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ВИКОРИСТАННЯ STEAM-ОСВІТИ У ПІДГОТОВЦІ ВЧИТЕЛІВ МУЗИКИ

Анотація. *З розвитком інформаційних технологій STEAM-освіта ((Science, Technology, Engineering, Arts, Mathematics) стала новацією. STEAM-освіта допомагає розвинути універсальні навички, необхідні для досягнення успіху в різних сферах життя. Міждисциплінарний підхід необхідний сьогодні для вирішення складних проблем сучасного світу. Дослідження того, як STEAM-освіта впливає на підготовку вчителів музики, є потенційно цікавим, оскільки музика має унікальні напрями міждисциплінарної взаємодії з іншими галузями знань. У STEAM-освіті музику слід сприймати як інструмент для більш глибокого аналізу сутності музики крізь призму інших наук. Ми використали кілька методів для визначення потенційного впливу STEAM-освіти на результати підготовки вчителів музики, серед яких теоретичні методи наукового пізнання: аналіз наукових публікацій та їх систематизація і узагальнення, а також порівняння і абстрактне моделювання для виявлення можливих впливів STEAM-освіти на результати підготовки вчителів музики. У статті наведено приклади практик використання елементів STEAM-освіти у вивченні музики та описуємо різні аспекти взаємодії музики з кожним компонентом STEAM. Доведено, що STEAM-освіта має низку переваг, які роблять її актуальною для сучасної підготовки майбутнього вчителя музики: розвиток критичного мислення та креативності, які є важливими для успішного вчителя музики.*

Ключові слова: *STEAM; музика; вчитель музики; освіта; освітні технології; STEM; підготовка вчителів музики.*

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THE USE OF STEAM EDUCATION IN THE TRAINING OF MUSIC TEACHERS

Abstract. *With the development of information technology, STEAM education (Science, Technology, Engineering, Arts, Mathematics) has become an innovation. STEAM education helps you develop the versatile skills you need to succeed in various areas of life. An interdisciplinary approach is needed today to solve the complex problems of the modern world. The study of how STEAM education influences the training of music teachers is potentially interesting, as music has unique areas of interdisciplinary interaction with other fields of knowledge. In STEAM education, music should be perceived as a tool for a deeper analysis of the essence of music through the prism of other sciences. We used several methods to determine the potential impact of STEAM education on the results of music teacher training, including theoretical methods of scientific knowledge: analysis of scientific publications and their systematization and generalization, as well as comparison and abstract modeling to identify possible impacts of STEAM education on the results of music teacher training. The article provides examples of practices for using elements of STEAM education in the study of music and describes various aspects of the interaction of music with each component of STEAM. It has been proven that STEAM education has several advantages that make it relevant for the modern training of a future music teacher: the development of critical thinking and creativity, which are important for a successful music teacher.*

Keywords: *STEAM; music; music teacher; education; educational technology; STEM; music teacher training.*

Statement of the problem. In modern education, monitoring the development of the latest pedagogical approaches and their impact on specialist training is essential for the scientific community. Today, scientists have different approaches to solving urgent problems of professional training of music teachers. As the analysis of scientific sources shows, its improvement takes place in the following areas: introduction of a comprehensive, integrated, interactive approach to the process of professional training; modernization of the content of vocational education; taking into account the specifics of music classes and, accordingly, the peculiarities of the practical activity of a music teacher; study of certain aspects of vocational training.

Music as an art has its own unique characteristics and interacts with other branches of knowledge. In STEAM education, music becomes an object of study and a means to achieve a deeper understanding and application of concepts from various fields. With the development of IT and the consequences of humanization and humanitarianization of education, one such promising area is the STEAM direction, which is recognized as effective and innovative for developing the educational industry. STEAM (Science, Technology, Engineering, Arts, Mathematics) has become a methodological approach in education and a guiding principle for forming deep and comprehensive knowledge. In this regard, the impact of STEAM education on the training of a music teacher is especially relevant and interesting.

Analysis of current research. Research on the implementation of elements of STEAM education is underway in the USA, Canada, Australia, South Korea, Thailand, etc., which is confirmed by several scientific and pedagogical studies related to STEAM [1; 3; 9; 11; 16].

