

PEDAGOGY

BİOLOGİYA DƏRSLƏRİNDƏ STEAM METODUNUN SƏMƏRƏLİ TƏŞKİLİ ÜÇÜN UYĞUN TƏLİM MÜHİTLƏRİNİN YARADILMASI

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CREATING SUITABLE LEARNING ENVIRONMENTS FOR THE EFFECTIVE ORGANIZATION OF STEM METHOD IN BIOLOGY LESSONS

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Xülasə

Məqalədə STEM metodunun tədrisdə tətbiqi ilə eğitim sisteminin yeni dönəmə girməsi əsaslandırılmış, təhsil fəaliyyətinin güncəllənməsi problemləri müəyyənləşdirilmişdir. Bütün dövrdə təhsil sahəsində islahatlar aparılmış, böyük addımlar atılmış, nailiyyətlər qazanılmışdır. Bu reformlar əksər hallarda təhsilin və cəmiyyətin inkişafına səbəb olan yeniliklər və kəşflərlə nəticələnmişdir. Hazırda STEAM metodunun tədrisə tətbiqi də müəllimi və məktəbi tamamilə yeni səviyyəyə qaldırdı. İnkişaf etmiş bütün ölkələrdə bu üsula maraq günü-gündən artır. Bunun bir çox səbəbləri vardır. STEAM metodu: biznesin inkişafına, təhsil və digər müəssisələrin maddi gəlirinin artmasına, yeni və ucuz, ekoloji təmiz məhsulların yaradılması üçün xammalın əldə edilməsinə, cəmiyyətin sürətli inkişafına və yeni keyfiyyət göstəricilərinə malik olmasına səbəb olmuşdur. Tədqiqatda biologiyanın tədrisində STEAM metodundan səmərəli istifadə üçün zəruri təlim mühitinin yaradılmasının zəruriliyi və STEAM texnologiyasının əsas aspektləri araşdırılmışdır.

Tədqiqatın məqsədi biologiyanın tədrisini müasir dövrün tələblərinə uyğun təşkil etmək üçün mümkün olan müasir təlim texnologiyalarından istifadənin perspektivlərini diqqətə çatdırmaqdır. Artıq təlim texnologiyaları dedikdə, yalnız kompüter avadanlıqları nəzərdə tutulmamalıdır. Biologiya eksperimental elm olduğundan tədris prosesini mühazirə, əyani vəsaitlərin nümayişi, multimedialı təqdimatlarla təşkil etmək artıq günün tələblərini ödəyə bilmir. Doğru hesab edilən bir çox hipotezlər texnologiyaların elmdə tətbiqi sayəsində öz əhəmiyyətini itirir, yeni elmi kəşflər sayəsində fərqli elm və peşə sahələri yaranır. Müasir dövr, yalnız biliklərin öyrənilməsinə hədəfləmir. Alınan biliklərin həyata tətbiqi, elmi biliklərin cəmiyyətin inkişafına istiqamətləndirilməsi XXI əsrin əsas problemi olmuşdur. Yeni dünya standartları bu istiqamətdə işlərin aparılmasını, modern texnologiyaların tədrisə gətirilməsini müəllimlərdən tələb edir. Aparılmış təcrübələr göstərdi ki, yeni metod və texnologiyaların tətbiqi öyrəncilərin də marağına səbəb olmuş, materialın dərk edilməsi prosesi daha səmərəli olmuşdur. Məsələn STEAM metodundan, 3D texnologiyalardan istifadə etməklə canlı orqanizmlərdə gedən fizioloji prosesləri, onların anatomik-morfoloji quruluşunu rəqəmsal səviyyədə öyrətmək müəllimlərin də güncəllənməsini tələb edir. Universitet və orta məktəblər səviyyəsində aparılmış eksperimental dərslərdə yeni yontəmlər həm müəllimlər, həm də öyrəncilər tərəfindən rəğbət görmüşdür. Məqalədə STEAM metodunun və 3D texnologiyaları, AR, VR və MR texnologiyalarının perspektivləri göstərilmiş, gərəkli tövsiyələr verilmişdir. Tədqiqat prosesində müxtəlif müəllimlərin texnoloji potensialları, iş təcrübələri araşdırılmış və əldə olunan nəticələrə uyğun olaraq müvafiq təkliflər də verilmişdir. Məqalədə xüsusilə biologiyanın tədrisində istifadəsi gərəkli olan STEM metodu və texnologiyaların tətbiqi zəruri sayılmışdır.

