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Features of interdisciplinary connections between natural and humanities disciplines in the context of a competency-based approach to teaching staff training

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Abstract

Relevance. In modern conditions, interdisciplinary links have acquired the character of integrated cognition, which contributed to the formation of a holistic system of scientific knowledge about a single picture of the world without dividing it into natural sciences and humanities and required the elimination of isolation in the study of the content of relevant academic disciplines.

Purpose. The aim of the study is to determine the importance of interdisciplinary links between natural sciences and humanities as a means of developing the scientific world-view of future teachers.

Methodology. In the course of the work the methods of analysis and synthesis, induction and deduction, comparison, systematization, generalization, forecasting were used, among empirical ones – the method of testing.

Results. The study explored the difference and commonality between natural sciences and humanities with their identical structural composition (facts, concepts, phenomena, theories) as the basis of the method of formation of students' scientific consciousness, which contributes to the implementation of the educational goal, that is, the formation of students' knowledge integrity in the designated directions. The significance of interdisciplinary links as a fundamental means of competence-based approach to education is revealed.

Conclusions. It is concluded that the conditions of quality implementation of interdisciplinary links in teacher training are mandatory at every stage of higher education. The main requirements for the implementation of interdisciplinarity aimed at the study of natural sciences and humanities should be fulfilled starting from primary grades. The growth of the diversity of sciences should take place in the conditions of integration and orderliness, which contributes to the enrichment of science at the level of integrative holistic complex. The practical significance of the study lies in the possibility of using the results obtained in the design and implementation of curricula and work programmes for the professional training of teaching staff.

Keywords: scientific world-view; professional consciousness; learning environment; fundamental education; integrative system.

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Introduction

The modern cognitive-scientific environment is dominated by the tendency of differentiation of skills and knowledge, but the importance of their integration is significantly increasing. The process of integration is conditioned by the reforming of the education system, transition to innovative standards of professional education, active introduction of interdisciplinary and competence-based approaches that influence the development of interrelationships of different types of sciences in different forms. Therefore, it is necessary to realize the stage of formation of pedagogical integrative approach.

Modernization of the educational system in the context of competence-based pedagogy expands the problem of revision and updating of approaches and methods of professional training. One of the key approaches is competence-based, which aims to implement the prevailing practice-oriented paradigm of education with the transfer to students not only subject skills and knowledge, but also the development of general learning skills, which form the basis for providing conditions for improving the formation of competences. In the context of interdisciplinary connection, it should be noted that the differentiation of sciences and, consequently, of academic disciplines does not always remain unambiguous. Thus, for example, language sciences are now referred to the humanities, but earlier they belonged to natural and psychological sciences, which confirms the need to study their interdisciplinary interaction, since the results of humanities subjects are often applied to scientific research in other areas.

In the pedagogy of the Kyrgyz Republic, there were earlier attempts of more detailed, rather than interdisciplinary, links of integrative level in the educational structure using an integrated approach to learning, which was formed as a negation of the formalism of the outdated school, its neglect of practice [1]. As a result of the development of this approach, educational disciplines were modified in terms of subject, content and included in their content additional elements of nature, society, labour, and the like. Despite the systematic variability of the subjects' structure due to the artificial connection between this or that material, it led to certain complexes. In turn, U. Mambetkunov [2], in his work devoted to the study of the current state of teacher training in Kyrgyzstan, concluded that in order to improve the level of teacher training in the Kyrgyz education system, a number of measures should be implemented in advance, including career guidance with all participants of the educational process, selection of students predisposed to the profession of a teacher and aimed at pedagogical activity, raising the prestige of a teacher through the improvement of pedagogical qualifications by the method of competence development.

Such scientists as G.T. Karabalaeva *et al.* [3], investigated the current trends in higher professional education in the Kyrgyz Republic, and in their conclusion state that the highest level of the associative complex is interdisciplinary links, which are important not only in the structure of individual educational programmes. Modernization and integration of natural sciences and humanities, and the formation of general theories of natural

science and language calls teachers to actively apply interdisciplinary links of natural sciences and humanities subjects in higher professional education, which will have a positive impact on the quality of its organization and increase the effectiveness of educational results. The application of the competence approach will contribute to the variability of functions of pedagogical training in individual subjects, which tend to lose their own self-sufficiency and will be components in the holistic system of professional training of the teacher and his readiness to work in modern innovative education.