The ability to attach the "Art" element in the abbreviation STEAM, as evidenced by the analysis of the experience of implementing STEAM education, is quite different. The experience of British researchers is

interesting, noting that in primary school, acoustics as a branch of physics can serve as an element that unites STEM and STEAM. This idea is described in more detail as the experience of the Acoustics Research Group, which collaborated with primary school teachers and successfully combined art and reading for a long time. In Chicago, the initiative was supported [5].

A U.S. Department of Education report defines STEAM education as an approach to teaching students to demonstrate innovative, critical thinking, and creative problem-solving by exploring the intersection of disciplines. STEAM education develops students' creative problem-solving skills using the arts as an instructional approach to experiential and inquiry-based learning. This provides opportunities to engage students in the creative process and achieve goals in various subject areas [6].

J.S. Miller, Es Reggivale, realizing that positive change can only be achieved through the integration of the arts with science, technology, engineering, and mathematics, point out that the implementation of the STEAM approach can enrich and take its predecessor – STEM – to a new level [7]. The introduction of STEAM education in the study of music helps to expand the horizons of learning, develop creative abilities, and stimulate students' interest in learning. STEAM classes can make learning music more interesting, effective, and relevant to the modern world. Implementing STEAM education can take many forms, including projects, laboratories, theatrical performances, workshops, and other forms of active learning. Teachers become facilitators, facilitating learning and using knowledge in practical tasks [10]. Compared to traditional education, the STEAM approach is considered more adaptable to the needs of modern society and the economy, as it considers the need to develop creative and technological skills to succeed in the world. It is designed to develop students' ability to work effectively in a changing environment.

Since in STEAM education music should be perceived as a tool for a deeper analysis of the essence of music through the prism of other sciences, the need to analyze the use of STEAM education in the training of music teachers is actualized.

The article aims to analyze the use of STEAM education in the training of music teachers.

Research methods. To determine the potential impact of STEAM education on the results of music teacher training, theoretical methods of scientific knowledge were used: analysis of scientific publications and their systematization and generalization, as well as comparison and abstract modeling to identify possible impacts of STEAM education within the professional training of music teachers.

Research results. STEAM education in music can be a fun and productive way to develop students' knowledge and skills. Based on the analysis results and systematization of existing practices, we believe that STEAM can be included in the music teachers' training (Table 1).

Table 1. Examples of STEAM in the study of music

STEAM Element	Use Case
Music Technology	• Using digital music instruments and software to create and record music.
	• Using programs for editing and processing audio.
	• Using virtual instruments to perform music creatively.
Music Engineering	• Designing and constructing your own musical instruments or devices.
	• Studying acoustic principles and their use in creating musical effects.
Integration with art	• Creating visual art projects that accompany the performance of music.
	• Organizing exhibitions of musical and artistic students' works.
Sound Design Projects	• Creating soundtracks for films, performances, and other events.
	• Learning the basics of sound design and its impact on visual material perception.
Learning the Mathematical Aspects of Music	• Analysis of rhythms, tempos, and meters as mathematical concepts in music.
	• Using mathematical models to create and understand musical structures.
Theatrical performances and musical performances	• Creating musical performances and theatrical performances based on stories, songs, or life situations.
	• Involving students in creating scenography, costumes, and other aspects of the performance.
Collaboration with other actors	• Organizing joint projects with physics (acoustic phenomena), computer science (programming of musical applications), mathematics (music theory), and other STEAM subjects.
Gaming aspects	• Using a slate and games to teach musical terms, sheet music, etc.
	• Creating music bands or projects to create music together.

Music, as the art of sound, has many aspects that can be successfully integrated into STEAM education. Music stimulates students' creativity and emotional development. By experimenting with sounds, students develop their musical style and express their own emotions through the creation of music. In addition, music provides a unique opportunity to comprehend mathematical and physical concepts. The study of the physical

phenomena of acoustics reveals the physical features of sound and sound waves that underlie musical phenomena.

In STEAM education, music is a medium for learning technology. Digital tools, music production, and editing software allow students to master technology and develop creative thinking. Thus, music (or musical art), an integral part of STEAM education, interacts with its other components (science, technology, engineering, and mathematics), complementing and enriching learning in these areas. The figure (Fig.1) shows the key aspects of the interaction of music with each of the components of STEAM.

