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INTERDISCIPLINARY CONNECTIONS IN ACTION: CREATION OF THE STEAM EDUCATIONAL ECOSYSTEM

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Summary

This article examines the basic principles of the organization of educational and methodological work, taking into account the implementation of interdisciplinary connections and integration in the context of the STEAM approach. In modern education, the task of combining science, technology, engineering, art and mathematics to ensure the comprehensive development of students is becoming increasingly important. Through the analysis of key principles such as a holistic approach, flexibility and individualization, partnership and collaboration, practical orientation and the creation of a stimulating educational environment, the article highlights the main principles that contribute to the effective implementation of interdisciplinary communication and integration in the context of the STEAM approach. The BioArtAttack 2,3D method is an innovative approach to teaching biology and natural sciences, aimed at developing students' key skills. This method actively uses three-dimensional models, visual materials and interactive tasks to create a learning environment conducive to the development of logical, objective and analytical thinking. The approach is aimed at creating conditions for the development of creative thinking, research skills and preparing students for successful adaptation in the modern information society.

Key words: *STEAM, Bioartattack 2,3d, interdisciplinary communication, integration, stimulating educational environment, teachers, professional development.*

Introduction. Modern education is increasingly focused on an integrated approach to learning, including the integration of sciences and arts. One of the most effective strategies in this context is the STEAM approach, which combines science, technology, engineering, art, and mathematics. The implementation of interdisciplinary connections and integration in the classroom is becoming a key element of modern educational and methodological work, with which many teachers have difficulty developing lessons using elements of STEM learning and, in particular, using 2.3D modeling [1, pp.150-156]. Understanding the basic principles allows the teacher to build a holistic picture of the educational process, optimize the learning process, keep up with the times, overcome difficulties and develop professionalism. Studying the principles helps answer key questions: what specific principles underlie STEAM education, how the BioArtAttack 2.3D method promotes the development of various skills among students, what difficulties may arise when implementing the STEAM approach and how to overcome them, how to evaluate the effectiveness of using the STEAM approach and the BioArtAttack 2.3D method.

Materials and methods. STEAM education in the 7th grade makes learning more visual, develops curiosity and forms a positive attitude towards learning. Using experiments, projects, and models allows children to better understand complex scientific concepts. The STEAM approach encourages children to ask questions and look for answers.

The authors believe that the development of the STEAM approach in education should develop in a logical chain of interrelated sections.

The main principles of the organization of educational and methodological work on the implementation of interdisciplinary connections and integration in the

context of the STEAM approach are: holistic approach; flexibility and individualization; partnership and cooperation; creation of a stimulating educational environment; development of creative thinking [2, 49-50]. To organize a study of the effectiveness of the developed principles of "STEAM in biology class", an experimental group of students aged 12-13 years of 7th grade (25 people) was organized on the basis of the KSU Regional Multidisciplinary Boarding School for Gifted Children. The study was conducted from January 2024 to May 2024.

Results and discussion. In order to confirm the effectiveness of STEAM principles in biology, a study was conducted among 7th graders of the lyceum.

Basic principles:

1.Holistic approach - "Introduction", the organization of educational and methodological work should be based on a holistic approach to learning, including the integration of knowledge and skills from various fields of knowledge. It is important to strive to combine subjects not only at the level of content, but also at the level of teaching methods and assessment of academic performance.

2. Flexibility and individualization - Educational and methodological work should be flexible and adapted to the individual needs and characteristics of students. This implies the possibility of choosing different ways to achieve educational goals and taking into account the interests of each student. A separate group can identify a number of active learning methods that solve the problem of forming the skill of critical information selection. The recommended forms of organizing work in the lesson for solving this problem are: reception "Hour X", "Jigsaw", "Scientific laboratory", "Delayed guessing" [1, pp. 150-156]. For example, the "Hour X" method. Educational materials on the topic of the lesson are prepared for students, but from different sources: textbooks, popular science literature, Internet resources. Students are asked a problematic question on the topic of the lesson, and the time frame for working with information sources is determined. At the end of the time, a conditional signal is given, hour X comes, when the students must give an answer to the question or questions posed.

3. Partnership and cooperation - The realization of interdisciplinary connections and integration requires close cooperation between teachers of various subjects. It is important to create partnerships and share experiences, which contributes to a more effective integration of knowledge. For example, when integrated with the optional course "Fundamentals of Robotics", students can print three-dimensional models for biology lessons on a 3D printer.: structural elements of DNA and RNA, components of plant and animal cells, models of viruses, bacteria, protozoa. This allows biology lessons to be clear, vivid, and memorable, and students will gain engineering competencies during the project. Thus, educational and methodological work should focus on the practical application of knowledge, which includes the use of project work, laboratory experiments, case studies and other forms of active learning, allowing students to apply the knowledge gained in practice, that is, to solve real problems and develop teamwork and creative thinking skills.