Abstract

In the article, the application of the STEM method in education and the entry of the education system into a new period are justified and the problems in updating the education activity are identified. During the period, reforms were carried out in the field of education, great steps were taken and gains were achieved. In many cases these reforms resulted in innovations and discoveries that led to the improvement of education and society. Currently, the application of the STEM method to teaching has also elevated the teacher and the school to a whole

new level. The interest in this method is increasing day by day in all developed countries. There are many reasons for this. STEM method: led to the development of business, an increase in the financial income of education and other enterprises, the acquisition of raw materials for the creation of new and inexpensive, environmentally friendly products, the rapid development of society and new quality indicators. In the study, the necessity of creating the necessary learning environment for the effective use of STEM method in biology teaching and the basic aspects of STEM technology were investigated.

The aim of the study is to draw attention to the possibilities of using modern teaching technologies, which are possible to organize biology teaching according to the requirements of the modern age. Learning technologies should no longer just mean computer hardware. Since biology is an experimental science, it is no longer possible to organize the teaching process with lectures, visual aids and multimedia presentations. Many hypotheses that are accepted as correct lose their importance due to the application of technologies in science, and different fields of science and professions are created due to new scientific discoveries. The modern age does not aim only at the study of knowledge. Putting the acquired knowledge into practice and directing scientific knowledge to the development of society has become the main problem of the 21st century. New world standards require teachers to work in this direction and to bring modern technologies to teaching. Experiments have shown that the application of new methods and technologies attracts students' attention and the process of understanding the material becomes more efficient. For example, using STEM method and 3D technologies to teach physiological processes and anatomical-morphological structures in living organisms on a digital level requires teachers to be updated. In the experimental courses held at the university and middle school level, new methods have been popularized by both teachers and students. Perspectives of the STEAM methodology and 3D technologies, AR, VR and MR technologies are shown, and necessary recommendations are given. Technological potentials and work experiences of various authors in the Tədqiqat process have been researched and consistent proposals have been received in accordance with the results obtained. In particular, the application of STEM methodology and technology, which is necessary for use in biology, has been deemed indispensable.

Açar sözlər: STEAM metodu, öyrənmə mühitləri, AR, VR, MR texnologiyaları, bioloji və texniki savadlılıq.

Keywords: STEAM method, learning environments, AR, VR, MR technologies, biological and technical literacy.

Introduction

Although America is the country that invests the most in the STEAM method in the world, it has also gained great popularity in the advanced countries of the developed world in a short time. After getting acquainted with STEM education, teachers prefer fun-practical activities and research in teaching technology, engineering, mathematics and natural sciences. The fact that the STEM teaching method combines most fields of science and the complex use of acquired knowledge requires teachers to properly guide learners in this field. Basically, STEAM technology gives special importance to two areas: research and creativity. Experiences show that for the effective organization of the STEAM method, the involvement of qualified personnel and the provision of appropriate training environments are the main issues. The first of them is "Planning Environment". The purpose of this is to provide the necessary room for learners to effectively design their STEM project and work planning. Because what kind of effect can we talk about in formally held STEAM classes. The second is the "Integrated environment", which is intended to provide the students with cabins and rooms where they can freely use modern and various technologies, where there is a necessary and complete database for the development of the project they present (Babayeva Z., 2023).

Apart from these, the "Presentation environment" can be achieved by providing information to the educational institution staff about various STEM projects, and by organizing exchange rooms where discussions and decisions can be made on this topic. The "research environment" consists of laboratories, enriched with equipment for laboratory and experiments, and rooms where discussion and exchange of experience can be held, where the interest of the young generation is further increased by discussing and analyzing what they have discovered and learned, meeting the needs of the society related to various STEM projects. "Collaborative environment" can also be created in rooms where different projects can be discussed among students in the STEM method, results and calculations related to the level of project implementation, problems encountered are identified, and solutions are evaluated. In order to create a "creative environment", there is a need for a creative product, design, or discovery room that includes individual, group, or collective research of participants around STEM projects implemented in educational institutions and obtained as a result of research. In the 21st century, adapting the teaching format to both STEAM learning technologies is the main task of the modern STEAM teacher (Babayeva.Z.Y., 2021). As a researcher with the teacher's direction, the student's interest and desire.



