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Designing content integrated course «Natural Science» based on the concept approach for the SVE system

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INTRODUCTION

Relevance. The transformation of the socio-cultural situation in Russia and the world focuses on the restructuring of educational systems at all levels of continuing education. The key trend of this restructuring is the focus on achieving a new quality of future graduates by developing their general competencies based on understanding the principles of harmonizing the relationship between the components of the system: «Man – Nature – Society».

Natural science education at the level of secondary vocational education (hereinafter referred to as SVE) is part of the mandatory general education training of qualified specialists, which ensures the level of secondary general education. The integrated course «Natural Science» (hereinafter – IC NS) was introduced for specialties of socio-economic and humanitarian profiles, focused on solving the problems of forming a modern scientific worldview and profiling general education training. It is aimed at creating conditions for people to understand their place in nature and society as an integral part of them, it is aimed at self-determination of the individual in the world around them, the development of the ability to adapt to the rapidly changing conditions of development of the world and the country, which justifies its relevance. The indicated planned educational results in the context of the competence approach can be presented as emotional-value competencies (A.V. Khutorskoy).

The development of IC NS by students in the SVE system in accordance with the profile of the professional activity being mastered can significantly affect the process of developing the emotional-value competencies (hereinafter referred to as VSC) of future specialists, due to its huge content, ideological and methodological potential. Methodological foundations of natural sciences were considered by V. A. Aseev, B. M. Kedrov, V. N. Kuznetsov, N. N. Moiseev, A.D. Sukhanov, G. P. Shchedrovitsky and others. The importance of the course «Natural Science» for the development of various aspects of personality is revealed in the works of I. Yu. Aleksashina, L. V. Dubitskaya, A.V. Lyaptsev, N. I. Odintsovo, N. I. Oreschenko, A. Yu. Pentin, E. B. Petrova, N. S.

Purysheva, Z. A. Skripko, A. A. Ulyanova, N. A. Kolesnikov, and others.V. Sharonova, M. A. Shatalova, O. A. Yavoruk, and others.

An analysis of the theory and practice of educational activities in the SVE system indicates that the process of mastering IC NS is not sufficiently effective when using educational and methodological complexes developed for general education schools. This is due to the specific nature of the target settings at the SVE level, the number of academic hours allocated for the development of general education disciplines, as well as the expediency of their adaptation in accordance with the content of future professional activities (N. I. Odintsovo, Z. A. Skripko, E. I. Tupikin).

Note that IC NS at the SVE level has significant differences from integrated science-oriented courses at different levels of continuing science education. At the level of general education, the course is aimed at general education training of students, which provides for the formation of subject-specific personal and meta-subject educational results that underlie the integral ENCM of the student (I. Yu.Aleksashina, A.V. Lyaptsev, N. I. Odintsovo, N. S. Purysheva, etc.). At the SVE stage, natural science training involves, along with general education training, the formation of general competencies, orients students to the awareness of the need to apply the acquired fundamental knowledge not only in everyday life, but also in future professional activities (N. N. Dvulichanskaya, Z. A. Skripko, S.E. Starostina, E. I. Tupikin, etc.). Natural science courses, implemented at the higher education level, are focused on the formation of the future specialist's competencies, but at a higher level of knowledge, provide for understanding the main concepts of modern natural science through the prism of philosophy, history and other humanities (L. V. Dubitskaya, A. N. Mansurov, N. I. Odintsovo, M. Yu. Korolev, etc.) The course «Natural Science» at the SVE level ensures continuity between general and higher education and actualizes the problem of designing the content of an integrated natural science course for the SVE system.

In studies devoted to the problem of integration in natural science education (I. Yu. Aleksashina, M. N. Berulava, B. V. Bulyubash, A.V. Lyaptsev, V. V. Sviridov, M. S. Pak, etc.) it is noted that in comparison with traditional linear (single-subject) courses (biology, chemistry, physics), integrated courses have specificity in the selection and structuring of content associated with the definition of a system-forming element - an integrator. In this research paper, a concept approach is defined as the system-forming basis for constructing the IC NS content for the SVE stage. Within its framework, students master natural science knowledge as personal meanings, and the SVE course concept system contributes to the integration of natural science and humanities content in the context of future professional activities. Understanding of the ideas that form the basis for the development of this approach is presented in the works of I. Yu. Aleksashina, N. V. Bordovskaya, N. L. Mishatina, V. D. Sukhorukova, L. V. Trubitsyna,I.A. Sherstobitova, A.V. Khutorsky, and others.

The study of the topics of dissertation research in recent years indicates that the issues related to the development of the content of integrated courses of natural science orientation and, in particular, IC NS, adapted for the SVE stage, remain unexplored, which causes the complexity of the problem field of developing programs of integrated courses of natural science orientation, selecting their content, organizing training, assessment of results at the operational level.

The analysis of scientific and methodological research in the field of pedagogy and psychology, regulatory documents, and the study of current pedagogical practice revealed **contradictions** that manifest themselves in inconsistencies:

- between the objectives of the discipline «Natural Science» at the SVE level and the content of existing educational and methodological complexes;

- between the features of integrated courses and the lack of development of the methodology for designing their content for the SVE system;

- between the didactic potential of the concept approach and the lack of practice of its implementation in the development of integrated courses and, in particular, the course «Natural Science».

The urgency of resolving contradictions determines the relevance of the study, and also determines its **problem:** the need to develop and justify a methodology that allows us to design the content of IC NS intended for the SVE stage on the basis of a concept approach SVE.

The relevance, theoretical and practical significance of the problem allowed us to determine **the topic** of the dissertation research: «**Designing the content of the integrated course «Natural Science» based on the concept approach for the SVE system»**.

Objective: to substantiate the concept approach for designing the content of the integrated course «Natural Science» for the SVE system.

Object: integrated course «Natural Science» at the SVE level.

Subject: methodology for designing the content of the integrated course «Natural Science», focused on the development of emotional-value competencies of students of the SVE system based on a concept approach.

The hypothesis of our research is formulated under the assumption that the integrated course «Natural Science» will contribute to the formation of emotional-value competencies of students of the SVE system:

- the system organizer and didactic unit of the course content is the concept, and the course structure is a hierarchical system of concepts of different levels;
- emotional-value guidelines of the course reveal the interrelationships in the system «Man-Nature-Society», reflecting the specifics of the content of the integrated course of natural science orientation;
- selection and construction of educational material is carried out in accordance with the system of concepts of the integrated course «Natural Science», reflecting the levels of integration of the content of natural science knowledge, and their role in the formation of emotional-value competencies of future specialists;
- methodological support provides students with a step-by-step development of the content of course concepts and corresponds to their hierarchical system.

Tasks:

1. To study the literature sources to identify the features of IC NS in the aspect of VSC development of SVE students and substantiate the pedagogical potential of the concept approach in the development of its content.
2. Define a hierarchical system of IC NS concepts and use it to structure the course content for the SVE system.
3. Perform modeling and description of the IC NS content design methodology

based on the concept approach.

4. Clarify the criteria for assessing the level of assimilation of VSC content and development VSC студентов of SVE students in the process of mastering IC NS.

5. In the course of the pedagogical experiment, develop, test and put into practice the methodological support of IC NS, aimed at step-by-step awareness, comprehension, and development of the system of course concepts by students.

6. Evaluate the effectiveness of the developed methodology based on the analysis of the conducted experimental work.

The methodological and theoretical foundations of the study were:

- works by B. S. Gershunsky, M. S. Kagan, V. V. Kraevsky, Yu. N. Kulyutkin, A. N. Leontiev, I. Ya. Lerner, M. Rokich, M. N. Skatkin, V. I. Slobodchikov, V. A. Yadova et al., devoted to the axiological approach in relation to the content of education;
- research that reveals various aspects of the formation of personal competencies (I. A. Zimnyaya, E. F. Golova). Zeer, Yu. G. Tatur, A. P. Tryapitsyna, N. V. Shestak, A.V. Khutorskoy, etc.);
- concept provisions developed within the framework of the cultural approach (M. N. Skatkin, I. Ya. Lerner, V. V. Kraevsky, K. V. Romanov, L. M. Vanyushkina et al.);
- research on the integrative approach in the content of natural science education and the specifics of the development of integrated courses of natural science orientation (I. Yu. Aleksashina, M. N. Berulava, B. V. Bulyubash, A. E. Gurevich, L. V. Dubitskaya, V. R. Ilchenko, D. A. Isaev, M. Yu. Korolev, A.V. Lyaptsev, O. V. Malyarchuk, N. I. Odintsovo, N. I. Oreshchenko, M. S. Pak, A. Yu. Pentin, E. B. Petrova, L. S. Pontak, N. S. Purysheva, V. V. Sviridov, Z. A. Skripko, A.V. Teremov, A. A. Ulyanova, M. A. Shatalov, O. A. Yavoruk, etc.);
- theoretical substantiations revealing the concept phenomenon (S. A. Askol'dov, N. N. Boldyreva, L. M. Vekker, F. Guattari, J. Deleuze, V. G. Zusman, V. I. Karasik, V. V. Kolesov, E. S. Kubryakova, D. S. Likhachev, S. Kh. Lyapin, N. L. Mishatina, S. S. Neretina, G. G. Slyshkin, Yu. S. Stepanov, V. P. Telia, M. A. Kholodnaya, I. A. Sherstobitova, etc.);

- concept ideas and research that reveal the pedagogical potential of the concept approach (I. Yu . Aleksashina, N. V. Bordovskaya, N. L. Mishatina, V. D Sukhorukov, L. V. Trubitsyn, I. A. Sherstobitova, A.V. Khutorskoy, V. F. Shatalov, E. P. Erdniev, and others).

In accordance with the system of tasks set in the dissertation research aimed at achieving the goal, the following **research methods were selected:**

- theoretical: the methods of analysis of philosophical, psychological, pedagogical and methodological literary sources were applied during the review of the results of research by various authors on the problems of: designing the content of integrated courses, and, in particular, IC NS, as well as the features of developing training courses for the SVE system, the use of a concept approach in natural science education in general, and how the method of searching for system-forming factors for integrated courses; the content analysis method was used during the assessment of the provisions of regulatory documents; methodological analysis is used in the framework of evaluating the results and systematization of documents reflecting the results of pedagogical experience (educational texts, work programs, products of educational activities of students); methodological interpretation and systematization of research results.

- empirical: including a group of private scientific pedagogical methods (pedagogical observations, pedagogical experiment), as well as a group of private scientific methods of sociological research (questionnaires, surveys);

- statistical methods, such as: correspondence analysis, sampling method, graphical method, are used in the assessment of the reliability of the results of the dissertation research, in particular, the analysis of experimental data and their graphical representation.

Research stages:

The first stage (2015-2017). Work was carried out to study domestic and foreign sources on the research topic. The methodological foundations of IC NS development for the SVE system are revealed. The content and development criteria of VSC SVE students in relation to IC NS were clarified. Based on the results of the analysis, the goals and objectives of the study were determined, and the research hypothesis was formulated.

Ascertaining and search experiments were conducted. A plan for conducting a formative experiment has been developed.

Second stage (2017-2018): The educational program of the discipline «Natural Science» was developed and tested on the basis of a concept approach. Educational and methodical products are developed in the logic of the concept approach. A formative pedagogical experiment was conducted. The methodology of designing the content of lessons and competence-oriented tasks based on a concept approach is clarified.

Third stage (2018-2023): The program of the training module for teachers on mastering and applying the developed methodology was developed. The IC NS program has been tested and implemented in practical teaching activities IC NS based on a concept approach in the SVE system. The methodological support of the course «Natural Science» is supplemented, which is aimed at gradual awareness, comprehension, and development of the system of course concepts by students. The interpretation, discussion and analysis of the data obtained in the course of an empirical study are presented, and conclusions are formulated based on the results of the study.

The scientific novelty of the study is that:

1. As a means of developing VSC students of the SVE system, the content of IC NS is considered, integrating the natural science knowledge of students in the «Man - Nature – Society» system in the context of their professional activities.

2. The possibilities SVE of using the concept as an integrator of the content and didactic unit of integrated courses of natural science orientation (using the example of IC NS for the SVE system) and applying the concept approach in the design of such courses are substantiated;

3. The criteria for assessing the levels of assimilation of the content and development of VSC students of the SVE system during the development of IC NS have been clarified;

4. A methodology for constructing the IC NS content for SVE was developed based on a concept approach.

The theoretical significance of the study is that:

1. The content and structure of the concept of «concept» in the pedagogical perspective and taking into account the specific features of IC NS are clarified;

2. A hierarchical system of ICNS concepts is defined, reflecting the levels of integration of the content of natural science knowledge, and their role in the formation of VSC students of the SVE system;

3. A model of a methodological system is created that provides for a step-by-step, variable algorithm of work when constructing the IC NS content based on the concept approach for the SVE system.

The practical significance of the research results is confirmed by the fact that:

1. The IC NS work program for the specialties of the socio-economic profile of the SVE system was developed on the basis of a concept approach and tested.

2. Tested and implemented in educational practice models of lessons aimed at gradual development of the hierarchy of IC NS concepts, methodological recommendations for designing the content of lessons of different types and COT of different levels based on concepts;

3. The developed program of the training module for teachers to master the methodology of designing the IC NS content based on a concept approach and adapted for the SVE system is implemented in the content of advanced training courses for teachers studying in the postgraduate education system.

The reliability and validity of the results of the dissertation research are determined by the following grounds: the research plan is completed in full; the developed criteria base of the research takes into account the best practices given in the scientific and pedagogical literature and is consistent with theoretical data; the selection of research methods was carried out in accordance with the purpose and objectives of the research; the established correspondence between objective trends in the development of theory and practice and the results obtained; the theoretical results of the study were tested experimentally using modern methods of qualitative and quantitative processing of experimental indicators.

The experimental base of the study included educational organizations, first of all, St. Petersburg State Educational Institution «Admiral D. N. Senyavin Marine Technical College» (since 19.08.2022 St. Petersburg State Educational Institution «Admiral D. N. Senyavin Marine Technical Academy») (hereinafter - St. Petersburg MTC), as well as St. Petersburg State Educational Institution of Higher Professional Education Ushinsky Academy of Postgraduate Pedagogical Education (hereinafter-St. Petersburg APPE). 308 college students from St. Petersburg took part in the ascertaining experiment; in the search engine - 120 students of educational institutions of the SVE system; in the formative - 86 students of the SVE system.

Testing and implementation of the research results included participation in scientific forums, conferences, and seminars: the First Moscow Pedagogical Forum (Moscow, 2021); the First Regional Congress of Teachers of the subject area «Natural Science» (Samara, 2020); the third All-Russian Scientific and Practical Conference «Neoclassical didactics in the context of the implementation of FSES of public organizations» (St. Petersburg, Russia). 2019); I All-Russian Scientific and Practical Conference « Development of science in the modern world «(Samara, 2018); II – IV All-Russian Scientific and Practical Conferences with international participation «Actual problems of natural science education» (St. Petersburg, 2018, 2020, 2023); All-Russian Scientific and Practical Conference with International participation Training of teachers of physics and natural sciences in the context of modernization of pedagogical education (Kolomna, 2017); symposium of young scientists «The problem of man in pedagogical research» (St. Petersburg, 2017); IV – IX city scientific and practical conferences of postgraduates, applicants, doctoral students, scientific supervisors, young scientists specializing in the field Educational challenges of our time: trends in the development of pedagogical research» (St. Petersburg, 2016 – 2023), etc.; at city methodological seminars held by St. Petersburg APPE (2017 – 2023); during the author's direct work as a teacher and through experimental work in educational organizations.

The structure and scope of the dissertation are determined by the logic of the research. The dissertation (212 pages long) consists of an introduction, two chapters, a conclusion, a list of references (150 titles) and 12 appendices. The main text of the dissertation is 143 pagess.

Personal involvement of the author consists in choosing the topic of the work, determining its purpose, setting and solving problems, choosing the object and subject of research, as well as in searching, collecting, and processing the necessary information that formed the research base.

Main scientific results:

1.Based on the analysis of literary sources, the pedagogical potential of the concept approach for the development of the content of integrated courses of natural science orientation is identified and reasoned. The system-forming, methodological, educational, developmental, and educational functions of IC NS concepts are shown, revealing the didactic potential of the content and features of the educational activity process based on a concept approach. The described results are presented in the first chapter of the study and published in the work. The described results are presented in the first chapter of the study and published in [63].

2. The features of the course «Natural Science» for the SVE system are shown. The relationship between the formation of VSC students of the SVE system and VSG content of the course «Natural Science» is established. The content of VSCs is specified, which ensure the coordination of requirements for the planned educational results of FSES SGE, FSES SVE for the development of IC NS in the SVE system, taking into account the specifics of future professional activity. The described results are presented in the first chapter of the study and published in [57, 64].

3. A model of the methodology for constructing IC NS content for SVE, focused on the development of VSC students on the basis of a concept approach, which is based on a hierarchical system of concepts, is developed and the methodology for its implementation is described. Based on the specification of the multidimensional structure of the concept in the pedagogical aspect, as well as the analysis of VSC components as planned educational results, the structural basis of IC NS design is determined and justified-the hierarchy of concepts: metaconcepts – megaconcepts – concepts of the semantic block-private concepts. It is shown that in the process of designing the IC NS content based on the concept approach, the concept acts as a didactic unit, determining the specifics of selecting content for an integrated course and the specifics of developing

the IC NS teaching methodology at the SVE level. The described results are presented in the first (section 1.3) and second (section 2.2) chapters of the study and published in [7, 9 – 11, 65]. The degree of personal involvement of the author in obtaining/achieving this result: literature analysis, development of a hierarchical system of concepts of the course «Natural Science», development of a model of the methodology, description of the methodology.

4.The structure and content of the integrated course «Natural Science» for the SVE system based on a hierarchical system of concepts are proposed and justified. The selection and structuring of the educational material of the course «Natural Science» was carried out on the basis of the selected hierarchy of concepts of the training course. The typology of lessons focused on step-by-step development of the IC NS hierarchy of concepts, methodological guidelines for designing the content of lessons of different types and COT of different levels based on concepts are shown. The described results are presented in the second chapter of the study and published in the following papers [8, 58, 60 – 62, 67]. The degree of personal involvement of the author in obtaining/achieving this result: selection of educational material, determination of the principles of designing the content of lessons aimed at mastering concepts of different levels; development of COT of different levels in accordance with the content of the course, their testing, methodological interpretation.

5. A toolkit is proposed and tested to identify the dynamics of the formation of VSC components of students of the SVE system when studying IC NS, developed on the basis of a concept approach: levels, criteria and indicators of VSC components of students characterizing the level of mastering the course content. The described results are presented in the second chapter of the study and published in the following papers [6, 59, 66]. The degree of personal involvement of the author in obtaining/achieving this result: development of the evaluation criteria base, development of the content of control and measuring materials, statistical analysis of the data obtained, interpretation of the results.

6. In the course of experimental work, it was found that students ' mastering the system of concepts of the integrated course «Natural Science» as a system of personal

meanings has a positive impact on the development of VSC students of the SVE system. The described results are presented in the second chapter of the study.

The main provisions submitted for protection:

1. The method of constructing the content of the general education discipline «Natural Science» for the SVE system, based on a concept approach, involves the allocation of a concept as a didactic unit of course content. The concept provides for the integration of natural science and humanities knowledge in the context of professional activity and is the basis for the development of emotional-value competencies of future specialists in professions and specialties of socio-economic and humanitarian profiles of professional education.

2. Highlighting VSC as the basis for the future specialist's activity, focuses on identifying the values and meanings of natural science knowledge in the «Man – Nature – Society» system (integrative approach), fixed in the format of leading course ideas, which at all stages of design set the vector of pedagogical goal setting and serve as criteria for designing the IC NS content for the SVE stage. This strategy ensures that the requirements for the planned educational outcomes of FSES SGE, FSES SVE for the development of IC NS in the SVE system are coordinated.

3. In accordance with the concept approach, the course structure is a hierarchical system of concepts: metaconcepts – megaconcepts – concepts of the semantic block – private concepts. The hierarchy of concepts of the course «Natural Science» reflects the logic of deployment of educational material within the course and the level of integration of its content. It also predicts the specifics of the planned learning outcomes: monopubject results at the level of private concepts; monopubject and integration results – concepts of a semantic block; integration results-megaconcepts.

4. The methodological support of IC NS is developed on the basis of a hierarchy of concepts and provides for the development of a system of course concepts by students, contributing to the development of VSC components. Mastering the concept of a certain level determines the specifics of designing the content of lessons (including the selection of educational material, educational technologies, methods and techniques): a lesson

based on intersubject connections is developed on the basis of a private concept, an integrated lesson – the concept of a semantic block, a metasubject lesson – a megaconcept. The teaching material of the lessons serves as a basis for developing the content of the corresponding COT: subject, intersubject, and metasubject.

CHAPTER 1. THEORETICAL AND METHODOLOGICAL GROUNDS FOR APPLYING THE CONCEPTUAL APPROACH TO DESIGNING THE CONTENT OF THE INTEGRATED COURSE «NATURAL SCIENCE» IN THE SYSTEM OF SECONDARY VOCATIONAL EDUCATION

1.1. Theoretical aspects of the development of emotional-value competencies of students of the secondary vocational education system when studying the integrated course «Natural Science»

The leading approach to the organization of the educational process at the level of professional education is the competence approach [25, 118,126, etc.]. The peculiarity of the content of education at the SVE level is associated with the need to integrate two standards: FSES SGE and FSES SVE. General education training at the SVE level is integrated into the main professional educational program (hereinafter referred to as OPOP). This leads to the search for strategies and mechanisms for integrating the two standards and approaches. In this regard, we will analyze the key characteristics of the competence approach.

The analysis of scientific and pedagogical studies of the practice of educational activities of SVE institutions shows that the problem of educational and methodological support for training specialists based on the competence approach remains relevant [25, 118, etc.]. The competence model of a specialist provides for a shift in emphasis from the abstract design of the content of education and quality control systems to the system of competence formation [70, 100, 148, 149, etc.].

The main goal of applying the competence approach in the education system is related to the need to train high-quality specialists in the system of developing professional education [4, 6, 79, 93, etc.]. From the standpoint of the competence approach, modernization of the content of professional education is accompanied by changes in subject programs, which implies individualization of educational routes. When mastering the same content, different students can achieve different levels of material assimilation, each of which is of practical importance for mastering the future profession.

The concept framework of the competence approach includes the terms «competence» and « competence». The analysis of domestic and foreign publications related to approaches to the definition and use of the concepts of competence / competence allows us to identify their fundamental characteristics:

- Integrative quality of the individual;
- They manifest themselves in real activities.
- They are activity-oriented and practice-oriented.
- They include experience and personal responsibility.
- Include emotional-value aspects.
- They are not stored in a «ready-made form», they are situational in nature.

To separate the particular and the general in our study, we will distinguish synonymously the concepts of «competence» and «competence». Here are the definitions offered in the Dictionary of Russian Professional Education [94]. Its compilers interpret competence (from English: competence) as the ability (in the understanding of ability as a complex integrative skill) to apply existing knowledge, methods of activity and accumulated practical experience in the course of work, which determines the success of the latter. From the point of view of the above-mentioned position, the presence of a system of competencies in one or several areas of activity can be considered as competence (English: competence, competence).

At the same time, the authors rightly note that different sources may contain different approaches to classifying these concepts and different definitions.

Let us consider the concept of competence as more general in the hierarchy. On the one hand, it is considered as a characteristic of personality (S. G. Vershlovsky and Yu. N. Kulyutkin). On the other hand, as the implementation of functions (V. Y. Krichevsky). For example, V. A. Slastenin notes the unity of theoretical and practical readiness to carry out professional activities and characterizes competence as professionalism [105]. From the point of view of the axiological approach, competence is considered as an educational value (K. A. Albukhanova-Slavskaya [3], B. S. Gershunsky [35], A. N. Gershunsky [3 5]). Yarygin [1-8] and others). Some authors universalize this category and believe (E.F.

Zeer, D.P. Zavodchikov) that competence ensures social and professional mobility of the individual, the ability to express oneself and self-creation, willingness and ability to update one's knowledge, determines openness to change and creative search [46]. Researchers V. A. Bolotov and V. V. Serikov define competence as the basis for self-realization, finding a person's place in the world. And its components are considered to be knowledge, skills and education [25, p. 13].

We share the position of supporters of the personal activity approach (A.V. Khutorskoy, I. A. Kolesnikova, G. S. Sukhobskaya), who consider competence in the inseparable unity of personality and professional activity. L.I. Panarin defines it as the personal quality of the subject, characterized by a set of skills, as well as the ability and willingness to use these skills in practice [93].

The concept of «competence» cannot be reduced to the concepts of «knowledge», «skills», «skills». Its content is expanded, first of all, by the orientation of the personality: motivation, value orientations, etc. Competence also involves such components as the ability to overcome stereotypes, to show flexibility of thinking [103].

Thus, the analysis of the literature allows us to conclude that competence is understood as a personality quality that integrates knowledge and experience acquired in the processes of learning and socialization. Competence can be fixed in the form of the ability and readiness of the subject for independent practical activity.

We share the position of A.V. Khutorsky, who understands competence as a personal quality associated with the formation of an individual's corresponding competence. At the same time, an important factor in the formation of competence is the personal attitude to it and the subject of activity. The development of competencies continues continuously, expanding and integrating with other competencies, it manifests itself in a new quality [130].

Let's analyze the interpretation of the concept of «competence».

I. A. Zimnyaya, analyzing foreign approaches to the consideration of this issue, suggests that competence is understood as internal, hidden psychological neoplasms (ideas, value system, knowledge, methods and algorithms of actions), which find expression in various human activities, competence to carry out this or that activity [4-7,

p. 23].

Within the framework of our research, we use the definition proposed by N. V. Shestak, in which competence is considered as a set of personal qualities based on a structured system of knowledge, skills, and skills necessary to carry out professional or other socially significant activities, as well as readiness to carry out this activity, guided by formed values and taking into account personalthe useful and (or) socially useful meaning of this activity. Taking into account the specific characteristics of competence, it is possible to note its complex nature – competence can be represented both as a system of reference points in training (learning goals, learning accents, planned learning outcomes, etc.), and also as a specific learning result to be measured [137, p. 40-42].

So, A. B. Khutorskoy suggests understanding competence as a social requirement (the norm for performing any activity), which is formed under the influence of objective reality and is used as a measure of the level of educational training of a student in determining his ability to carry out activities in a certain area [130, p. 78].

Within the framework of this study, in the context of considering the educational process in the SVE system, competence was decided to be defined as «an integrative skill formed through synthesis into a single system of knowledge, skills, practical experience and its conscious interpretation by the individual, as well as the emotional-value orientations of the student, expressed in the process of his attitude to cognizable objects the surrounding world, models of which are included in the composition of educational fields and academic subjects, as well as in the process of carrying out productive activities by students, in terms of the social significance of this activity and personal emotional-value attitude to it» [130].

Competence as a result of education involves the acquisition of certain competencies. The subject-activity component of general education, included in the composition of general education areas and academic subjects, is reflected in educational competencies.

It should be noted that the implementation of the competence approach allows us to implement continuity at all levels of professional education: the competencies formed at the SVE level are the basis and basis for further development of competencies at the higher education level. This is reflected in the wording of the planned educational outcomes of federal state educational standards.

The Federal State Educational Standard of Secondary Vocational Education (hereinafter referred to as FSES SVE) links the quality of specialist training to students ' mastery of general and professional competencies that reflect the expected results of mastering the educational program. These competencies are formed by studying all academic disciplines and professional modules included in the program.

General education training at the SVE level is integrated into the OPOP. At the same time, general education training in the SVE system should provide for the implementation of the principle of continuity in the assessment of learning outcomes, which determines the definition of general competencies as the expected results of **general education** training in the SVE system [39].

General competence should be considered as the ability to effectively apply common methods and algorithms of activity based on a formed system of value and semantic orientations, knowledge, skills, and activity experience to solve various tasks [106].

A comparative study of FSES SVE for various professions and specialties allowed us to identify a list of competencies common to various specialties. Their formulations are shown in Figure 1.1.

Note that the variable set of general competencies in terms of number is not clearly regulated and is absent in some specialties. The formation of general competencies in the process of professional training of specialists of various profiles is assumed in different ways, determined by the orientation of professional activity and the willingness of students to independently carry out professional activities.

Thus, general competencies can be considered as a set of personality characteristics that have a universal character and imply the readiness of a specialist to successfully solve practical (including professional) tasks.

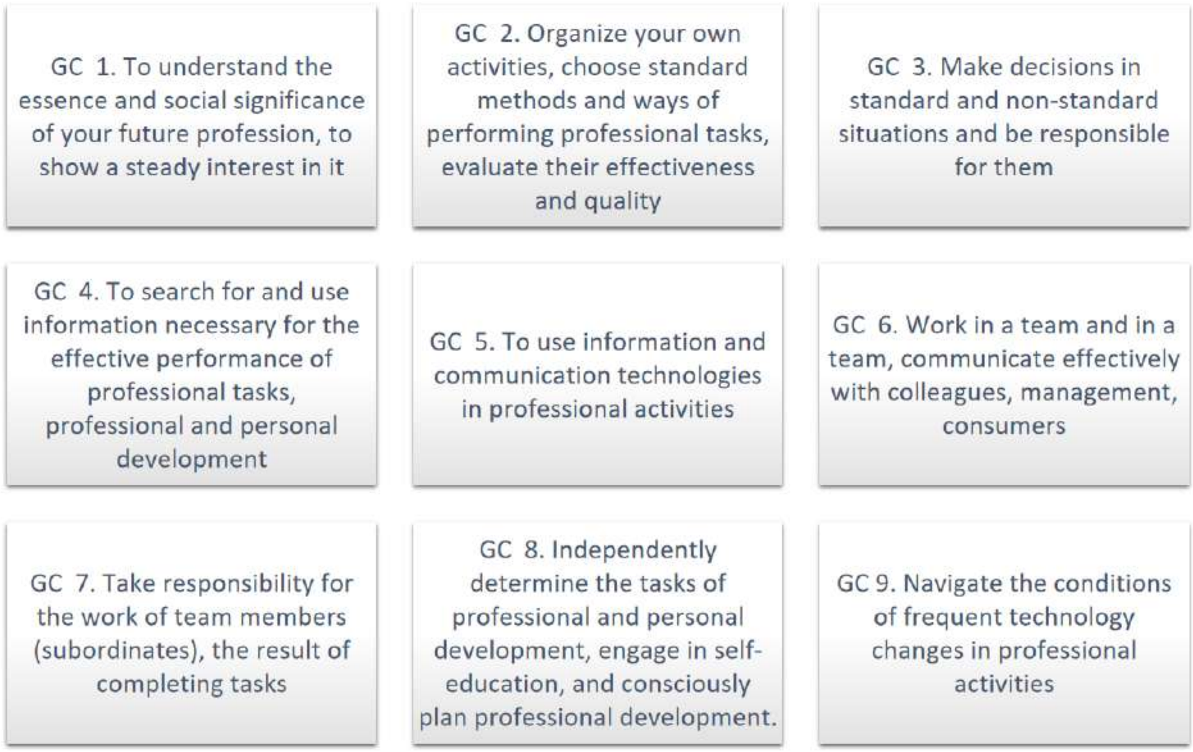


Figure 1.1 - General competencies of FSES SVE

In the context of the subject of our research, the hierarchy of general (key) competencies proposed by A.V. Khutorsky is of interest [130] (See the drawing 1.2):

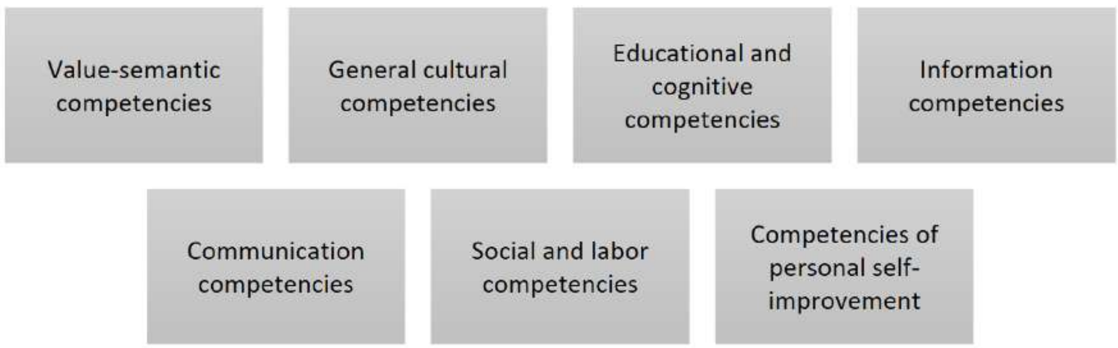


Figure 1.2 - General (key) competencies for A. V. Khutorsky

This system of competencies is structured based on the main goals of general education and ideas about social and individual experience. The classification of competencies is carried out on the basis of the possibility of their assignment (application) to a particular type of activity of students.

Analyzing the place of the competence approach, I. A. Zimnaya comes to the conclusion that the competence approach expands the traditional approach by including subjectivity of the student as a mandatory element. That is, the planned educational results in the competence paradigm are associated not only with the content proposed from the outside, but also with the individual characteristics of the student [4-7].

We agree with the opinion of I. A. Zimnaya that the competence approach from the position of domestic pedagogical science does not cancel the traditional knowledge approach (considering the result of education as a system of knowledge, skills and abilities) and does not contradict it, but expands it taking into account the personal component, namely, taking into account the value attitude of the student to the acquired knowledge and methods of activity the semantic value of this knowledge for a particular person, which determines the greater humanistic orientation of the competence approach [47, p. 36].

Based on this, it is legitimate to conclude that the competence approach is consistent with the cultural approach [2, 7, 50, etc.], since from the latter's point of view, the structure of the educational content includes an emotional and value component. This paradigm (M. N. Skatkin, I. Ya. Lerner, V. V. Kraevsky) justifies the idea of the content of education as a transmitted social experience, which is pedagogically adapted to the student's characteristics, and suggests a mechanism for developing the content and forms of educational activities, which is aimed at mastering the experience of various types of activities and relationships for students [120].

In a comparative analysis of the composition of the content of education in cultural and competence concepts, M. V. Dubova records that the latter includes similar components, namely: knowledge, ways of carrying out activities, value attitude to the activity performed, practical experience, determined collectively by a specific competence [42, p. 60]. However, these components of the competence approach have a different focus. If the cultural approach, notes E. O. Ivanova, considers the components of social experience as the individual's assimilation of the cultural code (based on the elements of social experience acquired in the course of activity), then the second approach is «the acquisition of activity experience», which is personally significant, and also subjectively transformed by each individual due to the presence of a unique subjective position « [4, 8, p. 74].

Let us agree with V. A. Slastenin's position that a person's self-determination in the system of cultures and its formation as a subject of culture occurs only on the basis of value relations [105]. V. A. Slastenin considers values as landmarks of socially significant and socially useful activities that are formed as personal formations in the structure of individual consciousness [94, p. 105].

In this regard, attention is drawn to the formula proposed by Yu . G. Taturov, according to which competence is the sum of knowledge (cognitive component) and skills (functional component) multiplied by the ratio (value-ethical component.) In this model, Yu . G. Tatur emphasizes the leading role of the value-ethical component, the change in the development of which is significantly more important than the other two [118, p.61].

Thus, the axiological component of the cultural approach allows us to determine the value aspect of the competence development process.

A.V. Kiryakova considers value orientations as the subjective attitude of an individual to generally accepted social values, as well as the motivation to be guided by these values when making decisions and carrying out any activity [56, p. 126].

M. S. Kagan characterizes the value attitude of a person to the world through the assimilation of collective value consciousness (which has some universality, although it may differ for different societies, based on the peculiarities of their historical development and culture) in the course of acquiring social experience [5, 3, p.194].

Yu. N. Kulyutkin notes in his works that a person's attitude to the world includes, along with the rational-logical or «knowledge» component, a emotional-value component [73]. Any object (phenomenon, event), in addition to its objective existence, independent of a person, also has a certain subjective significance for a person, related to the vital or social needs, interests and life goals of the individual. The subject's perception of an object occurs through the prism of his already existing ideas about its value. At the same time, the value attitude implies understanding the object being evaluated, i.e. it is associated with identifying and understanding that particular meaning. The value relation is the result of understanding the object through the prism of significance «for me» as a subject. Within the framework of natural science education, natural objects, processes or phenomena, as well as emotional-value content, acquire meaning for students only when they enter the cultural space. Assimilation of social experience forms an individual's system of value orientations and attitudes. They are found in various aspects of the personality: its chosen goals, motives, beliefs, interests, assessments, and other aspects of the personality. The conscious attitude of the subject to objects as values for which his activity is developed can be recorded as the personal meaning of this activity.

In the context of our research, the idea of VA is important. Yadov, according to which value orientation forms a complex, multi-level system that includes cognitive, emotional, and behavioral components [141].

Attention is drawn to the fact that psychological studies emphasize the importance of the age of 15-18 years for the formation of ideological attitudes, attitudes to the surrounding reality, and ultimately for the formation of emotional-value orientations of the individual. [73, 125, etc.]. The leading type of activity for this age is educational activity.

Note that at the SVE level, the development and imitation of professional activity takes place. At the same time, the attitude towards it as a component of integral self-determination is formed on the basis of a person's personal meanings, his attitudes and values. This allows us to conclude about the transformation and adjustment of the student's value orientations in the process of acquiring new knowledge, social experience, understanding the relationship between value orientations and the success of socially significant, including future professional activities[64, 66].

Consideration of future professional activity in general education training, as well as its significance in developing interest in the profession/specialty being obtained, and professional qualities of the future specialist are recorded in the «Methodological Recommendations for the implementation of secondary general education within the framework of mastering the educational program of secondary professional education based on basic general education», approved by the Ministry of Education of the Russian Federation on April 14, 2021 as specific when students master general education disciplines.

The professional orientation of the discipline assumes, on the one hand, the orientation of students on the continuity of acquired knowledge and skills during professional training. On the other hand, it allows the student to demonstrate ways to put into practice the knowledge of the studied fundamentals of sciences, the impact on the development of technology and technology, on the effectiveness of a specialist's production activities.

The above leads to the conclusion that it is advisable to single out as core for general educational disciplines and, in particular, for IC NS, from among the general competencies of FSES SVE a group of **emotional-value competencies (VSC)**, which manifest themselves in different spheres and are universal for various types of activities.

VSCs ensure the success of the emotional-value orientation of a specialist in the world. Their development contributes to the formation of the readiness and focus of the student on learning and improving himself, including in the aspect of the chosen professional activity, the readiness of the future specialist for productive activities. VSC presuppose the student's focus on continuous self-education, contribute to the definition of values necessary for life in a complex dynamic world [130].

An important condition for achieving effectiveness in the formation of competencies, considered as a single and integral educational result, is integration. It provides a synthesis of knowledge, skills, personality traits, value orientations that determine behavior, both in relation to oneself and in relation to the outside world. Integration helps students to form a holistic picture of an interconnected world characterized by the interdependence of all its components [45].

The above analysis allows us to conclude that the formation of the VSC of a future specialist in the process of general education training of SVE students is associated with the implementation of competence and cultural approaches, where integration is the fundamental principle.

Let us turn to the consideration of the phenomenon of integration in the pedagogical aspect. In the research of I. Yu. Aleksashina, B. G. Ananyev, V. S. Bezrukova, E. O. Galitskikh, A. Ya. Danilyuk, I. D. Zverev, A.V. Lyaptsev, V. N.