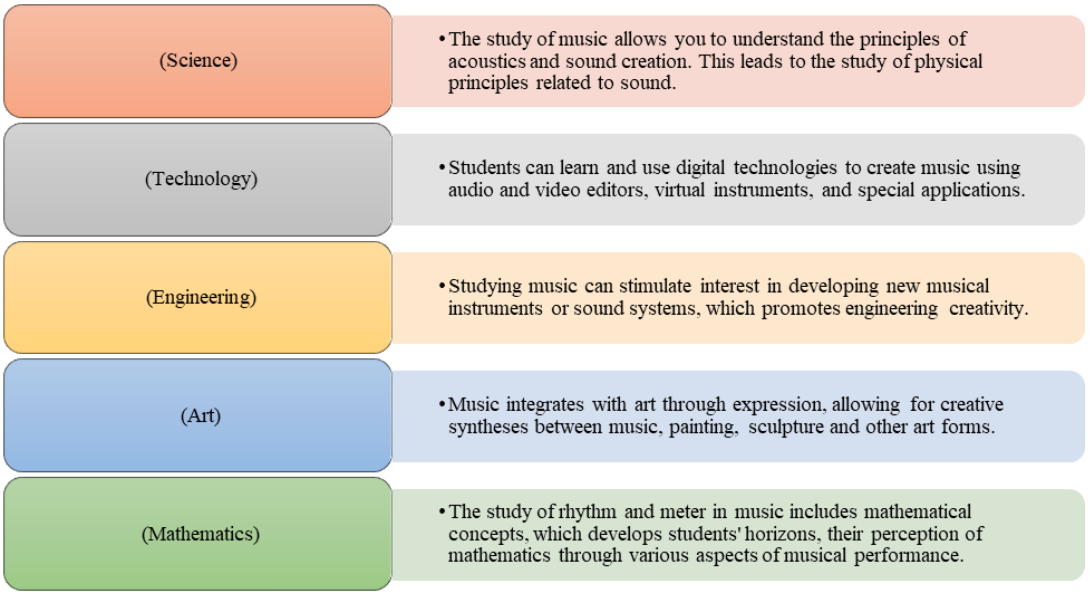

Fig. 1. Key aspects of the interaction of music with each of the components of STEAM education

We will present the main characteristics of STEAM education that correlate with the components of the information and digital culture of music teachers (Fig. 2, 3): subject integration (STEAM goes beyond the traditional separate study of disciplines, contributing to their joint study in the context of real tasks); active learning (the use of active methods in which students are involved in practical projects, research, creative tasks); problem-oriented learning (students solve real-world problems, which allows them to apply the acquired knowledge in practice); development of creative abilities (emphasis on the development of creativity, innovative thinking and ingenuity); use of IT (extensive use of ICT to support learning and the creative process); development of communication skills (teamwork, discussion and presentation of projects develop communication skills); flexibility and adaptability (adapting learning to students' individual needs and learning styles).

