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IMPLEMENTATION OF INTERDISCIPLINARY CONNECTIONS AS ONE OF THE DIRECTIONS IN THE TRAINING OF FUTURE BIOLOGY TEACHERS

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Abstract
This article reveals pedagogical conditions aimed at the effective instruction of prospective teacher of biology: strengthening of inter-subject links between the curricula for studying methods of teaching chemistry and biology in a pedagogical higher educational institution; improvement of the curricula for studying methods of teaching chemistry and biology in a pedagogical higher educational institution due to introduction of pedagogical teaching technologies.

Keywords: Inter-subject links, pedagogical technologies, chemistry, biology, prospective teacher, pedagogical conditions.

Introduction

Annotatsiya. Ushbu maqolada bo‘lajak biologiya o‘qituvchilarini samarali tayyorlashga qaratilgan pedagogik shart-sharoitlar yoritilgan. Jumladan, pedagogika oliy ta’lim muassasalarida kimyo va biologiyani o‘qitish metodikasi kurslari o‘rtasidagi fanlararo aloqalarni mustahkamlash hamda ta’lim jarayoniga zamonaviy pedagogik texnologiyalarni joriy etish orqali ushbu kurslarni takomillashtirish masalalari ko‘rib chiqilgan.

Kalit so‘zlar: fanlararo aloqalar, pedagogik texnologiyalar, kimyo, biologiya, bo‘lajak o‘qituvchi, pedagogik shart-sharoitlar.

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Аннотация

В данной статье раскрываются педагогические условия, направленные на эффективную подготовку будущего учителя биологии: укрепление междисциплинарных связей между курсами методики преподавания химии и биологии в педагогическом вузе; совершенствование курсов методики преподавания химии и биологии в педагогическом вузе за счет внедрения педагогических технологий обучения.

Ключевые слова: межпредметные связи, педагогические технологии, химия, биология, будущий учитель, педагогические условия.

The changes in the socio-economic situation of Uzbekistan resulting from the reforms initiated in the 1990s have defined a new direction for the development of professional education. The ongoing reforms have introduced new requirements for the content of education, particularly in the context of professional teacher training. Consequently, graduates of educational institutions must be competitive in the labor market.

A future teacher should be capable of organizing not only collective but also individual learning activities of students. In addition, teachers must be able to comprehend innovative pedagogical technologies and creatively implement them in their own professional practice. The education of a new generation characterized by high mobility and strong social responsibility largely depends on the preparation of teaching personnel capable of addressing the challenges of teaching the fundamentals of economics, ecology, and biology.

Such knowledge serves as the foundation for the development of professional skills and competencies among future specialists. It is also one of the most important factors ensuring the social protection of school students. A high level of education can only be achieved by highly qualified teachers with modern professional training.

According to the main directions of the state educational policy of the Republic of Uzbekistan, reflected in the Law of the Republic of Uzbekistan “On Education” and the “National Program for Personnel Training,” education is considered a key factor in the humanization of socio-economic relations and the formation of new life values and attitudes.

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The developing agricultural sector requires modern, well-educated professionals. Therefore, higher education institutions are expected to prepare teaching personnel who are adapted to the demands of contemporary schools. Future biology teachers must possess modern pedagogical technologies that enhance students' interest in studying biology and support their further professional development.

The preparation of biology teachers for school work is being actively carried out at Kokand State Pedagogical Institute. Modern scientific and pedagogical experience in training biology teachers has shown the necessity of revising and rethinking, from entirely new perspectives, the goals, content, forms, and methods of preparing future biology teachers for professional activity in schools. One of the essential conditions for such improvement is the establishment of a comprehensive and continuous system of teacher education at pedagogical universities, including the specialty "Chemistry and Biology."

In this area, the following trends aimed at the effective preparation of future biology teachers have emerged:

1. Strengthening interdisciplinary connections between the courses "Methods of Teaching Chemistry" and "Methods of Teaching Biology" and the specialized scientific disciplines studied at pedagogical universities;
2. Improving the courses on chemistry and biology teaching methodology through the introduction of more effective pedagogical teaching technologies.

One of the fundamental scientific disciplines studied by students majoring in Chemistry and Biology at pedagogical universities is the course "Chemistry." Its significance in teacher preparation has increased due to the growing amount of biochemical content included in school courses of organic chemistry and general biology. However, the methodological potential of this course, which is based on interdisciplinary integration, is still not fully utilized in pedagogical higher education institutions.

Let us consider each of the identified trends in preparing future biology teachers for professional pedagogical activity.

In our study, interdisciplinary connections are understood as the reflection of relationships among sciences in the content of educational material, its structure, and teaching methods [7].

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A survey conducted among the faculty members of Kokand State Pedagogical Institute showed that 76% of respondents consider the implementation of interdisciplinary connections in students' educational and cognitive activities to be one of the most promising directions for enhancing such activities and improving the content of higher education.

Various types and forms of interdisciplinary connections have been identified in pedagogical research. For example, M.V. Bulanova-Toporkova distinguishes the following types of interdisciplinary connections: research-oriented interdisciplinary connections, mentally mediated connections, and indirectly applied connections [4, p. 202].

V.T. Fomenko distinguished types of interdisciplinary connections according to the manner in which content is developed over time. A "vertical" interdisciplinary connection refers to a situation in which logical and temporal relationships do not coincide. A "horizontal" connection implies that blocks of selected disciplines are studied simultaneously and in parallel, although with varying degrees of integration and interaction [4, pp. 208–209].

Horizontal interdisciplinary connections involve identifying several core disciplines that incorporate elements of other courses. In this case, each discipline is divided into modular blocks. Vertical interdisciplinary connections determine the sequence of instruction at different levels of training and ensure a unified methodology, methodological framework, and terminology for studying the cycle of natural science disciplines.