Maksimova, T. V. Mukhlaeva, M. S. Various types, characteristics, levels and indicators of integration are distinguished [12, 20, 37, 79, 86, 134, etc.] The works of M. N. Berulava, V. V. Kondratiev, A. A. Kirsanov, A.A. Kupriyanov, Z. A. Skripko, O. A. are devoted to the development of the problem of integration in vocational education. Yavoruk et al. [22, 104, 140, etc.].

In a broad sense, integration is understood as the process of connecting disconnected elements or systems into a single system, which forms their integrity as a new qualitative common property. From a pedagogical perspective, these can be new qualities of objects of study, new ways and algorithms of students' activities, new connections between the studied objects and phenomena of the surrounding reality, new functions of the pedagogical system and, as a result, competencies formed on the basis of their study and development.

S. Y. Temina considers this phenomenon from the standpoint of the process and result of combining complex objects. The relationships between them are determined by the relationship of autonomy/dependence. The researcher considers the solution of the problems posed based on the optimal use of resources as the source of integration [119, p. 16].

I. Yu. Aleksashina considers the process and result of integration through separate, sequential stages of formation, development and formation of a single quality of the system based on many qualities of its elements, i.e. the formation of integrity. This understanding is based on a philosophical view of the process of evolution of nature (according to G. V. F. Hegel): «mechanism» - a simple combination of qualities of different elements, «chemism» - connections between qualities, «organism» - unity [12, p.29]. The first involves the interaction of relatively independent elements. The second stage of integrity formation is qualitative changes in components. The level of organic integrity predicts the appearance of such a system, when the components can no longer exist outside of it.

In pedagogical reality, integrative processes are considered in relation to the properties and characteristics of the individual. Another context is the content of education, which manifests itself both in the concept foundations and at the level of educational material. As applied to the learning process, integration actualizes the creation of innovative forms and methods of mastering educational information that provide new mechanisms of cognition [16]. An analysis of the literature on the integration of educational content shows that there is no unified approach to determining the key characteristics of integration.

It is important to clarify the levels of integration of educational content in the context of the study. Some authors understand integrative content as any content that includes elements of knowledge from several areas. Another approach considers integrative content as an independent integrity. In particular, M. N. Berulava distinguishes three levels of content integration: the level of intersubject connections, the level of didactic synthesis, and the level of didactic integrity [22].

The historiographical analysis of integration shows that in the 60 – 70s in Russian pedagogy, interdisciplinary connections are considered the main means of reflecting inter-scientific integration in the content of education. As a way to implement them, issues of interdisciplinary content, interdisciplinary texts, complex tasks, etc. were used. Interdisciplinary connections acted as a means of overcoming subject autonomy. The result of such interaction, based on the system of concepts of each academic subject, in relation to integration reflects the first level of the formation of integrity.

The reorientation to the humanistic paradigm in education, which took place in the 1980s and 1990s, changes the functions of integration. It appears as a mechanism of the process of humanitarization of science and education.

The integrative approach is currently considered as a means of forming professional competence in general and individual competencies in particular [110, 134, 139, etc.].

The analysis of modern pedagogical literature on the problem of integration in education, devoted to the experience of developing integrated training courses, allows us to fix the following:

1. Integration is a principle and condition for the development of modern educational systems. At the same time, it can be considered as a means of holistic development of the student.

2. Pedagogical integration is a form of expressing in theoretical and practical activities the unity of goals, principles, content, organization of educational activities within the framework of the process of training and upbringing in the system of training future specialists;

3. Integration of the content of education is the process of interaction of structural elements of various sciences, the universal basis of their integrity is the material unity of the world.

4. Integration of learning content is a means of forming professional competence in general and emotional-value competencies in particular.

The formation of competencies, including VSC, is carried out to a large extent in the process of mastering the content of education. Mastering the disciplines of the natural science cycle has a significant impact on the development of VSC students due to the huge content, cognitive, ideological and methodological potential of their foundations. They serve as the basis for the formation of scientific thinking, worldview, and cognitive abilities, which determine the development of VSC for future specialists.

Aleksashina's research shows that the basis for the formation of a worldview that corresponds to the current level of development of society and science is the complementarity and partial synthesis of two paradigms: the humanistic paradigm in assessing the relationship between man and the world and the holistic approach in studying the world [1-2, p.25]. As the researcher notes in his works, understanding the integrity of human existence, its relationship with nature and society is achievable only on the basis of integrating ideas, knowledge from different levels and areas of human interaction with one's own «I», society, and nature. At the same time, such integration should be carried out on the basis of universal values and humanistic ideals [12, p.38].

Taking into account this position, VSC is an integral part of a holistic worldview, since they determine the ability to understand the surrounding reality, comparing its phenomena and processes, as well as ideas about them with universal values, the ability to understand the meaning of knowledge for an individual, society, nature, taking into account the possible level of development of methods of activity and technologies based on them. In addition, VSCs determine the ability to successfully socialize due to the fact that performing socially useful activities is the basis of socialization [124, p.156]. The competence of this group also directly affects the formation of significant ideals of activity and behavior in the individual, understanding the meaning of the activity performed and its value, understanding the world around them, and collective social values [128].

Let's analyze the integrated course «Natural Science» from the positions indicated above. It was included (at the time of the study) in the basic cycle of general education elective subjects for the humanities and socio-economic profiles. The course content reflects the interrelation of natural sciences and integrative processes in the sciences themselves, is aimed at forming a holistic modern natural science picture of the world among students as a component of a common culture, and also reveals the significance and applied nature of natural science knowledge for all spheres of modern life. In the course «Natural Science», students 'perception of the importance of natural science knowledge for each person as the basis of orientation in the system «Man-Nature-Society», regardless of his professional activity, implies the formation of an idea of nature as a single integral system, the relationship between man, nature and society, creates conditions for understanding the place of the profession in the system «Man-Nature-Society» and the need to organize professional activities taking into account the principles of sustainable development.

In the context of the subject of our research, we consider it important to note that the design of linear (monopredject) and integrated courses is fundamentally different. The first ones reflect the methodological foundations of a particular science (astronomy, biology, physics, chemistry, etc.). The starting point for developing an integrated course is to determine the system-forming basis for integration [12, p. 32].

The research of A. Yu. is of interest. Pentin, which contains an analysis of existing approaches to selecting the content of the integrated course «Natural Science». The author identifies two principles: the fundamental (or hierarchical) approach (courses include traditional material from physics, chemistry, and biology) and the methodological approach (the study of methods of scientific cognition); as well as the approach of universal concepts (a number of concepts that are close in meaning are used as a system for building a complete natural science picture of the world for students); natural philosophy approach (emphasis is placed on the interpretation of natural laws, on the philosophical aspects of natural science knowledge); pragmatic approach (the course contains a minimum amount of knowledge and skills relevant to solving everyday problems; the course content includes applied issues of energy, environmental safety, biotechnology, medicine, as well as some fundamental research selected on the principle of mention in literature and mass media); integrative approach (integration of natural science knowledge of different academic subjects through the prism of interaction in the system «Man-Nature-Society») [96].

Original evolutionary-synergetic approach to the development and structuring of the content of the integrated course «Natural Science» by N. S. Purysheva and I. V. Razumovskaya. Within the framework of this approach, natural systems are considered as complex open systems, the elements of which are interconnected and determine the evolution of the system as a whole. The course content in this approach is a consistent analysis of the development over time of the system of nature from the Big Bang to modern man and forecasts of its further evolution [99].

An interesting typology of interdisciplinary teaching of natural sciences at the level of structuring content, proposed by Swiss researchers L. Huber and P. Labudde [145, 146]:

1. Intradisciplinary (Overlapping subject): drawing information from another academic subject when considering objects and phenomena. For example, a biology teacher, when considering the details of the circulatory system, not only reveals the biological content, but also the physical (in the context of hydromechanics), medical explanation, etc.

2. Multi - or multidisciplinary: one topic is simultaneously studied in several academic subjects. An example of such a multidisciplinary topic can be the concepts of

«Time» and «Energy». Simultaneously, students develop various aspects of these concepts in the humanities and natural sciences classes.

3. Interdisciplinary or Coordinating subject (in the narrow sense of problem-oriented): the basis for creating such courses is a complex problem that cannot be solved within a single academic subject. The problem may be local (for example, the problem of energy efficiency of a school) or have a higher rank (for example, conservation of endemics of the region).

The «Natural Science» course in the SVE system, in contrast to the implementation of the course at school, should be correlated with future professional activities. As noted in the works of E. I. Tupikin, Z. A. Skripko, etc., the content of natural science training at the level of professional education should be correlated with the content of future professional activity, then each subject area is perceived by the student as a necessary element of his professional development [104, 122, etc.]. This is its specificity and peculiarity, which shows the inexpediency of directly transferring school course programs to the SVEN system.

TThe analysis showed that the implementation of professional orientation in the study of natural science can be carried out in the following ways:

1) selection of content and methodically based application of specific educational material for a certain group of professions / specialties, taking into account the main types of professional activity;

2) formation of certain practical skills focused on future professional activity by solving competence-oriented tasks and performing practical (laboratory) work that involves modeling conditions (situations) directly related to future professional activity.

The review of materials on the organization of teaching the course, the analysis of work programs, educational and methodical complexes, conducted by many authors, indicate the lack of a unified approach to the development of the content of educational and methodical complexes for the course «Natural Science», developed specifically for the SVE system [91].

In our study, the methodological basis for the development of an integrated course is the integrative approach developed by the scientific and pedagogical school under the leadership of I. Yu. Aleksashina, as most consistent with the goals of the course «Natural Science» in the SVE system. An integrative approach involves forming the foundations of a natural science culture that combines natural science competence and humanistic ideals [12]. natural science knowledge in the prism of an integrative approach is considered in the interrelation and interdependence of man, human activity and nature. These goals form the basis **of the course's leading ideas**. Formulated in the form of propositions, they fix postulates about the unity, integrity of the organization and functioning of nature. These provisions predict the value component of the content of the course «Natural Science» (pedagogical goals) and the content личностных смысловof students ' personal meanings (planned educational results), which serve as the basis for clarifying goals at the lesson level, section level, and also set the vector for selecting educational material. These constructs in the course content are defined as emotional-value guidelines or VSGs.

Y. N. Kulyutkin considered VSG as a construct combining the value relation of the subject to the object and the personal significance of the object, i.e. the semantic component. The researcher associated VSG directly with the target settings of human choice [73]. Developing this idea, A. A. Ulyanova in her research connects the success of the educational process with the interiorization of the values of natural science knowledge, the main factor of which suggests considering specially organized content and meaning-forming activity [123].

A number of studies on the theory and methodology of natural science education reveal ways that contribute to the development by students of the values of the «Man - Nature - Society» system, the inclusion of the concept of «value» or the value system of society in the content of a natural science subject [4, 92, 95, etc.]; orientation of the content towards the development of environmental values [102, 121, etc.]; inclusion of culturological information in the content [111, etc.].

A.A. Ulyanova presents a number of value and target orientations in the organization of the cognition process:

- reliability and objectivity of scientific knowledge;

- understandingthe development patterns and ways of developing complex self-organizing systems based on a system-synergetic approach;

- biocentric approach (man is a component of nature);

- an understanding of the relationship between values and knowledge of the humanities and natural sciences;

- orientation of scientific knowledge to the search for ways to preserve life on Earth and the joint evolution of man and nature, [123, p. 37].

At the same time, the definition of VSG for a training course is understood in the framework of our research as one of the directions for implementing the humanitarian and axiological aspect of the competence approach in education.

It should be noted that the VSGs allocated for the integrated course «Natural Sciences» reveal a concept relationship between the requirements for planned educational results recorded by the FSES SGE for the academic discipline [12].

The understanding of the VSG course by students involves the formation of a value attitude towards nature, culture, science, production, and the appropriation of rational consumption values. Assigning a VSG course to students creates conditions for their awareness of the social significance of the profession being mastered, increasing motivation to perform professional activities, which serves as the basis for the development of VSC [64-66].

There is no doubt that becoming a VSC of a future specialist is a multidimensional process. This is due to the integrative nature of competencies. The interpretation of the component composition of the content of competencies is based on the idea that in addition to cognitive and operational-technological components, motivational, ethical, social and behavioral components are also combined in their structure [118, p.14]. The concretization of these provisions in relation to our interpretation of competence and its level structure allowed us to present their component composition and VSC content (see Figure 1.3) [57].

In relation to the Natural Science course, the generalized VSC formulations presented in FSES SVE require detail. The basis for disclosing the content of the components of these competencies is the VSG course, taking into account the specifics of the profession being acquired. The resulting formulations of the VSC components can be considered as planned educational results in the academic discipline «Natural Science», on the basis of which they can also be considered as criteria for evaluating the formation of the VSC. This makes it possible to justify the expediency of using the VSG course «Natural Science» and its leading ideas to reveal the content of the VSC in the context of the specifics of the acquired profession at the goal-setting stage when developing a course for the SVE stage.

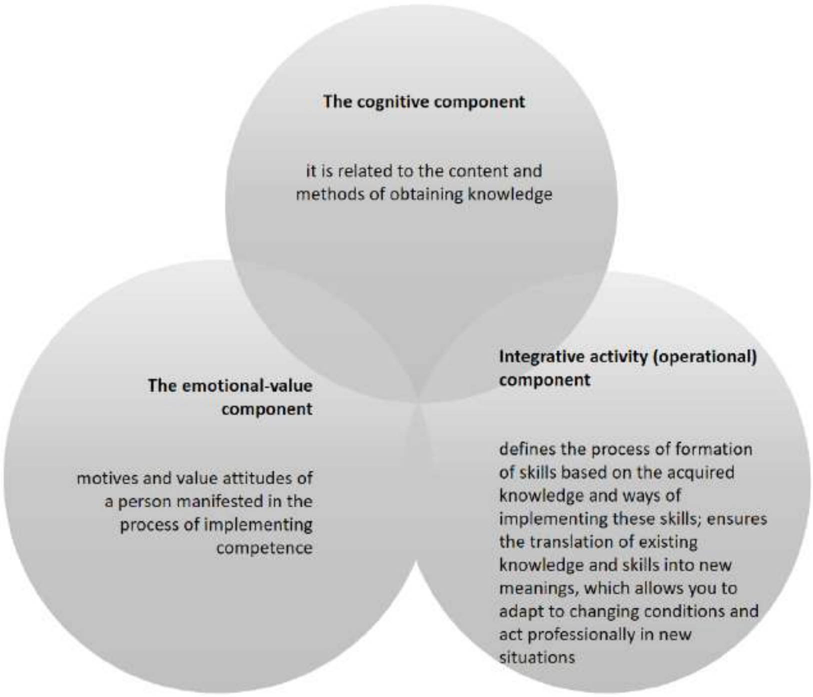


Figure 1.3-Relationship of competence components

The integration nature of the expected results actualizes the need to determine the system-forming mechanism for integrating the course content. In this study, he defined a **concept approach**. The following paragraph describes in more detail the features of the concept approach from a pedagogical perspective.

1.2. Conceptual approach as a basis for developing the content of the integrated course «Natural Science»

A review of pedagogical research shows that the frequency of mentioning the concept of «concept» increases-this indicates its formation in the categorical apparatus of pedagogical science [43, 121, 142, etc.].

The phenomenon of the concept is actively used in the terminology of philosophy, linguistics, linguoculturology, cognitive psychology, political science and sociology. This served as the basis for S.G. Vorkachev's definition of the concept as an «umbrella term» [3, 3].

It is mentioned in the works of Pierre Abelard in the XII century and is considered by him as a way of forming a unified point of view on a cognizable object by linking opinions and ideas about this object [87].

The active development of the concept of «concept» begins in philosophy in the 2000s, appearing in an article by S. S. Neretina in the « New Philosophical Encyclopedia» [87]. The concept of it is directly connected with the theory of knowledge, in the context of the formation of complex ideas about the subjects and phenomena being studied. This idea is developed by researchers Yu. G. Bobkova [2, 3] and Yu.V. Surzhanskaya [114].

The term «concept» is introduced into Russian humanities by the epistemologist S. A. Askoldov (1870-1945), who points out that in the Middle Ages concepts were called «universals» (this partly reflects their essence at the present time), and that in general, the concept concept is not sufficiently developed in Russian science [1-9].

In the ideas of J. Deleuze and F. Guattari, the concept is considered as the «beginning of philosophy». They consider it as a certain integral event or phenomenon that can be studied by representatives and methods of different sciences and according to which a diverse number of points of view can be formed, each of which characterizes or affects one or another side of a given event [38, p. 56]. Post-structuralist philosophers refer the concept to the number of cognitive categories and distinguish such characteristics of the concept as dynamism, constant self-actualization (based on the development of scientific knowledge), self-healing, features of individual-subjective experience in the cognition of each concept by a separate person [Ibid., p. 36].

The authors of the article in the» New Philosophical Encyclopedia», analyzing the appeal of postmodernism to the concept, summarize that the revival of the concept is caused by the transition to the idea of creativity, which is always unique, and to the idea of speech represented by «stable clusters of meaning», which is similar to the understanding of the concept in both medieval and postmodern philosophy. However, the concept is filled with a different content. [88].

L. A. Mikeshina somewhat expands the idea of the concept, in terms of the possibility of thinking about it as cognitive entities that represent the organic integrity of the properties of an object. Concepts cannot be reduced to logically structured concepts, since they appear in the form of «semantic images» [83, p. 508].

Let us agree with the philosophical understanding of the concept proposed by Yu. V. Surzhanskaya, who understands the concept as the starting point of thinking [114].

Let us analyze the existing understanding of the term «concept «from the point of view of identifying its structure and components from the standpoint of psychology, psycholinguistics, cognitive science and other areas that operate with the term»concept» and can help in interpreting it for modern pedagogical science.

The first position that we will consider is psychological. L. M. Vekker introduces the concept into psychology as a mental formation within individual concept experience; «an intelligence-forming integral unit» [2, 8, p. 348].

The theoretical analysis conducted by M. A. Kholodnaya allows us to conclude that the structure of the concept is hierarchical. The ordering of its structure is due to the varying degree of generalization of the features of the displayed object. «The subject acquires the ability to distinguish between many simultaneously conceivable features of the same object» [127].

E. S. Kubryakova considers concepts in the form of elementary particles of knowledge («quantum»), which each person operates in the process of thinking» [72, p.90]. From the point of view of cognitology, the forms of concept manifestation are diverse; along with mental ones (images, gestalts, frames, schemes, etc.), they can also have a verbal manifestation.

According to the psycholinguistic view, the concept can be represented as a personal formation in the consciousness of an individual, which is dynamic, conditioned by existing experience [44, p. 39]. The core of the concept is a system of figurative elements that the human brain forms based on information received from external stimuli (visual, auditory, etc.). Thus, the concept sphere can be represented as a set of discrete mental units ordered in consciousness, which acts as an information base of thinking. A. A. Zalevskaya notes the personal characteristic of the concept: «The concept is the property of the individual» [Ibid.].

The multi-dimensionality and ambiguity of the concept is determined by the variety of pragmatic and associative elements, including the content of naive concepts included in its content.

D. S. Likhachev reveals the linguoculturological function of the concept in his works. From the point of view of this approach, language is considered as a cultural concentrate [75, p.37]. To denote the system organization of concepts, D. S. Likhachevuses the term «conceptosphere «by analogy with the concepts of «noosphere» and «biosphere» [Ibid., p. 4].

N. D. Arutyunova, presenting a linguophilosophical approach to understanding the concept, suggests considering it synonymously with the «worldview concept», contrasting scientific and «naive» knowledge. The researcher suggests considering the following worldview concepts: truth, falsehood, norm, knowledge, etc. [76, p. 3-4].

The linguoculturological approach considers the concept of a» clot « of culture in the human mind. Functionally, the purpose of the concept is considered in two ways: it is a mechanism for a person's entry into culture and acts as a conductor of culture into the mental world of a person [112, p. 42]. According to this point of view, a concept cannot be exhaustively described by the dictionary meaning of the «name» of the concept (the core of this concept).

Yu. S. Stepanov identifies a multi-layered structure of meaning in the concept: «internal form» (literal meaning), «historical layer» and actual (active) layer. This multi-layered structure is a historically formed stratification of meanings. The boundaries of cognition of a concept are determined by the researcher by the sphere of abstract definitions and the sphere of individual experience [Ibid., p. 21]. The author's idea that concepts «hover» over conceptized areas and can be expressed in a word, image, or material object seems significant to us [Ibid., p. 43].

Analyzing the definition of concept, V. V. Kolesov comes to the conclusion that a concept always represents integrity, despite the fact that its content is historical and intentional [68, p. 69].

From the standpoint of cognitive linguistics (V. I. Karasik, Z. D. Popova, G. G. Slyshkin, I. A. Sternin), the concept is an elementary basis for conscious perception, reflection of reality by the psyche. The content of the definition «concept» is correlated by researchers with those ideas about meanings that are actualized in the processes of thinking. In the context of our research, the position of V. I. Karasik, who suggests considering the layers of the concept (highlighted by Yu. S. Stepanov), is important as separate concepts of various volumes [5, 4, p. 3].

Z. D. Popova and I. A. Sternin believe that the source of concept formation is the cognitive activity of people. Mental images are structured in the concept sphere of a person. The concepts that form the concept sphere are in a systematic relationship with other concepts [98, p.17].

S. G. Vorkachev, a proponent of the interdisciplinary scientific direction «linguoconceptology», suggests describing the concept through three components:

* concept;

* figurative.

* significant [34, p. 81].

S. Kh. Lyapin offers an integrative understanding of the concept. The researcher considers the concept to be a multidimensional integrity of meaning, in which it is possible to distinguish rational, emotional, abstract and concrete components that are closely intertwined [77, p. 20].

Summing up, we can assume that any concept in the mind of the carrier is an element of the concept system and contains information about the reality or expected state of things in the world.

N. V. Bordovskaya, in a monograph devoted to the consideration of logical and methodological problems of modern scientific and pedagogical research, correlates the understanding of the concept with the unit of semantic representation of a particular form of scientific reasoning [22-6]. The concept is considered by the researcher as the result of logical structuring of scientific ideas about the pedagogical object. N. V. Bordovskaya fixes the multiplicity of the concept, which can be compared with a logical category: a concept (according to the nominative construction), a judgment (according to the predicate construction). It also identifies the concepts of the scientific and pedagogical whole that it associates in form and meaning with an idea or system of judgments, a concept or theory. We see the appeal to the concept as natural from the perspective of the ideas of pedagogical systemology, which focuses on identifying new structural components of pedagogical science that have historically developed, have continuity and allow us to correlate pedagogical knowledge that is obtained within the framework of individual areas of pedagogical science, as aspects of one whole. The position of N. V. Bordovskaya allows us to conclude that the definition of «concept» occupies an independent place in pedagogical science, as a reflection of a holistic view of pedagogical reality and can be used in the design of new pedagogical objects.

The analysis of the works has shown that in pedagogical research, most interpretations of the concept are based on the indicated positions. The most complete, in relation to the subject of our study, we consider the interpretation of I.A. Sherstobitova and I. Yu. Aleksashina: «the concept is a emotional-value unit of an integrative nature, formed in consciousness as a meaning, establishing an associative relationship between natural and humanitarian sciences within the framework of the analysis of certain phenomena, processes, objects of the surrounding world» [136].

The analysis of the definition «concept» allows us to identify the following properties of the concept, presented schematically in Figure 1.4. [7]:

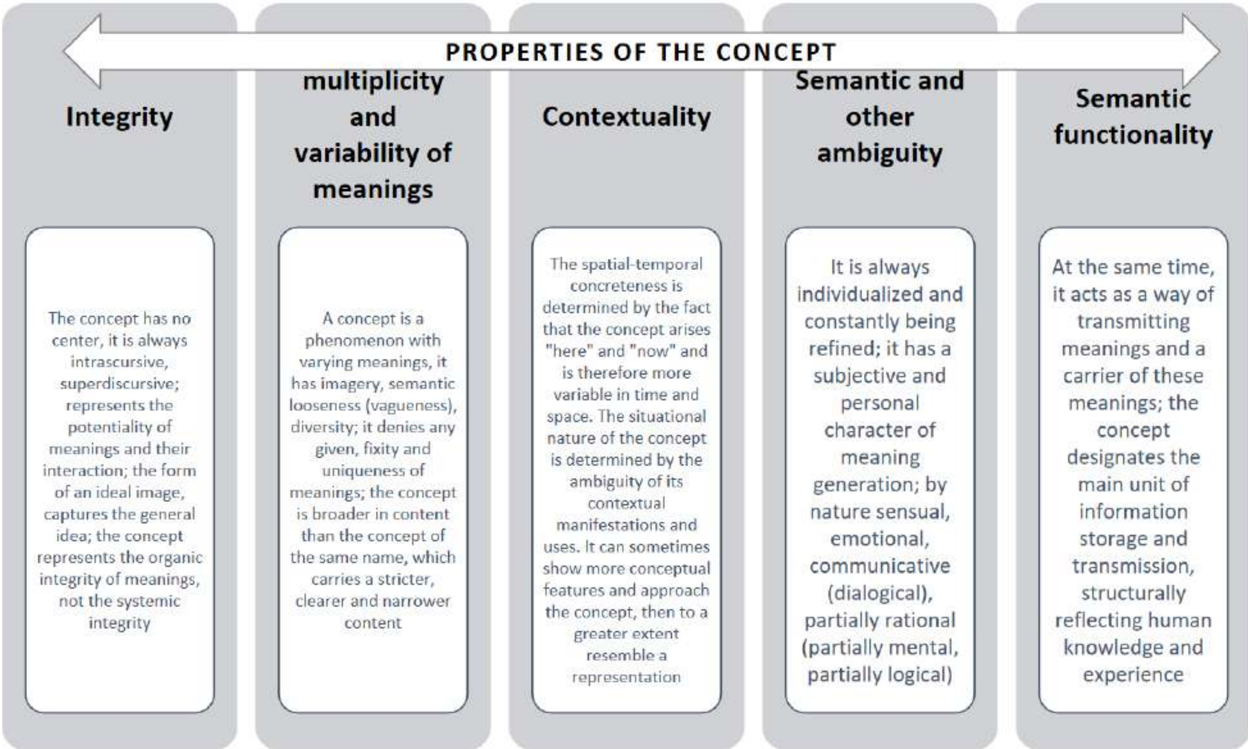


Figure 1.4-Concept characteristics

The indicated characteristics allow us to conclude that, being a complex mental complex, the concept includes, in addition to the semantic component, an evaluative one. In relation to the subject of our study, it becomes possible to conclude that the concepts of the course are co-dependent with the formulations of the VSG course. Then the development of concepts of different levels is inextricably linked with the awareness, comprehension and assignment of the VSG content of the training course.

Various sources serve as the basis for the formation of concepts in human consciousness (see Figure 1.5).

The designated functions of the concept actualizes the activity nature of the concept. The concept cannot be obtained in a ready-made form, the concept is created, developed by the subject himself, which may serve as a reason to believe that concepts play a significant role in the formation of competencies.

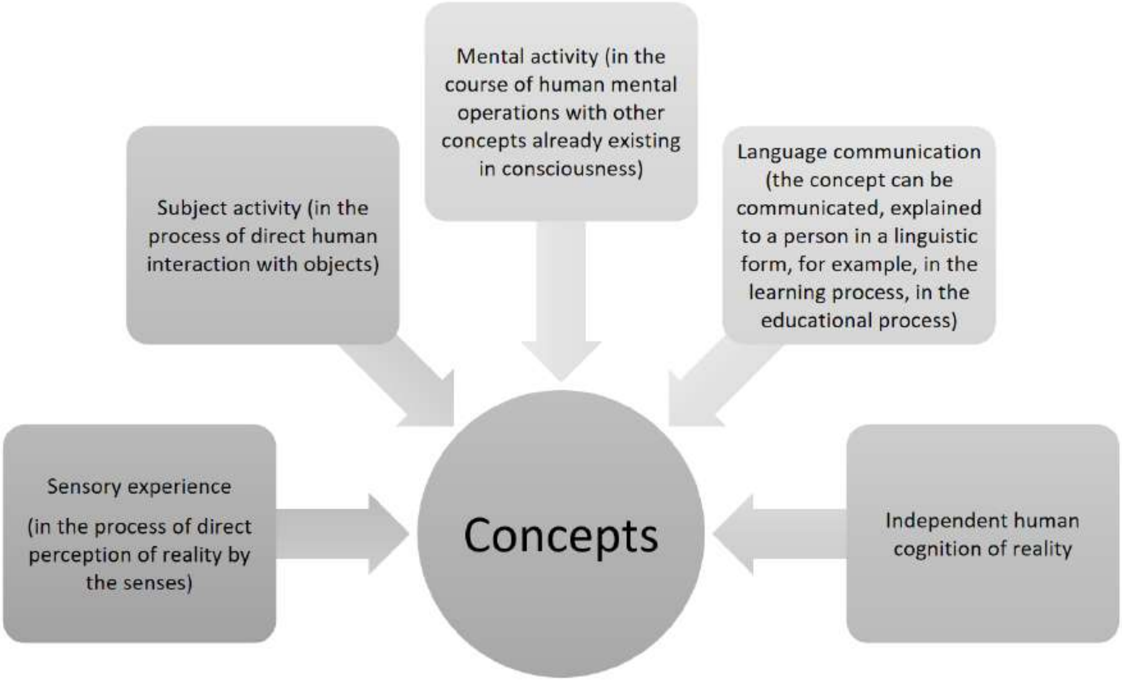


Figure 1.5-Sources of concept formation in human consciousness (according to V. G. Zusman) [80]

In the works of Yu. S. Stepanov [112], V. I.Karasik [5, 4], N. N. Boldyrev [2, 4], E. S. Kubryakova [72] and others, it is proved that human consciousness operates precisely with concepts, that is, they are the original «elementary units» in the system of human representations about the world. the world.

Researcher R. A. Latypov also comes to the conclusion that concepts can be considered as a system of meanings on the basis of which a person carries out activities, this determines such a characteristic of concepts as situationality [74].

This allows us to make an assumption that if an individual's worldview is determined primarily by a system of concepts (although the latter is dynamic and changes in the course of life, activity, and training), then the development of VSC is also determined by the process of assimilation of concepts and their systematization, which is also true for the process of mastering the course «Natural Science» [7].

Yu. S. Stepanov believes that the concept system includes the foundations of the cultural code, that is, concepts are formed in the consciousness of the individual, of course, on the basis of the existing system of values, norms, and guidelines in a particular society. [112, p. 43].

The information field formed around the concept is extremely rich. It includes learned concepts, associations, ratings, images, frames, etc.that reflect information about the object in all its diversity. The heterogeneity of the concept content is integrated into an organic whole. This allows us to consider the system of knowledge about the world as a network of concepts. These concepts have different SVESVE origins and different levels of complexity and abstraction. The concept is not isolated from other concepts, it is extremely variable, and multiple concepts in consciousness do not exist separately from each other, they are interconnected and mutually penetrate each other, forming a complex system.

The network organization of concepts among themselves, grounded in the works of J.Deleuze and F.Guattari [33-8], is consistent with the postmodern concept of rhizome-like learning, which represents learning goals as a diverse, multi-factor system that aims to carry out cognition in different directions, and explore different objects of knowledge from different positions and sides [52, p. 883].

Analyzing the phenomenon of the concept in the field of cognition or art, S. A. Askol'dov suggests distinguishing between artistic concepts and cognitive (logical)ones [1-9]. The latter are defined as cognitive models that arise in the process of semantic search activity, due to the unity of science and culture. Replacing concrete representations, they serve as the basis for analysis and synthesis, and for formulating hypotheses about the nature of the designated object. The identification of cognitive concepts as integrators of science and culture, actualizes the study of their role in interdisciplinary activities (B. N. Poizner, E. A. Sosnin [97]).

Concepts perform a number of functions. On the one hand, concepts allow us to rationalize sensory cognition (from general concepts to concepts). On the other hand, concepts are used to communicate at different levels. They determine the transition of forms of knowledge: from the level of private science to the level of philosophy [109].

In the pedagogical aspect, it is important to understand the intellectual heritage of N. I. Oreshchenko. In her works, she notes that the maximum use of the potential of natural science knowledge for the moral education of a person with humanistic value orientations imposes requirements not only on the selection of educational content. There is no doubt that a fundamentally new structure of the traditional didactic unit of knowledge is needed. Focused on showing students the world as holistically as possible, it should lead to an understanding of why the biosphere is currently «suffering» from the presence of humans in it and to the conclusion that human activity in nature is currently consistent with its laws. This pedagogical task, according to the researcher, does not require transferring the amount of knowledge to children in traditional «portions» of educational material. The structure of each didactic unit of knowledge should be inextricably intertwined with a emotional-value component, subordinated to the cross-cutting leading ideas of the entire course, which, in turn, are aimed at understanding nature as a value, the ambiguous significance of science for society, and the personal position expressed in the phenomenon of «knowledge – beliefs» [92].

This leads to the assumption that the concept can be a system-forming factor in the content of a natural science training course and, first of all, an integrated one.

Let us consider the features of the system-forming factors of designing the content of integrated courses of natural science orientation.

As noted earlier, the key stage of course development is the search for an integrator, which is considered from the point of view of the concept approach (the integrator is also called a system-forming factor).

There are different approaches to the definition of this concept, the unity of which is manifested in the fact that the system-forming factor is the result of the functioning of the system. At the same time, the result can be either specific, achievable in a certain time interval, or ideal, which is not achievable by itself, but sets the direction of system development. The integrator acts simultaneously as the basis for the emergence of the system, and ensures the maintenance of its stability, as well as sets the direction of its functioning and development. Considering the integrator as a result of the functioning of the system, we can conclude that it determines the ordered interaction between all its components. The level of system development is determined by the system-forming factor.

The backbone of the integrative course, according to V. R. Ilyichenko, can be the fundamental laws of nature: the laws of conservation, the frequency of processes in nature. O. A. Yavoruk, in his research, suggests relying on general scientific theories, as well as those objects that are studied by different sciences [140]. In his works, I. S. Dmitriev considers the principle of historicism as an integrating factor [39]. V. N. Maximova suggests integrating natural science knowledge based on objective phenomena, processes, objects of the surrounding world (for example, time, Earth, water, periodicity, etc.), studied simultaneously by various sciences and fields of scientific knowledge [79].

When designing a propaedeutic course «Introduction to natural science subjects. Natural science. Grades 5-6», its authors (A. E. Gurevich, D. A. Isaev, L. S. Pontak) propose to integrate physical and chemical knowledge based on ideas about the unity of nature and the method of cognition common to all-natural sciences. Integrators used in the natural science and humanitarian fields of knowledge correspond in structure, functions and properties to the characteristics of the concept.

In the research of V. S. Bezrukova, we find the position that any content component can change its functional purpose depending on the selected system-forming factor [19, p.56].

Interesting in the context of our research is the idea of fundamental educational objects developed by the scientific school of A. V. Khutorsky [130]. They act as a generalizing element of the content of education and have an environment-forming character. As such objects, the researcher suggests considering the nodal points («first meanings») of the meta-subject content of education, which form its structural basis. The deployment of each node provides for a different scope of cognitive questions and problems [129]. In the course of educational activity, the scope of the student's «first thoughts» is expanded by increasing the amount of knowledge they realize, their personal experience and competencies. The author suggests designing academic subjects, meta-subjects, and meta-subject topics around fundamental educational objects. As fundamental educational objects, the author suggests considering universal concepts: sign, number, letter, plant, person, etc. Understanding the concept as a unit of meaning, which obviously has various degrees of generalization, we can conclude that the fundamental object can be considered as a concept.

Within the framework of subject-based learning, the idea is interesting V. D. Sukhorukov's idea about the possibility of identifying so-called didactic codes for building a rational structure of scientific knowledge and implementing personal (value), meta-subject and subject tasks of school geography is interesting in the framework of subject training. The didactic codes of school geography are understood as basic theoretical provisions and criteria for personal, meta-subject and subject results, which underlie the formation of students ' general ideas about the content and tasks of the courses studied. [116, 117].

In the works devoted to the problem of organizing educational project activities in natural science education, V. N. Davydov suggests using the so-called concept systems of natural sciences, which are systems of theories united by general concepts, laws, and fundamental principles, to determine the subject of educational research [36]. For example, in chemistry, they are found in the form of teachings on chemical composition, on the chemical process; in physics, they define physical pictures of the world (mechanical, electromagnetic, etc.).

Important for our research are the works of I. A. Sherstobitova, which reveal the possibilities of the concept in a natural-scientific context. The author substantiates the idea that the concept can act as an integrator by assigning VSG students the course «Natural Science» [135]. The system integration of humanitarian and natural-scientific content based on concept analysis makes it possible to systematically influence the formation of emotional-value orientations of the individual, its concept sphere, through the concept (as a unit of language and a unit of text). Thus, the concept approach can actas a way of cross-subject integration of knowledge.

L. V. Trubitsyna, on the way to find a possible solution to the issue of designing the content of environmental education, explores the advantages of using the cultural concept as a basic unit of environmental culture as a structural element of the organization of this content. She justified the possibility of using the category «cultural concept» to coordinate the content of different subject areas (natural sciences and humanities) in the field of sustainable development [121].

In our opinion, L. V.'s idea is also interesting. Trubitsina on the possibility of a comprehensive assessment of the components of ecological culture using cultural concepts.

Referring to the foreign experience of natural science education allows us to fix the fact of using concepts as system-forming elements of biological content. The so-called «cumulative learning» involves students mastering natural science material through the prism of «basic concepts» (Basiskonzepten), which allow students to use their existing experience, knowledge, and skills in new contexts. Thus, a network of knowledge on biological topics is gradually being formed, which is based not on memorizing incoherent facts, but on understanding their commonality. Thus, the topics in the course, in accordance with the biology curricula in Lower Saxony (Germany), are coordinated by the following concepts underlying the diversity of biological phenomena and facts: structure and function, cell, control and regulation, transformation of matter and energy, information and interconnection, reproduction, variability and adaptability, historical development and kinship [143, 144, etc.].

The presented positions make it possible to consider the concept as a didactic unit of the course of integrative content [15].

Since the concept cannot be obtained in a ready-made form, the concept is created and developed by the subject himself, and since the concept captures the emotional-value component of the learning process, the development of the concept is associated with processes that directly affect the features of meaning formation, meaning generation and meaning expression of students as components of the individual emotional-value sphere of the individual. Thus, it becomes possible to conclude that the development of concepts can be considered as meaning-making.

It is worth noting that the concept of «meaning-making» is relatively new for pedagogy. Addressing the problem of values and meaning in Russian pedagogy leads to the emergence of a sense-value direction in science (I. Yu. Aleksashina, E. V. Bondarevskaya, N. M. Borytko, Z. I. Vasilyeva, Yu. N. Kulyutkin,

L. P. Razbegaeva, A. P. Tryapitsyna). To date, the scientific field of «sense didactics» is being formed, revealing the pedagogical potential of meaning-making, and identifying the pedagogical conditions for organizing this process [1, 14, 25, 73 et al.].

Meaning-making activity, from the standpoint of pedagogical science, is interpreted as the process of developing a personal meaning by the subject of activity, through the transformation of the activity process through the prism of individual perception and attitude to this activity, as well as its creative improvement [71]. Thus, meaning-making can be considered as a process of conscious development of concepts by subjects of the pedagogical process.

It is important to note that mastering the concepts of the training course involves mutual enrichment of individual meanings (concepts) of students by presenting an individual image of the concept in various verbal and nonverbal forms.