4. Creating a stimulating educational environment - An important principle is to create a stimulating educational environment that promotes creativity, research and self-development of students [3].

Currently, many teachers have advanced knowledge in the field of application for the formation of research skills of information and communication technologies. For example, they prepare interactive tasks using the portal. https:// learningapps.org /. The portal provides convenient templates for developing tasks for logical matches, knowledge of subject terminology, classification, sorting by any feature or combination of features, using game technologies, using video and audio content. It's also easy to find the right task, and if you don't have one, you can develop it yourself. Popular and other resources such as https://bilimland .kz/ru, https:// quizizz.com, https://kahoot.it, https:// quizlet.com. They have a large list of ready-made resources for lessons, which include organizing a space for working in groups and individually [4].

5. Developing creative thinking - The STEAM approach aims to develop creative thinking among students. The updated biology curriculum includes the study of biotechnology, but this knowledge will only become competencies when students apply the elements of biotechnology themselves. For example, the fermentation of milk using acidophilic bacteria at home. This can be organized as an advance homework assignment.

From the discipline of STDM to integration, many methods have been used, it is not only about the integration of disciplines, but also about the appropriate teaching methods of each discipline. Thus, common methods that can be used in different disciplines are "project-based learning, scientific research, and modeling." Therefore, this type of structured integration of disciplines using these methods can allow teachers to focus on their core disciplines without missing any of their features [5].

Of all these principles, the principle of developing creative thinking was used in biology lessons in the classroom.

Figure 1 shows the use of the BioArtAttack 2,3D method in biology lessons in 7th grade "The internal structure of a spider" - the work of student No. 14

Figure 1. "The internal structure of the spider" - the work of student No. 14

Using the BioArtAttack 2,3D method in biology lessons promotes the development of imagination. This allows students to visualize internal processes that are usually hidden from view. The method stimulates the imagination, encouraging them to imagine how the individual organs and systems of the spider work, how they interact with each other and with the environment.

Emotional intelligence is also developing: understanding the internal structure of an animal increases awareness of the fragility of life and the importance of caring for nature.

The ability to innovate is also stimulated: by analyzing the image, students look for new ways to solve problems, for example, analyzing a three-dimensional model of a spider, a student can not only study the structure of its organs, but also figure out how to improve the strength of the web or create a new material that mimics its properties.

The student examines the smallest parts of the natural world that can only be seen through a microscope: for example, the internal structure of a spider (Figure 1). Practical and laboratory work using the BioArtAttack 2,3D method becomes the center of creativity, as colored pencils and paints can be used as tools and devices that allow children to make wonderful discoveries, and teachers to create more exciting and effective lessons, as well as to identify the individual characteristics of each student.

Figure 2 shows the use of the Bio-ArtAttack 2,3D method in biology lessons in 7th grade "Chameleon structure" - the work of student No. 11

In Figure 2, the BioArtAttack 2,3D method, applied to the study of chameleon, opens up an amazing world of adaptation and survival for students.

Visualization of the inner world. A vivid and detailed drawing of a chameleon created using this technique allows students to literally look inside this mysterious animal. They see how his organs work, how the process of respiration, digestion and blood circulation takes place. Such visualization greatly facilitates the understanding of complex biological processes and makes them more interesting.

The development of creative thinking. By recreating the chameleon's internal structure on paper, students use their imagination. They represent how certain organs function, how an animal uses them to survive in its habitat. It stimulates creative thinking and helps to develop the ability to think abstractly.

Figure 2. "The structure of the chameleon" - the work of student No. 11

Understanding Adaptation - By studying the chameleon's structure, students will learn about its unique adaptations that allow it to survive in difficult rainforest conditions. For example, they can understand how his long tongue works, allowing him to catch insects at a great distance, or how his skin color changes to disguise himself. This helps to form a deep understanding of the principles of evolution and adaptation of living organisms.

All this contributes to the development of logical, objective and analytical thinking skills [6, p.336].

Conclusion. Art can be a great way to visualize something that may seem complicated or difficult to understand [6, p.336]. BioArtAttack 2.3D combines multiple modes of research and reasoning that arise from multiple disciplines such as STEM and STEAM, art, and design, with the goal of exploring multiple ways students solve and approach problems. The effectiveness of using 2.3D modeling in the educational process can be achieved by organizing feedback. Monitor students' reactions, conduct questionnaires and discussions to understand which aspects of working with technology can be improved or supplemented [7].

The introduction of the STEAM approach into the educational process requires a systematic and comprehensive approach based on well-defined principles. The principles ples proposed in this paper for organiz-

ing work on the development of STEM lessons, using the principle of developing creative thinking, are important for the successful implementation of STEAM education.