S.S. Kulueva & A.N. Gudimova [4], R.U. Isaeva [5; 6] also devoted their research to the improvement of the process of teacher training in higher education. In particular, the implementation of interdisciplinary links between natural sciences and humanities disciplines in the implementation of competence and unified methodological approach to the learning of similar structural elements of the disciplines "National History", "Concepts of Modern Natural Science", "Physics". At the same time, they conclude that it is reasonable to take the competences formed by the capabilities of these disciplines as a related basis for combining and harmonizing these disciplines. Due to the fact that the structure of any competence includes not only subject knowledge (facts, phenomena, laws, concepts, theories), but also general academic skills (metacognition), and personal (behavioural) qualities, and motivation and experience of activity, the result of interdisciplinarity will be not only a holistic integrative knowledge, but a holistic integrative competence of a future teacher.

The essence of scientific research by E.E. Sin [7] was to study the issues of integration of school disciplines and conducting a system of integrated lessons by teachers, came to the conclusion that the task of pedagogy is to help educational institutions and teachers in the development of integration of disciplines and reproduction of individual fundamental knowledge in a unified system. Integration of the basic sciences will help students to develop a holistic view of the environment and events in it, starting from school. Researcher N.B. Khasanov [8], whose aim was to analyse the development of students' professional speech communication skills in the conditions of professional training, concluded that the formation of language competence in the conditions of complex communication and information space is a priority task at the stage of educational professional training of a student in an educational institution.

Analysing the above-mentioned studies, it can be argued that in the context of studying professional training of pedagogical staff little attention is paid to the issues of interdisciplinary links of specific sciences, which is relevant in the conditions of development of modern innovative education. Therefore, the aim of the work is to study interdisciplinary links in the system of humanities and natural sciences through the competence-based approach to teacher training.

Materials and Methods

In the conditions of scientific research, such methods as analysis and synthesis, methods of comparison, systematization, generalization, forecasting were used, as

well as testing was conducted in the empirical part of the work.

With the help of analysis, the educational programmes and plans of teacher training, including competences, structural elements of the content of natural and humanitarian disciplines, their interdisciplinary links were investigated and the necessity of implementing interdisciplinary links in the context of the competence approach in teacher training was substantiated. The method of synthesis helped to unite the investigated components of the pedagogical system of professional training, interdisciplinary system of knowledge, skills, and competences of the studied disciplines into a single complex.

With the help of the induction method the formal results of the research were obtained and the necessity of studying the peculiarities of interdisciplinary links in teacher training was proved, especially those links in which competences are taken as a related basis for uniting and harmonizing disciplines. The deductive method helped to confirm the logical conclusion about the common understanding of interdisciplinary links and individual elements under study, namely the competence approach in teacher training.

With the help of the comparison method, the differences, and commonalities of interdisciplinary links in the study of Kyrgyz and world experience were identified. Under the conditions of using the method of systematization, the studied phenomenon of interdisciplinary links of natural sciences and humanities as a separate system with its characteristic features, as well as the knowledge system of educational disciplines was considered. With the help of the generalization method, the general requirements for the skills and abilities to master the structural elements of knowledge of disciplines, which are a component of competence, were determined, the general properties of the studied object of pedagogical professional training were fixed, and the transition from the features of pedagogical training in the context of the competence approach to the general professional training was made. The forecasting method was used to predict the future state of professional innovative training of teachers in the direction of interdisciplinary links.

In the empirical part of the study, testing of students of higher educational institution of pedagogical direction, namely Jusup Balasagyn Kyrgyz National University was conducted. 35 future teachers of humanitarian (philology, pedagogy) and 25 natural directions (geography, biology, chemistry faculties) took part in it. The test tasks were handed over to those responsible for the implementation of the pedagogical experiment in the educational units of the university, who conducted the test in groups of students. The test had 10 general questions (7 multiple-choice and 3 open-ended) in the context of understanding the connection between natural sciences and humanities:

1. Select a common set of research methods for humanities and sciences (logical and theoretical; logical and empirical; theoretical and empirical).

2. Select the object of the humanities (physical nature, features of human existence, abstract component).

3. Select the object of natural sciences (physical nature, features of human existence, abstract component).

4. Identify the attributes of the humanities (historicity, subjectivity, objectivity, unambiguity, mathematics, rigour of language).

5. Define the attributes of natural sciences (historicity, subjectivity, objectivity, unambiguity, mathematicality, rigour of language).

6. Identify the characteristic functions of the humanities (explanation and proof, interpretation and understanding).

7. Identify the characteristic functions of the natural sciences (explanation and proof, interpretation and understanding).