In the context of our research, the important idea expressed by S. H. Lyapin is that the development and research of the concept can be carried out in two opposite directions. One of them is aimed at enriching the content of the concept with mental structures: concepts, images, associations, etc. This format of work can be defined as a concept synthesis. Another direction is concept analysis, which involves splitting the concept into its components and forms [77].

If the concept analysis is aimed at segmenting the concept sphere into concepts, establishing the status of selected concepts, and taking stock of them, then the purpose of synthesis, first of all, is to model the structure and content [34, p.81]. On the other hand, the relationship and interrelationships of the individual structural components of the concept are not symmetrical. Its basic structural components are dispersed in different parts of the semantic field of the concept. Both areas of work can be considered as ways of directional translation of meanings.

The process of synthesis removes inconsistencies, oppositions, and contradictions, forming a new theoretical unity. The result of the synthesis of concepts is completely new knowledge, qualitatively different from the simple sum of concepts that enter the synthesis process. Since the course «Natural Science» has continuity with monopubject courses, the development of concepts is associated with existing ideas, as well as personal experience of students.

Comprehension of concepts in the educational process should be considered not as separate methodological techniques, but as something procedurally integral, which reflects the implementation of the principle of unity of the content of education, due to the concept approach [63].

Thus, the analysis shows that the concept has the necessary properties for its integrator to determine the content of an integrated course. The IC NS concept system is the basis for an objective view of the world around us, ideas about the integrity and unity of the values of scientific and humanitarian knowledge. This justifies the role of the concept as a system-forming mechanism for selecting and developing IC NS content for the SVE stage.

The following section of the study describes the methodology for constructing the content of an integrated course based on a concept approach.

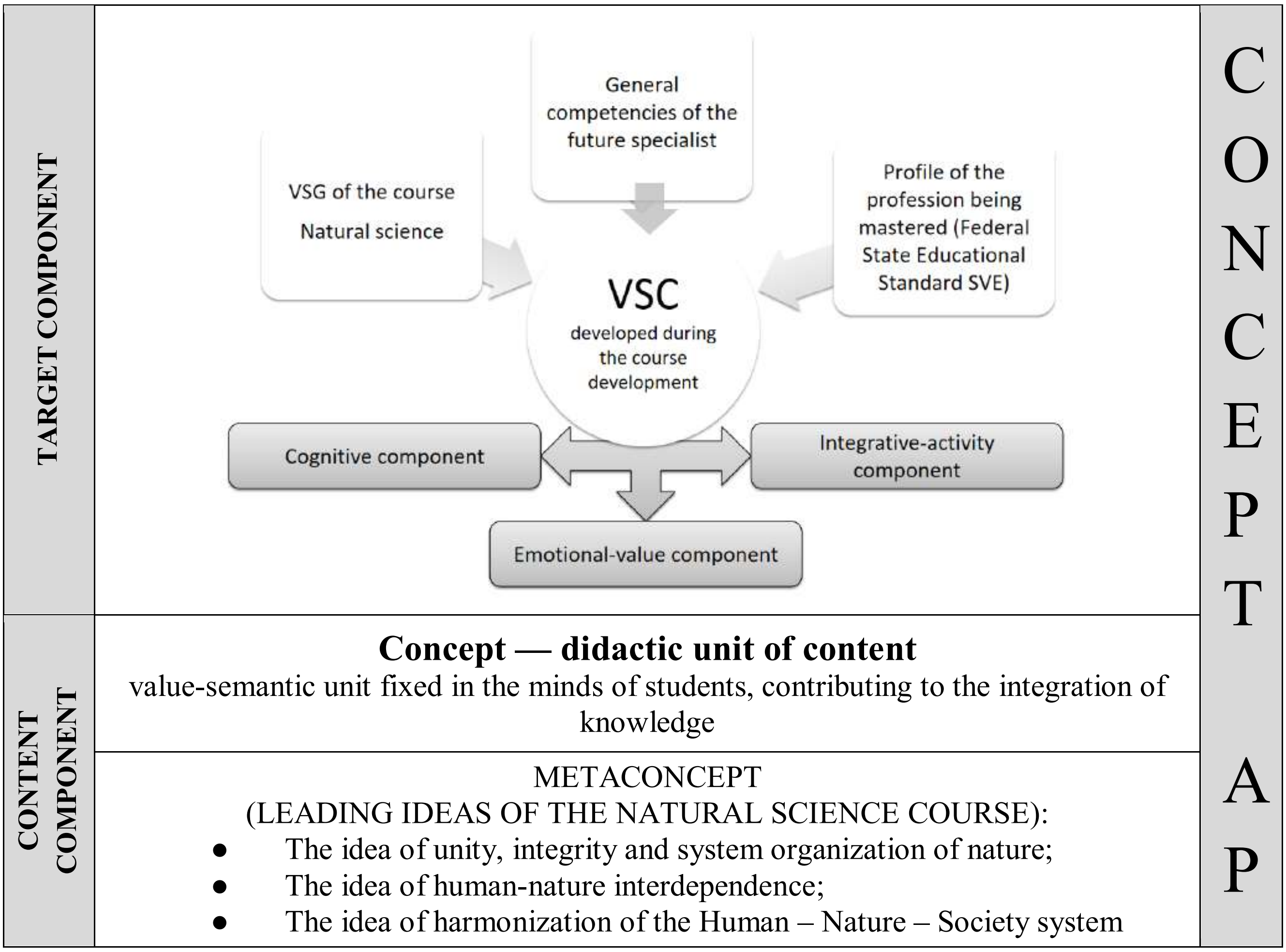
1.3. Methodology for designing the content of the integrated course «Natural Science» based on a concept approach for the system of secondary vocational education

In the practice of linear (single-subject) natural science courses, content development is based on the methodology of development of the corresponding science. The methodological system of such courses is built in accordance with the logic of forming a system of basic concepts of the subject. An integrated course is developed on the basis of a synthesis of the content of several sciences, which makes it difficult to select and design its content [12, 16, 89, 96, 123 et al.].

The methodological foundations of the dissertation research are the concept ideas of a number of approaches: competence-based, integrative, culturological, axiological.

In our work, we proceeded from the definition of pedagogical design by S. I. Vysotskaya and V. V. Kraevsky as an activity of a special kind, embodied in the form of pedagogical design, the main elements of which are the formation of normative representations (models) of pedagogical activity and the creation of projects for such activities. The created models and pedagogical projects are real, fixed design results. This definition is consistent with the position of N. V. Bordovskaya on pedagogical constructology and key principles of designing pedagogical objects [26]. This made it possible to determine the components of the educational content of the developed model: target, content, procedural, performance-evaluation components, the unity and consistency of which is provided by the concept approach.

We consider the concept approach used in the selection and development of IC NS content as the most appropriate (discussed in paragraph 1.2.) in relation to an integrated course involving the development of VSC students and consistent with the general didactic principles of selection and structuring of content. The conclusions obtained from the analysis of literary sources served as the basis for the development of a model of the IC NS content design methodology for SVE (see Figure 1.6) [65].



	Private concept (corresponding to the scale of the lesson, key question, or problem)	**Concept of a semantic block** (combines particular concepts into a semantic block that captures one of the directions of consideration of the topic; it can be represented as a sub-topic)	**Megaconcept** (stated on the scale of the topic of the training course)	P R O A C H
PROCESS-TECHNOLOGY COMPONENT	**Lesson based on intersubject connections (intradisciplinary)** Purpose: integration of the concept and informational sphere of natural science subjects	**Integrated lesson (multidisciplinary)** Purpose: comparative and generalizing study of the material of natural science and humanities cycles	**Metasubject lesson (interdisciplinary)** Purpose: synthesis and generalization of knowledge	
	Subject GOATS -Reproductive level; - Material of one or several natural science monopredjects	**Intersubject GOATS** - Search level; - Material of several natural science monopredjects	**Metasubject GOATS** - Creative level; - Complex practice-oriented nature of tasks	
PERFORMANCE-EVALUATION COMPONENT	**Monoresults**	**Integration Monoresults + monoresults**	**Integration results**	
	1 level (low) of VSC development	**2 level (medium) of VSC development**	**3 level (high) of VSC development**	
	Criteria for evaluating VSC development			
	First VSC – Understanding the essence and social significance of the profession: ● development of knowledge about the modern natural science picture of the world and methods of natural sciences; ● awareness of the place of the future profession in the system «Man-Nature-Society»; ● application of basic methods of cognition (observation, scientific experiment) to study various aspects of the natural science picture of the world, which it is necessary to face in the professional sphere.			
	Second VSC – Solving professional tasks: ● mastering knowledge about the most important ideas and achievements of natural science that have had a decisive impact on the development of technology and technology; ● confidence in the possibility of knowing the laws of nature and using the achievements of natural sciences for the development of civilization and improving the quality of life; ● development of intellectual, creative abilities and critical thinking in the course of conducting simple research, analyzing phenomena, perception and interpretation of natural science information.			
	Third VSC – Defining the tasks of professional and personal development: ● development of knowledge about ways to harmonize relations in the system «Man-Nature-Society»; ● awareness of the importance of natural science knowledge to explain the phenomena of the surrounding world, perception of information of natural science and			

	professionally significant content; ● readiness to apply natural science knowledge in professional activities and everyday life to ensure the safety of life; competent use of modern technologies; advanced training in a selected field of professional activity; health and environmental protection.	

Figure 1.6 - Model of the methodology for selecting and developing the content of the integrated course «Natural Science» based on the concept approach for the SVE system

The system-forming approach to designing the course content is the concept approach, and the concept system is an integrator of natural science and humanities educational material in the context of future professional activity.

The target component reflects the unity of the goals of the educational content presented in the FSES SVE, FSES SGE, VSG course «Natural Science». The strategy «from VSG to VSC», described in paragraph 1.1. of this study, provides specification and refinement of generalized target formulations of the level of educational content to the level of learning content.

The target settings presented in the formulations of general competencies, expected results of mastering the course, general professional and professional competencies in the profile of the specialty being mastered, reflected in the FSES SVE for the relevant specialty, set the prism of goal-setting, allowing to determine the vector of professional orientation of the content of the integrated course and highlight on their basis the key knowledge of the natural science field necessary for more successful development professions. The VSGs of the Natural Science course define the value and semantic guidelines for the study of integrated content, highlighting the conditions necessary for the formation of a VSC at the level of an academic discipline. Their content focuses on the development of scientific representations of the modern worldview and creates the basis for the formation of a worldview and worldview that determine the motives and ways of human activity, including in professional life. Thus, the VSG of the course, in relation to the student, can be considered as a personal meaning and subjective value. Based on the VSC formulations (hereinafter, general competence 1 – VSC 1, general competence 4– VSC 2, general competence 8– VSC 1) recorded in FSES SVE (19.02.10 Technology of public catering products, approved by Order of the Ministry of Education and Science of the Russian Federation No. 384 dated 22.04.2014; 43.02.01 Organization of public catering services, approved by order of the Ministry of Education and Science of the Russian Federation dated 7.05.2014 G. N 465), as well as the sample educational program of the course «Natural Science» for SVE, the clarification and structuring of target settings that fix the expected educational results of students in the context of VSCis carried out. Reference points, which were clarified by the VSG course contents, selected on the basis of the course's leading ideas.

The VSGs of the course, selected at the goal setting stage, allow you to reveal the content of three competencies that belong to the group of emotional-value competencies and are fixed in the FSES SVE. This makes it possible to decompose VSCs in relation to the course of «Natural Sciences», specifying their components (see Tables 1.3.1 – 1.3.3) [57].

The specification of the first VSC in relation to the course «Natural Science» is based on the understanding of nature as a holistic, unified, dynamic structure and aims students to understand the role of the profession they are learning for the development of nature and society (see Table 1.3.1).

Table 1.3.1-Relationship between the VSG of the Science course and the VSC

First VSC (FSES SVE - general competence 1): Understand the essence and social significance of your future profession, show a sustained interest in it	
VSCs formed by students during the development of the course «Natural Science»	**VSG of the course «Natural Science»**
Cognitive component: mastering knowledge about the modern natural science picture of the world and methods of natural sciences;	Universal interrelationships and interdependence determine the integrity and very existence of nature and man;
Emotional and value component: awareness of the place of the future profession in the system «Man-Nature-Society»;	The complex structure of nature, when studying it, assumes a conditional division of objects of study into areas of natural science knowledge and ways of understanding the world;
Integrative-activity component: application of basic methods of cognition (observation, scientific experiment) to study various aspects of the natural science picture of the world, which it is necessaryto encounter in the professional sphere.	The methodology, objectivity and reliability of natural science knowledge, the use of modern methods of environmental assessment provide scientifically sound research results.

In addition, understanding the concepts of nature and society makes it possible to update knowledge about the subject of study and methods of natural sciences in order to obtain new knowledge about various elements of the scientific picture of the world, that is, the closest to objective one, which allows you to interact most effectively with society in the future in the process of future professional activity.

The content of the second VSC is consistent with the leading idea of interdependence and mutual influence in the system «Man – Nature – Society» and focuses on the awareness and assignment of the VSG course, which forms the basis for personal and professional development at the present time and in the future. Subject-specific educational results are consistent with the content of the cognitive and integrative-activity components (see Table 1.3.2).

Table 1.3.2-Relationship between the VSG of the Science course and the VSC

Second VSC (FSES SVE - general competence 4): Search, analyze and evaluate information necessary for setting and solving professional tasks, professional and personal development	
VSCs formed by students during the development of the course «Natural Science»	**VSG of the course «Natural Science»**
Cognitive component: mastering knowledge with the most important ideas and achievements of natural science that have had a decisive impact on the development of engineering and technology, including in the aspect of the acquired profession;	Man is one of the forms of life on the planet, nature provides human life with a variety of life support factors; The results of scientific knowledge reflect the level of development of technology and scientific culture of society;
Emotional-value component: conviction in the possibility of knowing the laws of nature and using the achievements of natural sciences for the development of civilization and improving the quality of life;	Man is a unique component of the biosphere (nature), able to realize himself and the world around him, able to know nature and the laws of its functioning;
Integrative-activity component: development of intellectual, creative abilities and critical thinking during the simplest research, analysis of phenomena, perception and interpretation of natural science information.	Natural science knowledge is one of the components of the culture of human civilization.

The idea that actualizes the need for harmony in relationships in the «Human - Nature - Society» system is reflected in the content of the components of the third VSC (see Table 1.3.3), which include: the ability to develop and make scientifically based, practically oriented decisions, the application of natural science knowledge in practice at the moment and in the future. in the future.

Further steps at the goal-setting stage are related to the decomposition of the content of the components for each VSC, characterizing the logic of the formation of competencies in the process of mastering the course «Natural Science» by students. This allows you to correlate the results of learning by lesson, semantic block, topic with the results of mastering the course as a whole. On the other hand, it allows you to select the content, technologies and teaching methods, to develop assessment funds to assess the development of competence elements at the entrance, during the course development and at the exit.

Table 1.3.3-Relationship between the VSG of the Science course and the VSC

Third VSC (FSES SVE – general competence 8): Independently determine the tasks of professional and personal development, engage in self-education, independently plan professional development	
VSC formed by students during the development of the course «Natural Science»	**VSG of the course «Natural Science»**
Cognitive component: mastering knowledge about ways to harmonize relations in the «Man - Nature - Society» system;	Natural phenomena on our planet are a reflection of cosmic processes; Knowledge of the organization of the biosphere (nature) enables a person to understand his place in nature;
Emotional-value component: Awareness of the importance of natural science knowledge to explain the phenomena of the surrounding world, the perception of information of natural scientific and professionally significant content;	Natural science knowledge is the basis for the harmonization of the «Man - Nature - Society» system;
Integrative-activity component: readiness to apply natural science knowledge in professional activities and daily life to ensure the safety of life; competent use of modern technologies; advanced training in selected professional activities; health and environmental protection.	Unregulated anthropogenic load, without taking into account the laws of nature (movement), leads to the destruction of natural systems.

The content component reflects the hierarchy of the system–forming elements of the content of IC NS concepts of different levels from meta-concepts to particular concepts.

The IC NS structure is organized as a hierarchically structured system of concepts. During the dissertation research, concepts are structured into four levels: metaconcepts –

megaconcepts – concepts of semantic blocks – private concepts. Schematically, the model of the hierarchy of concepts in the structure of the training course is shown in Figure 1.7 :

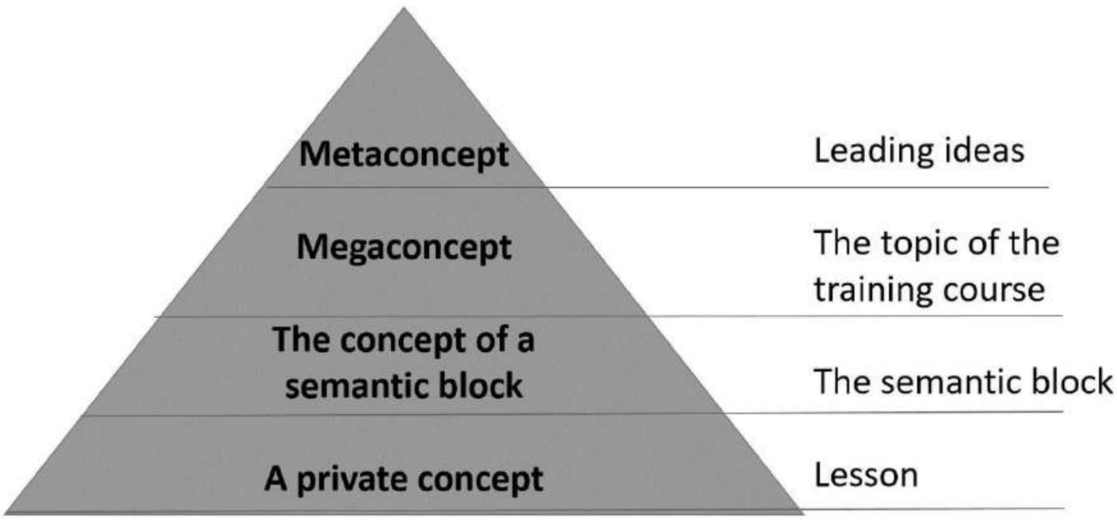


Figure 1.7 – Hierarchy of concepts in the structure of the content of the training course

The meta-concepts of the course content are the leading ideas, representing the highest step in the hierarchy of concepts. On the basis of metaconcepts, the context of studying the content of the course is formed, focusing on the development of ideas about the relationship and coevolution of nature and man, natural and anthropogenic-transformed, as well as artificial (man-made) systems), the unity of the patterns of their development and the need to take into account the external conditions of development.

The meta-concepts of the course are the leading ideas highlighted within the framework of the integrative approach (I.Y. Aleksashina).

These leading ideas are the basis for setting goals in the VSG – VSC strategy, as they form the guidelines for selecting and developing the course content. The disclosure of meta-concepts is carried out through the content of the course, structured through a system of concepts at lower levels.

The structure of the course content is based on **megaconcepts** reflecting the main complex concepts from the content of natural science education (based on the corresponding approximate educational program). Megaconcepts within the course are the basis for generalization and systematization of knowledge, concepts, patterns, processes. Each topic of the training course corresponds to a megaconcept in scale, which allows you to identify semantic areas in the construction of educational information, called **concepts of semantic blocks**. The function of semantic block concepts is to establish relationships between the topics of the training course, which allows you to determine the overall structure (outline or framework of the course topics).

The content of the concepts of the semantic block is revealed by concepts of a lower level, which we define as **private concepts** – they are consistent with the educational elements covered during the implementation (based on the corresponding approximate educational program). Understanding of each natural phenomenon, law, object, etc. Within the framework of the concept approach, it occurs through the prism of metaconcepts and involves determining the value significance for the «Nature – Man – Society» system, the humanitarian background, organizing a polycontextual field of information around each of them, allowing them to be considered as concepts.

To reveal the content of the system of concepts and their structuring, the research uses the technology of logical-semantic modeling in the context of didactic multidimensional technology (DMI, V. E. Steinberg). The implementation of the technology of logical-semantic modeling consists in structuring information in the form of a semantically connected network according to the criterion of semantic proximity. The sequence of stages provides for the identification of significant semantic elements of information in the form of keywords and the establishment of relationships between them, which leads to the identification of semantic elements and the reflection of the multiplicity of semantic connections between them. Such a network model is consistent with the specifics of the concept approach [138].

Let's consider the logical-semantic model of the VSC system (See Figure 1.8.):

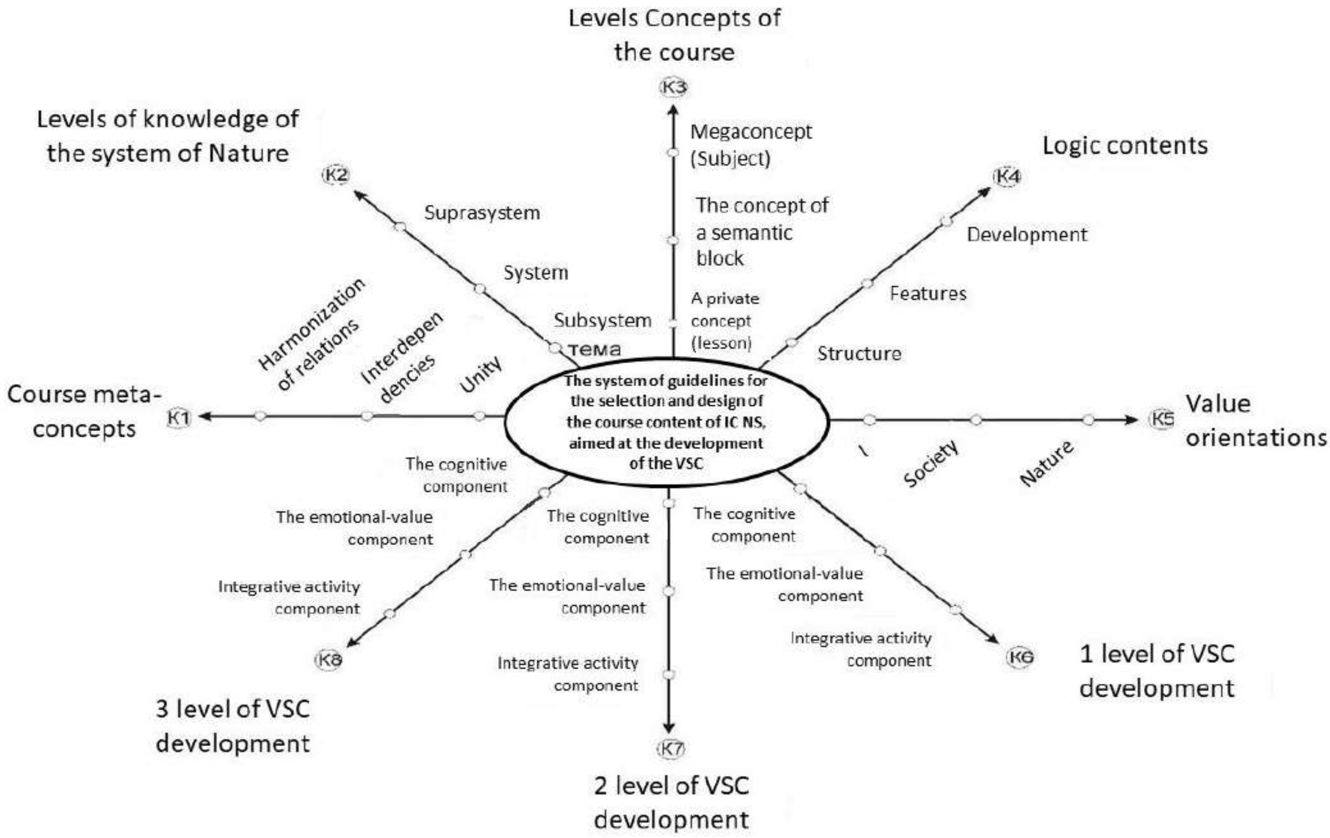


Figure 1.8 – Logical and semantic model of VSC students' development

The multidimensionality and hierarchy of the components of the course content design determine the corresponding coordinate axes K1 – K8. The K1 – K4 axes emphasize the course objectives in the format of leading ideas, which are reflected in the approach to the selection and structuring of the content of the course «Natural Science». The K5 axis fixes the mandatory identification of emotional-value orientations of the content, which creates conditions for the development of VSC students in the process of mastering the course. The resulting component of the content design (axes K6 – K8) actualizes the competence-oriented nature of the planned educational results. The levels of development of the VSC components show the degree of mastering the content of the course «Natural Science», awareness of its leading ideas and VSG by students.

The sequence of procedures used in the construction of logical-semantic models also reveals the mechanism of allocation of megaconcepts, private and semantic concepts of content and structuring of IC NS content. Thus, the highlighted leading ideas placed in the center of the logical-semantic model define semantic groups – a set of **megaconcepts**, the ranking of which determines the sequence of their study.

The definition of the reference nodes of the coordinate axes of the logical-semantic model of the course under construction allows us to identify the key elements of megaconcepts - **the concepts of semantic blocks**. They fix semantic connections within the topic, setting a vector for selecting content that reveals the VSG of the megaconcept. Note that the block structuring within the topic has many features with the ideas of P. M. Erdniev's enlarged didactic units.

The next stage involves identifying particular concepts that correspond to the scale of the lesson topic. It should be noted that the number and depth of mastering private concepts is determined by the specifics of future professional activity.

Further clarification of the scope of the content is associated with the construction of appropriate multi-level logical-semantic models of concepts. In this case, it is the concept that becomes the center of a multidimensional system. The first coordinate axis is represented by the target installations developed in accordance with the logic «from VSG to VSC». The didactic units of the sample program through the prism of VSG and leading ideas reveal the content of concepts of different levels, allow us to identify their value component, the applied nature of knowledge, the accompanying humanitarian background and are reflected in the subsequent vectors of the logical-semantic model. The last axis models the structure of personal meanings acquired by students during the development of the corresponding concept.

We emphasize that the hierarchical structure of concepts (private concepts, concepts of semantic blocks, megaconcepts) is considered from the perspective of the presentation of natural science knowledge in the «Nature - Man – Society» system fixed in the format of the course meta–concepts (leading ideas).

Adapting the content to different SVE specialties, it is advisable to design it based on two components: an invariant core and a variable component. The invariant core of the mega-concepts of the course includes the basic natural science concepts, laws, theories, facts and research methods used in the natural sciences. The variable component of the mega-concepts of the course reflects the specifics of the profile, establishes and illustrates the interrelationships of natural science content with the content of general professional and professional disciplines. It also includes mathematical and humanitarian components.

The hierarchy of concepts allows you to coordinate the elements of the educational material into an integral block on the basis of intra- and interdisciplinary integration, aimed at achieving the course objectives. Structuring the course content on its basis involves the integration of the main components of educational information based on basic knowledge and understanding the relationships between the concepts of the course. The allocation of VSG at each stage of mastering the content of the course concepts focuses on the acquisition of personal meanings by students. Thus, conditions are created for the development of not only cognitive, but also emotional-value spheres that act as components of the VSC of future specialists.

The procedural-technological component reflects the stages of mastering the concepts of the course «Natural Science» through the description of the methodology of conducting lessons and developing the content of COT, which differ in the level of integration of the content of the educational material.

Defining a concept as a didactic unit of content does not require abandoning traditional forms of lesson organization, however, it makes certain adjustments to the content due to the properties of the concepts discussed in detail in paragraph 1.2. The features of the target settings in the concept approach, involving the comprehension of the VSG concepts being mastered, actualize the use of active meaning-making techniques in lessons.

The levels of development of the hierarchy of concepts define a system of lessons involving the achievement of a certain level of development of the VSC components identified at the goal-setting stage (see Table 1.2.4). The levels of integration serve as the basis for the typology of lessons. In order to emphasize the specificity of the content of the lessons in the context of the ratio of interdisciplinary content, the terminology of Professor P. Labudde is used in the title (see Figure 1.9.).

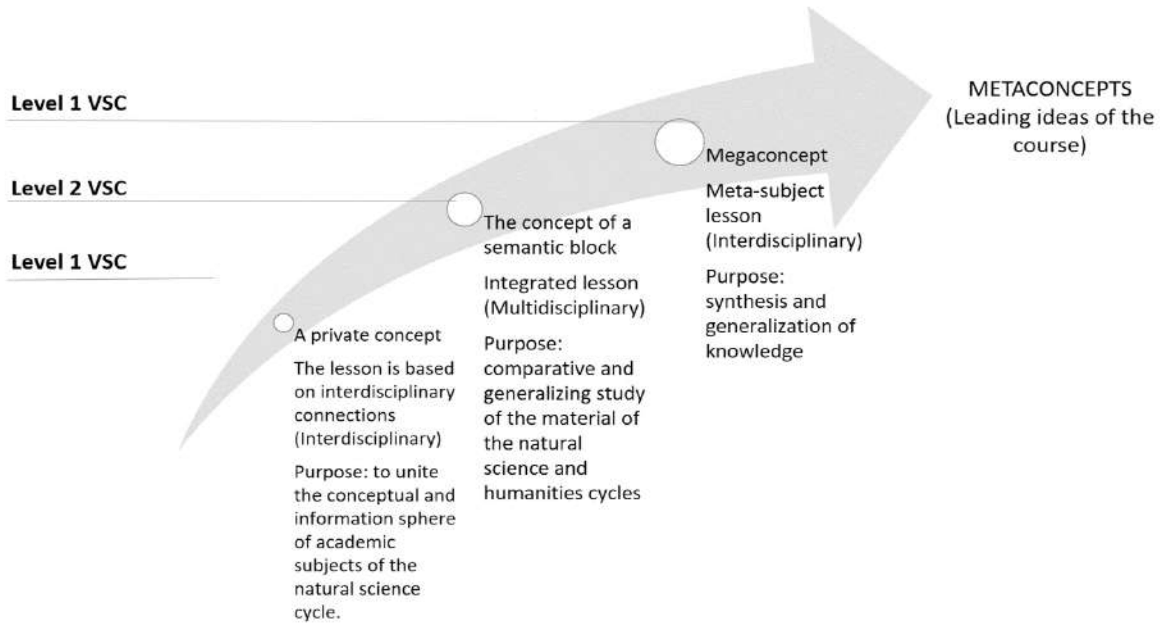


Figure 1.9 – Matrix of the relationship between the level of the concept and the type of lesson

A lesson based on interdisciplinary connections or an interdisciplinary lesson involves the development of particular concepts. The content of which reflects specific knowledge (facts, laws, phenomena, objects) of the educational monopredmet, for consideration of which material from other disciplines of the natural science cycle is involved. The content of this type of lesson is focused primarily on single-subject results that are correlated with the first level of development of VSC components.

The content of the training, organized by the concept of the semantic block (integrated lesson), is mainly focused on a deeper understanding of natural science information, establishing relationships, and evaluating it, which creates conditions for the transition to the next level of development not only of cognitive and integrative-activity components, but also contributes to the formation of the emotional-value component of VSC. We characterize the achievement of such expected educational results as a combination of monopredject and integration results.

The content of the suprasubject nature of the meta-subject lesson contributes to a deep understanding, generalization and synthesis of natural science knowledge integrated into the mega-concept of the course through the prism of the meta-concepts of the course in the unity of contexts, which is an important condition for achieving integration results, i.e. the development of all VSC components at a high level.

This division does not negate the fundamental possibility for the simultaneous development of VSC components, however, it sets key guidelines for the organization of the learning process of the integrated course «Natural Science» based on a concept approach. It also reflects the structure of the organization of the course content in accordance with the levels of integration (see Figure 1.10).

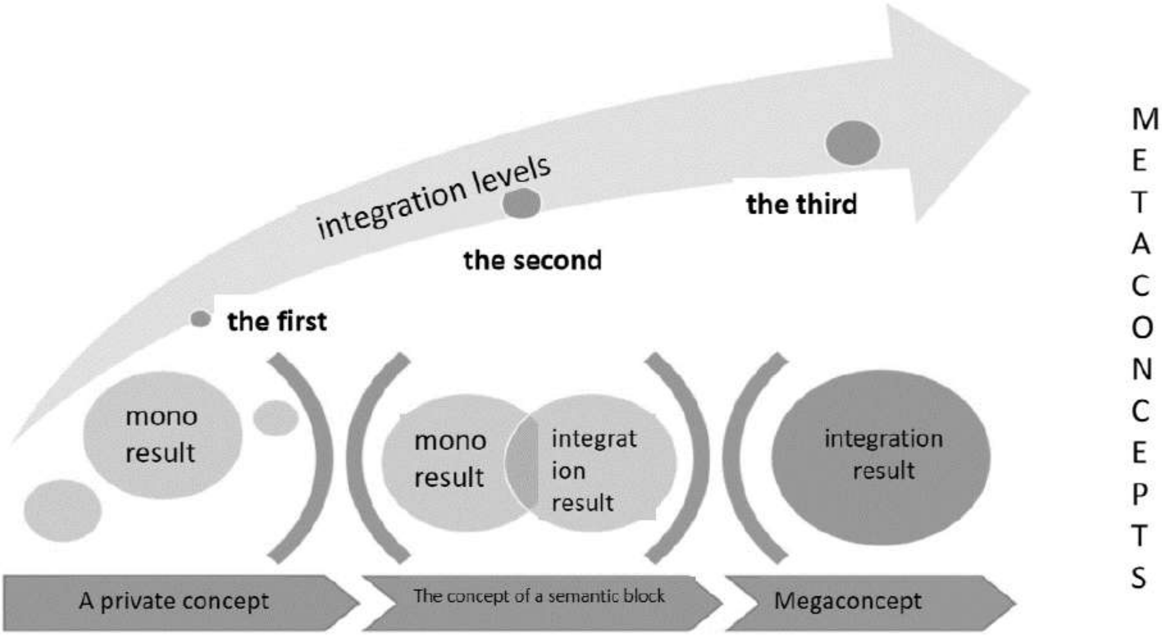


Figure 1.10 – The structure of the organization of the course content in accordance with the levels of integration

The activity unit of the content is COT, aimed at updating existing knowledge in the activity aspect. The hierarchical system of course concepts determines the specifics of the development of COT content [60, 67]. Mastering a concept of a certain level by students involves the implementation of the appropriate type of COT: subject–based - at the level of private concepts, interdisciplinary - when mastering concepts of a semantic block and meta-subject type when working with a megaconcept (see Figure 1.6). The content of the COT covers the material of one or more single-subject courses. Subject COT create conditions for the assimilation of the lesson content on the basis of interdisciplinary connections (intra-disciplinary type). Working with subject COT involves the development of VSC components at the first level, and the planned result can be designated as knowledge-understanding, i.e. it is characterized mainly by the reproductive level.

Interdisciplinary COT are more practice-oriented in nature. The reference point in the preparation of tasks of this type is knowledge-application, which corresponds to a productive level of assimilation of the content. We associate interdisciplinary COT with the development of VSC at the second level of development of VSC components. Their use is advisable when conducting integrated lessons.

The content of the meta-subject COT models activities in conditions as close to real as possible, including professional ones, and correspond to an interdisciplinary type lesson. The situations proposed within the framework of this type of COT provide for a complex nature of activities, which determines the specifics of their development. This requires the involvement of a wide range of knowledge and skills, as well as personal experience and values. The success of solving meta-subject COT by students characterizes the achievement of VSC components of the third level.

The performance evaluation component provides an assessment of the effectiveness of mastering the course «Natural Science», allows you to identify difficulties in mastering knowledge, skills, emotional-value understanding of the course content necessary for the development of VSC students, and also allows you to make adjustments to the course content.

The scale of the concept determines the level of educational results that can be achieved at each stage of assessment [59, 66]. Thus, at the level of private concepts, educational results correspond to monopredject results. At the level of concepts of semantic blocks, the structure of educational results is a combination of monopredject and integration. The integration educational results of students can be recorded at the level of mega-concepts.

The trinity of the VSC structure makes it possible to build a criterion system for evaluating the development of VSC in pedagogical practice. The degree of VSC development in this case determines the level characterizing the effectiveness of the student's mastering IC NS. Since the groups of VSC components that we identify are formed by the student at different stages of the course development, have a complex and end-to-end character, we rank them according to three levels: 1st level (low), 2nd level (medium), 3rd level (high) (see Table 1.3.4). They are consistent with the levels of natural science culture identified by A.V. Mukhanova [85].

Table 1.3.4-Development levels of VSC students

Level	Feature
1 level (low)	Some VSC components are characterized by a low level of development. The student is aware of the main components of the modern natural science picture of the world; has an idea of the main directions and methods of natural sciences, the assignment of which is associated with meeting them in specific situations, in the course of educational and practical activities, as well as in connection with individual characteristics. The attitude to reality is mainly emotional and sensual, which is combined with a low level of awareness of responsibility for the results and consequences of practical, including professional activities. At the same time, the motives of behavior and activity are determined by considerations of personal gain. The student's activity is characterized by a low level of using natural science knowledge to solve practical problems in professional activities and life situations.
2 level (Medium)	It is characterized by a fairly high level of VSC development. Students are shown a positive attitude towards the development of natural science competencies for a modern person and a specialist in the chosen professional field; shows the possession of theoretical knowledge about the main ideas and achievements of natural sciences, understands their intersubject connection; occasionally uses them in the context of future professional activity. The student accepts the values of natural science knowledge for the future profession. The student knows and applies general scientific and natural-scientific methods in the framework of cognitive activity, including in other subject areas, but not in other areas; occasionally shows a need for reflection and creativity. They are shown to be proficient in ways of self-education and understand the need for further continuous natural science education for development in future professional activities. In practice, he tries to avoid solving non-standard situations and making responsible decisions. When solving life (extracurricular) tasks, it mainly acts according to a well-known pattern, in accordance with established stereotypes.
Level 3 (high)	All VSC components are developed. The student shows a strong command of knowledge that reflects the modern scientific picture of the world; and they have a high degree of integration. The student demonstrates readiness to apply existing knowledge and value orientations in fundamentally new situations, and creatively solve life (extracurricular) tasks, including those related to professional activities; is able to make responsible decisions based on the optimal set of tools and methods. The attitude to reality is of a value-based nature, the student purposefully strives to master natural science knowledge in the context of the future profession; in personal experience of behavior and in the process of creative activity, he is guided by the principles of harmonization of relations of the «Nature - Man - Society»system. The student is aware of the importance of the competencies acquired in the process of natural science education for a modern person and specialist. The student is able to reflect on their own activities in the context of the principles of harmonization of relations of the «Nature - Man - Society» system.

These levels represent the stages of mastering VSC. The hierarchy of these stages is determined by the development of VSC components in the relationship.

Practical implementation of the IC NS content selection and development methodology based on the concept approach is presented in section 2.2.

Conclusions on Chapter 1

1. In the SVE system, it is advisable to consider the VSC of future specialists, consistent with its target settings, as the planned educational results of the general education IC NS. The basis for their development is a personal understanding of the interrelationships in the «Man –Nature – Society» system, as well as the assignment of the VSG course content in the context of the mastered professional activity. The reflection in the VSC formulations of the focus on the profile of professional activity determines the specifics of the content and methodological support of IC NS at the SVE stage.

