visual memory, which was identified by 52% of

students; logical memorisation – 36% of respondents; mechanical memorisation in 12% of respondents, as shown in Figure 2.



**Figure 2.** Distribution of students according to the selected factors that affect the understanding and memorisation of educational material

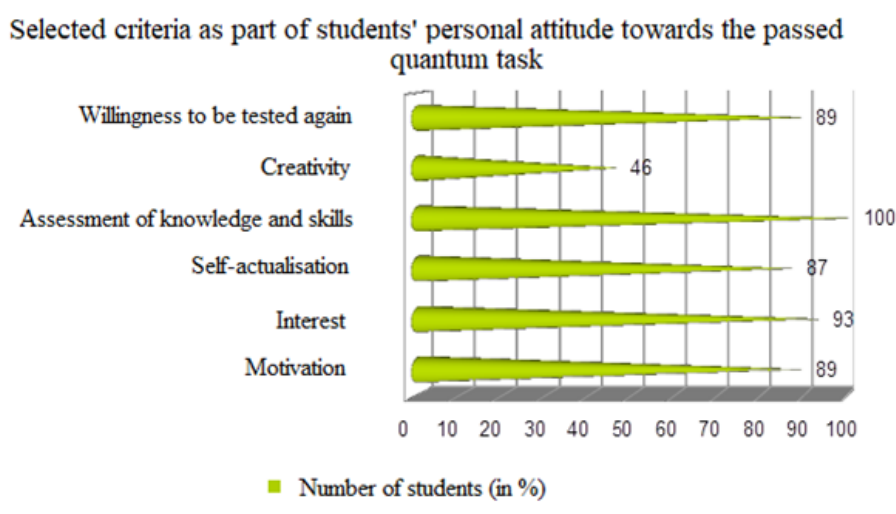
Based on the data obtained, the implementation of the research conditions for the development of scientific and methodological foundations in the factor of creating quantum text tasks for environmental and chemical

disciplines was carried out, which required detailed methodological work on the data obtained during the study. A step-by-step and structured analysis of the results allowed for the identification of the main components of this process. The key findings were determined with a focus on establishing an ecological worldview among students, which is fundamental to developing their ecological culture. This is an important task in the greening of chemical subjects. Understanding the importance of preserving the natural environment through chemical and environmental safety factors [26-28].

Considering all the details of the research and the above, a model of scientific and methodological foundations has been developed that will allow the establishment of quantum text tasks in the field of environmental chemistry, which includes the establishment of a text task that will be a quantum highlighted detail, based on the current issues in the field of environmental chemistry. It will reflect the semantic or practical part of it in the form formed by the targeted execution of a task or question, in the parameter of the presentation of the foundations of special knowledge of a quantum-isolated element without the presence of philosophical and literary statements, in its logical presentation with the arrangement of questions in the order of thematically highlighted foundations, which will be reflected in the greening of tasks in their quantisation level based on the inherent for the restoration of ecology within the framework of indirect answers to questions in the semantic background: "How are ecology and chemistry related?", "How do chemical technologies affect ecology?", "What is the dependence of ecological balance and practical application of chemical knowledge?", "What chemical components of knowledge can help in restoring ecology?", "How to apply chemical knowledge in the framework of environmental safety?". This includes other issues related to the integral interaction of ecology and chemistry, which will form a scientific basis for the semantic parameters of the tasks.

Quantisation of the text based on the selected information criteria will also allow students to create an understanding of the environmental friendliness of the application of the field of chemistry in its various components, which will also contribute to the establishment of their ecological culture [29; 30]. Such a level of knowledge assessment will be relevant for teaching certain thought processes, which, due to quantisation of the necessary elements, in fact, will be in phraseological expression reflecting the essence of the problem of ecologisation of the chemical discipline, and from a cognitive standpoint, this will allow at an indirect level to form value orientations for careful attitude to nature and ecology among students. Thus, the parameters were determined and a model of methodological and scientific characteristics of evaluating control based on quantum text tasks was developed, which will be the key for students to use chemical knowledge in their scientific, research, professional, and other activities within the framework of its environmental impact on the natural ecological balance in the criteria for its restoration and preservation.