8. Your understanding of interdisciplinary connections (open-ended question).

9. Describe the commonalities between the humanities and natural sciences (open-ended question).

10. Give examples of applying your course's connection to the opposite (humanities or natural science) in a lesson.

Along with this, a four-block test was used for comprehensive testing to determine the level of basic knowledge in four academic disciplines, motivation of educational and professional training, the level of self-management and professional orientation to pedagogical activity.

And also, to improve the methodological support of natural and humanities disciplines within the framework of interdisciplinary links in the implementation of the forming experiment were prepared "Leaflets" with a general system of structural elements of disciplines and generalized plans-requirements for each of them [9], as well as a textbook on the discipline "Concepts of modern education" [10], a textbook on the discipline "Concepts of modern education" [9], a textbook on the discipline "Domestic History" [11], in each section of which the structural elements of knowledge are highlighted and the requirements for their mastering according to the general principle of competences are placed common for all disciplines: "know – can – own". The textbooks provide a list of project topics and various types of essays as part of the CDS.

Results

Integrative competence is an integrated result of interdisciplinarity and an integral characteristic of the student's personality, based on the mastery of procedural, substantive and motivational components of different directions of interdisciplinary interrelation, as a systematic study by different disciplines of the same phenomenon; the use by different disciplines of the same techniques and theories to study phenomena; the application of scientific laws to study phenomena of other disciplines and directions. Appropriate use of links between natural sciences and humanities disciplines contributes to the activation of learning, methodological, developmental, constructive, and educational functions. Interdisciplinary links are a modern educational principle that influences the system and structure of curricula in different disciplines. It is a principle that improves the quality of knowledge and general learning skills, implements common teaching methods, focuses on the use of complex educational tools, and forms the integrity of the learning process.

In the conditions of introduction of interdisciplinary connection and improvement of the process of educational integration in the training of pedagogical staff at the stage of primary school, knowledge interacts with the knowledge of different educational areas of another direction on the basis of interdisciplinary approach, which contributes to the development of an innovative set of educational knowledge, key competences of students. This implies their understanding of the holistic perception of the environment. Interdisciplinary links can be defined as the interaction of certain academic disciplines that consider common concepts, reveal their essence from different positions, highlight their properties and, as a result, substantiate their interdisciplinary nature, reflecting in them the attributes of different academic subjects [12].

Interdisciplinary integration should be analysed through its content, procedural and organizational components. The content component of the interdisciplinary connection provides the following: activation of natural and humanities disciplines that promote the combination of logically structural and personal-emotional means of cognition of the educational space, influencing students' awareness of the integrity of the environment and the development of generalized skills and means of activity implementation. For the purpose of implementation, it is important to introduce integrated classes, courses, events, educational projects aimed at the integration of diverse knowledge and skills of educational branches; to achieve the dynamism of theory and practice in the structure of education, determining the specificity of scientific cognition and realizing the interaction with the phenomena of integration and differentiation, which are closely related to the material integrity of the world. The process of differentiation contributes to the mastering of theoretical knowledge about individual phenomena, and integration affects their approbation through practical activity. Due to this connection, students develop both an innovative approach to science and readiness to work [13].

The procedural component of the implementation of interdisciplinary integration is based on the basis of integrative means and methods of education, which are within the framework of different concepts, such as individual and group learning at the interpersonal and inner-personal levels according to the used form of the learning process; means of research and reproduction, which have the purpose of synthesizing classical and latest approaches to the performance of actions by students depending on their tasks and situations in the learning environment. And on the basis of interaction of rational-logical and emotional-imaginative means of cognition, which is determined by the synthesis of educational materials that realize the rational possibility of learning and productive self-development of the student, the formation of his intuitive skills and emotional intelligence.

The organizational component of inter-subject integration is based on the integrity of spontaneous and ordered actions, ambiguity and regulation, order, and problematics. The learning process in the centralized subject form is planned in a concretized systemic structure according to stages. This facilitates timely analysis of the programme material and provides for clear organization of learning activities, diagnostics of goal planning, ensuring appropriate learning technology, qualitative development

of skills, saves time in mastering disciplinary knowledge. At the stage of embedded education implementation, the activity is manifested in the structure of uncertainty, in the conditions of which personal traits are formed [14]. It follows from international experience that quality technologies have already been developed that contribute to the realization of the main idea of the competence approach. In them the main components are defined as key competences, basic types of educational and cognitive work, team and individual activities, practical, research, and other scientific works, performances, work on portfolio or CV development, social practical activities [15].