2. The analysis of the concept of «concept» carried out in the pedagogical context made it possible to identify a number of its essential characteristics (diversity and variability of meanings, contextuality of manifestation, dynamism, ambiguity, etc.) and establish its integrative essence. This allows us to consider the concept as a system-forming factor in the integration of natural science and humanities knowledge. In the process of designing the IC NS content based on a concept approach, the concept acts as a didactic unit, defining the specifics of the methodology for designing the content of an integrated educational subject. The concept as an integrator of educational content combines knowledge of various fields of scientific knowledge, practical and emotional experience, as well as value aspects of cognition into a system. The concept approach can serve as the basis for building an integrated methodological system for designing the IC NS content, since it provides for students to comprehend and assign the VSG course as the basis for the development of VSC students of the SVE system, and also allows them to take into account the profile of the profession being mastered.

3. The specification of the multidimensional structure of the concept in the pedagogical aspect, as well as the analysis of the VSC components as a planned educational result, allowed us to determine the structural basis for modeling the integrated course – the hierarchy of concepts: metaconcepts – megaconcepts – concepts of the semantic block – private concepts. The meta-concepts of the content of the course «Natural Science» are the leading ideas of the course, which are consistent with the planned educational results of the course development (VSC students of the SVE system). Metaconcepts serve as the

basis for highlighting the VSG course and clarify the content of pedagogical goal-setting at the course level, topic (megaconcept), sub-topic (concept of a semantic block), lesson (private concept). VSG serve as a guideline in the selection of the content of the training course and create conditions for meaningful activity when students realize the values of natural science knowledge in the process of mastering it. The content of IC NS concepts at the SVE stage is enriched by taking into account the specifics of future professional activity.

4. The VSGs of the course, highlighted at the goal-setting stage, make it possible to clarify the content of three competencies related to the group of emotional-value and fixed in FSES SVE. This makes it possible to decompose the VSC in relation to the course of «Natural Sciences», specifying their components taking into account the specifics of the profession being acquired. The resulting formulations of the VSC components can be considered as planned educational results in the academic discipline «Natural Science» and act as criteria for evaluating the formation of the VSC.

5. The theoretical model of designing the content of IC NS, focused on the development of VSC students of the SVE system, provides for the integrity and interconnection of components due to the concept approach, and includes: a target component (fixing the goal–setting strategy in the system: «VSG of the course – general competencies of the future specialist - the profile of the profession being mastered (FSES SVE requirements)), a meaningful component (a hierarchical system of concepts that reflects the levels of integration of educational material); the procedural component (a system of lessons and COT of different levels in accordance with the hierarchy of course concepts), the performance evaluation component (reflects the hierarchy of educational results in accordance with the hierarchy of course concepts).

CHAPTER 2. APPROBATION OF THE METHODOLOGY FOR DESIGNING THE CONTENT OF THE INTEGRATED COURSE «NATURAL SCIENCE» BASED ON THE CONCEPT APPROACH FOR THE SYSTEM OF SECONDARY VOCATIONAL EDUCATION

2.1. Identification of the level of formation of emotional-value competencies of students in the system of secondary vocational education

The development of students' VSC components in the development of IC NS is associated with the creation of conditions that promote understanding and assignment of the VSG course and the use of natural science knowledge in solving practical problems, including in the context of the future profession. To assess the effectiveness of the developed methodology, experimental work was organized, including ascertaining, searching and forming experiments. A description of the educational experiment program is provided in appendix A.

The development of the program of experimental work was based on the pedagogical experience of the author of the study when testing three approaches to constructing the IC NS content. At the stage of the ascertaining experiment, the course program included three autonomous modules in physics, chemistry, and biology. The search experiment was carried out using the course program developed for students in grades 10-11 of general education organizations. The formative experiment involved testing the author's course program and its methodological support, developed in accordance with the developed model based on a concept approach.

The ascertaining experiment was conducted in the 2015-2016 academic year. It was aimed at identifying the main difficulties and educational needs of students of the SVE system in mastering IC NS. The experiment involved 308 first-year students of the SVE system in St. Petersburg. A prerequisite for the selection of participants was the development of IC NS, which includes three sections presented as relatively independent and integral modules - «Physics», «Chemistry», «Biology».

The goal settings of the ascertaining experiment determined the solution of the following tasks:

- determine the level of students 'understanding of the goals of the integrated course «Natural Sciences» and its significance for solving educational and professional tasks;

- identify the educational needs of students;

- get information about the level of motivation of students to study the course «Natural Science».

To solve these problems, a questionnaire was created for students. When developing the toolkit, the recommendations for conducting a pedagogical study by S. G. Vershlovsky were taken into account [30, 31].

The questionnaire consists of open-ended questions divided into two blocks. The questionnaire was filled out anonymously. The wording of the questions is as generalized as possible.

The questions of the first block-questions 1-4 of questionnaire No. 1 (See Appendix B) - were intended to identify the level of understanding of target settings and subjective assessment of students ' performance in mastering IC NS. Analysis of the responses allowed us to get information about the importance of the course «Natural Sciences» in mastering the program of training middle-level specialists.

The questions of the second block are related to the assessment of the process of mastering the course «Natural Science» from the point of view of the student, are aimed at identifying difficulties in the process of mastering the course and the necessary assistance from the teacher for the successful development of the content. The study of students ' answers revealed the level of satisfaction with the learning process, awareness of mastering techniques and techniques in the learning process; necessary adjustments to the content of IC NS.

In the course of the content analysis of the obtained variants, the answers were highlighted, the wording of which does not contain internal contradictions and relates to the context of mastering the «Natural Science» course. The respondents ' answers were grouped according to the principle of the greatest repeatability, ranked and correlated with the total number of responses to this question as a percentage.

Let us turn to the analysis of the results of the ascertaining experiment.

The first question was intended to identify the level of understanding of the goals of the course «Natural Science». Content analysis of students ' responses showed that the majority of respondents (92.2%) noted: the purpose of the course is to repeat and / or generalize knowledge in physics, chemistry, and biology; 48.1% of the responding students expressed the opinion that the course is aimed at general development; 22.7% of the questionnaires mention the importance of the course in the formation of scientific activity. 14% of respondents ' responses refer to various aspects of natural science knowledge necessary for life safety and health preservation. The data obtained allow us to draw conclusions about the lack of a meaningful understanding of the integrated course's goals. This can be attributed not only to the isolated development of educational material of physical, chemical and biological content, but also to the fact that in the practice of many educational organizations, the teaching of the course «Natural Science» is carried out by different teachers.

The answers to the second question «The course helped me understand...» were distributed according to the frequency of mentions in the questionnaires of respondents as follows: 69.8% – to restore gaps in knowledge in biology, chemistry and physics; 30.2% – how to maintain my health; 24.4% – what are the new directions and achievements in natural science (genetic and cellular engineering, nanotechnologies, space technologies, etc.); 7.8% – everything in nature is interconnected, including the possible consequences of global environmental problems; 7.1% – the cause and specifics of the course of particular natural phenomena and processes. The distribution of responses indicates a low assessment of the role of natural science knowledge as a mechanism for mastering the profession and a tool for solving practical problems. This distribution can be attributed to the predominance of monological forms of presentation of the material.

On the question « natural science knowledge in my profession...», the following results were obtained: 39% of the respondents doubt the need for natural science knowledge; 25% of the answers state that this knowledge is not needed in the profession they are learning; in 16.6% of the questionnaires, respondents are aware of the importance of natural science knowledge, but in the majority of the respondents, they do not understand the importance of They could not give an example in the context of the profession being mastered; only 10.7% of the questionnaires provide examples of the application of the acquired knowledge in future professional activities. This result is attributed to the lack of profilization of the content of the course mastered by students, as well as the lack of examples in educational materials of applying the acquired knowledge in future professional activities.

In the answer to the 4th question, 31.2% of the students who answered summarize their goal setting in the format of «self-realization in the chosen profession»; 20.5% of the respondents who answered define «improving their material well-being» as their further goals; 26.6% expect to clarify and apply the knowledge gained in solving practical and professional tasks; 25.3% of the respondents who answered the respondents indicate their desire to continue exploring the natural world. We assess these results as low readiness to apply natural science knowledge, as a means of self-development and self-education.

Analysis of respondents ' responses to this group of questions allows us to conclude the following:

- when studying the course «Natural Science», built on the basis of relatively independent blocks «Physics», «Chemistry», «Biology», students experience difficulties in understanding the value of natural science knowledge from the point of view of personal significance, mastering the future profession, solving educational and professional tasks;
- students identify the course objectives, but do not fully comprehend them.
- students of the SVE system do not appreciate the role of the science course in mastering their future profession.
- students have difficulties in applying natural science knowledge as a tool for further self-education and self-development;
- students do not fully understand the role of natural science knowledge in solving practical problems.

Next, we will present the results of the survey on the second block of questions (questions 5-8 of questionnaire No. 1. Appendix B).

In the fifth question, respondents were asked to evaluate their activities during the course: 42.9% reflect on their activities at the reproductive level: take notes, rewrite, answer simple questions, etc.; 28.9% of respondents note that they were best able to systematize and classify; 20% - create three-dimensional models.

When answering the question about what they learned from studying IC NS, 26.6 % of students indicated the solution of computational problems in physics and chemistry; 21.8% highlighted the ability to make simple crossing schemes. A significant number of respondents indicated that they have learned to «make abstracts»; 33.4% of the answers can be combined with the ability to explain the conditions of individual natural processes and phenomena.

Variants of answers to the question about what they liked during the course content development were grouped into the following blocks: «form of organization of work in training sessions» - 35.7% (laboratory work was the most mentioned); «content of individual topics» - 38%; «practical significance of educational information» - 8.8%; «independent work format» – 21.1% (at the same time, project activities were the most mentioned). The «other» block – 3.2% – includes judgments that are not directly related to the course content.

Analysis of the answers to the eighth question on possible ways to improve the course gave the following results: 48.3% of participants expressed the opinion that it is necessary to reduce the amount of educational material for independent training; 39.9% of respondents would like more laboratory classes in the course; 33.4% answered with complete satisfaction with the course and no wishes for its change; 31.8% of respondents a subjective assessment of the content of some of the topics that caused the greatest difficulties, or that they would like to consider in more detail, 3.5% of responses did not relate to the course content.

The last question of the questionnaire provided an opportunity to express a subjective position that was not reflected in the main questions of the questionnaire (question 9 of questionnaire No. 1. Appendix B). In 63% of the questionnaires, students noted time savings for mastering three disciplines as positive aspects of the course.

Based on the results of the survey on the second group of questions, the following conclusions were drawn:

- students are aware of the role of practical tasks in achieving educational results;

- students recognize the need to understand various natural objects, laws and phenomena in order to preserve their health and life safety;

- students have difficulties with a large amount of educational material for self-study.

The search experiment was conducted in the 2016-2017 academic year and was aimed at substantiating the potential of the concept approach in the development of IC NS. In the course of the search experiment, we developed and tested lesson models and competence-oriented tasks aimed at understanding concepts of different levels, as well as individual methods of working with the concept.

For this stage of the experiment, the course was designed on the basis of an integrative approach. The reference point was made by the EMC course «Natural Science» of the author's team under the direction of I. Yu. Aleksashina. The course content included occasional use of some techniques for working with concepts. So, as tasks for independent work, students were asked to create concept maps, and when organizing lessons, the technology of logicaland semantic modeling, methods of meaning-making, etc. were used. As part of the course, lessons aimed at understanding concepts of different levels were tested. At the time of completion of the course, a final questionnaire was conducted. 120 St. Petersburg MTC first-year students studying in the specialty «Technology of public catering products»took part in the questionnaire survey.

The goal settings of the search experiment determined the solution of the following tasks:

- to identify the level of students 'understanding of the goals of the integrated course «Natural Sciences» in the context of the leading ideas of the course and its significance for solving educational and professional tasks;

- to study the question of students ' attitude to the use of methods of working with concepts in the learning process.

A questionnaire identical to the one used in the ascertaining experiment was used for the survey (See Appendix B).

In the course of the content analysis of the received variants, the answers were also highlighted, grouped according to the principle of the greatest repeatability, ranked and correlated with the total number of responses to this question as a percentage.

Let's turn to the analysis of the results of the search experiment.

The first question was intended to identify the level of understanding of the goals of the course «Natural Science». Content analysis of students 'responses allowed us to identify four groups of formulations in accordance with the leading ideas of the course: «studying the system of nature to understand the relationships between its components» - 16.0%, «studying the system of nature to understand the interdependence of man and nature» - 19.6%, «studying the system of nature to harmonize relations» Man-Society-Nature»- 14.3%, variants containing combinations of the first three variants-35.7%; answers containing incomplete formulations were classified as «other» and amounted to 14.2%. The data allow us to draw conclusions about the assimilation of the leading ideas of the course.

The second question «The course helped me understand...» allowed us to identify the following groups of answers and their distribution: the largest number of answers are related to understanding nature and knowledge about it as a value (42.9%); the same number of answers is related to understanding the role of natural sciences as an element of professional training and as a tool for solving practical problems (17.9%); 10.8% of responses contained a phrase that reflects the idea of a person as a component of nature; responses that contain incomplete formulations made up 10.8%. This content of answers can be explained by the course's focus on understanding the value of natural science knowledge from the point of view of the personal significance of mastering the future profession, solving educational and professional tasks. At the same time, the distribution of responses indicates a low assessment of the role of natural science knowledge as a mechanism for mastering the profession and a tool for solving practical problems, this can be attributed to the predominance of monological forms of presentation of the material.

The answers to the question «natural science knowledge in my profession...» can be divided into: «necessary/important» (detailed answer) – 50%, «necessary/important, but not sure what exactly» – 28.6%, 12.5% – «not necessary/ not important»; 8.9% – contain contradictory statements. This result is associated with the lack of profilization of the content of the course mastered by students, as well as the episodic nature of solving practice-oriented tasks related to professional activities.

As goals (question No. 4), the majority of respondents identify further development, including professional development based on natural science knowledge- 28.6%; 21.4% - limited themselves to formulations that can be presented as «further learning about Nature»; 21.4% of students show a focus on nature conservation; 17.8% – generalize their goal setting in the format of «full self-realization». We assess these results as a general readiness to apply natural science knowledge as a means of self-development and self-education.

The answers of the respondents to the first part of the questions allow us to note the following:

- students recognize the contribution of the course «Natural Science» to the emotional-value attitude to nature;
- students identify the main ideas of the course, but do not fully comprehend them;
- students of the SVE system do not appreciate the role of the science course in mastering their future profession.
- students are partially ready to apply natural science knowledge as a tool for further self-education and self-development;
- students do not fully understand the role of natural science knowledge in solving practical problems, including in the context of their future profession;

Next, we will present the results of the survey on the second block of questions (questions 5-8 of questionnaire 1. Appendix B).

The survey participants, reflecting on their work during the development of the integrated course «Natural Science», note that the best way was to analyze and draw conclusions-39.3%, the second is the answer «perform creative work» – 35.7%, 25% formulated their answer as «understand the importance of context when considering a question/ isolate meanings», 21.4% of respondents – «draw up diagrams», 10% – «present / model phenomena, facts, consequences», 7.1% – «formulate questions». It should be noted that as creative works, students were asked to structure the educational material on the mastered topic in the format of a concept map and logical-semantic models, the context of the topic consideration was determined by the students themselves.

In the sixth question, students were asked to describe what they learned during the course and evaluate what helped them in this. The analysis of the results showed: to a greater extent, students believe that they have learned to «reason and think logically» – 28.5%, 21.4% – «express their thoughts»; 25% of respondents believe that during the course they learned to «analyze information and draw conclusions»; 17.9% expressed the idea that they have learned «to look «at things more broadly, to look for new meanings»; 4 respondents left the question unanswered (7%). As the main conscious mechanism for acquiring new skills of students, we were interested in the frequency of mentions of technologies for working with concepts, which turned out to be 48.2% (concept analysis, concept maps, logical-semantic models). The correspondence between the formed skill and the specific form of work could not be established. In the second place, students indicated discussions and seminars that were organized using the methods of meaning-making. So, 21.4% - associate the appearance of new skills with the educational material, the form of organizing the lesson (without specifying), a good atmosphere, etc. These options were not ranked due to the difficulty of determining the conditions.

The answers to the question of what you liked during the course of mastering the course content had great variability. We have divided them into blocks: «the form of organization of work in the classroom» – 35.7% (while the most mentioned were the forms of group work: seminars, discussions, conversations, techniques for working with concepts); «the content of individual topics» – 25%; «the practical significance of educational information» – 19.6%; «the format of the proposed creative tasks» – 12.5%;

the «other» block – 7.1% – contains judgments that are not directly related to the content of the course.

A summary analysis of the answers to questions No. 4-7 shows that 60.7% (34 questionnaires) of respondents mention methods of working with concepts as optimal in understanding, comprehending and mastering natural science knowledge. Of these, 23.5% noted the opportunity to express their own opinion on the substance of the issue under consideration as an advantage of using these technologies, 29.4% – the opportunity to structure existing knowledge, 47% - the opportunity to take a fresh look at natural science knowledge and find new meanings.

Analysis of the answers to the eighth question about possible ways to improve the course gave the following results: 28.6% of participants in the search experiment expressed the opinion that it is necessary to reduce the amount of educational material for independent training; 25% gave an answer about complete satisfaction with the course and no wishes to change it; 26.7% suggested increasing the number of interactive methods, 16% of respondents ' responses reflected a subjective assessment of the content of some of the topics that caused the greatest difficulties, or on the contrary, they would like to consider it in more detail; 3.5% of responses did not concern the course content.

The last question of the questionnaire provided an opportunity to express a subjective position that was not reflected in the main questions of the questionnaire (question 9 of questionnaire 1. Appendix B). Here are some answers of students that can be attributed to the content of the course «Natural Sciences»:

- «I want the academic subjects to be more focused on my profession»;
- «The whole course was interesting and informative!»;
- «I wish there were more subjects that teach you to reason»;
- «I understand why I studied biology, chemistry and physics at school!».

Analysis of the respondents ' answers to the second group of questions allowed us to draw the following conclusions:

- students are aware of the role of meaning-making activities in achieving educational results;

- students recognize the need to understand various natural objects, laws and phenomena in different contexts in order to better understand them;

- students positively assess the results of applying various methods of working with the concept.

A comparative analysis of the data from the ascertaining and searching stages of the experiment shows that understanding the content of natural sciences through the prism of the "Man –Nature – Society" system) based on the leading ideas and CSOs of the course (an integrative approach has a positive effect on understanding the value of natural science knowledge from a position of personal significance, as well as on the willingness to apply natural science knowledge as a tool for further self-education and self-development. At the same time, there remains insufficient influence on students' understanding of the role of natural science knowledge in solving practical problems, including in the context of a future profession. The results obtained determine the need for coordination of the CSR course content in the context of the acquired professional activity in the course design.

The occasional inclusion in the course content at the stage of the search experiment of some techniques for working with concepts, as well as lessons aimed at understanding concepts of different levels, about.

Empirical data from ascertaining and search experiments served as the basis for confirming the relevance of the study, clarifying the developed model and the features of the organization of experimental work.

The experimental work in the 2017-2018 academic year included several stages aimed at testing the developed methodology.

Taking into account the purpose of the study, as well as the complexity and dynamism of competencies as an educational result, the formative experiment was of a longitudinal nature and assumed the study of VSC dynamics in the same group of students during the school year. Three types of data were used as sources for obtaining diagnostic data: data obtained by registration as a result of observation, as well as expert assessments; data that recorded achievement indicators for educational products; and data on the self-assessment of the subject. The completeness and objectivity of diagnostics was ensured by a combination of these data sources.

The experimental group consisted of 57 first-year students 2017 – 2018 academic year from St. Petersburg MTC. Students were trained in the specialties «Technology of public catering» and «Organization of service in public catering». The experimental group was formed on the basis of comparability of the contingent: by age (16-17 years); by the equivalence of the conditions of training and basic training (admission of cadets is conducted on the basis of general secondary education after grade 9; the curriculum of the first year of study is completely identical); the general sphere of middle-level specialties being mastered – the sphere of public catering (socio-economic profile).

To determine the key indicators used in the experimental work, the method of expert assessments was used. The group of experts included teachers of general educational organizations and institutions of the SVE system that teach the subject «Natural Science», students of advanced training courses and professional retraining on the basis of St. Petersburg APPE. The total number of interviewees was 56 people.

At the first stage of the experimental work, the initial level of formation of the VSC components of the students of the experimental group was revealed according to the system of criteria and indicators developed within the framework of the theoretical part.

To solve this problem, a combined input diagnostic work was developed, containing a questionnaire part with open and closed questions (see Questionnaire 2. Appendix C). The questions of the complex questionnaire were formulated in accordance with the selected criteria and indicators of the development of the VSC components of students in the course «Natural Science» and aimed at identifying the level of both cognitive and emotionalboth the value and integrative-activity components of each of the VSCs.

For the possibility of evaluating a separate component, a point-based system of assessment of development was used for each indicator: 1 point – low level, 2 – medium, 3-high, 0 – no component/no data.

To assess the overall picture in the experimental group in terms of cognitive, emotional-value, and operational-activity components for each VSC, we summed up the responses of all students for each component. Since the indicators differ in the degree of integration, the summation was carried out in accordance with the weighting coefficient established by the expert assessment method. Let us present a general cyclogram of the distribution of cognitive, emotional-value, and integrative-activity components in the first VSC (see Figure 2.1), where the gradation by numbers 1, 2, and 3 corresponds to the low, medium, and high level of development of the VSC components. An analysis of the comparison of data for the first VSC (see Figure 2.1) shows the level of natural science training of students mainly above average, which generally correlates with a high average score of the certificate at the time of admission. Let us explain that the results of the comprehensive questionnaire were compared with the level of natural science training of students on the basis of scaling the results of the input diagnostic work, which included questions on the content of physics, chemistry, biology of the main school.

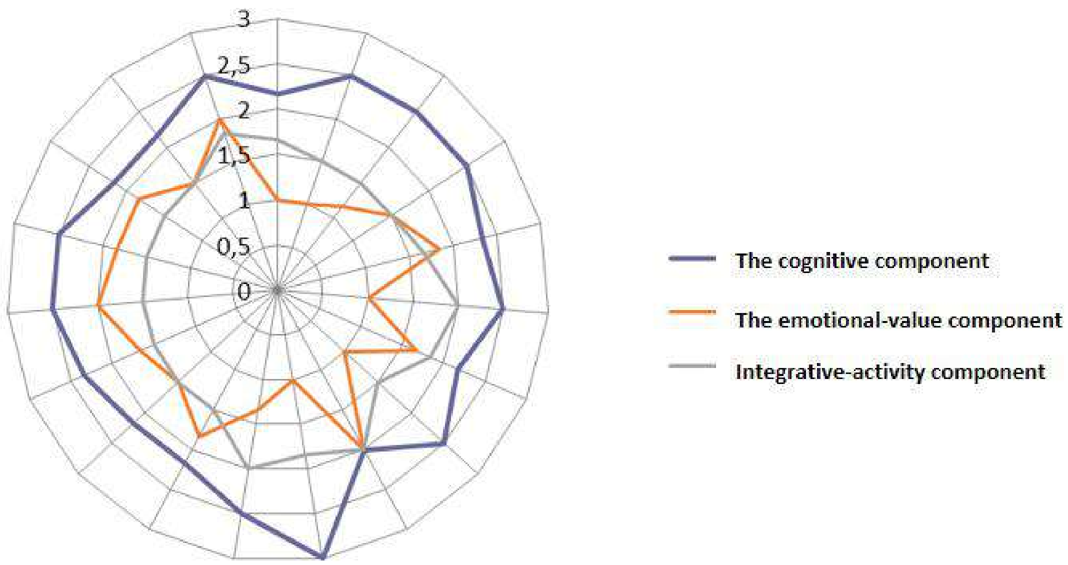


Figure 2.1-The degree of development of the components of the first VSC of students in the experimental group at the entrance control stage

The results of the distribution (see Table 2.1.1) indicate a high proportion of students who have formed ideas about the need to organize a scientific approach to the study of the surrounding world (63.2%). The average value in the field of understanding the role of natural science knowledge in practical activities is shown by 78.9%.

We also diagnosed the level of students ' awareness of the need for scientific knowledge in their future profession, which characterizes the emotional and value component of the first VSC. Analysis of indicators of the level of manifestation of the emotional and value component of respondents showed the following distribution (see Table 2.1.2):

Students demonstrate a low level (73.7%) of emotional and sensory attitude to the surrounding reality. These data generally correspond to the data on the pragmatic orientation of value attitudes at this age [125]. Quite often, the transition from school to the SVE system is motivated by the desire of students to finish their studies faster and start earning their own income. The level of meaningfulness of the practical significance of natural science knowledge (see Table 2.1.2) affects the underestimation of general natural science knowledge for the future profession (63.2%).

The results of the distribution of data on the ability and readiness of students to apply the main methods of scientific knowledge are presented in Table 2.1.3. The average data for the first two indicators indicate the meaningfulness of using natural science methods to solve practical problems in educational activities. The results show the potential ability of students to use these methods in solving problems related to future professional activities. The low level of the third indicator is associated with a lack of experience in solving problems that model professional activity, as well as an insufficient amount of information about the components of the natural science picture of the world that can be encountered in the professional sphere. It should be noted that first-year training in these specialties involves only general education training.

In general, the analysis of the results for the three components of the first VSC shows a fairly similar picture among students. This is also reflected in the identification of a general trend in the experimental group. For this purpose, the relative values of the VSC components, which serve as criteria in our study, were rolled up in accordance with the specific weight established by expert assessment methods: cognitive criterion – 16.7%, integrative-activity criterion – 33.3%, emotional-value criterion – 50%.

Table 2.1.1-The level of mastering students ' knowledge about the modern natural science picture of the world and methods of natural sciences (first VSC)

Indicators of the cognitive criterion	low level	medium level	high level
-has an idea of the main characteristics of the modern natural science picture of the world and its place in the holistic scientific picture of the world	26.3%	10.5%	63.2%
- knows the nature of relations in the system «Man-Nature-Society»	5.3%	10.5%	84.2%
- understands the importance of natural science knowledge for practical (professional) activity in the system «Man-Nature-Society»	5.3%	78.9%	15.8%

Table 2.1.2-Students ' awareness of the place of their future profession in the «Man - Nature - Society» system (first VSC)

Indicators of the emotional-value criterion	low level	medium level	high level
-emotional and sensual attitude to the surrounding reality	73.7%	26.3%	0.0%
- accepts the values of natural science knowledge for the future profession	63.2%	36.8%	0.0%
- purposefully strives to master natural science knowledge in the context of the future profession	36.8%	57.9%	5.3%

Table 2.1.3-The level of students ' use of basic methods of cognition (observation, scientific experiment, etc.) to study various aspects of the natural science picture of the world (first VSC)

Indicators of the integrative-activity criterion	low level	medium level	high level
-understands how to use natural science methods to solve practical problems	0.0%	73.7%	26.3%
- he is able to use natural science methods to solve problems related to future professional activity	0.0%	68.4%	31.6%
- he is able to apply the basic methods of cognition to study various aspects of the natural science picture of the world, which there is a need to face in the professional sphere	100.0%	0.0%	0.0%

The obtained values were scaled, which made it possible to determine the level of the first VSC of students participating in the experiment (see Figure 2.2). Criterion scores were also determined by expert analysis (up to 1.5 – low level, from 1.5 to 2.5 – medium level, more than 2.5 – high level).

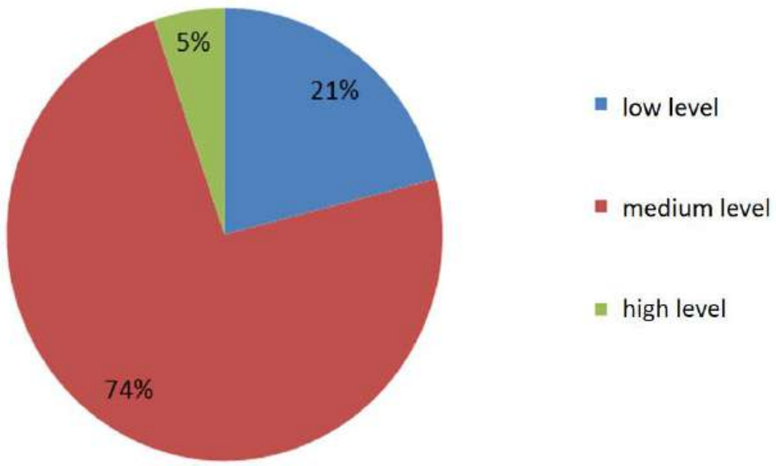


Figure 2.2. – The level of development of the first VSC students of the experimental group at the entrance control stage

Let us consider the results of identifying the initial level of development of the components of the second VSC of students (see Figure 2.3).

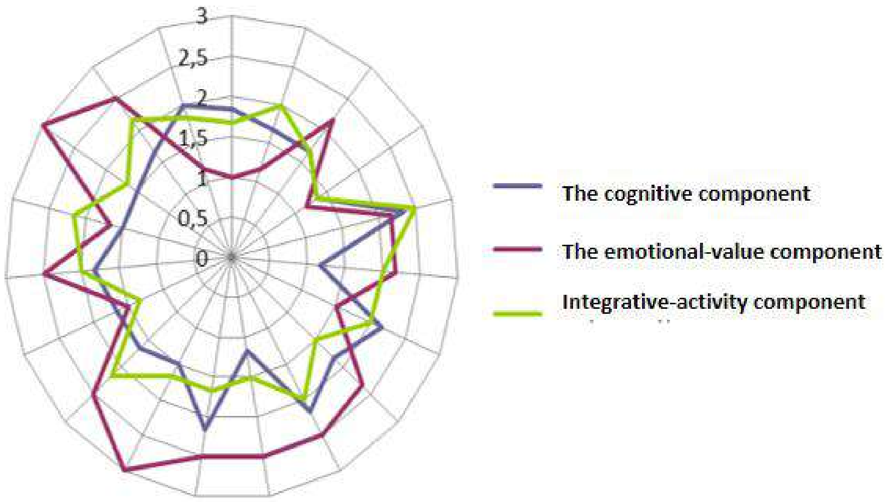


Figure 2.3 – - The degree of development of the components of the second VSC of students in the experimental group at the entrance control stage

The results of empirical data on the three criteria of the second VSC, in general, allow us to note a large number of intersections in the range of values corresponding to the average level of manifestationof VSC components, where the gradation by numbers 1, 2, 3 corresponds to a low, medium and high level of development of VSC components.

Empirical data obtained at the entrance control stage indicate an average awareness of students about the main areas of natural science (63.2%). Students demonstrate the need for knowledge about important ideas спothat have contributed to the development of engineering and technology in general, as well as in the field of their specialty. The results of the questionnaire show readiness to master natural science knowledge relevant in the context of the profession being mastered, which correlates with the data for the first VSC.

The results for the cognitive, emotional-value, and integrative-activity components of the second VSC are presented below (see Tables 2.1.4-2.1.6).

Analyzing the results obtained, we come to the conclusion that the students ' level of mastering the system of value orientations is insufficient, which is manifested in the number of responses at low and medium levels and indicates the formal assignment of moral, moral and ethical principles and norms of relations in the «Man-Nature»system. Insufficient awareness of the negative impact of the professional activity chosen by students does not allow us to conclude that they are fully aware of the possible consequences. The high level of this indicator (63.2%) is attributed to the fact that environmental problems are considered at the end of the development of science courses in the main school.

Table 2.1.4 - Students ' level of mastering knowledge about the most important ideas and achievements of natural science that have had a decisive impact on the development of engineering and technology, including in the aspect of the acquired profession (second VSC)

Indicators of the cognitive criterion	**low level**	**medium level**	**high level**
-familiar with the main areas of natural science	5.3%	63.2%	31.6%
- knows the most important ideas and achievements of natural science that have had a decisive impact on the development of technology and technology, including in the aspect of the acquired profession	63.2%	36.8%	0.0%
- assigns natural science knowledge necessary for the development of for future profession	31.6%	57.9%	10.5%

Table 2.1.5 Level of development of confidence in the possibility of knowing the lawsof nature andusing the achievements of natural sciences for the development of civilization and improving the quality of life (second VSC)

Indicators of the emotional and value criterion	low level	medium level	high level
-has an understanding of the moral, moral and ethical norms and principles of the «Man – Nature»	relationship 15.8%	73.7%	10.5%
- understands the consequences of the anthropogenic influence of humanity on Nature, including in the aspect of the acquired profession	26.3%	10.5%	63.2%
- assigns a system of social relations to VSG and leading course ideas	47.4%	42.1%	10.5%

Table 2.1.6-The level of readiness of students to develop intellectual, creative abilities and critical thinking during the simplest research, analysis of phenomena, perception and interpretation of natural science information (second VSC)

Indicators of the integrative-activity criterion	low level	medium level	high level
-understands how to conduct simple research, analyze and interpret natural science data	10.53%	42.11%	47.37%
- is able to use various sources to obtain natural science information and assess reliability in order to achieve his goals and objectives	set 10.5%	84.2%	5.3%
- is able to independently acquire natural science knowledge and creatively solve practical problems, including in professional activities	42.1%	57.9%	0.0%

The level of development of the first two components can be compared with the data on the indicators of the integrative-activity component (see Table 2.1.6). The low level of VSG assignment, which serves as the basis for harmonious development in the «Man - Nature – Society» system, correlates with the low and average willingness of students to independently acquire natural science knowledge and creatively perform practical tasks in educational and professional activities. We associate this with a predominantly developed reproductive and algorithmic level of skills. This is confirmed mainly by the average level identified among students in terms of their abilities to extract and process natural scientific information using different sources. At the same time, students demonstrate difficulties in analyzing and evaluating the information received, which is illustrated by indicators of a high level of integrative-activity component.

In general, the initial level of development of the second competence in students taking part in the experiment can be interpreted on the basis of the obtained data as an average (see Figure 2.4).

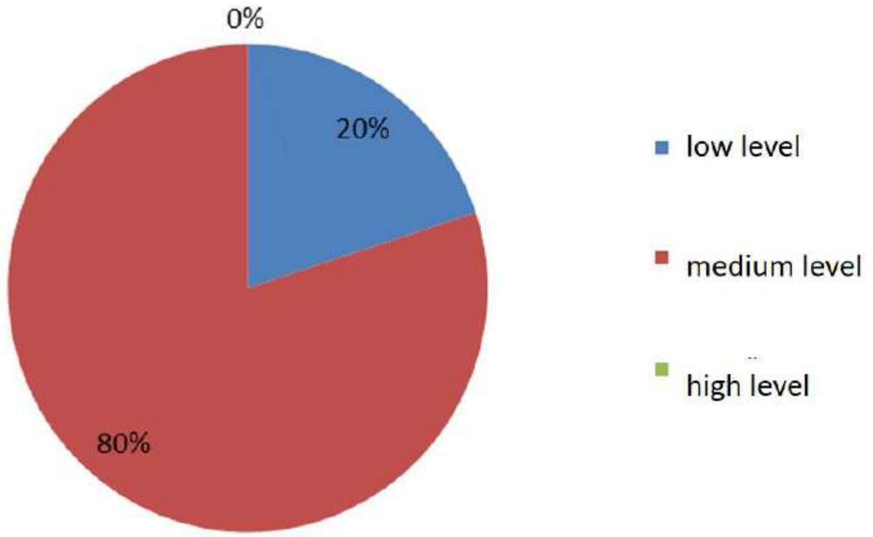


Figure 2.4. - The level of development of the second VSC students of the experimental group at the stage of entrance control

Summary analysis of data on the level of development of the components of the third VSC allows us to record a decrease in the level of manifestation of the operational-activity component in the group in comparison with the cognitive and emotional-value components. These results are presented in a cyclogram format in Figure 2.5. (values 1, 2, and 3 correspond to low, medium, and high levels of VSC component development).

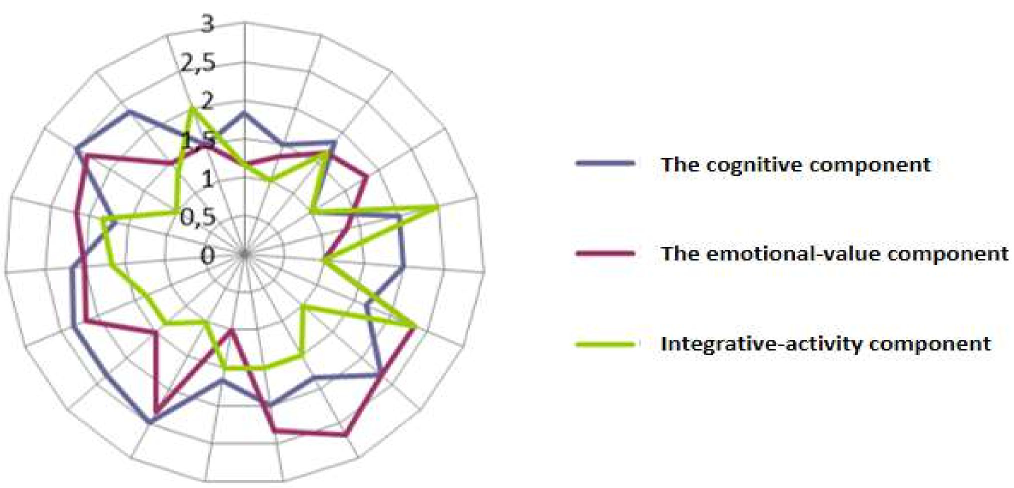


Figure 2.5-The level of development of components of the third VSC of students in the experimental group at the entrance control stage

The results of the distribution of students by VSC 3 components are shown below in Tables 2.1.7-2.1.9. The analysis of the results shows the average level of mastering knowledge about ways to establish relationships in the «Man - Nature - Society» system. At the same time, more than 50% of students showed high results in the areas of applying natural science knowledge in practice and their transformative role. Data on the first and third indicators of the emotional-value criterion indicate the need for students to understand the significance of competencies acquired in the process of natural science education for a person and society, which, presumably, will contribute to the assessment of educational and cognitive activity as a way to understand the harmonious development of the «Man-Nature - Society»system.

Table 2.1.7 - Students ' level of mastering knowledge about ways to harmonize relations in the «Human – Nature – Society» system (third VSC)

Cognitive criterion indicators	**low level**	**medium level**	**high level**
-has an understanding of the system organization of nature	15.8%	52.6%	31.6%
- knows the areas of application of natural science knowledge in practice (in the sphere of future professional activity) and their transformative role	15.8%	21.1%	63.2%
- understands the main ways of sustainable development of the «Man - Nature» system - Company «	47.4%	52.6%	0.0%

Table 2.1.8-Level of students ' awareness of the importance of natural science knowledge for explaining the phenomena of the surrounding world, perception of information of natural science and professionally significant content (third VSC)

Indicators of the emotional-value criterion	**low level**	**medium level**	**high level**
-it refers to educational and cognitive activity as a way of understanding the harmonization of relations in the «Man - Nature - Society» system.	42.1%	47.4%	10.5%
- understands the degree of responsibility for the results and consequences of practical activities, including in the aspect of the acquired profession	42.1%	21.1%	36.8%
- understands the importance of competencies in the field of natural sciences for humans and society	36.8%	57.9%	5.3%

Table 2.1.9-The level of readiness of students to apply natural science knowledge in their professional activities and everyday life (third VSC)

Indicators of the integrative-activity criterion	**low level**	**medium level**	**high level**
-represents how to apply natural science knowledge in professional activities and life situations	63.2%	31.6%	5.3%
- has mastered the basics of self-education in the field of natural science to improve their own intellectual development in the chosen professional activity	47.4%	36.8%	15.8%
- is able to make responsible decisions, including in professional activities, based on the principles of sustainable development of the Human - Nature - Society system	system 68.4%	31.6%	0.0%

The aggregate of data obtained during the survey on the integrative-activity component is presented further in Table 2.1.9 and shows mainly a low level of manifestation of this component of the third VSC among students; 68.4% of students make decisions based on the principles of sustainable development to a lesser extent, which we attribute to a low level of understanding of these principles and students ' awareness of responsibility for results and the consequences of practical activities, including professional ones.