At the same time, it is necessary to carry out organizational and methodological measures, including the revision of existing curricula in order to strengthen the interrelationships among natural science disciplines. This necessitates preparing future biology teachers to develop individual plans for implementing interdisciplinary connections within biology courses. Such preparation requires knowledge of the methodology of teachers' creative work, which includes the following stages:

1. Studying the section "Interdisciplinary Connections" within each biology course, as well as related topics from curricula and textbooks of other subjects; reviewing additional scientific, popular science, and methodological literature.
2. Lesson-by-lesson planning of interdisciplinary connections using course and thematic plans.

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3. Developing instructional tools and methodological techniques for implementing interdisciplinary connections in specific lessons.
5. Designing methodologies for the preparation and implementation of integrated forms of instruction.
6. Developing methods for monitoring and evaluating the effectiveness of interdisciplinary connections in the educational process.

In our study, interdisciplinary connections within students' educational and cognitive activities are considered through the application of integration based on the organic interrelationship of natural science disciplines.

Integration (from the Latin *integratio* – restoration, renewal) is the unification of separate parts or elements into a whole, resulting in a qualitatively new formation and the restoration of a certain unity. It is not merely the sum of combined parts but their organic interaction, which gives rise to a new holistic or systemic entity. Systems theory defines integration as both a state of interconnection among individual system components and a process that leads to such a state [8].

Interdisciplinary integration is the unification of knowledge, beliefs, and practical actions at all stages of specialist training, as well as the synthesis of all forms of instruction in relation to each specific educational objective within higher education institutions [9].

There is no doubt that natural science disciplines are organically interconnected; that is, they are linked in such a way that they "relate to the very essence and internal integrity of something" [3, p. 459].

In our study, we examine interdisciplinary connections between the disciplines of Biology and Chemistry, since both belong to the natural science cycle and are closely related. Scientific literature identifies various types and forms of interdisciplinary connections. The full range of functions of interdisciplinary relationships is realized in the educational process when biology teachers employ their diverse forms.

Interdisciplinary connections are generally classified into intracurricular (e.g., the relationship between biology and chemistry) and intercurricular (e.g., the relationship between biology and history or vocational education). Based on the main components of the teaching process—content, methods, and organizational forms—interdisciplinary connections can be divided into content-informational and organizational-methodological categories.

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Content-informational interdisciplinary connections are further classified according to the scientific knowledge reflected in biology curricula into factual, conceptual, theoretical, and philosophical connections.

Interdisciplinary connections at the factual level involve establishing similarities among facts, utilizing common facts studied in chemistry and biology, and examining them comprehensively in order to generalize knowledge about natural phenomena, processes, and objects. For example, in teaching biology and chemistry, future teachers may use information about the chemical composition of the human body.

Conceptual interdisciplinary connections involve expanding and deepening the characteristics of subject-specific concepts and developing concepts common to related disciplines. General scientific concepts within the natural sciences include body, substance, composition, molecule, structure, property, as well as broader concepts such as phenomenon, process, and energy. These concepts are widely used in the study of assimilation and dissimilation processes. In this context, they become more detailed and concrete through biological material and acquire a generalized scientific character.

A number of general biological concepts reflect complex processes occurring in living nature that cannot be adequately explained, even at the initial stage of their introduction, without the use of chemical concepts. For example, the concept of photosynthesis was developed through the study of this process in plant physiology and related disciplines such as biophysics and biochemistry.

Theoretical interdisciplinary connections involve the development of fundamental principles of general scientific theories and laws studied in related subjects in order to help students acquire an integrated scientific worldview. A typical example is the theory of the structure of matter, which serves as a fundamental link between physics and chemistry. Its principles are further applied to explain the biological functions of inorganic and organic substances and their role in the life processes of living organisms.

Let us now consider the next trend aimed at improving the effectiveness of future biology teacher preparation.

According to V.S. Lazarev, “there is no problem in modern education that is more important and, at the same time, more complex than the organization of students’ independent work” [5, p. 77]. Independent work develops students’ skills and

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abilities in educational and cognitive activities, reinforces acquired knowledge, contributes to solving practical and scientific problems, and helps identify gaps in students' knowledge. However, practice shows that a significant portion of assignments intended for independent study is either not completed at all, carried out only formally, or simply copied from available sources.

Therefore, organizing students' independent work effectively means substantially increasing its role in achieving new educational goals by giving it a problem-based character that motivates both students and teachers to regard it as a leading means of activating students' educational and cognitive activities.

In our study, the effectiveness of independent work is enhanced through the systematic inclusion of professionally oriented tasks in the educational process.

By professionally oriented tasks, we mean creative tasks related to students' future professional activities that require the practical application of knowledge in solving problem situations, setting goals and formulating questions, conducting heuristic searches based on observation and logical thinking, and utilizing mathematical methods and tools.

Engaging students in the search for and solution of professionally oriented tasks promotes the development of their independence, which in turn stimulates their educational and cognitive activity.

Professionally oriented tasks are gradually introduced into the curriculum of natural science disciplines as students complete the modules of a particular course and study specialized subjects related to their future professional profile. After completing a relevant module, the instructor encourages students to independently find or design tasks connected with their future professional activities that require the application of the material studied in that module.

The completion of such assignments involves the independent collection of data. Students indicate the specific methods they used to obtain the data, such as conducting tests and surveys, working with reference materials, performing various measurements, and other research activities. All these activities contribute to the development of students' independence and research skills.

Thus, the contemporary trends identified in our study should have a positive impact on the preparation of future biology teachers, enhancing both their professional competence and their readiness for effective pedagogical practice.

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