The aim of the competence approach is to involve students in the implementation of learning activities. If in classical approaches educational activity involves the process of mastering knowledge and skills, the competence approach forms the unity, complementarity, and other important components. Its structure is based on the idea of the active character of the learning system. But in the conditions of competence approach application, education is aimed at the development of a set of competences in the participants of the learning process. Their content implies a personal attitude to phenomena and processes that are important for the successful implementation of activities. That is why competence acquires the significance of the student's personal values. The desire for the same result arises when using the own orientated educational approach. In the conditions of both approaches, an element of the phenomenon of education, socialization, professional pedagogical training should be a responsible person embodying humanistically oriented actions [15].

In the scientific literature, the concepts of competence approach are interpreted as the focus of education on the development of a set of basic disciplinary competences in the participants of the educational process. The key feature is the shift of emphasis from the educational process to the result, i.e. competences. They, in their turn, embody the components of professional training, consider previous experience and lean towards trends in promoting development [16]. Studying the interdisciplinary connection of humanities and natural sciences, it is important to firstly pay attention to their key differences (Table 1).

Table 1. Differences between natural sciences and humanities

Basics	Humanitarian sciences	Natural Sciences
Methods	Logical and theoretical	Logical, theoretical, empirical
An object	Features of human (individual and social) life	Physical nature (stable object, material)
Signs	Subjectivity, historicity	Mathematics, objectivity, unambiguity, rigour of speech
Functions	Interpretation, understanding	Explanation, proof

Source: [17].

Interdisciplinary links are a necessary factor in the development of the structure of academic discipline in the modern space of educational integration. Interdisciplinary links, if purposefully and systematically implemented, modernize the whole educational process and act as a basic didactic principle. The educational goal of interdisciplinary links between humanities and natural sciences is to form a unified system of knowledge about society and nature, a holistic scientific perception of the world. The key educational function of interdisciplinary links is the construction of the student's world-view, formed on the necessary interaction of disciplines from different cycles of the curriculum. In addition, interdisciplinary links can be interpreted as a didactic requirement that focuses the teacher's attention on the actualization of students' knowledge, skills, and abilities in different directions for mastering the components of academic subjects and skills, their application in life situations [18].

One example of interdisciplinary links in schools is the subject of geography, represented by two distinct disciplines, namely socio-economic and physical geography, respectively of humanitarian and natural directions. As a result, the integrative principle is expressed in the principle of integrative geography with a share of social subjects and in the principle of integrative internal geography as a single school subject. Thus, educational institutions should develop in students a unified system of perception of modern scientific space and involve them in its cognition. Awareness of this component plays a key role, as it favours the interaction of humanities and natural sciences. An interesting example of interdisciplinary links between such a natural science as biology and humanities disciplines. Since the knowledge of history contributes to the student's better understanding of the reasons for the creation of different scientific theories of biology in the context of specific historical periods. For example, students have the opportunity to combine knowledge from history about Aristotle and learn about him as an important discoverer of biology. This indicates a deepening and broadening of the knowledge system and an increased level of student interest [19].

A successful example of combining creativity and science is the presentation of biology knowledge by students in a poem form. This approach to teaching activates cognitive activity of students and develops interest in educational material, forms creative perception. A task of this type in a teacher can develop and use when introducing new topics, in the process of organizing practical work, during circles or electives. Another example of interdisciplinary links is the solution of tasks on ecology, the content of which includes local history information or knowledge about the environment. In this case, the solution of such problems will contribute to the fact that students will learn more about the world around them, develop their mathematical language, creative thinking, attention, and gain direct knowledge of ecological culture. The study of physical geography is necessary to analyse environmental issues and the biosphere. Also, biology has established an interdisciplinary connection with psychological sciences. In psychology, the application of basic biological laws and

certain sections, among which are physiology, ecology, ethology are important.

In the absence of knowledge of the basic principles of biology, the understanding of the peculiarities of human behaviour, manifestations of complex mental disorders will lose the biological basis. The general structure of biology leads to the formation of problems of philosophical content, so it requires the study of social science. These examples of interdisciplinary links play a significant role in education and upbringing. Educational institutions study the basics of various disciplines, but the knowledge students gain from different sciences should be systemic, united in a holistic understanding of nature and society. Teachers should facilitate this during communication, comparisons, generalizations, because at the school stage students often do not realize the connections between different subjects. And teachers introduce them. In turn, the identification of interdisciplinary links should not distract the student from the study of the main subject according to the programme [20].

