# APPLICATION OF MODERN INNOVATIVE TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE IN MUSIC EDUCATION (BASED ON STEAM, GML, AIM METHODOLOGIES)

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# MUSIQA TA'LIMIDA ZAMONAVIY INNOVATSION TEXNOLOGIYALAR VA SUN'IY INTELLEKT (STEAM, GML, AIM METODIKALARI)NING QO'LLANILISHI

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# ПРИМЕНЕНИЕ СОВРЕМЕННЫХ ИННОВАЦИОННЫХ ТЕХНОЛОГИЙ И ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В МУЗЫКАЛЬНОМ ОБРАЗОВАНИИ (НА БАЗЕ МЕТОДИК STEAM, GML, AIM)

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**Key words:** music education, artificial intelligence (AI), STEAM approach, GML methodology, virtual orchestra, digital music integration, sound engineering.

**Summary.** This article analyzes the importance of digital technologies, artificial intelligence, and innovative pedagogical methods in modern music education. The role of advanced methodologies such as the STEAM model, GML, AIM, and VME in improving the efficiency of music education is scientifically justified. The issues of developing students' artistic and creative thinking by integrating digital programs (DAW) and virtual reality (VR/AR) tools into the lesson process are highlighted.

**Tayanch so'zlar:** musiqa ta'limi, sun'iy intellekt (AI), STEAM yondashuvi, GML metodikasi, virtual orkestr, raqamli musiqa integratsiyasi, ovoz rejissyorligi.

**Rezyume.** Ushbu maqolada zamonaviy musiqa ta'limida raqamli texnologiyalar, sun'iy intellekt va innovatsion pedagogik usullarning ahamiyati tahlil qilinadi. Xususan, STEAM modeli, GML (Gamified Music Learning), AIM (AI-assisted Music) va VME (Virtual Music Ensemble) kabi ilg'or metodikalarning musiqiy ta'lim samaradorligini oshirishdagi o'rni ilmiy asoslanadi. Musiqa o'qitishda raqamli dasturlar (DAW) va virtual reallik (VR/AR) vositalarini dars jarayoniga integratsiya qilish orqali talabalarning badiiy-ijodiy tafakkurini rivojlantirish masalalari yoritilgan.

**Ключевые слова:** музыкальное образование, искусственный интеллект (ИИ), подход STEAM, методика GML, виртуальный оркестр, интеграция цифровой музыки, звукорежиссура.

**Резюме.** В данной статье анализируется значение цифровых технологий, искусственного интеллекта и инновационных педагогических методов в современном музыкальном образовании. Научно обоснована роль таких передовых методик, как модель STEAM, GML, AIM и VME в повышении эффективности музыкального образования.

**INTRODUCTION**. Today, the education system is closely intertwined with rapidly developing digital technologies and innovative approaches [1. p 6]. The field of music education is no exception in the 21st century, music education is undergoing fundamental changes on a global scale. The integration of traditional teaching methods with modern technologies, multimedia resources, artificial intelligence, and virtual learning systems makes the music teaching process more interactive and effective. The educational paradigm is shifting, with student-centered, competence-based, and integrative approaches gaining significant importance in the teaching process. Today, the main goal is not solely to provide theoretical knowledge, but to develop students' creative and technical skills, and to shape their musical thinking. In modern research dedicated to music teaching methodologies, the enhancement of the lesson process through digital notation programs and artificial intelligence (AI) systems is evaluated as a major trend. The primary purpose of this article is to deeply analyze the modern methodologies presented in the textbook *"Musiqa o'qitish texnologiyalari va loyihalash"* (Music Teaching Technologies and Design) by M.A. Ashurov and to demonstrate the prospects for their practical application (using the examples of sound engineering, digital simulation, and AI integration).

**METHODS.** Descriptive, analytical, comparative, and comprehensive approach methods were utilized in conducting this research.

In studying innovative methodological approaches in music education, the following key methodologies and their underlying principles were investigated:

- *SMART method:* Introducing a goal-oriented and result-driven approach in music education.
- *HMP (Hybrid Music Pedagogy):* Increasing efficiency by harmonizing traditional and digital teaching methods.
- *GML (Gamified Music Learning):* Boosting student motivation by enriching the music learning process with game elements.
- *AIM (AI-assisted Music):* Automating music creation and musical analysis processes using artificial intelligence.
- *VME (Virtual Music Ensemble):* Developing ensemble competence through the capabilities of virtual orchestras and choirs.
- *DMI (Digital Music Integration):* Integrating music education and organizing interactive lessons via digital technologies [4. 4].