There are also requirements and skills expected of students and teachers in the STEM development pathway:

- STEM student skills: students need to do research and present proposals rather than learning new knowledge to identify problematic directions, achieve a solution to a given problem.
- STEM teacher skills: Must be a guide, participate in STEM-related seminars and projects, develop learning and cooperation using technology, organize and develop STEM events, and quickly highlight the results of STEM educational events and related information on social media (Kearney, 2015).

STEM students can explore a specific device, information as a result of the goal they have set for themselves. For the successful completion of this work, a high school STEM student can start cooperation with any vocational school or a suitable specialist, thereby successfully fulfilling his desire. The product created at this time can be considered a novelty by being processed both in school and in other household areas. Or, in order to learn about the composition of various old and broken electronic devices, disassembling the devices and studying their internal structure and working principle can also give the student different ideas for creating a completely new product.

A STEM student already has the personality mission to immediately and effectively solve the challenges faced in the 21st century, to identify areas of need and gaps, to present new projects and solutions, and to create highly efficient products with little financial resources. The 21st century STEM student should learn accurate information about the problem he is investigating, and create a new product as a result of the project by conducting systematic, efficient work directed to the problem and solving the problem with creative capabilities. In order to demonstrate STEAM skills, a STEM specialist's ability to speak foreign languages, speech, psychological penetration, and product presentation skills are also necessary problems. In schools, students should first be introduced to the essence of the STEM teaching method. When STEM students absorb knowledge from all subjects during class, they understand the importance of this knowledge in their future lives and careers and are motivated to explore how to use this knowledge (Hua, M., 2022).

Differences in the characteristics of STEM classes. If STEM teachers use the guidelines given to take advantage of the new method in collaboration with the management of the institution, other employees and learners, and apply their potential creativity, we can get the desired results. If the number of students in the classes is large, this requires constant control of the class, flexibility, restraint and skill from the teacher. The character of these shaman students should be taken into account, attention should be paid to the development of their thinking. One of the important factors is giving tasks to students who understand each other in the same group during work with groups (Huseynov A.M., Abdullayeva T., 2012). The help of someone who is considered a "leader" who has authority among the students should also be used. By instructing them, it is possible to improve the quality of group management, control, and performance of work. By involving the laboratory assistants working in the appropriate subjects in educational institutions - (informatics, biology, chemistry, physics) - in the teaching process, it is possible to create conditions for conducting the lesson completely creatively. Of course, in order to create teamwork habits of students, it should be gradually formed by all teachers from the elementary school (Polat, M. and Konaş, H., 2018). Mathematical calculations are also required in addition to the scientific explanation of the topic studied by the students, both in team work and during the performance of individual tasks. At this time, the teacher's help is also needed. In some cases, cooperation with the teachers of these subjects can be provided for the integration of knowledge from the subjects of physics, chemistry, biology, mathematics, and geography. In this situation, students can show effective creativity together, seeing that mathematics is not isolated from different subjects. Another advantage of the STEAM method is distinguished by the fact that the "STEAM environment provides rich opportunities for creative solutions". Thus, STEM lessons, which enable several solutions to a certain task, experience, problem, and give a different approach, form the skills of comprehensive use of scientific knowledge in learners. This will eventually result in new models, products being designed, tested and presented. But what are the distinctive features of STEM lessons? For this, what qualitative changes should be

made in the teacher's activity to be formed as a STEAM teacher. It is the teachers who conduct the STEAM classes and form different skills and habits in the students. Therefore, it is considered that the face of a modern teacher is a STEAM teacher.

Methodology

In addition to the scientific knowledge of the subject he teaches, the STEAM teacher must also acquire the competencies of modern pedagogical and modern learning technologies. These competencies include some important characteristics that all teachers today, especially STEAM teachers, must possess:

- In the modern era, when training standards and educational reforms are rapidly changing, teachers must also acquire the skills and habits of flexible adaptation to the changing educational innovations, methods and tools of the digital age. In order to be able to answer students' questions about technologies, the teacher of the modern digital age is obliged to be aware of innovations;

- A STEAM teacher should be able to communicate with colleagues, students, and their parents, and should demonstrate ethical behavior. Only then, thanks to student-teacher-parent communication, students will be able to easily communicate with the teacher about their dreams, about any project they want to design;

- A teacher who performs the subject and methodology he teaches with a sense of self-confidence can get a positive result of his work. A self-confident teacher should communicate with colleagues in the classroom with the same confidence. In particular, a STEAM teacher must learn with confidence in his work and impart what he knows to his students with a sense of self-confidence. A teacher who wants to teach learning must first learn to teach. The principles of the STEAM method direct teachers in this direction;

- As we learned from the interactive training, working in a team shows even better results in the STEAM method. Here the teacher can also become a member of the team. This will increase the enthusiasm of the students. Also, participating in online webinars and trainings with leading STEAM experts on social networks, by teaming up with other teachers, real or virtual, increases the competence of STEAM teachers. This also improves the skills of teachers by creating conditions for the exchange of ideas and experiences.