The ways of realization of interdisciplinary links between humanities and natural sciences at the stage of both school education and teacher training can be different. An example is the formulation of problems that require the application of knowledge from different disciplines. The following ways consist in the development of: interdisciplinary problem cases due to the development of problem tasks; homework in the context of establishing interdisciplinary links; messages and solutions to interdisciplinary problems; visual aids and presentations, tables and maps. The development of interdisciplinary, communicative, cultural and information competence has a direct impact on the quality of integrated interdisciplinary lessons. Such classes can be held in the form of seminars, conferences, excursions [21].

Formation of interdisciplinary connection in the conditions of teaching material by a teacher, discussions, students' answers is of great importance for understanding of concepts. During the lessons in natural disciplines, it is important to ask questions that require analysing, identifying components, separating the whole, reproducing the textbook material. Of particular importance are questions that reveal terms that require synthesized expression, for example, linking the structure of a phenomenon and its function. With systematic organization of work, students will be able to construct questions that require the use of material from other subjects. During the research work, students of pedagogical direction of Jusup Balasagyn Kyrgyz National University were tested on test tasks in the direction of understanding the differences of humanities and natural sciences, their interdisciplinary relationship, presented in the table (Figure 1).

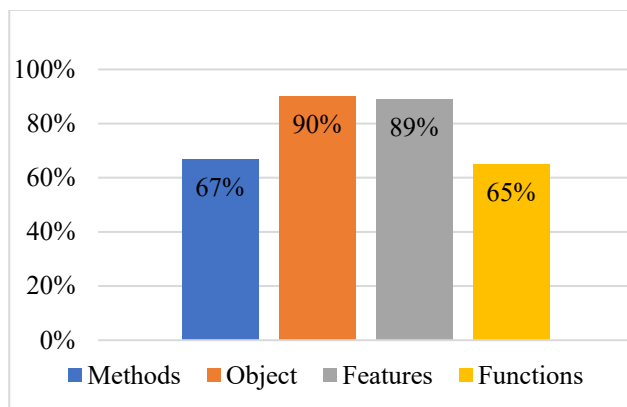


Figure 1. Level of students' competence in interdisciplinary connections

From the obtained test results it follows: 37 students (26 humanitarian sciences and 11 natural sciences), which is 67% of all interviewees, correctly understand the research methods of the mentioned sciences and apply them in practical pedagogical training. 33% of test participants noted that they apply empirical methodology in the process of scientific research in the implementation of interdisciplinary links, regardless of the discipline direction. At the same time, according to the results, 90% of students are competent in the object of humanities and natural sciences; however, in the item of open-ended answers, 52% of the interviewees indicate that in teaching conditions the objects of scientific processing can be a complex of humanities and natural sciences. In the context of the attributes of the studied sciences, 89% of the interviewees (49 persons) are clearly oriented and have chosen the correct answer option. In the open answers, 58% of the test participants noted that as a result of pedagogical activity on the development of tasks of interdisciplinary direction, the attributes can be modified in accordance with humanities or natural subjects. Only 65% (36 students interviewed) correctly indicated the features characteristic of the specializations studied. The remaining 35% state in open-ended answers that these sciences fulfil all the listed functions. 93% of interviewees gave examples of using the connection between humanities and natural sciences in the classroom during teacher training. Among them, the most widespread are the study of biological, geographical, ecological topics in foreign and native language lessons, the connection of human biology with physical education, basics of health.

Comparing the data obtained today, it should be noted that since the period of transition of the educational system of Kyrgyzstan to the state educational standard of higher professional education (SES HPE) in 2013-2014, there has been reforming and searching for integration into the international space [22]. From the very beginning, higher education in the Kyrgyz Republic had a strategic intention to join the European educational space, which, in turn, promotes interdisciplinary and competence-based approach. Therefore, already in the layout of the State Standard of Higher Education in the field of Bachelor's and Master's degrees, the competences to be possessed by a graduate of this or that educational direction were specified. In this context, the competence approach is an important methodological tool for Kyrgyz education to penetrate the world educational space. In European