## RESULTS AND DISCUSSION

*Integration of the STEAM Model and Music Education.* The STEAM (Science, Technology, Engineering, Arts, Mathematics) model is widely used as one of the most innovative approaches in the modern educational process [5. p 9]. This approach aims to develop creative and critical thinking skills by integrating traditional subjects, wherein the *Arts* element holds particular significance. While the physics of musical sounds and the laws of acoustics relate to physics, elements such as rhythm, metrics, intervals, and scale structures in music rely entirely on mathematical foundations. In the realm of engineering and technology, DAW (Digital Audio Workstation) platforms (e.g., FL Studio, Ableton Live, Logic Pro) have become powerful tools for music creators and educators. Through these applications, students can develop professional-level musical projects, enhancing their creative and technical skills by working with synthesizers and electroacoustic instruments [5. p 10].

GML (Gamified Music Learning) Methodology and Educational Motivation. The GML methodology serves as the scientific foundation for combining music learning with game elements [6. p 29]. This methodology is closely linked with pedagogy, neuropsychology, and digital technologies, and is primarily aimed at maintaining students' focus. Game elements trigger natural stimulating factors (dopamine) in the human brain, keeping learners in an active and motivated state. For instance, in musical applications like *Yousician* or *Simply Piano*, features such as progress bars, point accumulation, and level-ups provide continuous encouragement to students. Through real-time feedback, learners can identify their mistakes and make immediate corrections, which drastically increases educational efficiency.

*AIM Methodology: Integration of Artificial Intelligence and Neurotechnologies.* The utilization of artificial intelligence tools in music education represents the most promising frontier of innovative education. The AIM (AI-assisted Music) methodology applies AI capabilities to the processes of music composition, arrangement, and analysis. AI tools such as ChatGPT, Soundraw, AIVA, and Amper Music are introducing a revolutionary approach to music teaching and creative workflows. Through ChatGPT, educators can explain complex music theory (chords, tonality, rhythm) and obtain stylistic advice during the composition process. *Soundraw*, on the other hand, automatically generates tracks matching the user's selected genre, tempo, and emotional mood within seconds.

This capability allows teachers to prepare abundant audio samples for ear training. While AIVA (Artificial Intelligence Virtual Artist) is geared towards creating classical and orchestral music, Google Magenta is designed to produce art projects based on machine learning algorithms. Thanks to the AIM methodology, students' musical perception and associative thinking are highly developed, and automated assessment systems for intonation, tempo, and dynamics are established.

*VME (Virtual Music Ensemble) and Virtual Reality (VR/AR)***.** Gaining experience playing in a traditional orchestra is not always accessible for students. VR orchestra technologies resolve this issue by offering learners an immersive acoustic experience. In a VR environment, students are placed among various instrumental groups, allowing them to practice under realistic conditions and build stage confidence.

Through the VME methodology, ensemble participants, despite geographical distances, can improve their synchronous performance skills via low-latency audio transmission and DAW platforms. This virtual collaboration deepens students' auditory sensitivity and refines their responsiveness to rhythm and dynamics. Meanwhile, the DMI (Digital Music Integration) model necessitates the systematic use of software like GarageBand, FL Studio, Ableton Live, MuseScore, and Sibelius during practical lessons. Furthermore, the mastery of music theory is both automated and personalized through LMS (Learning Management Systems) such as Moodle.

## CONCLUSION

In the 21st century, music education is transitioning from a traditional knowledge-delivery paradigm to an innovative, practice-oriented, and technology-driven model. Modern methodologies comprehensively covered in M.A. Ashurov's textbook—such as STEAM integration, GML (gamification), AIM (AI-assisted music creation), and VME (virtual ensembles)—elevate educational efficiency to unprecedented levels. Teaching the fundamentals of sound engineering, technical analysis, and digital acoustics through DAW platforms and AI algorithms empowers musicians to raise their competencies to international standards. Integrating these advanced digital pedagogical technologies into the curricula of art and culture institutes is a fundamental prerequisite for training the next generation of highly competitive musicians and educators.

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