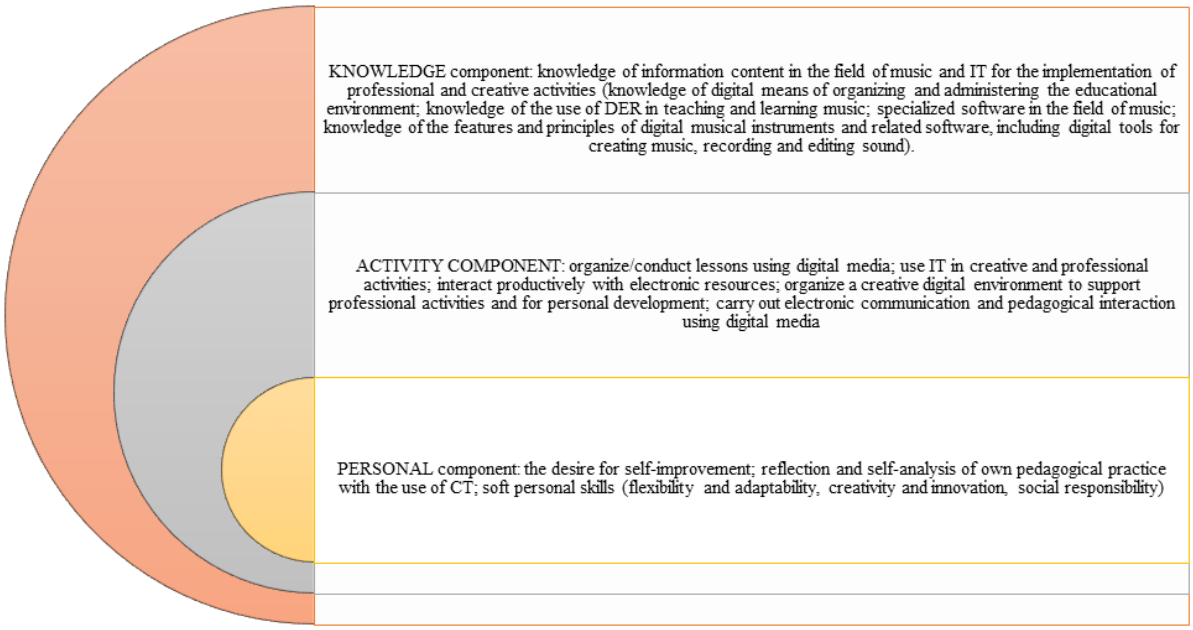

Fig. 2. Components of a music teacher's digital culture

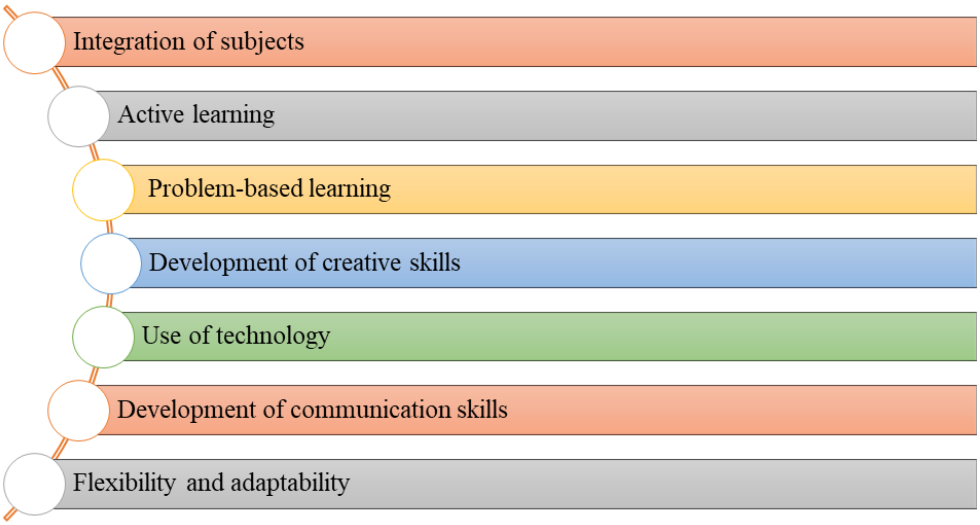

Fig. 3. Main Characteristics of STEAM Education

Discussion. The results obtained expand the possibilities of purposeful creation of links between school and social practice, between the educational process and the whole world in terms of the development of children's abilities, and the important benefits of STEAM education [15]: accumulation of ideas, exchange of opinions, creation of a single information and educational space with the ability to search and create content, organization of continuous learning that unfolds over time, emphasis on the integration of key disciplines. Researchers, in particular [2], identify three main ways of implementing STEAM education (Fig. 4).