education, it was believed that the comparison of educational levels and the degree of qualification of students can be made by comparing their learning outcomes in the form of competences and competencies. The competences of graduates include innovation, flexibility, initiative, mobility, constructiveness and interdisciplinarity. A future specialist should possess the skills of self-education, master new technologies and understand the need for their application, make decisions independently, adapt to new conditions in future professional activity. In this regard, the requirements of the State Standard of Higher Education indicated that a higher education institution providing professional training should have an appropriate material and technical base and modern methodological equipment, providing the organization of various types of interdisciplinary training in practical, scientific and research work provided by educational programmes [22]. In addition, it was emphasized that graduates of educational institutions should be aware of and critically evaluate innovative approaches and theories, tools and methods, be able to apply an interdisciplinary approach and integrate it into future professional activities; possess problem-solving skills in new conditions, quickly adapt in an interdisciplinary context, formulate their position and conclusions; solve communicative situations in various interpersonal spheres, interdisciplinary and intercultural; have the skills to manage interdisciplinary and interdisciplinary activities; and be able to use interdisciplinary approaches and methods.

It follows from the above and the analysis of national scientific research that during the transition to the SES HPE, there is an increased interest in solving the problem of interdisciplinary links in the context of the competence approach, including between humanities and natural disciplines [23]. Thus, for example, N.B. Khasanov [8] successfully implements interdisciplinary links between language and technical disciplines in professional training. S.S. Kulueva & A.N. Gudimova [4], R.U. Isaeva [5; 6] show that the implementation of interdisciplinary links between humanities disciplines ("Domestic History") and natural disciplines ("Concepts of Modern Natural Science", "Physics") has a positive impact on the development of integrative competence and constituent components of competences. This is evidenced by the following indicators.

As a result of the conducted forming experiment, there was a redistribution of students into subgroups with high and low level of mastering the components of competences. Thus, the subgroup of students with the level of motivation above average increased by 23% and the subgroup with the level below average decreased by 47%. The subgroup of students with the level of self-management above average increased by 24%, and the subgroup with the level below average decreased by 18%. The subgroup of students who have not decided on their professional orientation towards the profession of teacher decreased by 16%. The indicators of academic performance have improved. Thus, the average score reached its maximum value at the final state examination and was 17.6 points on a 20-point scale. These results do not contradict the results of testing to determine the level of competence of students in the direction of

interdisciplinary links, shown in Figure 1. But it should be noted that most of the studies of Kyrgyz scientists on interdisciplinarity are devoted to the interdisciplinary links of disciplines of one direction or humanities or natural sciences. Thus, the application of interdisciplinary links in educational activities contributes to the formation of cognitive activity, creativity, creative thinking, successful solution of supercomplex problems using different resources, understanding of the connection between different disciplines, thanks to which a communicative and competent culture is qualitatively formed.

Discussion

Differentiation of scientific knowledge implies not only the tendencies of its detailed mastering, but also the necessity of synthesizing such structures, which affects the improvement of the knowledge system. In the educational environment, interdisciplinary links connect the content of certain disciplines with the goals of versatile study of types of activities and phenomena that tend to manifest themselves in different interactions and are components of competence. The development of interdisciplinary links can be at the level of one educational direction, a separate discipline, or a course of a certain educational branch. It unites knowledge into a single holistic system, shapes students' cognitive interest, associative skills, creative thinking and improves the universality of cognitive skills. Interdisciplinary links can be applied at different stages of lessons, namely: when realizing knowledge, learning new materials, controlling the assimilation of previously learnt information, doing homework. Regular improvement of the complex of versatile interdisciplinary links will contribute to the future modernization of the means of its application in the form of purposeful work of the educational institution: on the qualitative organization of various interdisciplinary events, discussions, contests, debates, on the coordination of the activities of all participants of the educational process, on improving and increasing the opportunities for practical assimilation of knowledge, on solving knotty problems with the help of different academic disciplines at the same time.

Modern teachers and methodologists understand that interdisciplinary communication is an effective way to systematically solve cognitive problems by obtaining a system of complex knowledge, their generalization, development of general academic skills, formation of scientific interest of the student. But in practice, the solution of the mentioned problematic is somewhat fragmentary, as it is often limited to the allocation of certain topics, parts of the educational plan, on which it is possible to develop only thematic interdisciplinary connection. Therefore, the connection between disciplines should be established on the basis of dialectical regularity, which is peculiar to different subjects and which is characterized by structural specificity that has common features for all educational disciplines. The theoretical and methodological concept of establishing interdisciplinary links is based on such foundations as the activity, competence, and system approaches, which aim the subjects of the educational process at productive activity. In contrast to the systemic approach, in which the educational activity is mainly reduced to the systematization of knowledge and subject skills, the

competence approach is based on the idea of the active nature of students' activity, tends to develop in the participants of the educational process a system of competences, including, inter alia, a personal perception of the discipline and processes that are important for increasing productivity. That is why competences are characterized by the personal values of the subjects of education.