Experimental data conducted on the basis of OMLIOD KSU among 7th graders confirm the effectiveness of the proposed principle - the development of creative thinking. Consequently, this approach to the transition from STEM to STEAM allows for a discrepancy between the nature of the disciplines integrated into educational practice, which can enhance students' creativity, thinking skills, and interest in the subject being studied.

The integration of art into STEM education (STEAM) allows:

To increase the level of material assimilation by visualizing complex biological concepts and artistic techniques, as this makes the learning process more vivid and memorable.

To develop interdisciplinary skills, combining natural science disciplines with art contributes to the formation of students' holistic worldview and the ability to apply knowledge in practice.

Stimulating creativity using the Bio-ArtAttack 2,3D method provides students with the opportunity to express themselves and develop individual creative abilities.

Thus, the STEAM approach, implemented on the basis of the proposed principles, is a promising direction for the development of modern education. It allows students not only to transfer knowledge from various fields, but also to develop key competencies necessary for a successful life: critical thinking, creativity, collaboration and the ability to solve complex problems.

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Іс-әрекеттегі пәнаралық байланыстар: STEM білім беру экожүйесін құру

Аңдапта

Бұл мақала STEAM тәсілінің контекстінде пәнаралық байланыстар мен интеграцияны іске асыруды ескере отырып, оқу-әдістемелік жұмысты ұйымдастырудың негізгі принциптерін қарастырады. Қазіргі білім беруде оқушылардың жан-жақты дамуын қамтамасыз ету үшін ғылымдар, технологиялар, инженерлік, өнер және математиканы біріктіру міндеті барған сайын маңызды бола түсуде. Біртұтас көзқарас, икемділік және даралау, серіктестік пен ынтымақтастық, практикалық фокус және ынталандырушы білім беру ортасын құру сияқты негізгі принциптерді талдау арқылы мақала steam тәсілінің контекстінде пәнаралық байланыстар мен интеграцияны тиімді жүзеге асыруға ықпал ететін негізгі принциптерді көрсетеді. Bioartattack 2.3 d әдісі оқушылардың негізгі дағдыларын дамытуға бағытталған биология мен жаратылыстану

пәндерін оқытудың инновациялық тәсілі болып табылады. Бұл әдіс логикалық, объективті және аналитикалық ойлауды дамытатын оқу ортасын құру үшін үш өлшемді модельдерді, көрнекі материалдарды және интерактивті тапсырмаларды белсенді қолданады. Тәсіл шығар-машылық ойлауды, зерттеу дағдыларын дамытуға және оқушыларды қазіргі ақпараттық қоғамда сәтті бейімделуге дайындауға жағдай жасауға бағытталған.

Түйінді сөздер: *STEAM, Bioartattack2, 3d, пәнаралық байланыс, интеграция, ынталандыратын білім беру ортасы, мұғалімдер, кәсіби даму.*

Материал баспаға 05.02.25 түсті

Межпредметные связи в действии: создание образовательной экосистемы STEAM

Аннотация

Данная статья рассматривает основные принципы организации учебно-методической работы с учетом реализации межпредметных связей и интеграции в контексте STEAM подхода. В современном образовании становится все более важной задача объединения наук, технологий, инженерного дела, искусства и математики для обеспечения всестороннего развития учащихся. Через анализ ключевых принципов, таких как целостный подход, гибкость и индивидуализация, партнерство и сотрудничество, практическая направленность и создание стимулирующей образовательной среды, статья выделяет основные принципы, которые способствуют эффективной реализации межпредметных связей и интеграции в контексте STEAM подхода. Метод BioArtAttack 2,3D представляет собой инновационный подход к обучению биологии и естествознания, направленный на развитие ключевых навыков учащихся. Этот метод активно использует трехмерные модели, визуальные материалы и интерактивные задания для создания учебной среды, способствующей развитию логического, объективного и аналитического мышления. Подход направлен на создание условий для развития творческого мышления, исследовательских навыков и подготовки учащихся к успешной адаптации в современном информационном обществе.

Ключевые слова: *STEAM, Bioartattack2,3d, межпредметная связь, интеграция, стимулирующая образовательная среда, учителя, профессиональное развитие.*

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Authors' contribution. The largest contribution is distributed as follows:

G. D. Suleimenova contributed to the conceptualization of the study, development of the research framework, and manuscript writing.

B.B. Gabdulkhayeva was responsible for data collection, statistical analysis, and interpretation of results.

S.Zh. Kabiyeva worked on the literature review, methodology design, and revision of the manuscript.

B.A. Baidalinova contributed to proofreading, editing, and finalizing the manuscript for publication.

Conflict of interest. The authors declare no conflict of interest.