In general, evaluating the components of the third VSC, we can conclude that the average level of development of individual students. The results are clearly presented in the form of a diagram in Figure 2.6.

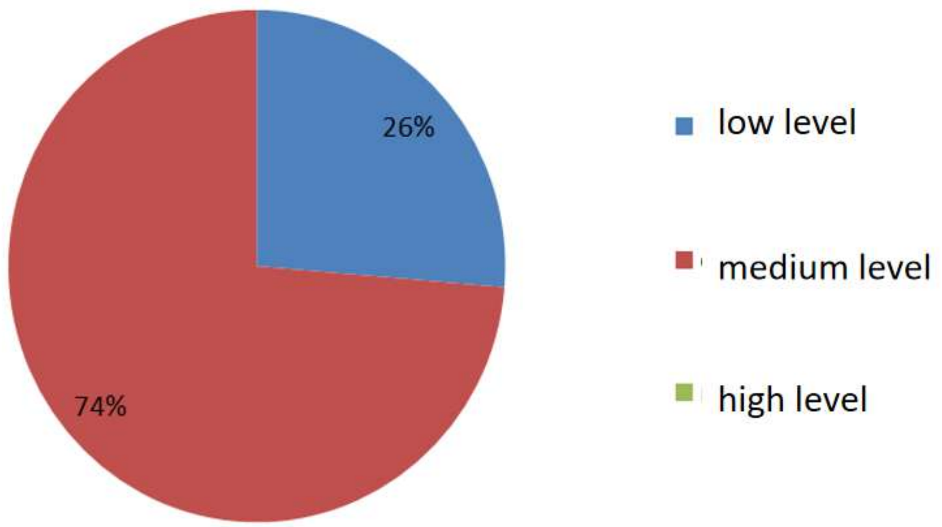


Figure 2.6-The level of development of the third VSC students of the experimental group at the entrance control stage

Analysis of the results of the input diagnostic work performed by the participants of the experimental group allows us to draw the following conclusions:

- students demonstrate an average level of development of the cognitive component in all three VSCs, which confirms the representativeness of the sample;
- students are aware of the importance of competencies acquired in the framework of natural science education for the individual and society;
- students experience difficulties at the operational level in the search, processing and application of natural knowledge to solve problems of educational and professional activities;
- students demonstrate low readiness to independently acquire natural science knowledge and creatively solve practical problems

Based on the results of the ascertaining and search experiments and the first (preliminary) stage of experimental work to identify the degree of development of components for each VSC, approaches to the construction of the second (main) and third (final) stages of the forming experiment are determined. During the testing of the integrated course «Natural Science», built on the basis of the developed methodology, the dynamics of the development of VSC components during its development was revealed. A detailed description of the implementation of the methodology for designing the course content is presented in the next paragraph.

2.2. Implementation of the methodology for designing the content of the integrated course «Natural Science» for the system of secondary vocational education based on a concept approach

The results obtained in the course of ascertaining and search experiments, as well as data on the level of VSC development of students before the start of the course, determined the peculiarities of the formative stage of the experiment, which provided for the implementation of the developed methodology (described in paragraph 1.3).

The main element of this stage was the testing of EMC in the discipline «Natural

Science» for these specialties, including the work program, lesson scenarios and COT in accordance with the proposed typology.

Based on the analysis of existing textbooks on natural sciences, the EMC of the author's team edited by I.Y. Aleksashina was chosen as the concept basis for the design of the course as being most focused on the development of VSC students according to leading ideas and target settings, as well as close to the implementation of a concept approach in terms of content structure [9]. The content of the EMC training material has been redesigned in accordance with the hierarchy of concepts allocated for the development of a course for the SVE system, and expanded in accordance with the requirement of profiling the content, as well as the specifics of the future profession. For example, when selecting the educational material of the course «Natural Sciences» for the specialties «Catering Technology» and «Catering organization», additional educational material was identified, which is considered in the course based on a concept approach from a higher methodological position: the basics of sanitation and hygiene; the principle of operation of the equipment used in professional activities; features of the preparation of diets for different groups of the population; modern approaches to the processing and preparation of food products; issues of food safety, etc. The volume of the student's mandatory classroom workload for mastering the curriculum of the discipline amounted to 82 hours.

Based on the goals formulated in accordance with the logic «from VSG to VSC», we started to work on designing content that meets the intended educational outcomes described by us in the format of VSC components and characteristics. This was done on the basis of logical-semantic models. The sequence of procedures for constructing logical-semantic models allowed us to identify the hierarchy of IC NS content concepts (see Figure 2.7).

The K1 axis is represented by the meta-concepts of the course, which define the contexts of consideration of natural science information. The K2 – K9 axes show the key megaconcepts of the course, the consistent consideration of which contributes to the understanding of megaconcepts and illustrates the logic of the content of the integrated course «Natural Science». Thus, megaconcepts define: «Science», «Structure», «System», «Movement», «Self-organization», «Technology and Technology», «Health», «Noosphere». The K10 axis captures the planned educational results of the course development.

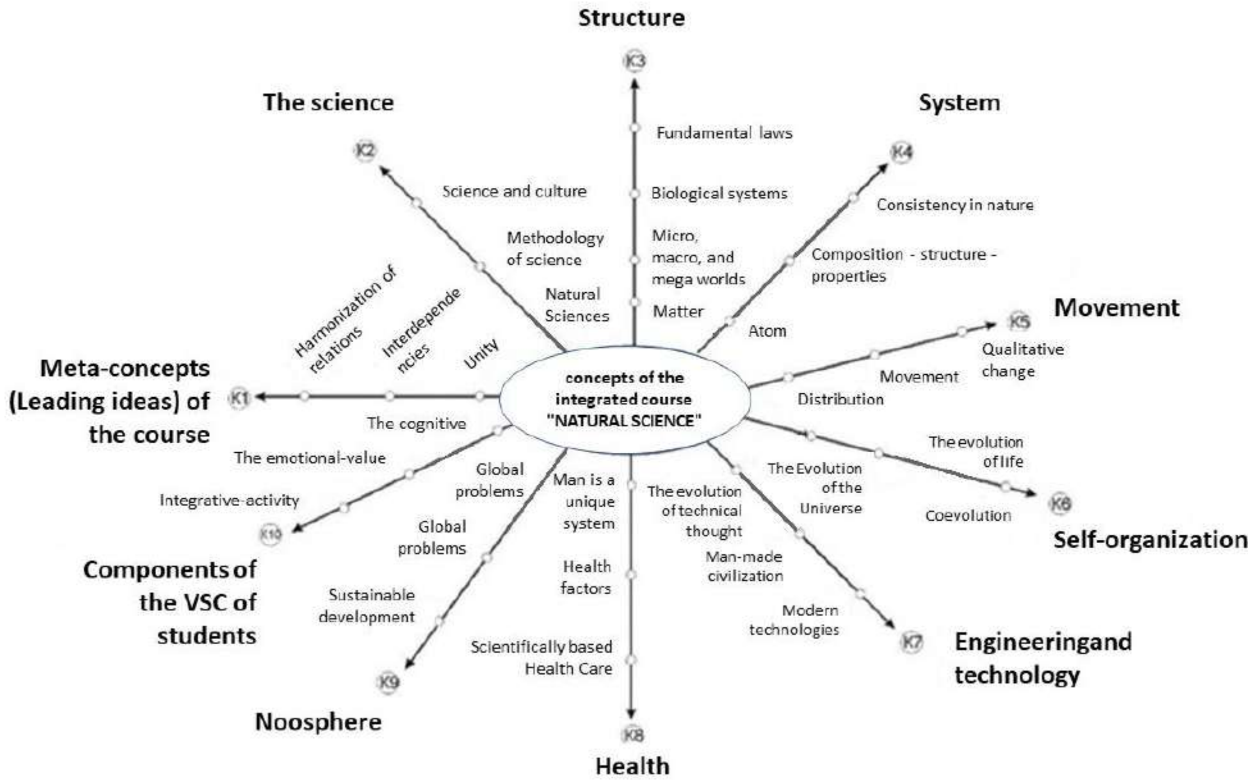


Figure 2.7-Logical and semantic model of IC NS content

Each megaconcept includes content considered in the context of the course's meta-concepts (leading course ideas). In the course structure, the megaconcept is implemented in the course topic format. Structuring the content of the course «Natural Science» on the basis of concepts involves the implementation of the modular principle. Functional nodes (goal achievements) act as modules (structurally oriented blocks). The hierarchical system of concepts allows you to form common didactic goals and forms links with the meta-concepts (leading ideas) of the course. Thus, each topic represents a complete training module. The list of course topics based on the selected mega-concepts is presented in Table 2.2.1.

Table 2.2.1-Compliance of mega-concepts and IC NS topics

No.	**Megaconcept**	**Topic title**
1.	Science	Natural science knowledge
2.	Structure	of the Structure of the natural world: unity of diversity
3.	System	From structure to properties
4.	Movement	Nature in motion, movement in nature
5.	Self	-organization From chaos to order
6.	Technology and technologies	Evolution of technical thought
7.	Health	to Healthy everything is healthy
8.	Noosphere	Civilization of mankind

Further refinement of the content of megaconcepts allowed us to identify the concepts of the content of the integrated course «Natural Science», the levels of semantic blocks and private ones. Figure 2.8 shows how the hierarchical system of topic concepts is defined by the content of the corresponding megaconcept using the example of a topic.

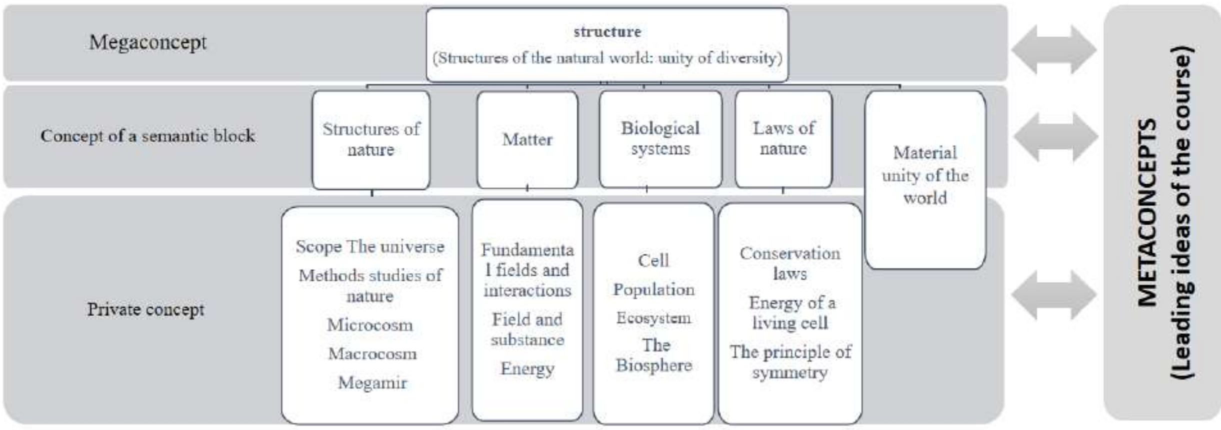


Figure 2.8. - Structure of the megaconcept «Structure» (theme «Structures of the natural world: unity of diversity»)

Next, we will present in detail the features of implementing the structural components of the methodology.

The target component of the methodology reflects the specifics of the target settings for mastering concepts, which are specified for the topic, sub-topic, and lesson.

The main idea of the topic is formulated as follows: The structure of the natural world reflects the interrelationships of the components of nature, which are the basis for the functioning of natural systems.

In turn, the refinement of VSG concepts of semantic blocks is reflected in the following guidelines (see Table 2.2.2):

Table 2.2.2-Value-semantic guidelines for concepts of semantic blocks

The concept of the semantic block	Value orientations
of the structure of nature	Micro -, macro-and Megaworld as proof of the possibility of studying nature by man. The system organization of nature, which includes both the person himself and his interaction with other natural components.
Matter	Material unity of nature as a proof of the commonality of chemical and physical processes in nature, which are the basis for the functioning of nature in general and the human body in particular; explanation of the diversity of the surrounding world.
Laws of nature	Unity of the laws of nature as a proof of universal interrelation and interdependence in nature.
Biological systems	Unity of the structure of living organisms as proof of the unity of origin and evolutionary development. Biogeochemical role of living things, including humans, as a manifestation of unity and integrity in nature.
Unity of Nature	Energy transformation as a basis for understanding interdependence in the «Man – Nature – Society» system.

VSG concepts of the semantic block set the perspective of the consideration of educational information and are reflected in the formulations of the target settings of lessons, contribute to the consistent development of these concepts and determine the orientation of the VSC components.

The content component of the methodology reflects the structural organization, logic and consistency of the content of the integrated course presented in the concept structure.

Structuring of the educational material of the topic is carried out in the context of each lesson, which is constructed on the basis of the formulated VSGs. Thus, the combination of lessons sets a possible direction for mastering the mega-concept of the topic (See Appendix D).

Mastering particular concepts in the context of meta-concepts of the course helps students identify the values and meanings of objects, laws, and phenomena of various nature (physical, chemical, and biological) offered for consideration, and helps them form an idea of moral, moral, and ethical norms and principles in the «Man-Nature»system. Mastering particular concepts of the course «Natural Science» is inextricably linked withthe use of natural science methods for solving practical problems. The result of working with a particular concept is that students understand how to conduct simple research, analyze and interpret natural science data. The inclusion of a professional context in the concept structure focuses on the conscious application of natural science knowledge in life situations and professional activities.

The concepts of the semantic block have a high degree of generalization of natural science information. The comprehension of the concept of the semantic block is aimed at establishing interdisciplinary connections, which focuses on understanding the nature of the relationship between man and nature, assessing the impact of human activity on nature, realizing the degree of responsibility for the consequences of practical activity in the aspect of the acquired profession. Particular issues of professional activity in the course of natural science are justified from a higher methodological position. The planned educational results of the concepts of the semantic block are also associated with a more conscious application of natural science methods to solve problems related to future professional activity; developing skills to use a variety of natural science information and its critical understanding; mastering methods of continuous self-education in the field of natural science education for development in future professional activity.

The functional purpose of megaconcepts of the course «Natural Science» is to transfer the results of mastering particular concepts and concepts of semantic blocks to a higher level of integrity, which is reflected in the intended educational results. Students build their own mega-concept on the basis of an awareness of the importance of competencies in the field of natural science education and the assignment of the VSG system and the leading ideas of the course, which is manifested in the student's purposeful desire to master natural science knowledge in the context of the future profession.

Mastering the megaconcept «Structure» allows you to understand and comprehend the content of educational information in the context of course meta-concepts. Simultaneous consideration of various objects of nature (physical, chemical, biological) creates the basis for understanding nature, on the one hand, as a developing multi-level system; on the other hand, it helps to assess the general essence of natural processes as internal changes in systems and energy transformations.

Consideration of the interrelationship of various structures of the natural world – corresponding to the macro-, micro- and megaworlds - illustrates the objectivity of natural laws, and also contributes to the conviction that the unity of physical and chemical processes is valid for all manifestations of life. Conditions are also being created for the formation of a lifestyle and behavior focused on the harmonious development of the «Man – Nature – Society» system, since consideration of the diversity of manifestations of natural processes focuses on understanding the impossibility of carrying out processes that contradict the laws of nature.

Considering a person as a component of nature, as a natural phenomenon based on the understanding that as a part of nature, he obeys its laws, so any human activity, including professional, should be carried out on the basis of knowledge of the laws of life of ecosystems.

An example of classroom planning and content is shown in Table 2.2.3.

Table 2.2.3-Content of the topic « Structures of the natural world: unity of diversity «(megaconcept «Structure»)

Concept of the semantic block	**Lesson No. in**	**the topic Lesson**	**topic Content**
of the Structure of nature	1.	Scale of the Universe	Variety of objects of the Universe. Methods of studying the micro -, macro-and Megaworld. Instrumental methods for studying mega-and micro-world objects. A microscope. A telescope.
Matter	2.	Fundamental fields as components of matter	Fundamental fields, fundamental interactions, electromagnetic, gravitational interaction
	3.	Particle-wave dualism	Photoelectric effect, Quantum, photon, Conditions for the manifestation of particle corpuscular and wave properties.

	4.	Interaction of matter and	the Energy field. Types of energy. Thermal radiation
Structures of nature	5.	Unity of diversity. Microcosm	Fundamental interactions in the microcosm: strong and weak interactions. The atomic nucleus. Neutron, neutrino.
	6.	Unity of diversity. Megaworld.	How the universe works. The solar system. Hierarchy of objects in the universe.
Biological systems	7.	Unity of diversity: biological systems	Signs of life; levels of organization of life, characteristics of levels of organization of life; the principle of hierarchy. Populations, ecosystems
	8.	Molecular structure of living	organisms Elementary cell composition; proteins, fats, carbohydrates, nucleic acids, minerals; water
	9.	Cell as a structural unit of living organisms	Structure and functions of cells. Mitosis, a variety of life forms.
	10.	Biosphere	Biosphere
Laws of nature	11.	The most general laws of nature. Conservation	laws The law of conservation of energy, the law of conservation of momentum, the law of conservation of angular momentum, the law of conservation of mass
	12.	Energy of a living	cell Energy (metabolism), principles of regulation of populations, ecosystems
	13.	Unity of nature. Symmetry	is the principle of symmetry in nature. Conservation laws. Breaking of symmetry, Symmetry in art
Material unity of the world	14.	Generalizing lesson	

The proposed lesson topics certainly do not exhaust the content of the concepts of semantic blocks, since they are designed to illustrate the general strategy for selecting and structuring educational material based on the integration of natural science and humanities knowledge in the «Man-Nature – Society» system for all groups of professions/specialties, in the course of which the «Natural Science»course is being developed. Their fullness with particular concepts can be significantly expanded if there is enough study time. The same factor largely determines the possibility of including the necessary laboratory and practical work, including those that take into account the specifics of professional activity.

Taking into account the specifics of professional activity is carried out through enriching the content of course concepts based on the analysis of the formed professional competencies of a specialist. For example, the analysis of professional competencies of the specialty 44.02.01 Preschool education (FSES No. 1351 of October 27, 2014 No.: PC 1.1. Plan activities aimed at strengthening the child's health and physical development; PC 1.4. Carry out pedagogical monitoring of the health status of each child, promptly inform the medical worker about changes in his well-being), predicts the consolidation of content of the mega-concept «Health» by including specific concepts: Physiological characteristics of preschool children; Problems of maintaining the health of preschool children, etc. In relation to the course we are developing, the content of lessons and COT of the mega-concept «Health» in the aspect of scientifically based rational nutrition, relevant for specialties related to public catering, was clarified.

Process component

The development of the concepts of the course «Natural Science» in experimental work was carried out in the format of lectures and practical lessons. Let us remind you that the concept approach does not cancel the traditional forms of work organization, but clarifies the approaches to lesson design. The system of topic concepts allows you to identify lessons that correspond to three types, which differ in the level of integrativity of the educational content. The types of lessons and educational technologies used when working with private concepts are shown in the Table 2.2.4.

Table 2.2.4-Lesson system on « Structures of the natural world: Unity of diversity «(megaconcept: Structure)

Concept of semantic block	**no.**	**Lesson topic Lesson**	**type**	**Technologies of the concept approach**
Structures of nature	1.	Scales	of the Universe	Integrated Concept analysis, intelligence maps
Matter	2.	Fundamental fields as components of matter	Intersubject	Logical-semantic modeling

	3.	Particle-wave dualism	Intersubject	Logical-semantic modeling
	4.	Interaction of matter and field	Integrated	Concept map
Structures of nature	5.	Unity of diversity. Microworld	Intersubject	Concept map, intellectual swing
	6.	Unity of Diversity. Megaworld.	Intersubject	Concept Map, Intelligent swing
Biological systems	7.	Unity of Diversity: Biological Systems	Integrated	Integrated Concept analysis, logical chain
	8.	Molecular structure of living	things Intersubject	Five questions
	9.	Cell as a structural unit of living organisms	Intersubject	Concept map
	10.	Biosphere	Integrated	Logicaland semantic modeling
Laws of nature	11.	The most general laws of nature. Laws of conservation	Intersubject	Concept Map,
	12.	Energy of living	Integrated	things, Logicaland semantic modeling
	13.	Unity of nature. Symmetry	Metasubject	Synthesis of the concept
Material unity of the world	14.	Generalizing lesson	Metasubject	Synthesis of the concept

Let's take a closer look at the description of the specifics of designing the content of lessons of the considered types.

Lessons based on intersubject connections (intradisciplinary lessons) are aimed at understanding a particular concept (Appendix E). A particular concept, representing a key definition, concept, key principle described by a particular science, is based on the educational content of a single-subject training course. The relevance of the introduction of specific scientific knowledge is justified by the need to comply with the fundamental principle and is determined by the expediency of disclosing the essence of the megaconcept of the topic. Consideration of particular concepts allows you to expand the scope of the megaconcept of the topic, outline key relationships with other private concepts. The model topic defines as particular concepts: fundamental fields; Megaworld, molecular structure of the living, cell and others, implemented in the format of corresponding lessons-this is the first level of integration (see Table 2.2.4.) As an illustration, we will give examples of the target settings of lessons of this type.

Lesson «Fundamental fields as components of matter»

Purpose: to create conditions for students to understand the role of fundamental interactions existing in nature as the basis for the existence of our world in general, and life on our planet in particular.

Lesson «The cell as the structural basis of living organisms»

*Purpose: to create conditions for students ' awareness of the principle of unity of diversity on the example of the cell structure as an elementary biological system of the ontogenetic level of organization of living*things.

Integrated lessons (multidisciplinary). The accumulation of the content of several disciplines within the framework of integrated lessons actualizes the consideration of the concept of a semantic block in different contexts. Attracting humanitarian and cultural information, students ' values, and personal experience creates conditions for integrating educational information at a higher level (Appendix F). Lessons of this type are an important part for mastering the megaconcept. Integrated lessons can begin the development of the concept of a semantic block, helping to comprehend the versatility of the concept under consideration, identify key points that cause difficulties in understanding students, and identify the value significance of this knowledge for students. For example, the lesson «The Scale of the Universe», which is the first lesson of the topic, not only updates knowledge about the diversity of objects and phenomena in the Universe, but also allows you to understand the logic of the development of the topic as a whole in the process of joint activity of the teacher and students. Multidisciplinary lessons that complete the consideration of the concept of the semantic block do not just summarize the knowledge gained during lessons of intradisciplinary content, their key task is to direct students in the process of collective semantic activity to identify and assign new meanings. At the same time, a deeper integration, in comparison with intradisciplinary lessons, allows us to consider the educational material at a higher level of consideration, while highlighting the most general and significant principles and patterns. As an illustration of the objectives of the integrated lessons of the topic, here are some of them.

Concept of the semantic block «Biosphere»

The purpose of the lesson *is to create conditions for students to understand the biosphere as an ecosystem of the highest hierarchical level of a planetary scale, the structure of which is represented by ecosystems of a lower hierarchical level and depends on their state and interaction with each other (transfer of matter, energy, information) between ecosystems and their components.*

Concept of the semantic block «The energy of the living»

The purpose of the lesson: *to create conditions for students to understand the fundamental nature of the law of conservation of energy on the example of the functioning of biological systems (open dynamic systems); to understand the essence of metabolism as a process of energy transformation of different types; to understand the unity of the organic world.*

Metasubject (or interdisciplinary) lessons on target settings involve a deep synthesis of the educational content of the topic (megaconcept) (Appendix G) and are not reduced to simple summation and generalization. The metasubject of the content focuses the goal setting on recreating the integrity of the image and enriching the emotional-value sphere of students in the context of the megaconcept being mastered. The content of such lessons has a high level of practice orientation. The focus is on a problematic situation that cannot be resolved only through knowledge of the natural science field. This creates conditions for activating the creative potential of students, readiness to apply non-standard approaches to solving problems. Meta-subject lessons involve consideration of the mega-concept of the topic in the context of the meta-concepts of the course, identifying its place in the system of course concepts and a holistic natural science picture of the world, thereby creating conditions for the integration of the mastered educational material and rethinking the VSG topic into a system of personal meanings. This makes it possible not only to assess the importance of natural science knowledge for society and nature, but also for the development and self-improvement and self-education. Simultaneous consideration of the contexts defined by the system of concepts of the topic contributes to semantic activity, creates conditions for the practical application of natural science knowledge, encourages responsible decision-making, predicts the development of optimal strategies for solving problems of educational and professional activities. Let's fix the specifics of the target settings of meta-subject lessons with the following example:

Mastering the megaconcept «Structure»

The purpose of the lesson: *to create conditions for students 'awareness of the material unity of the world as the basis of the structure and properties of its objects, which are objects of study in various fields of scientific knowledge; students' value and semantic choice in the context of the concept of «Structure», including in aspects of future professional activity.*

In accordance with the hierarchy of concepts, we distinguish three types of COT, mainly related to a certain type of lesson [8, 60, 66, 67].

Subject COT. It is built on the basis of subject material, possibly with the involvement of additional material from related disciplines, revealing the scope of a particular concept. This type can be attributed to a partially reproductive one, as it captures the students' understanding of the educational material mastered during the interdisciplinary lesson and the existing basic knowledge of the students. Tasks can combine several typical tasks, or contain an excessive or insufficient amount of data. At the same time, the subject content is expanded by including an activity component in the formulation of the task. So, when designing the subject COT, questions were used concerning the basic terms, concepts, facts, phenomena considered within the framework of a specific interdisciplinary lesson, and the content of the educational assignment was developed in accordance with Bloom's taxonomy. When performing a subject COT, the student needs to comprehend the information presented in various forms. The cognitive significance of completing a task consists in constructing a solution algorithm, combining already known methods of action to solve other tasks (tasks). Subject COT can be both a didactic unit of the lesson, acting as a mechanism for updating knowledge, consolidating the educational material of the lesson on the basis of interdisciplinary connections, and form the basis for students' independent work on practicing basic educational actions.

As an example of a practical COT, here is a test question:

Recall three examples of objects belonging to the micro-, macro- and megaworlds, and write them down, arranging them in order of increasing dimension. What is the connection that, in your opinion, exists between them?

Another example of a practical COT:

Almost all living organisms (a number of bacteria, fungi, animals, plants) on Earth breathe to provide oxygen to the body. This process is necessary for the oxidation of complex organic compounds, accompanied by the release of energy, which is used to ensure all vital processes. Of course, you can imagine how a person breathes, but how can you prove that plants also breathe?

Intersubject COTS are becoming an important element of integrated lessons. The task can be performed using knowledge from several subject areas, and it is assumed that this knowledge is more deeply integrated, since during the solution, the student needs to analyze the condition and highlight the contexts of these areas. To solve this type of task, students need to independently create algorithms that were previously unknown to them. Students need to find the missing data that is necessary for solving the task, which increases the level of independence. At the same time, the final result may change depending on the strategy chosen by the student. Intersubject COT involves a deeper analysis, synthesis, and evaluation of multidisciplinary learning information. Tasks can be offered in various forms, including completing logicaland semantic models [107], drawing up intelligence maps, identifying connections in concept maps, etc.

Thecпоmodel of intersubject tasks of natural scienceorientation, describedin the works of O. A. Abdulayeva [2], was used as a reference point for constructing intersubject COT and SPO. Here is an example of an intersubject taskoffered to students of the specialties «Technology of public catering» and «Organization of public catering»:

Plants are autotrophs by their way of nutrition. They synthesize the necessary organic substances on their own, using energy The sun.
1. Explain how the problems of photosynthesis and the provision of food to the world's population are related.
2. Draw up a diagram (figure) illustrating the role of global environmental problems in this.

The content of *metasubject* COT in the most general form is based on real situations related to the mega-concept of the topic, for the resolution of which it is necessary to apply not only knowledge from different subject areas, but also acquired by students in practice, in everyday experience. The data used in the preparation of tasks of this type are as close as possible to real life and professional ones (technological processes, equipment used, object sizes must correspond to reality). When developing the content of tasks of this type, an algorithm for constructing situational tasks was used, proposed by a research team led by O.V. Akulova [5]. The solution of such tasks is associated with the identification of new meanings, which implies the creative nature of mastering the educational material. Working with metasubject COT allows you to translate the sensory image developed during the development of private concepts and concepts of the semantic block into personal meanings. Performing this type of COT reveals how deeply students have understood the educational content in the context of the VSG megaconcept (topic). As an example, here are fragments of contextual practice-oriented metasubject COT offered to students of the specialties «Public Catering Technology» and «Public Catering Organization»:

Example of task 1:

Using the text «Vitamin C» and your knowledge, justify at least three ways to maximize the preservation of vitamin C that can be used in the preparation of vegetable dishes.

The text for the task «VITAMIN C»:

Vitamins are biologically active organic compounds of different chemical nature, vital for the normal functioning of the body.
Water-soluble vitamin C, or ascorbic acid, plays an important role in the redox processes of the body, affects metabolism. The body's resistance to various diseases decreases with a lack of this vitamin. The absence of it leads to a disease - scurvy. The vitamin is found in plant foods. There is especially a lot of it in currant berries, rosehip, greens parsley, dill, red pepper. The daily consumption rate is 70 - 100 mg. Vitamin C is extremely unstable in the external environment and quickly breaks down when heated. It is not stable in an alkaline environment; it is rapidly oxidized, losing its biological activity.

Example of task 2:

1. *Using knowledge about the processes occurring during cooking meat, prove the guilt or innocence of the cook.*
2. *Suggest two ways that can be used to reduce meat weight loss.*
3. *Evaluate the importance of heat treatment of meat in human nutrition.*

The text for the task «Is the cook a thief?»:
In the book «Employee of the Cheka» by authors A. Lukin and D. Polyanovsky in 1960, a story based on a historical fact is given:
Meat was delivered to the hospital. It seemed to the two wounded men on duty in the kitchen that the cook wanted to appropriate a part for himself. They demanded that the meat be weighed in front of them. When the dinner was cooked, they again demanded to weigh the meat, and it turned out that more than twenty pounds were missing. The wounded became agitated. Everyone who could walk besieged the kitchen. No matter how the cook dodged, no matter how he swore that the meat was simply boiled, no one listened to him. A twenty-pound lump seemed implausible. The case seemed as clear as day: embezzlement! The cook, and at the same time all his assistants, were tied up and locked in the basement. There was a whiff of lynching in the air.

It is important to note that tasks of the meta-subject type can have a different format of activity: drawing up concept maps and LSM, writing essays (for example, «Symmetry in cooking», «Cook-work according to the laws of nature»), working with contextual tasks.

The selection of educational technologies for organizing a lesson is determined by the main pedagogical task of teaching IC NS – the task of rethinking students through the prism of leading course ideas (metaconcepts) VSG megaconcepts of the course and their assignment as a system of personal meanings underlying the components of the VSC. We will present a description of some methods and technologies that have shown their effectiveness in teaching practice.

Let us remind you that the development of concepts is possible in various ways. This variety can be divided into two types. The first one – concept synthesis-involves restoring the integral image of the concept by integrating its constituent concepts, images, associations, etc. Another involves fragmenting the existing image of a concept to its reduced forms in order to further identify relationships and determine ways to expand its content. This type of work with concepts is defined as concept analysis. It should be noted that concept analysis, as a technology for mastering integrated courses of natural science orientation, is considered in detail in the research of I. A. Sherstobitova [135, 136].

The proposed educational model of concept synthesis is built on the basis of four stages. The first stage of the work – associative-figurative (study No. 1 *«World of Associations»*) - involves the selection of associations to the concept. This stage is aimed at integrating individual knowledge about the concept and stereotypes of perception of the concept in culture, updating the system of values and meanings of the student, his emotional and sensory perception. The second stage-vocabulary (study No. 2 *« In the beginning there was a word...»*) - includes working with dictionary definitions of the concept. At the third stage of concept analysis – dialogical *(*study No. 3 *«The word in the dialogue of cultures»)* – linear and nonlinear (subject, intersubject, metasubject)» deployment « of the concept is carried out. The fourth stage-identifying the values and meanings of knowledge *(*study No. 4 *«Values and meanings»)* - students construct hypotheses for the development of the concept in modern science and culture. These stages can become the basis for constructing a whole lesson, or they can becпoused as elements of one of the lesson stages.

The implementation of the concept synthesis strategy in educational activities can be illustrated by the example of the author's development of a lesson in the technology of working with a thing [58, 62]. The work in the lesson is built on the basis of a specially organized mono-exhibition. The proposed training model for working with a mono-exhibition includes a number of stages. **Step 1 «Getting acquainted with the thing»:** provides for a comprehensive study of the subject by students (visual, tactile, olfactory, etc.), which actualizes the emotional and value perception of students ' own activities. **The next step is «Comprehending the meaning of things»:** this stage is aimed at forming a holistic image of the thing under study (eqsponata), filled with multiple meanings. This is achieved by attracting additional information in the form of texts of various nature (continuous, non-continuous texts, composite texts, etc.). **The final step is «Comprehending the meaning of a concept»:** it creates conditions for fixing the integral image of a thing as a concept, synthesizing and interpreting multiple meanings and filling them with its own. This stage involves organizing creative transformative activities, during which students interpret the meanings embedded in things and fill them with their own meanings. For this work, as stimulating tasks, creative orientation is advisable: to make a «list of questions to the thing»; to write an essay on the concept being mastered, etc.

Another variant of the educational model of concept synthesis is a lesson developed in the technique of meaning-making (Appendix G) [61]. The lesson involves going through two consecutive stages. The first stage is aimed at the semantic actualization and understanding of the megaconcept «Structures of the natural world» by students. At this stage, it is advisable to use the «Association» or «Alphabet» method. The second stage is directly related to the development of one's own meanings, the presentation and exchange of individual meanings, as well as the generalization of meanings. This stage is organized in the model of the «Working with concepts» methodology. Each stage is accompanied by a reflection of the participants.

When designing the lessons, we relied on the techniques proposed by S. Kashlev [55]. So, at the final stage of the lesson «Biological systems: unity of diversity», students were offered the «Logical chain» technique, during which groups of students in the process of discussion put together a logical chain and justify the sequence of the proposed group of words and phrases. In the lessons «Unity of diversity. Megaworld» and «Unity of diversity. Microworld» at the final stage, the students were offered the «intellectual swing» method. The essence of the reception is to organize an operational discussion. The teacher suggests a problematic question (or several questions) for discussion. Addressing a particular student, the teacher invites him to speak on the proposed problem. In the course of his statement, he comments on how intensively the student «swings the intellectual swing».

The multidimensionality and multidimensional nature of the concept creates conditions for a multiplicity of «inputs». As a form of graphical fixation of the volume and structure of the course concept, students were invited to use technologies for compiling «Concept maps» and «Logical and semantic models» [107]. Drawing up graphic images of concepts becomes both an object of independent work of students, and can act as a mechanism for organizing a lesson.

When working with texts, certain techniques of the technology of developing critical thinking were used. In our work, we relied on the developments proposed in the research of E. V. Ivanshina [108].

The panorama of the presented methods is not limited to the examples given, and can be expanded in the course of teaching. Structural and content guidelines of lessons are developed for all megaconcepts of the course. The appendices include a description of lesson models aimed at understanding some concepts of different levels of the topic «Structures of the natural world: unity of diversity» (Appendices E, F, G).

Performance- evaluation component.

If the value component of the VSG megaconcept, identified at the goal-setting stage, predicts the target settings of lessons, then the semantic component is reflected in the wording of the planned educational results of each lesson and determines the vector of development of the cognitive, emotional-value and integration-activity components of students ' VSC [59].

The criteria for the development of students ' VSCs in the process of mastering the course «Natural Science» are their components, and indicators are the levels of development of their characteristics, which reflect the degree of awareness, comprehension, and development of natural science knowledge in the context of course meta – concepts.

The hierarchy of lessons and the corresponding COT, set by the concept system, ensures the achievement of specific educational results. Thus, lessons based on interdisciplinary connections (interdisciplinary) are more consistent with the results of monopredject, which can be achieved by means of a single subject of the natural science field. Integrated lessons related to the content of several subjects can contribute to achieving not only single-subject, but also integration results. The meta-subject content of interdisciplinary-type lessons presupposes the achievement of integrative learning outcomes.

Types of educational outcomes in the VSC format are reflected in the formulations of the model components in accordance with the level of competence development.

The levels and characteristics of VSC components identified at the goal setting stage serve as guidelines for evaluating educational outcomes (see Tables 1.3.1-1.3.3). By the method of expert assessments, the components of each VSC group obtained characteristics in accordance with the selected levels. The single-subject results correspond to the VSC characteristics that reflect the first level of development of the components of each of the VSCs (see Table 2.2.5).

Table 2.2.5-Characteristics of VSC development at the level of a particular concept

VSC	**Characteristics of VSC components**		
	Cognitive	**Emotional-value**	**Integration-activity**
first VSC	- has an idea of the main characteristics of the modern natural science picture of the world and its place in the holistic scientific picture of the world;	- has an emotional-sensory attitude to the surrounding reality	-understands how to use the natural-scientific methods for solving practical problems
second VSC	-gets acquainted with the main directions of natural science	-has an understanding of the moral, moral and ethical norms and principles of the «Man – Nature»	relationship-understands how to conduct simple research, analyze and interpret natural science data
third VSC	-has an idea of the system organization of nature	-belongs to the educational process.- cognitive activity as a way of understanding the harmonization of relations in the system «Man-Nature-Society».	- represents how to apply natural science knowledge in professional activities and life situations

This level of planned educational results in the course «Natural Science» reflects the continuity of natural science education in primary and high schools. Achieving the level of meta-subject educational results is consistent with the planned educational results of linear (single-subject) courses. The assessment is subject to the degree of awareness of the main components of the modern natural science picture of the world; the formation of ideas about the main directions and methods of natural sciences. Another indicator of the level of meta-subject educational results is the level of use of natural science knowledge to solve practical problems in professional activities and life situations.

We will further consider the results, which are a combination of single-subject and integration learning outcomes, and reflect the second level of development of the components of each of the VSCs (see Table 2.2.6).

Table 2.2.6. - Characteristics of VSC development at the level of the concept of the semantic block

VSC	**Characteristics of VSC components**		
	Cognitive	**Emotional-value**	**Integration-activity**
first VSC	- knows the nature of relations in the system «Man - Nature - Society»	- accepts the values of natural science knowledge for the future profession	-is able to use natural science methods to solve problems in
second VSC	-knows the most important ideas and achievements of natural science that have had a decisive impact on the development of technology and technology, including in the aspect of the future profession	-is aware of the consequences of the anthropogenic impact of humanity on Nature, including in the aspect of the acquired profession	-is able to use various sources to obtain natural science information and evaluate the reliability of achieving the set goals and objectives
third VSC	-knows the areas of application of natural science knowledge in practice (in the field of future professional activity) and their transformative role	-is aware of the degree of responsibility for the results and consequences of practical activities, including in the aspect of the acquired profession	-has mastered the ways of self-education in the field of development in the chosen professional activity

This level of planned educational outcomes implies a higher level of integration of natural science content based on intersubject connections. The involvement of culturological educational material, information about the professional sphere being mastered, orients students to a deeper understanding of the course content in the aspect of the acquired profession, creates conditions for awareness of the consequences of professional and other practical activities on nature.