Researchers J. Berges *et al.* [24] when studying different approaches in the formation of interdisciplinary links, came to the conclusion that the connection in the study of different disciplines is a natural phenomenon due to the logic of cognition. The identification of interdisciplinary links in teaching contributes to the development of students' unified perception of the world, stimulates their synthetic and analytical activity, forms skills of comparative analysis of problems and complex phenomena in realities. The authors noted that the establishment of interdisciplinary connection forms methodological knowledge. From another point of view, it is the basic scientific methodological knowledge that is the foundation of interdisciplinary links. It is necessary to agree with scientists that the concept of "methodological knowledge" can be considered from different positions. Besides, it has already been determined that methodological knowledge is knowledge about the properties of the system of subject knowledge, its nature, various methods of cognition applied in both humanities and natural sciences.

Researchers M. Newman & D. Gough [25], who systematically studied methodology of educational research, concluded that methodological knowledge cannot be perceived by students independently, it should be facilitated by methodological materials. The authors argue that it is impossible to choose a system of methodological knowledge regardless of the content and structure of the subject. The values of methodological knowledge consist in the fact that they form a space for independent analysis and cognition, reveal in detail the essence of science from the perspective of activity, develop a scientific world-view, prepare for the awareness of drawing a parallel between reality and scientific explanation, contribute to the understanding of scientific models and approaches, have a direct impact on the emotional components of students' learning motivation and increase interest in learning. The authors' opinions coincide with the results of the study, as they identify common structural elements in the content of disciplines with a unified methodological approach to their mastering through a system of generalized plans-requirements.

The assertions of J.R. Barrett [26], who searched for the connection between the subjects and directly investigated the interdisciplinary connection between the study and teaching of music as a humanitarian science, coincide with the obtained results. The author came to the conclusion that in modern education there is a revival of axiological problems of social subjects, the interest of teaching axiology is developing, innovative directions or sub-objects are formed, an example of which is didactics of values. In the general sense, values are inherent in the personal and social meaning of an individual's life, constituting his or her moral guidelines. Any values of

general meaning are important only if they have an individual context.

The authors E. Rogora & F.S. Tortoriello [27], whose essence was to study the interdisciplinary links between mathematics, concluded that the improvement of the approach of interdisciplinary links between mathematics and physics has a positive impact on the intellectual education of students, which is based on the development of the concept of systems. Correct application of mathematical concepts and laws, their correct formation, application of models, methods and basic techniques of mathematics contributes to the development of flexibility, efficiency, articulation, and mastery of both procedural and declarative knowledge. The authors' view is largely consistent with these findings, but the difference is that students' mastery of mathematical and physical knowledge is often insufficiently detailed. This can be prevented by forming requirements for the application of the integrity of laws, symbols, and terms in defining objects related to mathematics or physics and harmonizing the definitions of functional dependence and function, vector quantities and vector, integrals, and derivatives, developing students' skills and control over the use of techniques and methods of mathematics.

The results of the conducted theoretical and empirical scientific research by the authors S. Jiang *et al.* [28], which consisted in studying the importance of interdisciplinary links in education, gave grounds to formulate conclusions, to develop a set of tasks of interdisciplinary nature of natural sciences and humanities, which develops creative skills of students on the basis of associative approaches and interdisciplinary formation of competences. Scientists argue that the additional work of interdisciplinary sense consists in the combination of detailed instructions with individual planning of experimental activities, which contributes to the formation of creative perception in students and its practical use. The authors' opinions coincide with the results of the conducted work, as it is determined that the holistic implementation of classes and activities of interdisciplinary direction forms creative and imaginative approach of students based on the experience of developing innovative competences during the resolution of educational situations.

Thus, the complex application of interdisciplinary links in the conduct of classes of natural or humanitarian orientation is an indispensable source of establishing a competent approach. Formation of interdisciplinary interaction of topics in literature, foreign or native language, music, art, natural science, mathematics, biology, geography, or any other direction forms a holistic content of educational achievements, develops students' cognitive interest, associative and creative thinking, understanding of the need to acquire common pi. Interdisciplinary links unite knowledge, activities, and value orientations. The basis of training sessions is the partial application of materials from other disciplines with the use of specially developed methodological support, which plays an auxiliary role and improves the space for the formation of general and subject competences.