Among the many characteristics, skills and abilities expected of a modern teacher in general, as well as a STEAM teacher

- flexible adaptation, excellent education, high ability of analysis and synthesis; approach to the taught subject with a different understanding and imagination, the ability to create motivation, the ability to teach based on analogies, the ability to apply different methods and techniques, to have the ability to be an example or leader for students;

- organizer, innovativeness, responsibility, socialization skills, looking to make lessons attractive, mastered the skills of using MimioTech board, Promethean board, Labdisk-physio digital laboratory equipment, Dyumo-physio instrument, Phywe-laboratory equipment, robotics and arduino and other opportunities;

- to develop self-development, problem-solving, integration skills, leadership and creative abilities in students in order to develop their logical and critical thinking.

A STEAM teacher who has all these features we have listed is already considered a high-level, reputable educator. But what should be done to maintain this high reputation, to be constantly renewed, to raise creativity? For this, it is one of the main conditions for the STEAM teacher to turn scientific knowledge into life, production, and products through experience, to identify the gaps in the areas of need and find a way to solve the problem.

The prospects of using AR, VR, and MR technologies in biology classes were investigated, and it was found that the use of VR glasses aroused the interest of the audience. Due to the wide spread of the STEAM method, the application of the same technologies in teaching has posed the problem of raising the level of teachers. In order to find out the situation on the spot, we investigated the possibility of applying the STEAM method and using VR goggles in the teaching of biology in the Nakhchivan State University's Faculty of Natural Sciences, Architecture and Engineering, Technology Market, Nakhchivan City No. 9 Secondary School. For this purpose, we held discussions with high school and high school teachers, and were interested in students' approach to new technologies. We are sure that the high interest of teachers and learners in new technologies will accelerate the introduction of new methods (Babayeva 2023).

N. Rzayeva, the principal of secondary school No. 9 in Nakhchivan city, created 5 groups of secondary school biology teachers who won the grant project "Application of 3D technologies in the teaching of biology" and started training to learn the working principle and possibilities of using VR glasses. The study of biological processes and the anatomical structure of living organisms using VR glasses is successfully continued in the trainings conducted by the trainer, professor of Nakhchivan State University, Z.Y. Babayeva, together with secondary school teachers.

From the conversations of school teachers with students, it became clear that the students are already familiar with the working principle and functions of 3D technologies and have used most of them for various games. This is one of the factors that facilitate their use of new technologies.

Foundations and Expected Outcomes of a STEM Curriculum. As the requirements and necessity of the 21st century, new educational reforms in the STEM method, the integration of physics, chemistry, biology and other natural sciences with technology, engineering, and mathematics are reflected in the content of these subjects. The real purpose of using the STEM method is not only to guide students in their future professional choices, but also to play an important role in shaping their 21st century skills. Therefore, it instills in students the necessary thinking, analysis-synthesis skills and problem-solving skills to solve the difficulties they may encounter in various areas of their lives.

There is a logical fit between the creation of 21st century skills and the application of knowledge during the teaching of the STEM method.

The 21st century skills, which include the goals, objectives, principles and directions of the STEM content curriculum, help to define the main directions and concepts facing modern education. At the end of our

research, STEM is becoming a program that reflects 21st century skills by including it in educational programs due to the integrated teaching of natural sciences, technology, engineering and mathematics. In addition, the use of mind maps in teaching biology is one of the methods that enriches the development of their thinking.