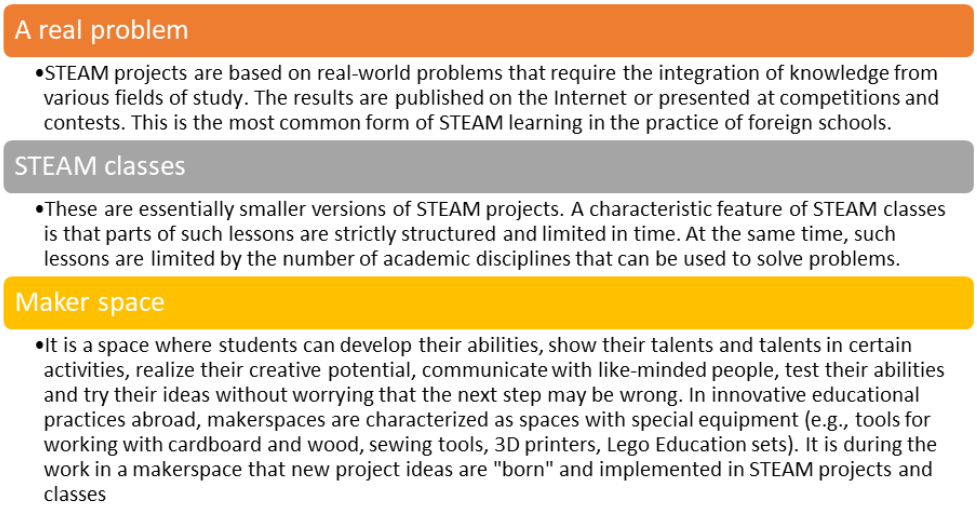

Fig.4. Ways to implement STEAM education

According to J. According to Yackman, an American expert on integrating art and STEAM education, the acronym STEAM reflects how all subject topics relate to each other and the real world. The author points out that the letter "A" stands for art, a discipline that goes far beyond music alone. The letter "A" organizes the relationship between all the humanities that are formally classified as the various arts, humanities, linguistics, social sciences, disciplines that help to understand which ideas have practical applications and which do not, and all the major arts, each of which stimulates the development of STEM disciplines.

S. Riley defines STEAM as an integrated educational approach to learning that uses science, technology, engineering, art, and mathematics as "access points" to guide students' research through dialogue and critical thinking skills [8]. STEAM education is interpreted as a creative space for a child's worldview, in which he/she fully realizes his/her needs. Therefore, all activities aimed at the implementation of STEAM education are designed to promote the development of the individual as a creator, and project activities in this regard are one of the most promising. Unlike traditional learning, STEAM projects bring students closer to reality and bridge the gap between theoretical problem-solving and the practical application of what they're studying.

STEAM education creates stable logical connections between disciplines that help students look at the world globally, and notice patterns and similarities in different fields of activity. To be a successful specialist, you need to combine and develop the skills of an inventor, scientist, manager, psychologist, etc [13; 14].

The STEAM approach destroys the notions of "technical" and "humanitarian" thinking. The initial goal of STEAM education was to popularize education in the scientific field. Currently, STEAM curricula are being developed to support humanities research through science and mathematics, and the development of the educational field is not limited to digital technologies, as it includes teacher training programs in various fields (not just in one subject).

In the article, the astors describe the relationship of music with other components of STEAM education [4]. Specifically, the authors point out that music uses the physical principles of sound, so it belongs to the natural sciences. Music can be used to create, record, and play sound, reflecting its relationship to technology. Music is related to engineering and can be used to create musical instruments and systems. It is also associated with mathematics using mathematical concepts such as harmony, melody, and rhythm. Thus, the authors note that music connects the various components of STEAM education, contributing to integrating knowledge and developing a wide range of skills.

L. Aristova, O. Gorozhankina, E. Provorova, R. Lotsman, and D. Levitt provide specific examples of how STEAM education can be useful for the training of music teachers [12]: STEAM can help music teachers better understand how music interacts with other areas of expertise; STEAM can help music teachers use technology to create more effective and engaging lessons; STEAM education can help music teachers develop students' critical thinking, creativity, and innovation.

Conclusions and prospects for further research. Summarizing the above results, it should be noted that STEAM education has several advantages that make it relevant for the modern training of a future music teacher. Firstly, it promotes the development of critical thinking, creativity, and innovation, which are necessary for the successful professional activity of a music teacher. Secondly, STEAM education helps to develop the universal skills needed for success in various areas of life. Thirdly, STEAM education contributes to creating an interdisciplinary approach, which is necessary to solve complex problems of the modern world. Our findings are supported by a review of academic papers on the training of future music teachers, demonstrating the connections and mutual impact of STEAM-focused professional training on developing the information and digital culture of future music teachers.

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