Integrative results, which reflect the highest level of development of the components of each of the VSCs, are presented in Table 2.2.7. Achieving this level of educational results by students is based on confident knowledge that reflects the modern natural science picture of the world, which has a high degree of integration.

Table 2.2.7. – Characteristics of VSC development at the level of megaconcept

VSC	Characteristics of VSC components		
	Cognitive	**Emotional-value**	**Integration-activity**
first VSC	- understands the importance of natural science knowledge for practical (professional) activities in the system «Man-Nature - Society»	- purposefully strives to master natural science knowledge in the context of the future profession	- applies the following methods: basic methods of cognition for studying various aspects of the natural science picture of the world that you need to face in the professional sphere
second VSC	-assigns natural science knowledge necessary for the future profession	-assigns the VSG system and leading course ideas	- is able to independently acquire natural science knowledge and creatively solve practical problems, including in professional activities
third VSC	-understands the main ways of sustainable development of the «Man - Nature - Society» system	- understands the importance of competencies in the field of natural sciences for people and society	- is able to make responsible decisions, including in professional activities, based on the principles of sustainable development of the «Human - Nature – Society» system

At this level, students ' readiness to apply their existing knowledge and value orientations in fundamentally new situations and creatively solve life (extracurricular) tasks, including those related to professional activities, is assessed. Students ' awareness of the importance of competencies acquired in the process of natural science education for a modern person and specialist, and their focus on mastering natural science knowledge in the context of their future profession are integral indicators of integrative educational results.

The presented formulations of the characteristics of the components of each VSC are not exhaustive and mutually exclusive. This is due to the fact that all components of competencies are integrated in the personality structure. The identified criteria and indicators for each level of mastering the hierarchy of course concepts formed the criteria base of the study and were used to analyze the effectiveness of the development of VSC students of SVE institutions in the study of IC NS, designed on the basis of a concept approach.

Based on the criteria base of the study, the level of development of students 'VSCs was analyzed based on the results of students' educational activities (results of COT, essays, concept maps, logical-semantic models, etc.) and the results of pedagogical observation based on the results of mastering each megaconcept (topic). Intermediate results of the study on the level of VSC development of students in the course of studying a discipline at the stage of a formative experiment are shown below (see Table 2.2.8). They record the presence of an increase in the development of VSC students from topic to topic, which made it possible to make sure that the use of a concept approach in studying the course «Natural Science» provides positive dynamics.

Table 2.2.8 – Dynamics of VSC development of students in the course of studying the integrated course «Natural Science»

No. of intermediate control	**Subject of the training course**	First group of VSC			Second group of VSC			Third group of VSC		
		Low level	Medium level	High level	Low level	Medium level	High level	Low level	Medium level	High level
1	Natural science knowledge: diversity of unity	5.3%	52.6%	42.1%	15,8%	73,7%	10,5%	15,8%	73,7%	10,5%
2	Structures of the natural World: unity of diversity	5,3%	47,4%	47,4%	5,3%	84,2%	10,5%	10,5%	78,9%	10,5%
3	From structure to properties	5,3%	42,1%	52,6%	5,3%	73,7%	21,1%	10,5%	68,4%	21,1%
4	Nature in motion, movement in nature	5,3%	36,8%	57,9%	5,3%	73,7%	21,1%	5,3%	52,6%	42,1%
5	From chaos to order	0,0%	26,3%	73,7%	5,3%	73,7%	21,1%	5,3%	42,1%	52,6%
6	Evolution of technical thought	0,0%	21,1%	78,9%	0,0%	73,7%	26,3%	5,3%	36,8%	52,6%
7	Everything is healthy	for a healthy person 0,0%	21,1%	78,9%	0,0%	63,2%	36,8%	0,0%	31,6%	63,2%
8	The civilization of humanity	0,0%	21,1%	78,9%	0,0%	57,9%	42,1%	0,0%	31,6%	68,4%

2.3. Analysis of the effectiveness of the development of emotional-value competencies of students of secondary vocational education in the study of the integrated course «Natural Science» on the basis of a concept approach

To determine the effectiveness of the developed methodology, we analyzed the dynamics of development of each VSC of students participating in the experimental group.

Identification of the level of development of the components of each VSC after mastering the course «Natural Science» was carried out on the basis of rating scales of students 'achievements, products of students' educational activities obtained in a formative experiment (results of performing COT, essays, concept maps, logical-semantic models, etc.), intermediate research results and pedagogical observation (see Table 2.2.8). We also used data from the final questionnaires (see Questionnaire 3. Appendix K). Objectivity and comparability of the results were achieved by using a single criteria base of the study to evaluate the data (see section 2.2). The cognitive component of the first VSC showed positive dynamics in three indicators (see Table 2.3.1).

Table 2.3.1-Dynamics of students ' knowledge development level about the modern natural science picture of the world and methods of natural sciences **(first VSC)**

Indicators of the cognitive criterion	**Start of the experiment**			**End of the experiment**		
	low level	**mediu m level**	**high level**	**low level**	**mediu m level**	**high level**
-has an idea of the main characteristics of modern NSPW and its place in the holistic scientific picture of the world	26,3%	10,5%	63,2%	5,3%	15,8%	78,9%
- knows the nature of relations in the system «Man-Nature-Society»	5,3%	10,5%	84,2%	5,3%	5,3%	89,5%
- comprehends the importance of natural science knowledge for practical (professional) activity in the system «Man-Nature-Society»	5,3%	78,9%	15,8%	15,8%	57,9%	26,3%

The results of the comparative analysis indicate a change in the level of students ' ideas about the modern natural science picture of the world and its place in the holistic scientific picture of the world. This is confirmed by a decrease in the number of students showing a low indicator from 26.3% at the beginning to 5.3% at the end. This confirms the increase in the number of students demonstrating a high level of development of the third component. At the same time, we pay attention to the redistribution of values for the third indicator, which we associate with the fact that five students decided to change their learning profile during the first year. This assumption is confirmed by the distribution of results in dynamics by the emotional-value component of the first VSC (see Table 2.3.2).

Table 2.3.2-Dynamics of students ' awareness of the place of their future profession in the «Man - Nature - Society» system (**first VSC**)

Indicators of the emotional-value criterion	**Start of the experiment**			**End of the experiment**		
	low level	**medium level**	**high level**	**low level**	**medium level**	**high level**
-emotional and sensual attitude to the surrounding reality	73,7%	26,3%	0,0%	31,6%	31,6%	36,8%
- accepts the values of natural science knowledge for the future profession	63.2%	36.8%	0.0%	0.0%	47.4%	52.6%
- purposefully strives to master natural science knowledge in the context of their future profession	36,8%	57,9%	5,3%	47,4%	36,8%	15,8%

The absence of changes in the dynamics at the average level for the first two indicators is associated with an increase in the number of students who showed a high level at the end of training, and a decrease in the proportion of those students who showed a low level. There is a noticeable increase in the proportion of students who demonstrate interest in obtaining knowledge of natural sciences in the future.

The dynamics of development of the integrative-activity criterion of the first VSC is presented below (see Table 2.3.3).

Table 2.3.3-Dynamics of the level of students ' use of basic methods of cognition (observation, scientific experiment) to study various aspects of the natural science picture of the world **(first VSC)**

Indicators of the integrative-activity criterion	**Start of the experiment**			**End of the experiment**		
	low level	**medium level**	**high level**	**low level**	**medium level**	**high level**
-understands how to use natural science methods to solve practical problems	0,0%	73,7%	26,3%	0,0%	31,6%	68,4%
-is able to use natural-scientific methods to solve problems, including among future professional activities	0,0%	68,4%	31,6%	0,0%	63,2%	36,8%
- he is able to apply the basic methods of cognition to study various aspects of the natural science picture of the world, which there is a need to face in the professional sphere	100%	0,0%	0,0%	5,3%	89,5%	5,3%

The analysis of the comparison of the results for the first indicator illustrates the positive dynamics for the first indicator, which has a positive effect on the actual use of basic methods of cognition to study various aspects of the surrounding reality. At the same time, some students showed a high level (5.3%), demonstrating their willingness to use these methods in the professional field. Note that the values for the second indicator remained almost unchanged. This is due to the fact that students do not have experience in solving problems related to their future professional activities.

Based on the experimental data obtained, we are able to graphically display the dynamics of the development of the first VSC in students (see Figure 2.9.), which demonstrates a significant increase in the level of development of the first VSC at the final stage of experimental work.

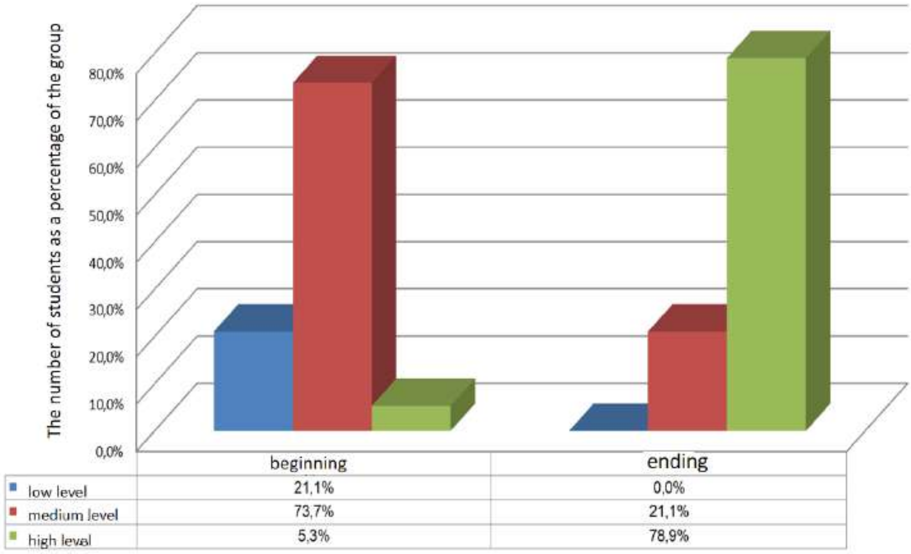


Figure 2.9. - Dynamics of the development levels of the first VSC in students of the experimental group during the development of IC NS

Let us turn to the analysis of the results for the components of the second VSC, the data for which are presented in Tables 2.3.4-2.3.6.

Table 2.3.4-Dynamics of the level of students ' acquisition of knowledge about the most important ideas and achievements of natural science that had a decisive impact on the development of engineering and technology, including in the aspect of the acquired profession **(second VSC)**

Indicators of the cognitive criterion	**Start of the experiment**			**End of the experiment**		
	low level	**medium level**	**high level**	**low level**	**medium level**	**high level**
-familiar with the main areas of natural science	5,3%	63,2%	31,6%	0,0%	36,8%	63,2%
- knows the most important ideas and achievements of natural science that have had a decisive impact on the development of technology, including in the aspect of acquired profession	63,2%	36,8%	0,0%	0,0%	89,5%	10,5%
- assigns natural science knowledge necessary for the future profession	31,6%	57,9%	10,5%	5,3%	47,4%	47,4%

Table 2.3.5-Dynamics of the level of development of students' conviction in the possibility of knowing the laws of nature and using the achievements of natural sciences for the development of civilization and improving the quality of life
(second VSC)

Indicators of the emotional and value criterion	**Start of the experiment**			**End of the experiment**		
	Low level	**medium level**	**high level**	**low level**	**medium level**	**high level**
-has an idea of the moral, moral and ethical norms and principles of the Human – Nature relationship»	15,8%	73,7%	10,5%	21,1%	47,4%	31,6%
- is aware of the consequences of the anthropogenic impact of humanity on Nature, including in the aspect of the acquired profession	**26,3%**	**10,5 %**	**63,2%**	**36,8%**	**5,3%**	**57,9%**
- assigns the VSG system and leading course ideas	47,4%	42,1%	10,5%	10,5%	78,9%	10,5%

Analysis of three indicators of the cognitive component of the second VSC shows an increase (see Table 2.3.4). As a result of mastering the integrated course «Natural Science», students demonstrate confident knowledge, both in the field of the main directions of natural science, and about important ideas and achievements of natural sciences, which, most likely, is a consequence of the inclusion of the megaconcept «Engineering and Technologies»in the structure of the course concepts. Dynamics in changes in the emotional-value component of the second VSC (see Table 2.3.5) draws attention to the change in students ' value attitudes in the context of moral, moral and ethical norms and principles of the «Man – Nature» relationship and, as a result, the manifestation of awareness of the consequences of anthropogenic influence of humanity on Nature, in the aspect of the acquired profession. This transformation is associated with the strengthening of pragmatic attitudes in the emotional-value sphere of adolescents, which, in general, does not cancel the assignment of the VSG system and the leading ideas of the course by students.

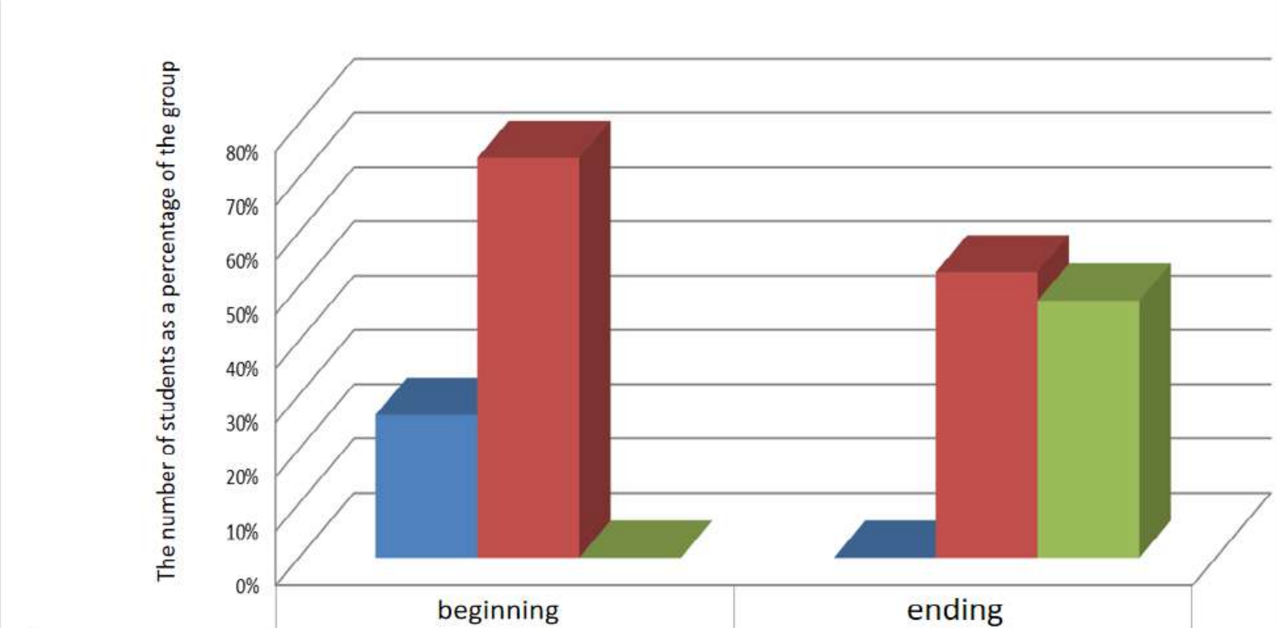
The high level of this component of the second VSC is expressed in the degree of readiness of students to develop abilities and critical thinking (see Table 2.3.6).

Table 2.3.6 - Dynamics of the level of development of intellectual, creative abilities and critical thinking during the simplest research, analysis of phenomena, perception and interpretation of natural science information **(second VSC)**

Indicators of the integrative-activity criterion	**Start of the experiment**			**End of the experiment**		
	Low level	**medium level**	**high level**	**low level**	**medium level**	**high level**
-understands how to conduct simple research, analyze and interpret natural science data	10,5%	42,1%	47,4%	0,0%	21,1%	78,9%
- is able to use various sources to obtain natural science information and evaluate the reliability to achieve the goals and objectives	10,5%	84,2%	5,3%	10,5%	36,8%	52,6%
- is able to independently acquire natural science knowledge and creatively solve practical problems, including in professional activities	42,1%	57,9%	0,0%	5,3%	42,1%	52,6%

The positive dynamics in all three indicators of the integrative-activity component of the second VSC is associated with the use of methods of working with concepts in the course of mastering the course «Natural Science», which are aimed at a multilateral consideration of natural science information and its structuring.

Empirical data on all components of the second VSC allow us to graphically display the dynamics of its development in students. The diagrams reflect the increase in the number of students with a high level of development of the second VSC (see Figure 2.10.)



	beginning	ending
low level	26%	0%
medium level	74%	53%
high level	0%	47%

Figure 2.10. - Dynamics of the development levels of the second VSC in students of the experimental group during the development of IC NS

Below we present the results according to the selected criteria of the third VSC (see Tables 2.3.7-2.3.9).

Analysis of the results by indicators of the cognitive criterion of the third VSC (see Table 2.3.7) shows the following: increasing students ' awareness of the systemic organization of nature, which is confirmed by an increase in the number of students with a high level of this indicator (94.7%), correlates with positive dynamics in understanding the main ways of human and nature co-evolution.

Table 2.3.7-Dynamics of students ' level of mastering knowledge about ways to harmonize man and nature **(third VSC)**

Indicators of the cognitive criterion	**Start of the experiment**			**End of the experiment**		
	low level	**medium level**	**high level**	**low level**	**medium level**	**high level**
-has an idea of the system organization of nature	15,8%	52,6%	31,6%	5,3%	0,0%	94,7%

- knows the areas of application of natural science knowledge in practice (in the sphere of future professional activity) and their transformative role	15.8%	21,1%	63,2%	15,8%	21,1%	63,2%
- comprehends the main ways of sustainable development of the «Man - Nature - Society «system»	47,4%	52,6%	0,0%	15,8%	42,1%	36,8%

Qualitative changes in the structure of knowledge are reflected in the positive dynamics of students ' awareness of the importance of natural science knowledge, which characterizes the emotional and value component of the third VSC (see Table 2.3.8).

Analysis of the results on the emotional and value component of the third VSC indicates a change in students 'motivation to the learning process, which is manifested in students' recognition of educational and cognitive activities as a way to understand the harmonization of relations in the «Man - Nature - Society» system (42.1% at high and medium levels). This not only leads them to realize the degree of responsibility for the results and consequences of practical activities, but also to rethink the importance of competencies in the field of natural sciences for each person and society as a whole. This is confirmed by an increase in the proportion of cadets demonstrating a high level in the second and third indicators.

Table 2.3.8-Dynamics of students ' awareness of the importance of natural science knowledge for explaining the phenomena of the surrounding world, perception of information of natural science and professionally significant content **(third VSC)**

Emotional-value (or personal) criterion	**Beginning of the experiment**			**End of the experiment**		
	low level	**medium level**	**high level**	**low level**	**medium level**	**high level**
- refers to educational and cognitive activity as a way of understanding the harmonization of relations in the «Man - Nature - Society» system	42,1%	47,4%	10,5%	15,8%	42,1%	42,1%
- understands the degree of responsibility for the results and consequences of practical activities, including in the aspect of the acquired profession	42,1%	21,1%	36,8%	26,3%	21,1%	52,6%
- understands the importance of natural science competencies for people and society	36.8%	57.9%	5.3%	10.5%	73.7%	15.8%

Table 2.3.9-Dynamics of students ' readiness to apply natural science knowledge in professional activities and everyday life **(third VSC)**

Integrative-activity (or operational) criterion:	**Start of the experiment**			**End of the experiment**		
	low level	**medium level**	**high level**	**low level**	**medium level**	**high level**
- represents how to apply natural science knowledge in professional activities and life situations	63,2%	31,6%	5,3%	0,0%	52,6%	47,4%
-has mastered the ways of self-education in the field of natural science to improve their own intellectual development in the chosen professional activity	47,4%	36,8%	15,8%	0,0%	5,3%	94,7%
- is able to make responsible decisions, including in professional activities, based on the principles of sustainable development of the Human - Nature - Society system	68,4%	31,6%	0,0%	31,6%	68,4%	0,0%

The analysis of the results in the distribution of data on the integrative activity component of the third VSC (see Table 2.3.9) allows us to record an increase in the level of readiness of students to apply natural science knowledge in everyday life and future professional activities. Thus, it draws attention to the fact that all students have a sufficient understanding of how to apply natural science knowledge in professional activities and life situations, as well as have mastered the methods of self-education in the natural science field to enhance development in their chosen professional activity. This is confirmed by the proportion of students who show a low level in three indicators. However, the lack of experience in solving professional tasks, professional experience, knowledge in the field of general professional and professional disciplines do not allow the principles of sustainable development of the «Man - Nature - Society» system to be fully used for making responsible decisions, and do not allow students to move to a high level in the third indicator.

The obtained empirical data allow us to graphically represent the dynamics of the development of the third VSC as a whole in comparison with the initial level and the level at the end of the «Natural Science» course (see Figure 2.11).

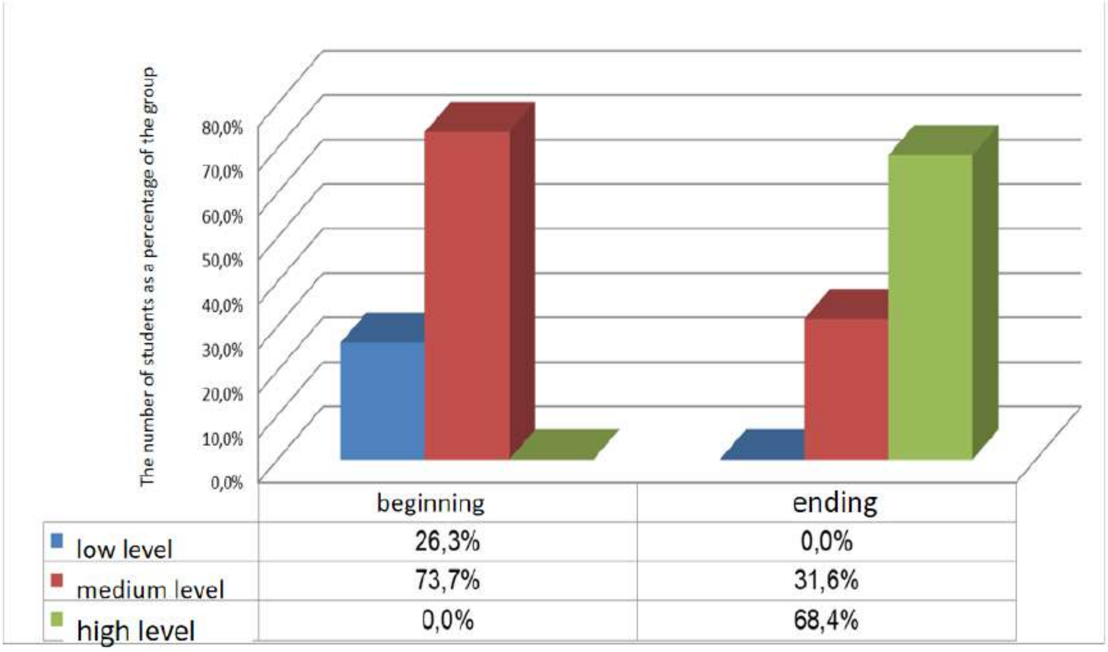


Figure 2.11. - Dynamics of the development levels of the third VSC in students of the experimental group during the development of IC NS

Comparing the levels of development of each VSC of students at the beginning of training and following the results of mastering the course «Natural Science» allows us to conclude about the positive dynamics of this process. In general, students demonstrate a positive attitude towards the development of natural science competencies; natural science knowledge is characterized by a high degree of integration, contributes to the formation of a holistic natural science picture of the world. In general, the number of students demonstrating the ability to use this knowledge in the context of future professional activities has increased. The data indicate that students who have successfully mastered the course «Natural Science» are guided by the principles of harmonization of the relations of the «Nature - Man - Society» system in their personal experience of behavior and in the process of modeling professional activities. Students generally demonstrate the ability to reflect in practical activities.

Maintaining some indicators at the average level according to a number of criteria is expected, since the development of VSC students is carried out during the entire period of study and by means of all disciplines of the educational program.

Statistical processing of the results of the study in order to identify their reliability was carried out according to the following indicators:

$x_{average}$ - the arithmetic mean of the level of development of cognitive, emotional-value, and integrative-activity components for each VSC group.

σ^2 - variance; σ - standard deviation;

V – coefficient of variation,

t_{exp} is the empirical value tof the Student's t-test [29].

The data of statistical processing of the obtained results are presented in Table 2.3.10.

Table 2.3.10 - Results of statistical processing of data on the total level of development of VSC components of participants in the experimental group after mastering the course «Natural Science»

VSC components	**Statistical indicators**				
	N	**$x_{average}$**	**σ^2**	**σ**	**V; %**
First VSC					
Cognitive	57	2.46	0.18	0.42	17%
Emotional-value	57	2.03	0.28	0.53	26%
Integrative-activity	57	2.24	0.08	0.28	13%
Second VSC					
Cognitive	57	2.35	0.12	0.35	15%
Emotional-value	57	2.09	0.29	0.54	26%
Integrative-activity	57	2.51	0.26	0.51	20%
Third VSC					
Cognitive	57	2.40	0.27	0.52	21%
Emotional-value	57	2.18	0.23	0.48	22%
Integrative-activity	57	2.24	0.06	0.24	11%

The coefficient of variation (V) for the group of participants in the experimental group turned out to be no more than 26%. This indicates that the degree of data dispersion is considered insignificant and the population is homogeneous (33%). The obtained value of the coefficient of applying the Student's criterion to establish the reliability of the results obtained.

For clarity, the results according to the criteria of each VSC were summed up taking into account the weight coefficients established by expert assessments (cognitive criterion – 16.7%, integrative-activity criterion – 33.3%, emotional-value criterion-50%). The empirical value of the Student's t-test for the first VSC is t_{exp} =6.1, for the second VSC

t_{exp} =3.4, for the third VSC t_{exp} =5.5. (The coefficient is 5.1>1.98 with a significance level of $p<0.05$), therefore, the data obtained experimentally are statistically significant.

To confirm the effectiveness of the experimental method, we compared the educational achievements of students in the experimental and control groups. The latter group included 28 students who mastered the content of IC NS, which was not adapted for the SVE system and was designed without using the developed methodology. To compare the results, we used a comprehensive diagnostic work on the subject educational results of mastering IC NS [6]. For a more visual representation of the results, a distribution was adopted to convert the primary test score to a mark. Data on the implementation of the integrated work are presented in Table 2.3.11.

Table 2.3.11-Distribution of marks in the experimental and control groups

Group	Number of participants	Average score	Median	Standard deviation	**Distribution of primary scores**			
					1-5	6-10	11-15	16-20
					Mark			
					2	**3**	**4**	**5**
Control group	28	10.14	10	2.56	0	64	31	5
Experimental group	58	16.83	17	2.16	0	0	24	76

The analysis of the results of the work showed that students of both groups coped well with tasks that require knowledge of fundamental concepts of natural science: basic concepts of physics, chemistry, biology. When performing the work, the students of the control group showed difficulties when working with information of natural science content and, first of all, related to the profile of the profession being mastered. The greatest difficulties for the students of the control group were caused by tasks, the content of which is aimed at understanding the role of scientific achievements in the creation of new technologies and knowledge of the methods of scientific knowledge and their components. Students of the experimental group demonstrate confident skills in using knowledge from different subject areas in solving problems; critical understanding of the role of natural sciences in personal, professional and social contexts. The results of the experimental and control groups were compared according to the Kramer-Welch test (Temp=15.12 > T0. 05=1.96). The reliability of differences in the characteristics of the compared samples is

95%.

An analysis of the educational achievements of students in the control group in the context of the dynamics of VSC development following the course completion showed a less pronounced increase in the proportion of students demonstrating a high level of development of three VSC. Data on the dynamics of the level of VSC development in students of the control group are presented in Table 2.3.12.

Table 2.3.12 – Dynamics of the development levels of three VSC in students of the control group during the course «Natural Science»

Competence	Stage	Low Level	Medium Level	High level
First VSC	Up	to 35.7%	57.1%	7.1%
	After	10.7%	42.9%	46.4%
Second VSC	Up	to 25.0%	64.3%	10.7%
	After	17.9%	60.7%	21.4%
Third VSC	Up	to 28.6%	60.7%	10.7%
	After	21.4%	42.9%	35.7%

Comparison of the results of the experimental and control groups allows us to conclude that the proposed method has a positive impact on the development of VSC students.

To determine the degree of satisfaction of students of the experimental group with the course «Natural Science», as well as the meaningfulness of the role of methods of working with concepts in the development of VSC, an additional questionnaire was conducted. The questionnaire questions (see Questionnaire 4. Appendix L) were intended to evaluate statements that reveal the essence of the integrated course «Natural Science», designed on the basis of a concept approach. The rating was assumed on a five-point scale, where «1» – absent/not implemented; «2» – partially present/ occasionally implemented; «3» – present/implemented; «4» – present in a larger volume/often implemented; «5» – present in full/fully implemented. Statements are divided into blocks according to the components of the developed theoretical model: target, content, process-technological, and performance-evaluation. Conclusions on the effectiveness and expediency of using the concept approach in designing the content of the integrated course «Natural Science» were made based on the summary data of the results of a survey of students at the end of the course development (see Appendix M). Interpretation of the data was carried out by scaling the number of selections of the corresponding score by students for each statement. At the same time, scores 4 and 5 were assigned to a high and very high level of manifestation, 3 – medium level, 1 and 2 – low level.

The analysis of the results of the survey of students of the experimental group on the block of statements on the target component of the course allows us to note that 93% of students noted the importance of the course material. 88.4% of the students noted that they understood the need for scientific knowledge learned in the lesson for the co-evolution of man and nature. 34.9% - that conditions were created in the lessons to understand the significance of the studied objects, facts, phenomena for the development of a future profession, more than 60% comprehended the proposed material in this context. The identification of VSG based on the meta-concepts of the course contributes to the meaningful development of the values of natural science knowledge. Thus, 32.6% and 67.4% of students believe that science lessons are interesting and useful, and assigned grades at the level of «4» and «5», respectively. The goal-setting logic «from VSG to VSC», designed to facilitate the work of students in mastering the system of concepts of the course «Natural Science» confirms its expediency by the fact that 83.7% of students note at a high and very high level that conditions were often and completely created in the lessons to realize the need to study the concept as one of the conditions for understanding its meaning.

The content block included a series of statements aimed at identifying the expediency of structuring the natural science material of the course «Natural Science» into a hierarchy of concepts. In general, 90.7% of the students in the experimental group highly appreciated the role of structuring educational information through concepts to facilitate understanding, assimilation and awareness of information. The analysis of the results shows the expediency of using concepts as a didactic unit of the content of the integrated course «Natural Science». The hierarchy of concepts helps in understanding the values and meaning of natural science knowledge, regardless of the field of activity (90.7%). The sequence and logic of the presentation of the educational material allows, in the opinion of students, to make sure that changing any component of the system without taking into account the laws of nature will lead to a violation of its integrity (79.0%). 83.8% of students noted that the content disclosed through the system of concepts contributed to the awareness of the general essence of natural processes and the disclosure of the value of acquired knowledge (88.3%).

For a number of questions, the distribution was less clear, demonstrating the diversity of students ' opinions indicating their difficulties. So, on the question related to the role of educational material in illustrating the boundaries of scientific knowledge, the results were as follows: 1 – 0,0%; 2 – 4,7%; 3 – 27,9%; 4 – 37,2%; 5 – 30,2%. We associate these results with the fact that a small number of hours are allocated for understanding the megaconcept «Science» in the curriculum, which made it difficult for students to understand the facts that allow them to judge the multidimensional nature of scientific knowledge.

Another example is related to the point of the questionnaire, where students were asked to assess how much the educational material was considered in accordance with the levels of natural objects, phenomena, and laws. The questionnaire processing results showed the following results: 1 – 32,6%; 2 – 23,3%; 3 – 27,9%; 4 – 11,6%; 5 – 4,7%. This distribution, with a high degree of probability, should be associated with the overlap of the concepts of «level organization of nature» and»levels of concepts». In the course, objects, phenomena, and laws of nature were considered simultaneously to identify commonalities, which some students probably perceived as consideration without taking into account the hierarchy of levels of nature. In this case, the linear deployment of educational material, which is typical for non-integrated courses, is really disrupted. A similar distribution is found in the results of responses stating that natural laws and phenomena are considered outside the system and without establishing relationships: 1 – 18,6%; 2 – 23,3%; 3 – 37,2%; 4 – 18,6%; 5 – 2,3%. This reflects the difficulties of 20.9% of students in establishing and understanding relationships between objects and phenomena of different nature (physical, chemical, biological, etc.). It should be noted that the content of many lessons provides for the consideration of facts, phenomena and objects that model different areas of natural science (physics, chemistry, biology, etc.). Structuring the course content on the basis of concepts involves identifying essential characteristics that differ in a greater degree of generalization, reflecting the systemic organization of nature.

The results of the answers to the question about the predominance of the focus on the disclosure of the idea of using natural resources in the content of the course showed that a large number of students in the experimental group (41.9%) noted the average level. These data indicate a balance in the material of information about nature as a source of ensuring human life and the need for scientifically based rational environmental management.

Analysis of the results of the survey of participants of the experimental group on the content component of the designed course allows us to make a judgment about the optimality of the proposed educational information, compliance of the course content with the principles of accessibility, informativeness while maintaining a good level of fundamental content. At the same time, the amount of information that is insignificant from the point of view of students, including regarding the development of a profession in the chosen professional field, is insignificant (27.9%) or absent (55.8%). This correlates with the high level of assignment of course objectives demonstrated by students when analyzing the results of evaluating the target component of the designed course.

Next, we present an analysis of the results of the responses of students of the experimental group on the process-technological component, aimed at identifying the attitude of students to the use of methods of working with concepts.

The high and very high levels of assessment of the issues in this block indicate the awareness of the use of methods of working with concepts by students of the experimental group in the process of mastering the course. Thus, students note that the tasks are aimed at understanding this concept in human life (90.7%), «dialogue» with the concept (72.1%), semantic «deployment» of the collapsed concept (72.1%), determining the place of the concept in the value system (69.8%), socialization of individual (associative-intuitive) experience to create a collective associative series of the concept (67.4%), the expansion of the «dictionary» of the concept (58.1%). Students note the importance of the proposed tasks in expanding the associative-intuitive field (69.8%), removing vocabulary from passive memory into active vocabulary (62.8%), arouse and develop interest in further study of the concept (93.0%). Students also note that the tasks implemented in the format of subject, interdisciplinary and meta-subject COT have practical significance and are aimed at activating the need to see and understand the holistic picture of the world, allowing them to correlate the information obtained in the lesson with the knowledge system about the holistic organization of nature (86.0%); They contribute to the understanding of the acquired knowledge for forecasting activities in the professional field (76.7%). It is also noteworthy that more than 80% of the students in the experimental group demonstrate confidence that the use of graphical forms of displaying concepts (concept maps, logical-semantic modeling) helps to structure knowledge.

The results of the assessment of the focus on taking into account the interdependence of man and the nature of the content of educational tasks turned out to be contradictory. The results of the responses to this statement were distributed as follows: 1 – 27,9%; 2 – 11,6%; 3 – 20,9%; 4 – 32,6%; 5 – 7,0%. We associate this with the peculiarities of meta-subject COT, which do not offer the only correct answer and, depending on the method chosen by the students to solve the problem, the result changes. This distribution correlates with the students' assessment of the content of the educational material in the context of the focus on the disclosure of the idea of using natural resources. This allows us to conclude that the COT we offer sets the optimal balance of tasks that focus on the interdependence of nature and man.

Analysis of the results of evaluating the statements of the questionnaire of the process and technology block allows us to conclude that students are positively motivated to use methods and techniques of working with concepts. Studentsofthe experimental group recognize their essential role in understanding, comprehending and mastering natural science knowledge as a hierarchical system of concepts.

This correlates with the results of the responses to the performance evaluation block of the questionnaire, which we will present later. 76.7% of students rate the high and very high expediency of considering natural science material in the system of concepts. 86.0% of students noted that conditions for expressing their own opinions were created in the lessons. 67.4% of respondents identified educational tasks that are focused on identifying the student's personal position on the interaction of nature and man. More than 80% of students express the belief that they have received the necessary (in-depth) knowledge in physics, chemistry, and biology in natural science lessons. As individual achievements of mastering the integrated course «Natural Sciences», designed on the basis of a concept approach, students identified: the level of natural science knowledge has increased (86.0%), knowledge in the field of natural sciences has become more systematic and structured (76.7%). According to the students, during the course they learned to think about the situation before making a decision (79.1%), express their thoughts and feelings simply and clearly to others (69.8%), learned how to set a goal and achieve it (65.1%).

The inclusion of the profile of the specialty being mastered as one of the guidelines for designing the course shows a fairly high assessment by students. Thus, 53.5% of students confidently note that in science lessons they were helped to learn individual abilities («what I can do») in order to determine some key aspects of their future profession.

Approbation of approaches to goal setting, structuring of educational material in accordance with the hierarchy of concepts, lesson models and COT has been carried out since 2017 as part of the author's teaching activities, as part of advanced training and professional retraining programs of the St. Petersburg APPE. The results of the study were presented and discussed with science teachers. The author has developed a program of a training module for teachers to master the method of constructing IC NS content based on a concept approach and adapted for the SVE system (see Appendix N). During its testing, the possibilities for the dissemination of the developed methodology were analyzed. A survey conducted among (see Appendix P) 97 teachers – trainees of the St. Petersburg APPE courses who have mastered the components of the methodology, demonstrated the respondents' interest in this research and development. The analysis of the teachers' answers showed: the choice of the concept as a system-forming element of the integrated content helps to identify intra-subject connections of the disciplines of the natural science cycle and interdisciplinary connections with the disciplines of the humanities, general professional and professional cycles (80%); the use of concepts as a didactic unit of the integrated course facilitates the work on compiling curricula in natural science and other integrated educational courses of natural sciences-scientific orientation (75%); The hierarchy of concepts allows for a more informed selection of teaching techniques and methods that contribute to the development of VSG courses by students (65%), as well as to develop a system of current and intermediate control of integrated courses (77%); the use of experimental methods facilitates the pedagogical design of IC NS content for different academic loads (78%). Teachers note that the techniques and methods of working with concepts allow for a «more understandable explanation» of educational material to students of a non-natural science profile. Among the conditions that make it difficult to implement the experimental methodology, respondents most often mention the following: the lack of natural science textbooks designed specifically for the SVE system based on a concept approach; the lack of didactic materials and, first of all, COT for different professions and specialties; the need for a teacher to acquire practical experience in developing COT, using methods and techniques of working with concepts.

The pedagogical experiment on testing the methodology of constructing the content of the integrated course «Natural Science» based on the concept approach for the SVE system has shown its effectiveness. The results of experimental work indicate the possibility of using this technique to develop integrated courses of natural science orientation at the general education level, including in conditions of pre-professional education with appropriate refinement.

Conclusions on Chapter 2

1. During the search experiment, it was found that the majority of students participating in the experimental study are aware of the need to integrate natural science knowledge, while the idea of joint harmonious development – coevolution of society and nature - should be taken as the basis for integration, which is the basis for understanding the unity, systemic organization of nature, understanding the relationship between man and nature, as well as for the harmonization of relations in the «Man - Nature - Society» system; 60.7% of students demonstrate positive motivation to master methods of working with concepts as optimal in understanding, comprehending and mastering natural science knowledge.