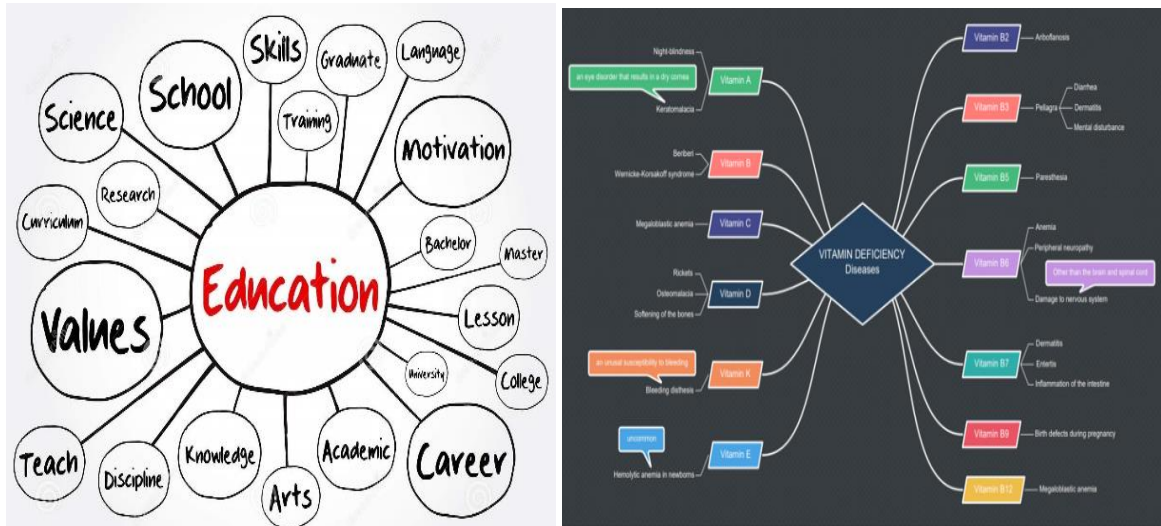


Figure 1., 2. Mind maps in teaching biology

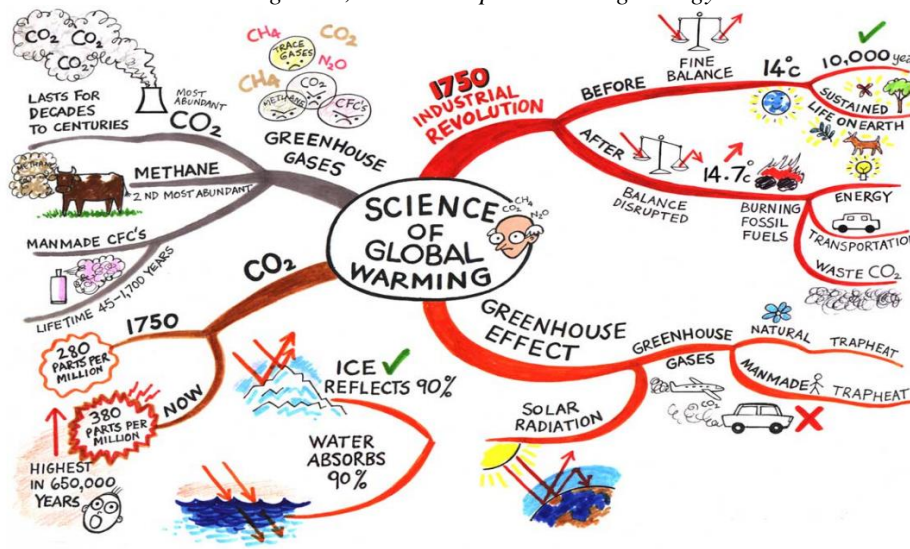


Figure 3. Mind maps in teaching ecology

Thus, based on our conclusions, we consider it necessary to make several suggestions:

- Curriculum with STEM content - as an educational program, is distinguished by the fact that it is based on the teaching of natural sciences not in isolation, but with interdisciplinary integration, ultimately serving the same goal and purpose;
- Curriculum with STEM content is an educational program that is designed to create a general idea of facts and events in life by not isolating one subject from another;
- Curriculum with STEM content – helps to clarify the explanation of the concept of STEM, which is explained in the explanation of the word STEAM;

Studies show that the curriculum with STEM content - helps to increase the efficiency of the achievements of students, to develop 21st century skills as a result of education, as well as 4C skills, to cultivate a young generation who dreams freely and has an increased sense of self-confidence.

Experiments show that the application of the STEAM method, the skills formed will play an exceptional role in the vital knowledge and skills of students:

- In order to get high results from the STEAM method, the right direction given to the young generation at the moment will open the way for their great discoveries;

- Heads of educational institutions should enrich the material and technical base with 3D technologies and other technical means, in order to bring new technologies to the teaching process.

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