Conclusions

Interdisciplinary links are the interaction between educational subjects studying common terminology, forming common competences, considering their structure, defining features and forming interdisciplinary content combining the properties of different educational disciplines. Beginning with knowledge-based learning in primary school in interaction with the materials of other educational branches and with the application of an interdisciplinary approach positively influences the development of innovative system of educational knowledge and basic competences of schoolchildren. This contributes to their realization of a unified world-view. At the international level, technologies have been successfully developed that translate the basic principles of the competence-based approach into reality. In them fundamental competences are defined as the main elements, the main types of scientific cognitive activity are defined as group and individual work, research activity, presentations, extracurricular work, CV and portfolio development, social activity.

During the testing of students of Jusup Balasagyn Kyrgyz National University, in order to identify the level of pedagogical competence in the direction of interdisciplinary connection of humanities and natural disciplines and mastering the components of competence, satisfactory results were obtained, indicating the quality of professional training of future teachers. According to the obtained results, 77.8% of students have an average indicator of competence in the direction of understanding the differences and commonalities of both disciplinary areas. The average and high level of motivation has 80% of students, self-management skills – 73%, 12% of students have not finally decided on their professional orientation to pedagogical activity. In addition, the students have gained practical experience in the application of an interdisciplinary approach in the learning environment, and mastered the general academic skills of composing their own tasks of interdisciplinary nature, which can be applied in their future professional activities.

The forms of implementation of interdisciplinary links between humanities and sciences at the level of education and teacher training can be different. An example is the identification of problems that require the application of knowledge from different subjects. Solving such problems increases students' cognitive interest and inclines them to search for cross-curricular links. The other forms consist of: solving interdisciplinary problem situations; project and other homework aimed at establishing interdisciplinary links; identifying the same structural elements of different disciplines and mastering them according to a single principle of competences “know – can – own”; developing messages; solving interdisciplinary problems; creating presentations, tables, graphs, maps. The formation of integrative (interdisciplinary), communicative, cultural and information competence has a positive impact on the success of integrated interdisciplinary in-class and extracurricular activities. Such classes can be conducted in the form of seminars, conferences, excursions.

The prospect of future research lies in the possibility of using the recommendations for establishing interdisciplinary links between natural sciences and

humanities disciplines in the teaching process, as well as in the process of publishing textbooks and publishing textbooks of pedagogical direction of pedagogy and training of future teachers.

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Conflict of Interest

None.

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Особливості міждисциплінарних зв'язків між природничими та гуманітарними дисциплінами в контексті компетентнісного підходу до підготовки педагогічних кадрів

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Анотація

Актуальність. У сучасних умовах міждисциплінарні зв'язки набули характеру інтегрованого пізнання, що сприяло формуванню цілісної системи наукових знань про єдину картину світу без поділу на природничі та гуманітарні науки та вимагало усунення ізольованості у вивченні змісту відповідних навчальних дисциплін.

Мета. Мета дослідження – визначити важливість міждисциплінарних зв'язків між природничими та гуманітарними науками як засобу формування наукового світогляду майбутніх учителів.

Методологія. У процесі роботи використовувалися методи аналізу та синтезу, індукції та дедукції, порівняння, систематизації, узагальнення, прогнозування, серед емпіричних – метод тестування.

Результати. У дослідженні досліджено відмінність і спільність природничих і гуманітарних наук з їх ідентичним структурним складом (факти, поняття, явища, теорії) як основи методики формування наукової свідомості учнів, що сприяє реалізації освітньої мети, тобто формуванню в учнів цілісності знань за означеними напрямками. Розкрито значення міжпредметних зв'язків як основного засобу реалізації компетентнісного підходу в освіті.

Висновки. Зроблено висновок, що умови якісної реалізації міждисциплінарних зв'язків у підготовці вчителя є обов'язковими на кожному етапі вищої освіти. Основні вимоги до реалізації міждисциплінарності, спрямованої на вивчення природничих і гуманітарних дисциплін, мають виконуватися, починаючи з початкових класів. Зростання різноманіття наук має відбуватися в умовах інтеграції та впорядкованості, що сприяє збагаченню науки на рівні інтегративного цілісного комплексу. Практичне значення дослідження полягає у можливості використання отриманих результатів при розробці та впровадженні навчальних планів і робочих програм для професійної підготовки педагогічних кадрів.

Ключові слова: науковий світогляд; професійна свідомість; навчальне середовище; фундаментальна освіта; інтегративна система.