2. The structure of the integrated course «Natural Science», developed on the basis of the proposed model, is a system of concepts: metaconcepts – megaconcepts – concepts of the semantic block – private concepts. The hierarchy of course concepts determined the specifics of goal setting, selection and structuring of educational information, lesson design (lessons based on interdisciplinary connections, integrated and meta-subject lessons) and COT (subject, interdisciplinary, meta-subject), forecasting of expected educational results corresponding to the levels of course concepts.

3. The criteria for the development of VSC students in the process of mastering the course «Natural Science» are the components (cognitive, emotional-value and integration-activity), and the indicators are their characteristics, which were determined in accordance with the hierarchy of concepts and taking into account the predicted levels of development of VSC students identified at the goal–setting stage.

4. The approbation of the experimental course «Natural Science», designed on the basis of a concept approach, showed that in the process of mastering its content, the cognitive, emotional-value and integrative-activity components of VSC students develop. An analysis of the dynamics of the level of development of VSC groups of students in comparison with the initial level and the level of development at the end of the Natural Science course, designed in accordance with the proposed methodology, found an

increase in the proportion of students demonstrating a high level of development in all three VSC groups (78.9% - VSC group 1; 53.2% - VSC group 2; 68.4% – The VSC group) and reducing the number of students showing a low level of VSC development. When comparing the results of the experimental and control groups, it was concluded that the proposed method has a positive effect on the development of VSC students.

5. The positive dynamics of the development of the VSC components of SVE educational institutions during the development of the integrated course «Natural Sciences», designed on the basis of a concept approach, as well as a high degree of student satisfaction with the results, content and process of mastering the course confirms the effectiveness of the developed methodology.

Conclusion

The theoretical and methodological analysis of approaches to the construction of the content of integrated natural science courses allows us to consider the concept approach as one of the mechanisms for implementing the integrative paradigm of the content of natural science education (I.Y. Aleksashina), where the concept is the leading tool. In this case, the concept is both a carrier of the meanings and values of natural science knowledge, and serves as a way of transmitting and mastering them. The use of the concept as a didactic unit of content construction allows you to model the hierarchy of course concepts, which helps the student to assign values of natural science knowledge and build a system of personal meanings.

The core planned educational results of the development of the integrated course «Natural Sciences» at the SVE stage are value-semantic competencies (VSC), and their identified components (cognitive, emotional-value, integrative-activity) serve as criteria for evaluating their development. The general target settings of the designed course are the value-semantic guidelines (VSG) of the course, developed on the basis of the leading ideas of the course (meta-concepts) that set the direction of integration of natural science knowledge based on consideration of interrelations and interdependencies in the «Man – Nature – Society» system in the context of the profession being mastered.

The formative experiment showed that the methodological support of the course «Natural Science», due to the development by students of a hierarchical system of course concepts in the context of the VSG course and the profile of the profession being mastered, contributes to the development of VSC students. The step–by–step development of course concepts sets the direction for the selection of forms, methods, techniques and teaching tools and determines the specifics of constructing lessons consistent with a concept of a certain level (a lesson based on interdisciplinary connections is developed on the basis of a private concept, integrated - the concept of a semantic block, meta-subject

- megaconcept) and their corresponding competence-oriented tasks (subject, interdisciplinary, meta-subjects).

The results of the empirical study confirmed the hypothesis, the tasks have been solved. Further research to identify the potential of the concept approach in the design and study of integrated natural science courses consists in expanding the methods and techniques of working with concepts and developing an integrated system for evaluating educational results.

List of abbreviations used

IC NS – integrated course «Natural Sciences»

SVE – secondary vocational education

VSC – emotional-value competencies

VSG – value and semantic guidelines

COT – competence-oriented tasks

NSPW – natural science picture of the world

St. Petersburg MTC – St. Petersburg Marine Technical College named after Admiral D.N. Senyavin (From 08/19/2022 St. Petersburg Marine Technical Academy named after Admiral D.N. Senyavin)

FSES –Federal State Educational Standard

EMC – educational and methodical complex

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APPLICATIONS

Appendix A
Description of the educational experiment program

The purpose of the pedagogical experiment is to assess the impact of the developed methodology for constructing the content of the educational program based on a concept approach on the development of the VSC of students of the SVE system.

The object of the experiment: a method of constructing the content of the educational program on the basis of a concept approach for students of secondary vocationaleducation.

Subject of the experiment: the level of VSC development of students formed in the process of mastering the course "Natural Science", developed on the basis of a concept approach.

In accordance with the purpose of the empirical study, the following tasks were formulated:

1.To study the state of the problem of mastering IC NS students of open source education in the practice of training.

2. To determine the effectiveness of the influence on the development of the VSC of SVE students of individual components of the methodological support of the ICS, which provides for step-by-step awareness, comprehension, and development of the system of course concepts by students.

3. To evaluate the effectiveness of the methodology for designing the content of IC NS based on a concept approach for the development of the VSC of SVE students.

Theoretical hypothesis of the study

Theintegrated course "Natural Science" will contribute to the formation of value-semantic competencies of students of the SVE system, if:

Empirical hypotheses:

- the system organizer and didactic unit of the course content is the concept, and the course structure is a hierarchical system of concepts of different levels;

- value-semantic guidelines of the course reveal the interrelationships in the system "Man-Nature-Society", reflecting the specifics of the content of the integrated course of natural science orientation;

- selection and construction of educational material is carried out in accordance with the system of concepts of the integrated course "Natural Science", reflecting the levels of integration of the content of natural science knowledge, and their role in the formation of value-semantic competencies of future specialists;

- methodological support provides students with a step-by-step development of the content of course concepts and corresponds to their hierarchical system.

The empirical study was carried **out in four stages** during 2015-2021.

The first stage provided for the development of a program of pedagogical experiment.

The ascertaining experiment was conducted in the 2015-2016 academic year. It was aimed at identifying the main difficulties and educational needs of students of the SVE system in mastering IC NS. The design of the ascertaining experiment was aimed at testing a particular hypothesis that teaching the course "Natural Science" through the implementation of three educational modules "Physics", "Chemistry", "Biology" will contribute to the implementation of the ideas of an integrated course. For this purpose, the author's questionnaire "Identification of student satisfaction with the results of mastering the course "Nature-knowledge" was developed and tested. The questionnaire was compiled on the basis of a theoretical analysis of the problems and tasks of the study. The relevance of this stage is due to the novelty of the problem under study, its agreement with the characteristic features of the course of "Natural Science" described in the pedagogical literature, as well as the lack of special tools for its study in accordance with the purpose of our study.

Empirical data was collected in May 2016 through an online survey using cloud-based applicationsand printed forms. The results of a survey of students of the SVE system who have mastered the coursepresented by three educational modules "Physics", "Chemistry", "Biology", showed its low performance. Analysis of theанныresults of the ascertaining experiment made it possible to determine the key educational needs and difficulties of students of the SVE system in mastering the course "Natural Science".

At the second stage (2016-2017 academicyears), a search experiment was conducted, during which осуществлялась the components of the methodology were tested in various combinations to determine their optimal combination. The idea of the search experiment provided for the implementation of the course "Natural Science" for general education organizations, developed by the author's team under the leadership of I. Y. Aleksashina. The course content included author's development of lesson models for working with concepts, and techniques for working with concepts were also occasionally used. A model for the development of competence-oriented tasks corresponding to different levels of the hierarchy of concepts and a model of verification works for thematic control were developed and tested. Following the results of the course, students were surveyed using the questionnaire "Identification of satisfaction with the results of the course "Natural Sciences". Empirical material was collected in May 2016 during a questionnaire using printed forms.

The content and development criteria of the VSC students SVE in relation to the IC NS areclarified, as well as the methods of their assessment. See Table A1

Table A. 1 - TOOLS FOR PEDAGOGICAL MEASUREMENT

VSC	Component of VSC	Criterion (based on an approximate work program)	Indicator			Assessment methodology
first VSC	*Cognitive*	mastering of knowledge about the modern natural science picture of the world and methods of natural sciences	-has an idea of the main characteristics of the modern natural science picture of the world and its place in the holistic scientific picture of the world	-knows the nature of relations in the "Man - Nature - Society"system	- comprehends the importance of natural science knowledge for practical (professional) activity in the system "Man-Nature-Society"	Testing, кcompetence-oriented tasks, complex test works
	Emotional-value	-based awareness of the place of the future profession in the system "Man-Nature-Society"	- has an emotional and sensory attitude to the surrounding reality	- accepts the values of natural science knowledge for the future profession	-purposefully strives to master natural science knowledge in the context of the future profession	Questionnaires, pedagogical observation
	Integrative-activity	-based application of basic methods of cognition (observation, scientific experiment) to study various aspects of the natural-scientific picture of the world that it is necessary to face in the professional sphere	-understands how to use natural-scientific methods to solve practical problems	-is able to use natural-scientific methods to solve problems, including among future professional activities	- he is able to apply the basic methods of cognition to study various aspects of the natural science picture of the world, which there is a need to face in the professional sphere	Competence-oriented tasks, complex test works

Continuation of table A. 1 - TOOLS FOR PEDAGOGICAL MEASUREMENTS

second VSC	*Cognitive*	development of knowledge with the most important ideas and achievements of natural science that have had a decisive impact on the development of technology and technologies, including in the aspect of the acquired profession	- is familiar with the main areas of natural science	-knows the most important ideas and achievements of natural science that have had a decisive impact on the development of technology and technologies, including in the aspect of the future profession	-assigns natural science knowledge necessary for the future profession	Testing, competence-oriented tasks, complex test papers
	Emotional-value	-based belief in the possibility of learning the laws of nature and using the achievements of natural sciences for the development of civilization and improving the quality of life	-has an understanding of moral, moral and ethical norms and principles of the "Man – Nature"	relationship - is aware of the consequences of anthropogenic influence of humanity on Nature, including: in the aspect of the acquired profession	-assigns a system of CSOs and leading course ideas	Questionnaires, pedagogical observation
	Integrative-activity	development of intellectual, creative abilities and critical thinking in the course of conducting simple research, analyzing phenomena, perception and interpretation of natural science information.	- understands how to conduct simple research, analyze and interpret natural science data	- is able to use various sources to obtain natural science information and evaluate the reliability to achieve the goals and objectives	- is able to independently acquire natural science knowledge and creatively solve practical problems, including in professional activities	Competence-oriented tasks, comprehensive test works

Continuation of table A. 1 - TOOLS FOR PEDAGOGICAL MEASUREMENTS

third VSC	*Cognitive*	development ofknowledge about ways to harmonize relations in the system "Man-Nature-Society"	- has an idea of the system organization of nature	-knows the areas of application of natural science knowledge in practice (in the field of future professional activity) and their transformative role	-understands the main ways of sustainable development of the system " Man - Nature – Society"	Testing, кcompetence-oriented tasks, complex verification works
	Emotional-value	awareness of the importance of natural science knowledge, for explaining the phenomena of the surrounding world, perception of information of natural science and professionallysignificant content	-refers to educational and cognitive activities as a way of understanding the harmonization of relations in the "Man – Nature – Society"system	- understands the degree of responsibility for the results and consequences of practical activities, including in the aspect of the acquired profession	-understands the importance of competencies in the field of natural sciences for a person and society	Questionnaires, pedagogical observation
	Integrative-activity	readiness to apply natural science knowledge in professional activities and everyday life to ensure the safety of life; competent use of modern technologies; professional development in the chosen professional activity; health and environmental protection	- represents how to apply natural science knowledge in professional activities and life situations	-has mastered the ways of self-education in the field of natural science to improve their own intellectual development in the chosen professional activity	- is able to make responsible decisions, including in professional activities, based on the principles of sustainable development of the Human - Nature - Society system	Competence-based tasks, comprehensive test works

The aim of the third stage of the study (2017-2018 academicyears) wasto conduct a formative experiment, which involved testing the developed methodology.

At the preliminary stage of the formative experiment, the level of development of VSC components in the participants of the experiment was determined.

The main stage of the formative experiment involved testing by the author of the IC program and its methodological support, developed in accordance with the developed model based on a concept approach during the training of students of the experimental group. In accordance with the purpose and objectives, the methodology was tested on the experimental group in the format of a longitudinal study. The chosen format is determined by the need to assess the dynamics of VSC (related to general competencies) of students in the development of the developed IC NS. Based on the criteria base of the study, based on the results of mastering each megaconcept (topic), control sections were provided for analyzing the dynamics of the development of students VSC based on the products of students' educational activities (results of performing VSC, essays, concept maps, logical and semantic models, etc.) and the results of pedagogical observation. Empirical material was collected in the experimental group from September 2017 to May 2018. Cloud resources were used to collect data, which consisted of tasks for students ' extracurricular independent work, as well as questionnaires and surveys. Also, during the course development period, the included closed pedagogical observation was carried out to determine the level of expression компонентовof students VSC components in accordance with the criteria base of the study. Theaverage valuesof e for each student and the study group as a whole were taken into account when assessing the dynamics of VSC development of students participating in the experimental group.

Also, a control group was formed, which was trained according to the IC NS program based on the EMC for general education institutions, developed by the author's team under the leadership of I. Yu . Aleksashina. Teaching in the control group was also carried out by the author of the study.

The final stage of the formative experiment involved identifying the dynamics of the development of the VSC of students participating in the experimental group based on the results of its development.

To confirm the effectiveness of the experimental method, a comparative analysis of the educational achievements of the experimental and control groups was carried out. To compare the results, we used a comprehensive diagnostic work based on the subject-specific educational results of the development of the IC NS.

Empirical data was collected in the control group in September 2017, and May 2018.

Stage IV of the study. This stage included the interpretation of the results obtained and the formulation of research conclusions. We also developed and tested the author's program of the educationalого moduleя on teachers mastering the methodology of constructing the content of the educational program based on a concept approach and adapted for the SVE system. During its testing, we analyzed the possibilities for distributing the developed methodology by questioning teachers who attended the courses of the St. Petersburg APPO who had mastered the components of the methodology

Description of the study sample

308 first-year students of the St. Petersburg vocational education system took part in the ascertaining experiment. A prerequisite for the selection of participants was the development of IC NS, which includes three sections presented as relatively independent and integral modules - "Physics", "Chemistry", and "Biology".

The search experiment involved 120 first-year students of St. Petersburg MTC, studying in the specialty "Technology of public catering products".

85 first-year students of the St. Petersburg MTC of three study groups took part in the formative experiment. The results of the input control showed no statistically significant differences, which allowed us to consider the groups as comparable. To increase the reliability of the results, two training groups in the formative experiment are considered as one experimental group. The experimental group included 57 first-year students of St. Petersburg MTK. Students were trained in the specialties "Technology of public catering" and "Organization of service in public catering". The experimental group was formed on the basis of comparability of the contingent: by age

(16-17 years); by the equivalence of the conditions of training and basic training (admission of cadets is conducted on the basis of general secondary education after grade 9; the curriculum of the first year of study is completely identical); the general sphere of middle-level specialties being mastered – the sphere of public catering (socio-economic profile).

The control group included 28 first-year students studying in the specialty "Public catering Technology".

В апробации программы учебного модуля 97 teachers of the natural science cycle took part in testing the program of the training module on teachers ' mastering the methodology of constructing the content of educational programs based on a concept approach and adapted for the SVE system as part of advanced training courses held on the basis of the St. Petersburg APPOe in the period from 2017 to 2021.

The following methods and techniques were used in the empirical part of the study:

1. To identify the initial level of formation of the components of the VSC of the students participating in the formative experiment, a combined input diagnostic work was developed according to the system of criteria and indicators developed within the framework of the theoretical part, containing a questionnaire with open and closed questions: The questionnaire "Assessment of the formation of the components of the VSC of students at the beginning of the course "Natural Science""

2. To assess the level of VSC development of students participating in the experimental group, we used competence-based tasks, as well as complex diagnostic works on topics, products of educational activities, etc., developed on the basis of the criteria base of the study (see Table A. 1).

3. To record the results of pedagogical observation of the dynamics of the formation of VSC components, a map of pedagogical observation was used, compiled on the basis of a system of criteria and indicators. The observation map was completed based on the results of each chapter of the course.

4. To self-assess the level of formation of VSC components of the training participants of the experimental group, a questionnaire was developed "Self-analysis

of the formation of VSC components based on the results of mastering its IC NS, developed on the basis of a concept approach."

5. To identify the degree of satisfaction of students of the experimental group with the course "Natural Sciences", as well as the meaningfulness of the role of methods of working with concepts in the development of the VSC, a questionnaire was developed "Assessment of student satisfaction with the results of mastering the IC NS, developed on the basis of a concept approach".

6. To compare the educational achievements of the experimental and control groups, a comprehensive diagnostic work was used based on the subject educational results of mastering the EE-IC. The model of complex diagnostic work is described in the article: Abdulaeva, O. A., Aleksashina, I. Yu., Kiselev, Yu. P Model for assessing the quality of achieving educational results of studying the integrated course "Natural Science"/O.A.Abdulaeva, I.Yu. Aleksashina, Yu . P.Kiselev / / Modern problems of science and education. – 2022. - No. 2.

7. To analyze the demand for the possibility of spreading the experimental methodology among teachers была разработан, a questionnaire with open questions was developed.

8. To determine the key indicators used in the experimental work, the method of expert assessments was used. The group of experts included teachers of general educational organizations and institutions of the secondary vocational education system that teach the subject "Natural Science", students of advanced training courses and professional retraining on the basis of St. Petersburg APPO. The total number of interviewees was 56 people.

9. Statistical methods, such as: correspondence analysis, sampling method, graphical method, are used in the course of evaluating the reliability of the results of the dissertation research, in particular, the analysis of experimental data and their graphical representation.

The results of the main stage of the study were processed using the Microsoft Excel program.

Appendix B

Questionnaire 1. Identification of satisfaction with the results of mastering the course «Natural Sciences»

Dear students!

You have completed the integrated course «Natural Science».

We want to improve our course!

The questionnaire is anonymous. The survey results will only be used in summary form to improve the quality of education.

Please do not skip any questions and answer them sincerely.

1. What is the purpose of the Science course?________________________________

____

2. The course helped me understand____

____

3. natural science knowledge in my profession_______________________________

____

4. My best goals are as follows: ____

____

5. I was best at completing tasks ____

____

6. What I learned:____

____

7. I enjoyed this course:____

____

8. In this course, I would like to change: ____________________________________

____

9. Special requests____

Appendix C

Questionnaire 2. Assessment of the formation of VSC components of students at the beginning of the course «Natural Science»

Full name ______________________________

CHOOSE ONE OR MORE CORRECT ANSWERS (K2. 1, K2. 2)

Choose the concepts that are considered in the natural sciences:

- Irritability;
- an atom;
- conjugation;
- cloning;
- revolution;
- biotope;
- the body;
- monarchy;
- population;
- rhetoric;
- management;
- evolution;
- punctuation;
- republic.

The author of the periodic table of chemical elements is:

1) M. V. Lomonosov;
2) D. I. Mendeleev ;
3) A. Avogadro;
4) R. Hooke.

The author of the evolutionary theory in biology is:

1) h. Darwin;
2) V. Vernadsky;
3) J. B. Lamarck;
4) K. Behr.

The occurrence of current in a conductor near a moving magnet –is:

1) electromagnetic deduction;
2) magnetism;
3) electromagnetic induction;
4) electrical conductivity.

A position that is expressed verbally or mathematically, reflects the permanent properties or permanent connections of natural events-these are:

1) definition of nature;
2) a natural anomaly;
3) a natural phenomenon;
4) the law of nature.

Was he the first to classify and organize animals?

1) Charles Darwin
2) V. Vernadsky
3) Aristotle
4) M. Faraday

Who formulated the law: a body immersed in a liquid or gas is affected by a buoyant force equal to the weight of the liquid or gas in the volume of the submerged part of

the body – this is:
1) Aristotle;
2) A. Avogadro;
3) Archimedes;
4) Democritus.

The science of substances, their transformations, interactions and the phenomena that occur in this –process is:
1) chemistry;
2) geology;
3) genetics;
4) astronomy.

The science of the motion of bodies under the action of applied forces is called:
1) mechanics;
2) dynamics.
3) ecology;
4) physiology.

The science that studies the most general properties of matter and the forms of its motion (mechanical, thermal, electromagnetic, atomic, nuclear) –is:
1) chemistry;
2) ecology;
3) physics;
4) bionics.

The emergence of genetics – the science of the laws of heredity and variability-is associated with the name: (K2. 1)
1) J. B. Lamarck
2) Charles Darwin
3) V. I. Vernadsky
4) G. Mendel

The scientist who founded the heliocentric system, according to which the Earth and other planets revolve around a common center-the Sun. (K2. 1)
1) N. Copernicus
2) E. Rutherford
3) Ptolemy
4) E. Hubble

Tiger, killer whale, and platypus are animals that belong to:
1) one view
2) one team
3) one family
4) the same genus

Compare the formula of the substance and the class of substances to which it belongs.
(K2. 1)

1. CO	A. oxides
2. NaCl	B. oxygen-containing acids
3.$Al(OH)_3$	C.salt
4. H_2SO_4	D. grounds

CHOOSE THE ANSWERS THAT YOU THINK ARE MOST CORRECT

What does the concept of «natural science worldview» mean in your opinion? (K 1.1.)
- it is a system of the most important principles and laws underlying the functioning and development of the natural world, proven and proven ideas about the structure of the world;
- flora, fauna and the whole world considered by a natural scientist;
- general concept of everything interesting and beautiful;
- the world viewed through a microscope and translated into formulas and laws,
not subject to identification.

What is the role of man in nature? (K1. 2)
- man is the king of nature, who must subordinate it to his own interests;
- a person is an outside observer, whose main purpose is not to interfere with natural processes;
- a person is a «slave» of nature, he has to obey the elements of nature;
- man is a part of the system «Man-Nature-Society» and his role is to understand the laws of nature, their inevitability.

What is your opinion on the necessity of studying the course «Natural Science» for your future profession? (K 1.3)
- knowledge of natural sciences is important in my future profession;
- probably necessary, since knowledge of natural sciences is relevant in any profession;
- I can't answer because I'm not familiar with the specifics of my work;
- I don't see the point, because my specialty does not use knowledge of natural sciences.

What is the universal value of nature? (E 1.1)
- it is the main condition of human life;
- it provides precious metals and crystals;
- it provides a person with minerals, food and clothing;
- it is a source of inspiration in human activity;
- it provides an opportunity for a person to learn about the world around them and their place in it;
- special opinion____.

Which of these reasons do you personally follow when choosing your future professional career as a catering technologist ? (E 1.2)
- satisfaction of their material needs;
- preserving people's health;
- realization of their creative activity ;
- a sense of personal significance;

- awareness of the social utility of the chosen profession;
- an opportunity to contribute to social development;
- improving people's quality of life.

Do you feel that there is a lack of scientific knowledge to solve problems of various directions? (E 1.3)
- yes, when solving life problems;
- yes, in cognitive (educational) activities;
- in rare cases;
- No, I don't feel it.

Is it not a distinctive feature of the scientific method? (O 1.1)
- relying only on data that can be objectively verified;
- belief in the cognizability of the world by the human mind;
- the principle of subordination of the minority to the majority opinion;
- a critical approach to any statement, theory, or hypothesis.

In your opinion, what academic disciplines (other than professional ones) are necessary for a catering technologist? (K 2.3)
- knowledge of human psychology;
- knowledge of human physiology and health protection;
- knowledge of microbiology, sanitation and hygiene;
- knowledge of cultural content;
- knowledge about the environment (environmental knowledge);
- mathematical knowledge;
- other____.

Choose statements that you think reflect the relationship between man and nature(E 2.1):
- man is one of the forms of life on the planet, nature provides human life with a variety of life support factors;
- a person is unique in himself, and his role is to subordinate nature to his own interests;
- a person is a unique component of the biosphere(nature), спocapable of being aware of himself and the world aroundhim,capable of knowing nature and the laws of its functioning;
- knowledge of the organization of the biosphere (nature) enables a person to understand his place in nature;
- a man-made artificial habitat спothat can exist independently from nature and provide for itself.

How do you assess the impact of human activity on Nature ?(E 2.2)
- although humanityспouses the resources of Nature for its activities, this does not have a noticeable impact on the biosphere;
- human activity has a minor impact, which can be described as «environmental pollution»;
- the increase in material production threatens both the existence of the biosphere and the human being himself.

Select all statements that you think reflect the values of natural science knowledge (Es):
- natural-scientific knowledge is the basis for the harmonization of the «nature-man» system;
- unregulated anthropogenic load, without taking into account the laws of nature (movement), leads to the destruction of natural systems;
- natural phenomena on our planet are a reflection of cosmic processes;
- man is the highest value, nature exists to provide him with everything necessary;
- Nature is a well-established mechanism that a person cannot change.

In what situations do you turn to information of natural science content? (O 2.1)
- when additional information is needed to solve practical problems;
- when you need to organize your life, improve your health, etc;
- when I want to expand my horizons;
- I practically don't use it;
- special opinion____.

How to proceed if you need to find information for preparing an answer, report, or abstract (choose the ones that you most often use) (O 2.2):
- I select one source on the Internet with the highest word match and copy the entire text;
- I choose a single source from the Internet or a textbook, read the entire text, and delete any incomprehensible or unnecessary information;
- I use several sources (Internet, books, magazines) to assess the reliability of information and write my own text;
- special opinion____.

Are you ready to apply your existing knowledge in an unusual situation? (O 2.3)
- no, I always need help in interpreting natural science knowledge;
- I am able to search for and comprehend natural science data, if necessary within the framework of educational activities, but I do not use it in my life;
- I am ready to independently acquire natural science knowledge to solve practical problems, including in professional activities;
- I always creatively solve practical problems, for this I independently choose a way to solve them- special opinion____.

What is the systemic organization of nature ? (K 3.1)
- all components of nature can be divided into living and inanimate;
- Nature consists of a large number of objects;
- Nature is the unity of all elements, which is ensured by their interrelation and interdependence;
- special opinion____.

Where are natural science knowledge applied in practice ? (K3.2)
- the study of objects and natural phenomena is necessary only for scientists and specialists;
- natural science knowledge can be useful in professions directly related to them;
- natural science knowledge is applied in all areas of human activity, as it lays the foundations of natural science culture;
- natural-scientific knowledge is the basis for the harmonization of relations in the system «Man-Nature-Society»;
- special opinion____.

What character, in your opinion, should be the interaction of man with Nature in the process of socio-economic activity (the sphere of your future professional activity)? (K 3.3)
- a person can take from Nature everything that is necessary to meet their needs;
- achieving high economic efficiency, along with implementing environmental policies;
- the main task of humanity is to preserve the environment, so it is necessary to reduce the rate of socio-economic growth;
- it is necessary to find a compromise between the pace of socio-economic development ability of the environment to self-repair.

Do you feel the need to use natural science knowledge in the process of practical activity? (E 3.1)
- yes, quite often;
- rarely;
- I don't know.

Can your professional activities have an impact on Nature ? (E 3.2)
- I guess maybe I didn't think about it;
- no, because my future profession is not related to nature;
- my future professional activity may have an impact on changing the environment;
- it can, because any human activity is connected with nature and can have, among other things, a negative impact;
- special opinion ____

Which of the listed motives, in your opinion, is the leading one in the professional activity of a catering technologist? (E 3.3)
- satisfaction of their material needs;
- preserving people's health;
- implementation of creative activity;
- a sense of personal significance;
- awareness of public utility;
- an opportunity to contribute to social development;
- improving people's quality of life.

What is the significance of studying natural sciences for you? (O3. 1)
- I am not interested, because I believe that knowledge of these disciplines will not be useful to me in my life and future professional activities;
- I am interested in learning about the world around me for general development;
- knowledge of technological achievements in natural science is important; they are needed because they will be useful for future professional activities;
- knowledge of natural sciences is necessary for me to preserve my health and the health of the people for whom I will work;
- knowledge of natural science disciplines helps my intellectual development in the chosen professional activity;
- knowledge of these disciplines will help me build my professional activity in such a way as to cause minimal damage to nature;
- special opinion____.

Do you show any interest in the problems of Human-Nature interaction? How is this expressed? (O 3.2)
- I purposefully study information on natural science topics, including those related to the profession I receive;
- sometimes I read individual articles;
- I'm not interested in these issues;
- did an essay on environmental issues;
- conducted/participate in projects / research on environmental issues;
- special opinion____.

What, in your opinion, should play a crucial role in making a responsible decision in the field of future professional activity? (O 3.3)
- economic efficiency;
- the decision made should correspond to the management style of the higher instance;
- my decision should not infringe on anyone's interests;
- comprehensive performance assessment;
- compliance of this decision with your moral principles ;
- compliance of my decision with the guidelines adopted by the company;
- my decision should not contradict universal values;
- my decision must be consistent with the laws of development of nature and society.

Choose the methods that you use when getting acquainted with new material and evaluate the degree of proficiency in it (O 1.2)

	Satisfactory	Good	Excellent
Memorizing			
Comparison			
Drawing up diagrams, graphs, tables			
Trying to highlight the main thing, the features of the described			
Meaningful reading (highlighting new, interesting, already familiar)			
I come up with associations to the phenomena and objects			
under study Other (specify) ______________________			

How often do you use scientific knowledge methods in your studies to solve your practical problems (O 1.3)

	Often	Rarely	Never
Observation			
Experiment			
Analysis			
Comparison			
Modeling			

Generalization			
Other (specify) ___________________			

Table B. 1-List of abbreviations in the questionnaire text

Indicator Code	**CRITERIA AND INDICATORS**
	First VSC
	Cognitive Criterion:
K 1.1	-has an idea of the main characteristics of the modern natural-scientific picture of the world and its place in the holistic scientific picture of the world;
K 1.2	-knows the nature of relations in the system «Man-Society-Nature»;
K 1.3	-understands the importance of natural-scientific knowledge for practical (professional) activities in the system «Man-Society». - Nature»;
	Emotional-value (or personal) criterion:
E 1.1	-emotional and sensual attitude to the surrounding reality
E 1.2	-accepts the values of natural science knowledge for the future profession
E 1.3	-purposefully strives to master natural science knowledge in the context of the future profession;
	Integrative-activity (or operational) criterion:
O 1.1	- understands how to use natural science methods to solve practical problems
O 1.2	- is able to use natural science methods to solve problems related to future professional activity
O 1.3	- is able to apply the basic methods of cognition to study various aspects of the natural science picture of the world, which it becomes necessary to face in the professional field
	Second VSC
	Cognitive criterion:
K 2.1	-gets acquainted with the main areas of natural science
K 2.2	-knows the most important ideas and achievements of natural science that have had a decisive impact on the development of technology and technologies, including in the aspect of the acquired profession
K 2.3	-assigns natural science knowledge necessary for the future profession
	Emotional-value (or personal) criterion:
E 2.1	-has an understanding of the moral, moral and ethical norms and principles of the «Man – Nature»relationship
E 2.2	-understands the consequences of human impact on Nature, including in the aspect of the acquired profession
E 2.3	-assigns the VSG system and the leading ideas of the course
	an Integrative-activity (or operational) criterion:
O 2.1	-understands how to conduct simple research, analyze and interpret natural science data
O 2.2	-He is able to use various sources to obtain natural science information and assess reliability in order to achieve his goals and objectives
O 2.3	- able to make responsible decisions, including in professional activities, based on the principles of sustainable development of the "Man – Society – Nature" system
	Third VSC
	Cognitive criterion:

K 3.1	-has an understanding of the system organization of nature
K 3.2	-knows the areas of application of natural science knowledge in practice (in the sphere of future professional activity) and their transformative role
K 3.3	- understands the main ways of sustainable development of the «Man – Society – Nature»system
	Emotional-value (or personal) criterion:
E 3.1	-refers to educational and cognitive activities as споa way to understand the harmonization of relations in the «Person – Society» system – Nature».
E 3.2	-understands the degree of responsibility for the results and consequences of practical activities, including in the aspect of the acquired profession
E 3.3	-understands the importance of competencies in the field of natural sciences for a person and society
	Integrative-activity (or operational) criterion:
O 3.1	-represents how to apply natural science knowledge in professional activities and life situations
O 3.2	-has mastered the ways of self-education in the field of natural science to improve their own intellectual development in the chosen professional activity;
O 3.3	-is ready to make responsible decisions, including in professional activities, based on the principles of sustainable development of the «Man – Society» system - Nature»

Appendix D

After-school planning of the «Natural Science»course

№ Class number	Name of sections and topics
	Topic I. natural-scientific knowledge: diversity of unity. (Megaconcept: SCIENCE) 3 hours
1.	Natural science as a cognitive activity.
2.	Experimental methods in natural sciences.
3.	Great experiments in the natural sciences.
	Topic II. Structures of the natural world: unity of diversity. (Megaconcept: STRUCTURE) 14 hours
4.	Scales of the Universe
5.	Fundamental fields as components of matter
6.	Particle-wave dualism
7.	Interaction of matter and fields
8.	Unity of diversity. Microcosm
9.	Unity of diversity. Megaworld.
10.	Unity of diversity: biological systems
11.	Molecular structure of the living
12.	Cell as a structural unit of living organisms
13.	Biosphere
14.	The most general laws of nature. Conservation laws
15.	Energetics of living
16.	things Unity of nature. Symmetry
17.	Generalizing lesson
	Topic III. From structure to properties. (Megaconcept: SYSTEM) 6 hours
18.	Atoms and Elements. Two solutions to the problem of the genesis of the properties of substances.
19.	Periodic law of D. I. Mendeleev.
20.	Composition-structure-properties. Object properties depend on their structure and composition.
21.	Biological systematics. Practical work 4: Methods for determining species.(Working with the determinant)
22.	Modern ideas about the diversity of living things. Implementation of genetic information.
23.	Generalizing lesson.
	Topic IV. Nature in motion, movement in nature. Megaconcept: TRAFFIC (8 hours)
24.	Causes of mechanical movement. Movement as propagation. Waves, properties.
25.	Practical work 5: Sound and its characteristics.
26.	Motion, space, time, matter.
27.	The rate of chemical reactions.

	Practical work 6: Chemical reactions.
28.	Movement in the wild.
29.	Movement as a qualitative change. Practical work 7: Nuclear reactions.
30.	Forms and types of traffic.
31.	Generalizing lesson.
	Topic V. From chaos to order. Megaconcept: SELF-ORGANIZATION (6 hours)
32.	Between order and chaos. Self-organization. Causes and conditions.
33.	Self-reproduction of living organisms. Self-organization in the development of organisms.
34.	Principles of evolution of living organisms.
35.	The development of life on Earth.
36.	Human evolution. Formation of a reasonable person.
37.	Generalizing lesson .
	Topic VI. Evolution of technical thought. Megaconcept: MACHINERY AND TECHNOLOGIES (23 hours)
38.	Technology as a human-made reality.
39.	Technique human needs: essential and redundant.
40.	Hydrodynamics and aerodynamics. Floating and flying vehicles.
41.	Conservation laws, jet propulsion, and space travel.
42.	Principles of design and operation of heat engines.
43.	Laws of thermodynamics and efficiency of heat engines. Efficiency of different cycles.
44.	Heat and power engineering today.
45.	Principles of operation of electric generators and electric motors. Practical work 8: Study of the operation of an electric generator and an electric motor.
46.	Power sources in modern technology. Conversion and transmission of electricity.
47.	Electric power industry and ecology.
48.	Use of radio waves. Principles of mobile phone communication. Practical work 9: Radio waves and their propagation features.
49.	Geometric optics and optical devices. Practical work 10: The principle of operation of glasses.
50.	Devices that use the wave properties of light. Manifestation of the wave properties of light.
51.	Practical work 11: Stereo image and holography. Artificial light.
52.	Devices that use the corpuscular properties of light.
53.	The principle of laser operation. Practical work 12: Properties of laser radiation and the use of lasers.
54.	Harm and benefits of nuclear technologies. Nuclear weapons and nonproliferation issues.
55.	Nuclear power and environmental problems. (The principle of operation of nuclear reactors. The problem of controlled thermonuclear fusion and future energy.)
56.	Information and electrical signals. Devices that convert electrical signals. History of development and prospects of information technologies.
57.	Long-term storage of information.

	Practical work 13: Human-computer: information exchange.
58.	From natural polymers to synthetic polymers. Practical work 14: Synthetic polymers-the basis of plastics.
59.	Biotechnology and human progress. Cloning «pros» and «cons».
60.	Summary lesson
	Topic VII. Everything is healthy for a healthy person. ***Megaconcept: HEALTH (15 hours)***
61.	Man as a unique living system.
62.	Adaptation of the human body to environmental factors. Human health factors: pros and cons.
63.	Practical work 15: Increased muscle activity and adaptation of the body to it.
64.	Practical work 16: Biochemical bases of sports training.
65.	Problems of maintaining human health (alcohol, smoking, drug addiction).
66.	Drawing up abiochemically sound diet. Practical work 17: Biochemical bases of rational nutrition.
67.	Practical work 18: Vitamins as biologically active substances.
68.	Principles of using medicinal substances. Biologically active substances – problems of use.
69.	Practical work 19: Protective mechanisms of the human body.
70.	Human diseases caused by microorganisms. Parasites and parasitic diseases.
71.	Viruses and their effects on humans. Prevention and treatment of diseases caused by viruses.
72.	Practical work 20: Hereditary patterns.
73.	Human genetics.
74.	Hereditary diseases. Family planning.
75.	Summary lesson
	Topic VIII. The civilization of mankind. ***Megaconcept: NOOSPHERE (6 hours)***
76.	Global problems of our time.
77.	Man as a component of the biosphere. Environmental problem. Practical work 21: Environmental pollution and its consequences.
78.	Problems of scientifically based nature management. Global climate change and its consequences.
79.	Practical work 22: Environmental disasters and environmental expertise.
80.	Biosphere and noosphere. Human responsibility for the state of the biosphere.
81.	Problems of sustainable development of society and the biosphere.
82.	**Summary of basic course information**

Appendix E
Scenario lesson plan based on intersubject connections

Topic of the lesson-lecture: «Interaction of field and substance»

The purpose of the lesson is to create conditions for students to understand the role of knowledge about the interaction of matter and field as a basis for explaining the color diversity of our world.

Megaconcept: Structure

Concept of the semantic block: Matter

Private concept: «field and substance»

Planned learning outcomes

- Mastering the concepts of «spectrum», «linear spectrum», «continuous spectrum», «absolutely black body»;
- Mastering the private concepts of «energy», «field», «substance»;
- Ability to simulate the process of decomposition of a white light beam into rays of rainbow colors;
- Ability to select proofs when revealing the essence of color coloring of physical bodies of different nature.

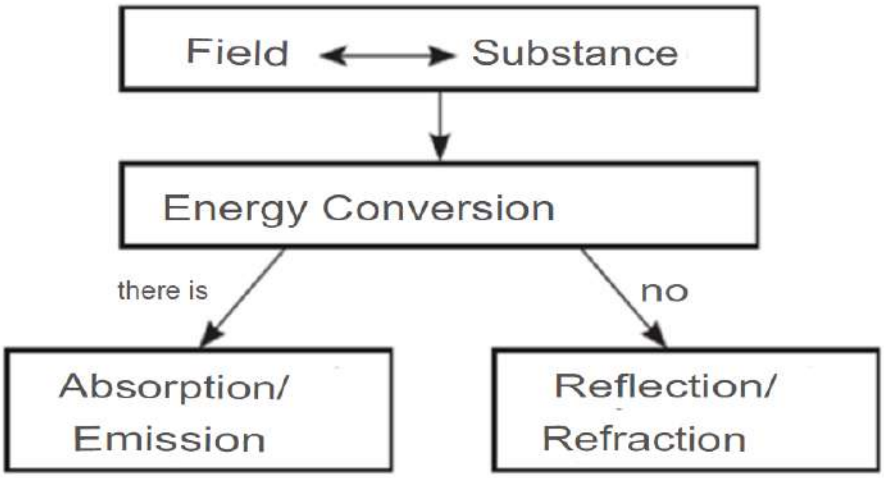
Expected course of the lesson

I Motivation.