Further, at the control stage of the study, the data were revealed considering the results obtained during a repeated survey of students after testing the developed model of the scientific and methodological foundations for composing quantum text tasks in practice, and the analysis of the results showed the success and effectiveness of the developed model. This was emphasized because the answers to the quantum tasks aroused students' interest and made them consider the impact of detailed chemical knowledge on ecology. Students appreciated the time criterion, which allowed them to work at a calm pace. They also noted that the competent structure of the presentation, with a clear sequence and thematic segmentation of tasks, helped them understand the material more effectively. The described and other value concepts in the criteria of evaluative and cognitive factors are reflected in Figure 3.



**Figure 3.** Distribution of students based on the selected criteria as a result of a survey within the framework of their personal attitude to the completed solution of quantum tasks

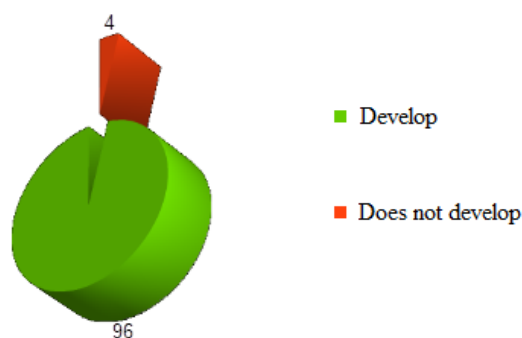
In addition, the survey of students revealed that they note a high degree of benefit for themselves through the development of cognitive function, which determines the

purposefulness of the thought process when reading quantum texts of the task on the direction of competent provision of information that reflects environmental

relevance, and in the factor of pedagogical clarification of personal predisposition in the described format of

evaluation activities, so all students noted their positive responses in this, as shown in Figure 4.

#### Development of ecological thinking by giving answers to quantum tasks



**Figure 4.** The distribution of students depending on their opinion on the level of influence of giving answers to quantum text tasks in the framework of the establishment of their ecological thinking

The analysis of the results obtained allows the study to form criteria of a cognitive nature, which, in fact, affect the main provisions in the criteria presented by educational activities at the level of organisation, evaluation and analytical work and in the direction of the factor of the thought process of creating the fundamental foundations of an ecological worldview. After all, it is known that any task and question make an individual think exactly in a certain target path, expressed directly or indirectly in the question, and due to the ecological component formed within the framework of quantum text tasks, this allows forming an ecological line of thinking in chemical disciplines [31-34].

This involves the success of the application of the developed model of methodological foundations for the creation of quantum-text tasks, which allows methodologically directing the pedagogical approach within the framework of its evaluation of the ecologisation of mental activity. Such an approach, in turn, brings environmental education, allowing students to understand the importance of building their work based on professional knowledge of the discipline, which greatly affects the result in many areas of production and life support based on maintaining the restoration of ecological balance contributing to the prosperity of life.

In this study, correctness was ensured through careful attention to the characteristics and data parameters of the diagnostic survey, clarifications, and the developed model

of scientific and methodological foundations for quantum task development. These parameters were appropriately compared in the study. The analysis of the results determined that the developed model successfully improves the educational process. It is expected to contribute significantly to the establishment of an ecological culture among specialists.

Any evaluation activity can have several directions, and one of them will be the correction of the purposefulness of mental activity in the factor of selecting special material for study, because based on this criterion, each student, reading the same text, will select for himself certain parameters that reflect their understanding of various processes. And further, based on the factor of the importance of the establishment of ecological thinking in the framework of the study of chemical disciplines in the framework of the application of special knowledge, it becomes important to identify the elements of knowledge that will be reflected in the target setting from the position of internal establishment of value orientations in the framework of the greening of knowledge. This will also create conditions for the establishment of ecological culture through the passage of evaluation material [35; 36].