It is carried out in the technology of meaning-making. The «Smart Swing» technique.

II Learning new material

At the beginning of the lesson, the teacher explains the phenomena of reflection, refraction, absorption, and radiation in terms of energy conversion. It is energy that is the general quality of matter and field. Therefore, the nature of energy conversion reflects the essence of the phenomena under consideration.



Students ' attention is focused on the fact that color, in itself, cannot be a complete characteristic of a substance. Here it is possible to demonstrate Newton's experience with the formation of gray color during the rotation of a three-color disk. The development of optics allowed us to identify that each color corresponds to a wave of a certain length. This implies the concept of the spectrum as a dependence of the radiation intensity on the wavelength (or frequency of the wave). The names of the spectra correspond to the processes: absorption, reflection, refraction, and radiation spectra. In conclusion, the students ' attention is drawn to the fact that the spectrum can accurately identify a substance. The spectral method is one of the most accurate methods for determining the composition of a substance.

Students should be reminded that the method of modeling is used to study certain phenomena in science. It is the model that is absolutely black body.

Subject COT

Based on the idea of color as a result of the interaction of field and matter, you will put forward a hypothesis that reveals the physical meaning of the proverb «In the night all cats are gray».

III Homework assignment

Work out the information on the Internet on the topic «Particle-wave dualism», make a synopsis.

Appendix F
Scenario plan for an integrated lesson

Lesson topic: «The scale of the Universe»

Lesson goal: Creating conditions for students ' awareness of the diversity of objects in the universe and the specifics of methods of studying them, due to the possibilities of modern science.

Concept of the semantic block: Image of the Universe (the World of Nature)

Private concepts: Megamir, macrocosm, microworld

Planned learning outcomes:

- Mastering the private concepts of «macrocosm», «megamir», «microcosm», «scale».
- Analyze information about objects in the universe.
- Compare the scale of the micro -, mega -, and macro worlds and the laws that apply in these worlds.
- To understand the reasons for the existence of boundaries of the possibility of studying the macro - and micro-world.

Equipment: school laboratory microscope (for example, from the biology classroom); school telescope. In the absence of such materials, it is necessary to prepare visual aids in the form of posters, multimedia projections, etc. Prepare material on modern microscopes and telescopes, their operation principles, and their use. It is advisable to visit a planetarium, observatory, or any other institution where students can get the necessary information on the topic of this lesson.

Main work format: concept analysis technology

Expected course of the lesson

I Learning new material

The semantics of the word «world»can serve as a starting point. The teacher asks the question: «How do you understand what the world is?» Using the suggestive phrases «underwater world», «all the world», «feast for the whole world», brings students to the comparison of «world-system» and, as a result, to the idea that there can be as many worlds as you like. Then the teacher forms the concepts of «megamir», «macrocosm», «microcosm»: «What systems can be called macrosystems, microsystems, megasystems?», « By what characteristics do systems belong to this or that world?». It brings students to an understanding of the scale of worlds. The conclusions are recorded in a notebook

Intersubject COT (Working with text)

Independent work with a text that examines the scale and boundaries of the macrocosm. Key questions: «What are the characteristic dimensions in the macrocosm?», « What is the characteristic, distinctive feature of the macrocosm?» (Availability of direct observation, direct, direct research.)

Independent work with the text of the paragraph that discusses the scale of the mega-world. Key questions: «What is called a light year? What is the basis for introducing this unit?», « What is the basis for the hypothesis that we cannot observe objects that are more than 14 billion light years away from us?». Key questions for working with the text of the section that discusses the scale of the microcosm: «What are the characteristic dimensions in the microcosm?», «What is the complexity of microcosm research?», « What are the reasons that limit microcosm research?».

Methodological comment: Working with text can be implemented in various technologies (working in columns, groups, etc.).

II Securing the material.

At the end of the lesson – summing up the results. Students are asked to fill in the following table:

Parameters	of Eye	Microscope	Telescope
Resolution			
Magnification			
Observed World	Macro-	Micro-	Mega-

III Homework assignment.

Create a concept map of «World of Nature».

Appendix G
Scenario plan for a metasubject lesson

Summary lesson on «Structures of the natural world: unity of diversity» (Scenario of a concept synthesis lesson)

The main idea of the lesson: Universal interrelationships and interdependence determine the integrity and very existence of nature and man.

Megaconcept: Structure (Structures of the natural world)

Concepts of the semantic block: nature, structures of the natural world; levels of organization of matter; tools for obtaining scientific knowledge.

The purpose of the lesson: to create conditions for students to generalize and systematize knowledge about the structures of the natural world; students 'value and semantic choice in the context of the megaconcept «Structure».

Planned learning outcomes

· awareness of the material unity of the world as the basis of the structure and properties of its objects, which are objects of study in various fields of scientific knowledge;

· identification and awareness of students ' acquired educational content, learning deficits, assessment of the quality and level of learning;

· synthesis of knowledge about the characteristics of objects for building logical chains of reasoning using evidence of the unity of the chemical composition of objects in the Universe, the unity of the manifestation of physical laws in the Universe;

· mastering the meaning of the concept of «material unity of the world»;

· understanding the material unity of the world, the common origin and materiality of the world based on the facts established by science (the fulfillment of the same laws of nature in the entire universe, the unity of the chemical composition of objects in the Universe).

Methodological comment: Any concept, as well as any aspect of it, corresponds to a certain word – the so-called language units. Some concepts can be expressed not in one word, but in a verbal construction or another in a different sign form. Thus, concepts can be correlated with several forms of manifestation, which makes it possible for the student to enter the semantic field of the concept in many ways. Based on this, we used the judgment «Structures of the natural world: diversity of unity» as the name of the reconstructed megaconcept «Structure». The lesson is developed based on the methods of meaning-making (Source: Kashlev S. S. Modern technologies of the pedagogical process: A manual for teachers. Moscow: Universitetskoe Publ., 2000-95 p.)

Expected course of the lesson

The lesson involves two consecutive stages. The first one is aimed at semantic actualization and understanding of the megaconcept «Structures of the natural world»by students. At this stage, it is also advisabilities use the «Association» or «Alphabet» method. The second stage is directly related to the development of own meanings, presentation and exchange of individual meanings, as well as generalization of meanings. This stage is organized in the model of the «Working with concepts» methodology. Each stage is accompanied by a reflection of the participants.

It is worth noting that in the context of these methods, the teacher acts not only as a facilitator, but also as an active participant in meaning-making activities, generating new meanings «here and now».

I.Challenge.

<u>Updating</u> During the problem discussion, students are invited to note the key features and functions of the concept in the human mind.

<u>Motivation</u> The teacher leads students to the need to develop the concept of «Structures of the natural World», which is aimed at synthesizing particular concepts mastered during lessons on this topic.

Methodical comment:

Students in previous classes are already familiar with the concept of «Concept» and have an understanding of its structural components and functions. If this concept is introduced for the first time, then you should focus on the interpretation of the concept as a unit of meaning that a person operates with in real life.

<u>Setting lesson objectives by students.</u> The teacher invites students to formulate questions that have appeared or remained in the course of mastering the topic and that

they would like to receive answers to at the end of the lesson. To organize this stage, the «Camomile Bloom» technology is used. There are six types of questions in the «daisy»of petals – six types of questions:

1. Simple questions. Questions that will be answered with some facts.
2. Clarifying questions. They can start with the words: «So you're saying that...?», « If I understand correctly, then ...?». They specify information that is implied, but not named for some reason.
3. Interpretative (explanatory) questions. They are aimed at establishing causal relationships.
4. Creative questions. In their formulation, they include elements of assumptions, forecasts, etc.
5. Evaluation questions. They are aimed at identifying evaluation criteria for phenomena and events.
6. Practical questions. The formulations provide for identifying the relationship between theoretical knowledge and practice.

II. Comprehension

The first stage of the lesson involves a group refinement of the content and structure of the concept under consideration.

Necessary equipment: whiteboard, chalk / interactive screen.

Estimated time-15-20 minutes

Implementation algorithm

1. The teacher suggests that each student independently select several associations (words, phrases, sentences, etc.) for the concept under consideration in the notebook. After that, select in the resulting list those associations that most accurately reflect the essence (main meaning) of the concept.

2. The teacher invites students to voice associations to the concept, fixing on the blackboard Students can complete the list of words in the notebook. After the students, the teacher offers their associations to the concept under consideration.

3. The teacher offers to read (written on the blackboard), think about, feel the

concept-judgment «Structures of the natural world: diversity of unity».

4. The teacher suggests that each student independently select several associations (natural objects, phenomena of processes) to the considered concept-judgment in the notebook.

5. The teacher invites students to voice associations to the concept of judgment, fixing on the blackboard Students can complete the list of words in the notebook. After the students, the teacher offers their associations to the considered concept-judgment.

6. The teacher suggests students to distribute the received semantic series of associations of the considered concept-judgment into semantic groups that most accurately reflect the essence (main meaning) of the considered concept and the concept of judgment. The reference points are the concepts of semantic blocks, but students can also identify additional semantic groups.

7. The teacher invites students to voice the names of semantic blocks in which the selected associations were assigned to the concept and concept-judgment. At the same time, the record is kept on the board. After the students, the teacher offers their own options for semantic groups.

8. Semantic blocks that have received the least number of associations are supplemented by students.

9. The teacher invites students to conduct a meaningful reflection: how do you assess the completeness and accuracy of the selected semantic blocks; how much they reflect the essence of the concept under consideration?

10. The teacher conducts a meaningful reflection: characterizes, justifies the essence of the concept under consideration.

11. The teacher and students reflect on the interaction that has taken place.

The reflection algorithm can be as follows:

- record the state of your knowledge about the concept we synthesize, and determine how much it has changed.
- identify the causes of this condition.
- evaluate your activity and the importance of this method for yourself.

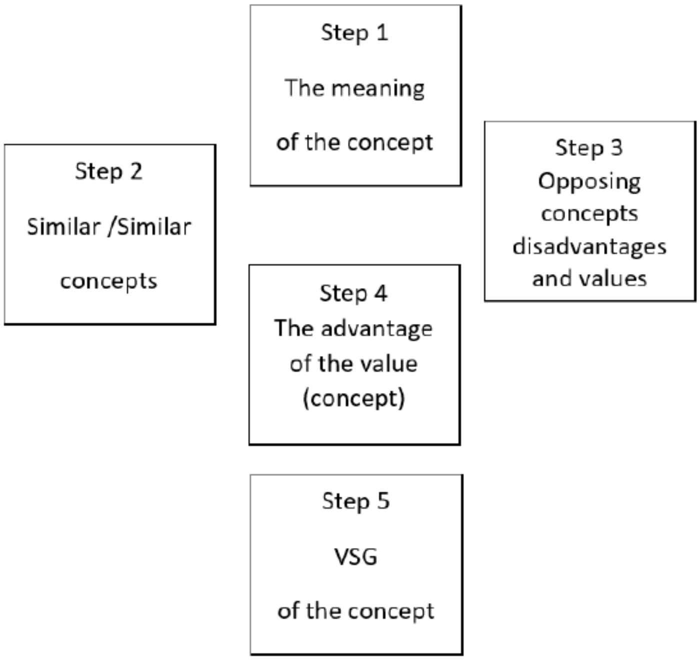
The second stage of the lesson. The main task of this stage is to directly synthesize already mastered VSG concepts.

Necessary equipment: technological maps (issued to each participant or one large one for all); blackboard, chalk / interactive screen.

Implementation time – 15-20 minutes.

Implementation algorithm

The introductory conversation serves as an orientation function, goal setting is carried out, the format and rules of work are discussed.



In accordance with the technological map, acceptance is implemented in stages.

Step 1-define the concept (values).

Students independently formulate the definition of a concept(value), highlighting their own meaning of the concept (value) in the proposed definition. After that, the results are discussed in the form of a conversation (in groups or in a class), the content copra of which is the materials of the previous part of the lesson. The ideas voiced by students are recorded on the blackboard.

Next, a generalized definition is jointly derived and fixed on the board.

Step 2-identify similar concepts (values).

Students are asked to choose similar concepts that are close to the concept being studied and/or the concept-judgment of «The Structure of the natural World». To do this, the teacher can use the following questions:

- What concepts (words) can mean the same thing as your proposed definitions?
- What are the characteristics of all the structures you have proposed?
- Which of the proposed objects and structures of the natural world should be considered in more detail?

All non-repetitive points of view are recorded on a piece of paper or blackboard.

Step 3-identify opposing concepts (values)/ we identify the disadvantages of the concept.

The selection of opposite concepts (values) allows you to compare them with each other, identify the essential characteristics of the concept (value) under study.

At this stage, students select antonyms for the concept being studied using the following sample questions:

· What is the opposite of this concept?
· If you don't know anything about this concept, what will change in a person's life?
· Why do some people say that learning this concept is not very important?

Identification of the shortcomings of the synthesized concept can be carried out by the teacher and students during a conversation on the following sample questions:

· Are there any drawbacks to the structures of the natural world? Which ones?
· Can you get into trouble because of the structures of the natural world you named?
· Are there any laws that restrict the use of this value?

Step 4-determine the advantages of the concept.

The definition of advantages contributes to the expansion of the meaning of students about this concept, positive motivation in expanding the content of this concept in it-self.

The following questions will help students identify the benefits:

· What is the value of this concept?
· What do people who have a clear image of this concept have?

- Does a person need a formed image of this concept? Why?
- What can happen to a person if they take into account the characteristics of the concept you mentioned?
- What advantages does owning an image of a given concept give a person?

Step 5-Formulate the VSG concept in the context of leading ideas.

Students are invited to fix the formulation of the value-semantic content of the concept through the prism of the leading ideas of the course:

The idea of unity (What is the unity of the components considered in the process of mastering the concept of «structure of the natural world»?)

The idea of interdependence (how are the structures of the natural world related to each other? What is the basis of these connections? What is the place of man among the structures of the natural world?)

The idea of harmonizing man and nature (How can a person build his activities in accordance with the structures of the natural world? What will happen if a person does not take into account the structures of the natural world in his activities?)

The wording is voiced. Non-recurring ones are recorded.

Step 6-reflect.

The second part of the lesson ends with the participants ' reflection on the interaction that took place. Each of the participants (including the teacher) is invited to reflect on their own activities, the activities of other participants in the interaction.

The reflection algorithm can be as follows:

- tell us about your emotional state (joy, frustration, satisfaction, confusion, delight, fear, depression, cheerfulness, etc.).
- evaluate your knowledge of the concept (increased, systematized, did not learn anything new, etc.);
- state the reasons for your condition (interesting, informative discussion; everyone was active; no one rejected my point of view; there was an exchange of opinions, etc.).

III. Reflection.

Students are asked to answer the questions they formulated at the beginning of the lesson and assess how much the results were achieved, which helped/prevented them from achieving.

IV. Homework assignment.

Introduction to the textbook «Generalization and comprehension of the material of the chapter « Structures of the natural world: unity of diversity».

Methodological tip:

The value-semantic guidelines of the megaconcept «Structures» can be formulated in the context of the leading ideas of the course as follows:

Various objects of nature (physical, chemical, biological) show nature as a developing system, which is represented by components of various levels of organization. Components interact with each other and influence each other. This interaction ensures the emergence and existence of the phenomenon of life on the planet Earth and the variety of forms of life.

The general essence of natural processes is the internal change of systems and energy transformation. Natural laws are objective - the unity of physical and chemical processes is valid for all manifestations of life. It is impossible to carry out processes that contradict the laws of nature.

Man is a component of nature. As a natural phenomenon, it obeys its laws. Therefore, any human activity should be carried out on the basis of knowledge of the laws of ecosystem life.

Appendix K

Questionnaire 3. Self-analysis of the formation of VSC components based on the results of mastering IC NS, developed on the basis of a concept approach.

Dear student,

Please fill out the proposed questionnaire –to assess the degree of development of the components of value-semantic competencies.

This questionnaire includes 27 tasks. Each task consists of a question and several possible answers. Please rate your statements on a four-point approval scale by crossing out the corresponding number:

«1» - no, I don't agree at all.
«2» - more likely no than yes.
«3» - more likely yes than no.
«5» - yes, I totally agree.

Try to answer quickly, without thinking too much about the meaning of the question and the answer options. Usually, the first option selected is the correct one.

Don't skip the statements, give an answer for each one.

Indicator Code	CRITERIA AND INDICATORS	
	First VSC	
	Cognitive Criterion:	
K 1.1	-I have an idea of the main characteristics of the modern natural science picture of the world and its place in the holistic scientific picture of the world	1 2 3 4
K 1.2	-I know the nature of relations in the system «Man-Society-Nature»	1 2 3 4
K 1.3	-I understand the importance of natural science knowledge for practical (professional) activity in the system»Man – Society – Nature»	1 2 3 4
	Emotional-value criterion:	
E 1.1	-emotional and sensual attitude to the surrounding reality	1 2 3 4
E 1.2	-I accept the values of natural science knowledge for the future profession	1 2 3 4
E 1.3	- I purposefully strive to master natural science knowledge in the context of the future profession	1 2 3 4
	Integrative-activity criterion:	
O 1.1	-I understand how to use natural science methods to solve practical problems	1 2 3 4
O 1.2	-I am able to use natural science methods to solve problems related to my future professional activity	1 2 3 4
O 1.3	-I confidently apply basic methods of cognition to study various aspects of natural science worldviews that need to be encountered in the professional sphere	1 2 3 4
	Second VSC	
	Cognitive criterion:	
K 2.1	-I am familiar with the main areas of natural science	1 2 3 4
K 2.2	-I know the most important ideas and achievements of natural science that have had a decisive impact on the development of technology and technology, including in the aspect of the acquired profession	1 2 3 4
K 2.3	- I assign natural science knowledge necessary for the future profession	1 2 3 4

	Emotional-value criterion:	
E 2.1	-I have an understanding of the moral, moral and ethical norms and principles of the «Man – Nature»	1 2 3 4
E 2.2	-I am aware of the consequences of the anthropogenic influence of humanity on Nature, including in the aspect of the acquired profession	1 2 3 4
E 2.3	- I assign the VSG system and the leading ideas of the course	1 2 3 4
	Integrative-activity criterion:	
O 2.1	-I understand how to conduct simple research, analyze and interpret natural science data	1 2 3 4
O 2.2	- I am able to use various sources to obtain natural science information and evaluate the reliability in order to achieve my goals and objectives	1 2 3 4
O 2.3	-ready to independently acquire natural science knowledge and creatively solve practical problems, including in professional activities	1 2 3 4
	Third VSC	
	Cognitive criterion:	
K 3.1	-I have an understanding of the system organization of nature	1 2 3 4
K 3.2	-I know the areas of application of natural science knowledge in practice (in the sphere of future professional activity) and their transformative role	1 2 3 4
K 3.3	- I understand the main ways of sustainable development of the system «Man-Society-Nature»	1 2 3 4
	Emotional-value criterion:	
E 3.1	- I treat educational and cognitive activity as a way of understanding the harmonization of relations in the «Man - Society — Nature» system	1 2 3 4
E 3.2	-I am aware of the degree of responsibility for the results and consequences of practical activities, including in the aspect of the acquired profession	1 2 3 4
E 3.3	- I am aware of the areas of natural sciences for humans and society	1 2 3 4
	Integrative activity criterion:	
O 3.1	-I can imagine how to apply natural science knowledge in professional activities and life situations	1 2 3 4
O 3.2	-mastered the methods of self-education in the field of natural sciences to enhance his own intellectual development in his chosen professional activity;	1 2 3 4
O 3.3	-I am ready to make responsible decisions, including in professional based on the principles of sustainable development of the «Human – Society – Nature» system	1 2 3 4

Appendix L

Questionnaire 4. Assessment of students ' satisfaction with the results of mastering IC NS, developed on the basis of a concept approach

Dear student,

You have completed the integrated course «Natural Science». We want to improve our course!

Please do not skip any questions and answer them sincerely.

Please rate your approval on a five-point scale by crossing out the corresponding number:

«1» - missing/ not implemented.
«2» - partially present/ occasionally implemented.
«3» - present / in progress.
«4» - present in a larger volume / often implemented.
«5» - present in full/fully implemented.

Target block The	
The formulated goals and objectives of the lesson reflected the importance of mastering the lesson material for understanding the unity and integrity of nature	1 2 3 4 5
proposed educational material was aimed at discussing the interdependence of man and nature	1 2 3 4 5
I understood the need for scientific knowledge learned in the lesson to organize the harmonious development of the «Man – Nature – Society» system	1 2 3 4 5
I understood the importance of the objects, facts, and phenomena being studied for the development of my future profession	1 2 3 4 5
I believe that science lessons are interesting and useful	1 2 3 4 5
The lesson created conditions for realizing the need to study the concept as one of the conditions for understanding its meaning.	1 2 3 4 5
Informative	
Only information about objects, phenomena and laws was offered: - objects were considered outside the system; - the phenomenon described without establishing relationships; - information on the functioning of nature was settled its laws	1 2 3 4 5
the Content of the training material it was clear to me, met my expectations	1 2 3 4 5
In a science class covered topics and issues that are interesting to me	1 2 3 4 5
the Content of the educational material was allowed to ensure that a change in any component of the system, contrary to the laws of nature, will lead to the violation of its integrity	1 2 3 4 5
In the course of «Natural Sciences» every component of nature studied in isolation, without any discussion of its role in the formation of the integrity of the system	1 2 3 4 5
the course Material illustrated the frontiers of scientific knowledge, it was possible to judge about infinity and complexity of scientific knowledge, the limited direct empirical observation	1 2 3 4 5
the Content of the educational information was confirmed by the material unity of the world and the existence of universal (intra - and inter-level) ties in nature	1 2 3 4 5

Training material is allowed to understand the General essence of natural processes – the internal system change and transformation of energy	1 2 3 4 5
Objects, phenomena, laws of nature in the course studied without respect to any level of the organization	1 2 3 4 5
the course Material is to disclose the value of the acquired knowledge about the objects, phenomena or laws of nature for the organization of human activity and the provision of technical progress	1 2 3 4 5
the course Material was overloaded with irrelevant information	1 2 3 4 5
the Material of the course is more focused on the disclosure of ideas andSPOlyzovanie of natural resources	1 2 3 4 5
the Content was aimed at understanding the values and meaning of scientific knowledge whatever sphere of activity	1 2 3 4 5
the Content of the educational information in the structure of the concept facilitates the understanding the assimilation and comprehension of information	1 2 3 4 5
the Material of the course met my expectations	1 2 3 4 5
Procedure	
of the lesson, conditions were created to identify my associative and intuitive field	1 2 3 4 5
Tasks aimed at the socialization of the individual (associative and intuitive) experience to create a collective Association of a number concept.	1 2 3 4 5
Tasks are aimed at transferring vocabulary from passive memory to active vocabulary.	1 2 3 4 5
My knowledge gaps were always taken into account in science lessons	1 2 3 4 5
Tasks aimed at expanding the «vocabulary» of the concept	1 2 3 4 5
The content of tasks was aimed at activating the need to see and understand a complete picture of the world.	1 2 3 4 5
The content of the tasks was aimed at» dialogue « with the concept.	1 2 3 4 5
Tasks were aimed at understanding this concept in a person's life	1 2 3 4 5
Tasks were aimed at semantic «unfolding» of the collapsed text (concept).	1 2 3 4 5
Proposed tasks, allowing you to correlate the information obtained in the classroom, with a system of knowledge about the holistic nature of the organization	1 2 3 4 5
assignments focused either on the role of nature in human life, or the role of man in nature, not taking into account their interdependence	1 2 3 4 5
Job was of no practical value	1 2 3 4 5
lessons had enough practical work to practice the acquired knowledge	1 2 3 4 5
The content of the tasks contributed to the students' understanding of the acquired knowledge for forecasting activities in the professional field	1 2 3 4 5
The use of a concept car, logical and semantic models helped to structure knowledge	1 2 3 4 5
Tasks were aimed at the socialization of the individual experience of the new concept are	1 2 3 4 5
The content of the assignments was the definition of the place of the concept in the system of values	1 2 3 4 5
Job assumed creativity	1 2 3 4 5
Job awaken and develop an interest in further study of the concept	1 2 3 4 5
Work in a science class was adequately planned	1 2 3 4 5
Reflexive estimated	
Study material through the prism of the concepts I think it appropriate	1 2 3 4 5
I can apply the acquired knowledge in their activities	1 2 3 4 5
My knowledge in the field of natural Sciences became more systematic and structured	1 2 3 4 5
In a science class I learned so well to prove your point, that is my opinion began to listen	1 2 3 4 5
In a science class I learned how to Express their thoughts and feelings clear and easy for others	1 2 3 4 5
Intended learning course, in my opinion, achieved	1 2 3 4 5

In a science class I learned how to think about the situation before making a decision.	1 2 3 4 5
In science lessons, I learned how to set a goal and achieve it	1 2 3 4 5
I understand the importance of natural science knowledge for the development of my future profession	1 2 3 4 5
Tasks involved determining the student's personal position on the interaction of nature and man	1 2 3 4 5
In science lessons I was helped to find out my abilities (what I can do) so that I correctly decided on my future profession	1 2 3 4 5
My level of natural science knowledge increased	1 2 3 4 5
In the classroom, conditions were created so that I could express my opinion	1 2 3 4 5
I became more critical of natural sciences.scientific information	1 2 3 4 5
I received the necessary (deep) knowledge in physics, chemistry, biology	1 2 3 4 5
In general, I am satisfied with my results of mastering the course «Natural Science»	1 2 3 4 5

Thank you for your participation and sincere responses!

Appendix M

Summary results of a survey to identify the degree of satisfaction of students in the experimental group at the end of mastering IC NS, designed on the basis of a concept approach

Indicators by course components	Number of students by degree of satisfaction				
	1	2	3	4	5
Target block					
Formulated goals and objectives of the lesson, reflected the importance of mastering the lesson material for understanding the unity and integrity of nature	0,0%	0,0%	7,0%	58,1%	34,9%
The proposed training material was aimed at discussing the interdependence of man and nature	0,0%	0,0%	7,0%	44,2%	48,8%
I understood the need for scientific knowledge acquired in the lesson to organize the harmonious development of the «Man – Nature – Society» system	0,0%	2,3%	9,3%	60,5%	27,9%
I understood the importance of the objects, facts, and phenomena studied for the development of a future profession	0,0%	4,7%	34,9%	48,8%	11,6%
I find science lessons interesting and useful	0,0%	0,0%	0,0%	32,6%	67,4%
The lesson created conditions for realizing the need to study the concept as one of the conditions for understanding its meaning.	2,3%	2,3%	11,6%	58,1%	25,6%
Informative					
Only information about objects, phenomena, and laws was offered: - objects were considered outside the system; - the phenomenon described without establishing relationships; - information on the functioning of nature was settled its laws	18,6%	23,3%	37,2%	18,6%	2,3%
the Content of the training material it was clear to me, met my expectations	0,0%	4,7%	25,6%	46,5%	23,3%
In a science class covered topics and issues that interest me	2,3%	7,0%	4,7%	37,2%	48,8 %
the Content of educational material allowed for sure a change of any component of the system, contrary to the laws of nature, will lead to the violation of its integrity	2,3%	2,3%	16,3%	39,5%	39,5%
the course «Science» every component of nature studied in isolation, without any discussion of its role in the formation of the integrity of the system	32,6%	39,5%	11,6%	16,3%	0,0% of

the course Material illustrated the frontiers of scientific knowledge, it was possible to judge about infinity and complexity of scientific knowledge, the limited direct empirical observation	0,0%	4,7%	27,9%	37,2%	30,2%
the Contents of educational information was confirmed by the material unity of the world and the existence of universal (intra - and inter-level) connections in nature	2,3%	2,3%	16,3%	48,8%	30,2%
the Training material has enabled us to understand the overall nature of natural processes – the internal system change and transformation of energy	0,0%	0,0%	16,3%	41,9%	41,9%
Objects, phenomena, laws of nature in the course studied without respect to any level of the organization	32,6%	23,3%	27,9%	11,6%	4,7%
the course Material to disclose the value of the acquired knowledge about the objects, phenomena or laws of nature for the organization of human life and support the technological progress	2,3%	4,7%	4,7%	48,8%	39,5%
the course Material was overloaded with irrelevant information	55,8%	27,9%	11,6%	2,3%	2,3%
the course Material to a greater extent was aimed at revealing the idea of using natural resources	4,7%	14,0%	41,9%	25,6%	14,0%
The content was aimed at understanding the values and meaning of scientific knowledge whatever sphere of activity	0,0%	4,7%	23,3%	39,5%	32,6%
the Content of educational information in the structure of the concept facilitated the understanding, learning and comprehension of information	2,3%	0,0%	7,0%	44,2%	46,5%
the Material of the course met my expectations	0,0%	0,0%	11,6%	27,9%	60,5%
Procedural					
The lesson created conditions for identifying my associative-intuitive field	2,3%	7,0%	20,9%	48,8%	20,9%
Tasks are aimed at socializing individual (associative-intuitive) experience to create a collective associative series of concepts.	2,3%	2,3%	27,9%	48,8%	18,6%
Tasks are aimed at transferring vocabulary from passive memory to active vocabulary.	2,3%	14,0%	20,9%	25,6%	37,2%
My knowledge gaps were always taken into account in science classes	11,6%	11,6%	32,6%	20,9%	23,3%
Tasks are aimed at expanding the «dictionary» the concept	9,3%	4,7%	27,9%	44,2%	14,0%
The content of the tasks was aimed at activating the need to see and understand a complete picture of the world.	2,3%	0,0%	9,3%	16,3%	69,8%
The content of the tasks was aimed at» dialogue « with the concept.	0,0%	0,0%	16,3%	55,8%	27,9%
The tasks were aimed at understanding this concept in a person's life	0,0%	2,3%	7,0%	30,2%	60,5%
The tasks were aimed at semantic «unfolding» of the collapsed text (concept).	0,0%	2,3%	25,6%	39,5%	32,6%

were Offered the job, allowing us to relate the information obtained in the classroom, with a system of knowledge about the holistic organization of nature	0,0%	0,0%	14,0%	34,9%	51,2%
assignments focused either on the role of nature in human life, or the role of man in nature, not taking into account their interdependence	27,9%	11,6%	20,9%	32,6%	7,0%
of the Task had no practical significance	67,4%	18,6%	7,0%	4,7%	2,3%
of the lessons were quite practical work to practice the acquired knowledge	0,0%	4,7%	16,3%	34,9%	44,2%
The content of the tasks contributed to the students' understanding of the acquired knowledge for forecasting activities in the professional field	0,0%	0,0%	23,3%	46,5%	30,2%
The use of a concept car, logical and semantic models helped to structure knowledge	2,3%	0,0%	14,0%	60,5%	23,3%
The tasks were aimed at the socialization of individual experience about the concept	0,0%	2,3%	27,9%	51,2%	18,6%
the content of the assignments was the definition of the place of the concept in the system of values	4,7%	0,0%	25,6%	55,8%	14,0%
Jobs assumed creativity	0,0%	2,3%	14,0%	48,8%	34,9%
Jobs awaken and develop an interest in further study of the concept	0,0%	0,0%	7,0%	32,6%	60,5%
Work in a science class was adequately planned	2,3%	0,0%	9,3%	27,9%	60,5%
Reflexive evaluation					
Study material through the prism of the concepts I think it appropriate	2,3%	0,0%	20,9%	48,8%	27,9%
I will be able to apply the acquired knowledge in their activities	0,0%	2,3%	7,0%	48,8%	41,9%
My knowledge in the field of natural Sciences became more systematic and structured	2,3%	0,0%	20,9%	39,5%	37,2%
In a science class I learned so well to prove your point that to my mind began to listen	0,0%	18,6%	20,9%	48,8%	11,6%
In a science class I learned how to Express their thoughts and feelings clear and easy for others	2,3%	9,3%	18,6%	37,2%	32,6%
Intended course, in my opinion, achieved	2,3%	4,7%	20,9%	30,2%	41,9%
In a science class I learned how to think about the situation before making a decision.	0,0%	4,7%	16,3%	34,9%	44,2%
In science class, I learned how to set a goal and achieve it	0,0%	9,3%	25,6%	30,2%	34,9%
I am aware of the importance of natural science knowledge for the development of my future profession	0,0%	4,7%	18,6%	53,5%	23,3%
The tasks involved determining a personal position a student on the interaction of nature and man	2,3%	2,3%	27,9%	34,9%	32,6%
In science lessons, they helped me find out my abilities (what I can do) so that I could correctly decide on my future profession	2,3%	11,6%	30,2%	44,2%	11,6%
My level of natural science knowledge has increased	0,0%	2,3%	11,6%	46,5%	39,5%

During the lessons, conditions were created for me to express my opinion	0,0%	0,0%	14,0%	32,6%	53,5%
I have become more critical of natural science information	2,3%	11,6%	39,5%	30,2%	16,3%
In science classes, I got the necessary (deep) knowledge in physics, chemistry, and biology	4,7%	9,3%	27,9%	32,6%	25,6%
In general, with my results of mastering the course «Natural Science», I satisfied	0,0%	0,0%	7,0%	23,3%	69,8%

Appendix N

WORKING PROGRAM OF THE MODULE (fragment)

Methodology for designing an integrated course «Natural Science» for the SVE system based on a concept approach

Objective: teachers will master the methodology of designing an integrated course «Natural Science» for the SVE system based on a concept approach.

Category of students: Specialists with higher pedagogical and non-pedagogical education and secondary special education, teachers of SVE: biology, chemistry, physics, geography, natural sciences

Form of study: full-time and part**-time.**

Calendar training schedule:

The total volume of the module in hours is 18 .

Planned learning outcomes

The task of professional activity: Designing the content and implementation of educational programs of academic disciplines based on the concept approach as the basis for goal setting and selection of the content of the subject.			
Professional competencies	The student should know:	The listener should be able to:	The student must be proficient (gain experience in the field)
PC 5.2. the ability to determine the goal setting, to design the content of the educational material of the integrated course «Natural Science» based on a concept approach.	Z 5. 2. 1. Characteristics of the concept as a didactic unit of the integrated course «Natural Science». Z 5.2. 1. Principles of selection and construction of educational material based on the hierarchy of concepts of the subject. Z5. 2. 2. Criteria for analyzing a science lesson based on VSG.	U5. 2. 1. Implement pedagogical goal-setting taking into account the features of the integrated course «Natural Science» at the SVE level. U5. 2. 2. Select training material based on the VSG integrated course «Natural Science».	O5. 2. 1. Determination of planned educational outcomes in the course scale, course topic, lesson. of the integrated course «Natural Science». O5. 2. 2. Construction of educational texts of the course «Natural Science» based on VSG.
The task of professional activity: Planning and conducting training sessions in accordance with the FSES and based on knowledge about students ' educational activities, educational content and effective teaching methods.			
Professional competencies	The student should know:	The listener should be able to:	The student must have (gain experience in):
PC 6.1. the ability to analyze the concept foundations of the development of	Z 6.1. 1.Fundamentals of teaching methods, basic principles of the competence approach, types and	U 6.1.1. To select and systematize material on specific topics (concepts) taking into account modern	O6. 1. 1. Planning and conducting training sessions taking into account modern

the content and methodology of teaching academic subjects in accordance with FSES.	techniques of modern pedagogical technologies. Z 6. 1. 2. Specifics of the methodology of teaching the integrated course «Natural Science» in accordance with its target settings.	ideas and trends in the development of natural science knowledge. U 6.1.2. To identify planned learning outcomes taking into account the features of the integrated course. U 6.1.3. To analyze the educational material of the course based on a multi-contextual and concept approaches.	achievements of natural sciences, adapted to the content of the course «Natural Sciences». O 6. 1. 2. Analysis of the planned educational results of the course «Natural Science», including subject mono-and integration results. O 6. 1. 3. Analysis of the lesson content in accordance with the objectives of
PC 6.2. the ability to plan the educational activities of teachers and students for all components of the methodological system on the subject in accordance with its concept and FSES requirements	Z 6. 2. 1. Specifics of the methodology of teaching natural science. Z 6. 2. 2. Features of selecting the content of the integrated course «Natural Science» in the context of its goals. Z 6. 2. 3. Characteristics of educational technologies and models of science lessons in accordance with the hierarchy of concepts.	U 6.2.1. To use effective pedagogical technologies in the planning of classes, which contribute to the development of motivation to study the fundamental foundations of science. U 6.2.2. Develop competence-oriented tasks at different levels, taking into account the specifics of educational technologies and lesson models.	O 6.2.1. The use of effective pedagogical technologies in the design of natural science lessons in the context of FSES. O 6.2.2. Constructing natural science lessons in accordance with the hierarchy of course concepts

Description of the educational process in the framework of this work program

n /	a Topic of a class (multiple sessions)	Number of hours	Forms of organization of training sessions	Main elements of content
1.	Features of the integrated course «Natural Science» in the context of profilization	9	Lectures 6	Leading ideas and value-semantic guidelines (VSG) of natural science education Comparative analysis of VSG courses of natural science orientation in the framework of subject and integrative approaches. Selection of the content of subject and integrated science courses in the context of VSG. Leading ideas and value-semantic guidelines (VSG) of the course «Natural Science». Value-semantic competencies as planned educational results of studying the course «Natural Science»
			Practical exercises 3	Analysis of educational texts of subject and integrated courses in the context of VSG. Development of a VSG course, course topic, and lesson

				for the integrated Science course. Algorithm for detailing planned educational results in the integrated course «Natural Science»: lesson, topic, course.
3.	Methods of teaching the integrated course «Natural Science» based on the concept approach	9	Lectures 5	Concept as a didactic unit of content. Hierarchy of concepts of the integrated course «Natural Science» Features of selecting the content of an integrated course in the context of course meta-concepts. Analysis of planned educational outcomes on the scale of the course, course topic, and lesson. Types of science lessons in accordance with the hierarchy of concepts
			Practical exercises 4	Identification of the lesson concept, subtopics, topics The use of concept analysis and text synthesis techniques in the lesson. Analysis and development of competence-oriented tasks in accordance with the hierarchy of course concepts Modeling lessons in a natural science course of different types.

Appendix P

Questionnaire to identify the demand for experimental methods among teachers

Dear colleagues!

You have mastered the components of the methodology for designing the content of the integrated course «Natural Science» based on a concept approach.

Please give usyour feedback!

The questionnaire is anonymous. The survey results will only be used in summary form. We kindly ask you to answer the suggested questions in detail

1. What is the meaning of defining a concept as a didactic unit of content in the integratedго course «Natural Science»?
2. In your opinion, which components of the methodological system of the course "Natural Science" (objective, substantive, procedural, effective and evaluative) are more focused on the concept approach?
3. How do you determine the methodological value of the developed methodology for constructing the content of the integrated course «Natural Science» basedona comprehensive approach?
4. How do you see the advantages of working with concepts in the course of teaching the course "Natural Science" in comparison with traditional methods of working with educational information?
5. In your opinion, what are the difficulties of introducing a concept approach to the pedagogical practice of teaching an integrated course «Natural Science»?