The use of quantum text tasks currently tends to spread fragments of target positions that will reflect internal aspirations to obtain the result sought by those who are the author of texts or are engaged in their quantisation. But in the field of consideration of the greening of the chemical discipline, this is of great importance and provides significant information support by forming targets for the influence of chemistry on ecology and in the factor of their smallest detail from the position of restoring and preserving the ecological balance, which together will form an ecological focus in the mental activity of students [37-40].

Thus, the developed model of the scientific and methodological foundations for the development of quantum text tasks in the field of ecology and chemistry has shown itself to be effective and can be used in practice

to form ecological thinking among students and contribute to strengthening the greening of the chemistry course.

## Conclusions

The current stage of improving the learning process also affects the modernisation of the assessment background of students of higher educational institutions, which should also reflect the high level of the relevant side of knowledge against the background of the manifestation of contributing components that allow the establishment of value prerequisites in the system of greening the educational environment and the characteristics of the chemical field. In this criterion, the mechanism of text quantisation is an important element that will shape the mental activity of students by solving quantum text tasks in the parameter of their environmental orientation.

The developed model of scientific and methodological foundations for the development and methodological establishment of this assessment material in the framework of the study of environmental chemistry reflects the necessary and relevant concepts related to the purposefulness of the knowledge of special chemical knowledge in the framework of their impact on the environment with the actants of the importance of environmental safety in this. This is determined in the

developed criteria, where the task consists of a quantum, highlighted detail through its expression, based on the considered ecological position of the study of knowledge, which will be determined within the framework of the answers to the questions posed, based on their environmental friendliness within the smallest detail in the semantic and practical implementation of these highlighted quantisation elements, and philosophical and literary statements will be absent in the tasks. They will be presented with a logical structure of presentation of several data within the same thematic area, which will make sense to the intellectual activity in the scientific version of the proposed based on giving answers to relevant questions in this area.

The materials of this study will be relevant and useful for workers in the field of education, chemical industries, methodologists, and can be applied in practice, which will contribute to the greening of the educational environment in the field of chemistry.

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## Conflict of Interest

No conflicts of interest are present to disclose.

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## **Науково-методичні особливості розробки квантово-текстових завдань з хіміко-екологічних дисциплін**

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## **Анотація**

**Актуальність.** Актуальність дослідження зумовлена удосконаленням якісної складової методичних засад розробки оцінного матеріалу з хіміко-екологічних дисциплін.

**Мета.** Мета дослідження – розробка методичних основ квантово-текстових завдань з хімічних та екологічних предметів.

**Методологія.** Провідним підходом до дослідження даної проблеми стало діагностичне опитування студентів на тему факторів впливу на засвоєння та розуміння матеріалу шляхом розв'язування текстових завдань, що дозволило б їм не тільки перевірити ступінь своїх знань, а й активізувати їх розумову діяльність, поглибити пізнавальні процеси.

**Результати.** У дослідженні представлено модель методичних засад розробки функціональних квантово-текстових завдань у рамках хімічних дисциплін екологічного спрямування, яка включає чинники відбору та складання текстових завдань у витриманих параметрах подання основ понять у короткій і простій формі, виключаючи філософські та літературні висловлювання, і логіку, яка виражається одним змістовим компонентом у факторі встановлення одиниці текстових завдань на рівні пізнання у відповіді на багато питань.

**Висновки.** Результати дослідження сприяють формуванню бази наукової інформації щодо розробки текстових завдань із семантичною структурою в межах їх квантового текстового розділу на основі деталей впливу галузі хімічних дисциплін на загальний екологічний баланс, що матиме практичне значення для сфери освіти та добробуту суспільства.

**Ключові слова:** екологічна спрямованість; екологічна хімія; аналітико-оцінювальна діяльність; розвиток мислення; освіта.