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Article

The Art of Opera Design in the Context of the Digital Turn: Culture, Technology, Ethics

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Abstract

The aim of the proposed article is to analyze the impact of digital technologies on the development of opera production design through the prism of culture, technology, and ethics, with particular attention to the Ukrainian context. To achieve this task, a scientific approach with elements of case study has been chosen. Semi-structured interviews with experts (10 individuals) were also conducted. Specific cases include the production of "Turandot" (Lviv, Ukraine), the VR-opera "Atlas" (New York, USA), and "Faust" (Geneva, Switzerland). The results of the study indicate that digital technologies have become a powerful factor that has significantly influenced the content, forms, and ethics of opera productions. The study of the Lviv Opera's "Turandot" showed that digital technologies can be a means of preserving and transforming cultural identity. Thanks to visual references to Ukrainian art, it was possible to create a local artistic context. In contrast, the cases of the productions "Atlas" and "Faust" pointed to a clear trend towards the globalization of stage space art. Technological innovations in productions largely depended on the financial and infrastructural capabilities of the theatres. At the same time, there are several ethical dilemmas. For example, there is the issue of opaque authorship of AI-generated content, and the challenge of technological inequality among viewers. Also, viewers and experts noted the issue of content control in the context of individualized perception. In conclusion, it is emphasized that digital innovations should be implemented as a means of enrichment, not as a replacement for the opera tradition.

Keywords: *cultural identity, ethical challenges, digital technologies, opera art, scenography.*

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Introduction

In the modern world of performing arts, technological shifts are taking place under the influence of digitalization, which is commonly called the "digital revolution". This process encompasses the technical aspects of creating performances and the transformation of aesthetic strategies, models of audience perception, and ethical approaches to art. Opera occupies a special place in this context, a multidisciplinary form that combines music, visual arts, dramaturgy, and choreography. Opera, which has always been strongly associated with technology, from baroque scenography to modern lighting technology, is today experiencing another wave of rethinking under the influence of digital innovations.

Augmented and virtual reality, projection 3D mapping, artificial intelligence, generative graphics, interactive interfaces - all these technologies are increasingly used to design opera productions in the world's leading theaters: from La Scala to the Bavarian State Opera (Roca et al., 2021). Digital tools are changing the visual language of opera and the structure of the interaction between the stage space, the performer, and the audience. In Ukraine, these processes are also developing dynamically. The Taras Shevchenko National Opera of Ukraine, the Lviv National Opera, the Kharkiv, and Odessa Opera Houses integrate different digital tools into the design of their performances (Shumilina & Varakuta, 2020).

Despite the active development of the digital design of opera, there is a clear gap in the academic discourse in interdisciplinary analysis that considers the cultural, technological, and ethical dimensions of these changes. It is especially true in the Ukrainian context, where the digitalization of performing arts, particularly opera, remains fragmentarily researched. Insufficient attention has been paid to the issues of artistic authenticity in the digital environment, copyright in the case of generative visuals, and the accessibility of opera products to a broad audience in digital format. At the same time, the question arises whether the essence of opera itself changes in the context of the virtualization of its components.

This topic is becoming particularly relevant in Ukraine, where culture is a tool of aesthetic expression and a form of preserving national identity in conditions of socio-political upheaval. Against war and social transformation, opera is again gaining symbolic importance as a carrier of collective memory and cultural heritage. Digital technologies, on the one hand, create new opportunities for creative innovation, attracting the younger generation, preserving, and archiving productions. On the other hand, they provoke complex questions about rethinking traditions, the boundaries of human and technological, and the ethical responsibility of the artist to the audience and to culture.

This study aims to analyze the impact of digital technologies on the design of opera productions through the prism of culture, technology, and ethics, with special attention to the Ukrainian context. The following questions are:

1. How do digital technologies influence cultural identity and aesthetic expression in the design of modern opera productions?
2. What key technological tools are used in the digital design of opera?
3. What ethical dilemmas arise when integrating digital tools into opera art?
4. To what extent do Ukrainian productions correspond to global trends in the digital stage, and in what ways do they retain a unique cultural specificity?

Therefore, the work aims to fill the gap in the critical discourse on the digitalization of opera design, to combine elements of cultural research with the study of modern digital practices.

Literature Review

The modern development of art is impossible without understanding the role of digitalization. Visual arts, particularly museums, art galleries, and the music industry, have long understood the advantages of using modern technologies. Working with such resources brought significant advantages, especially during the global COVID-19 pandemic, when many events and attractions were held remotely and required only a computer, camera, and software (Fissi et al., 2021). These changes particularly affected the field of arts education, which quickly adapted to the modern requirements of organizing the educational process (De Angelis, 2024). Some aspects of digitalization actively influenced the conduct of distance learning, enabling the replacement of the traditional educational process. Even after the lifting of quarantine restrictions, certain elements did not disappear but evolved into blended learning, which became a significant guarantee for the training of future art historians (Bobro et al., 2025). At the same time, the active use of artificial intelligence (AI) systems has expanded the potential of various art and art education fields. The rapid and thorough interaction with AI is driven by the evolution of software and integration with many educational platforms. For art education, this has become a powerful means of further utilizing the opportunities of digitalization for conducting blended learning (Muliarevych et al., 2023). However, while the impact of the active use of modern technologies for conducting education is quite well-researched in scientific literature, other manifestations of digitalization, particularly the direct impact on art and its development, are rather under-discussed. Such a gap opens prospects for further research.

The last few decades have also become a time for defining the rapid "digital turn," which changes socio-economic processes and specific existing cultural practices (Kaldygozova, 2024). In the field of performing arts, this influence is extremely palpable. Opera is considered a complex multidisciplinary form combining music, theater, certain types of visual arts, and literature (Kadanceva et al., 2023). In practice, this is manifested in a particular sensitivity to innovative changes, which are actively promoted by digital culture today.

In the studies of the digital impact of technologies on the development of theatrical art, the emergence of post-dramatic theater has been distinctly outlined, which has undergone the influence of digital interventions that have a radical impact on changes in the aesthetics of stage images (Tvrdišić, 2022). In particular works, there is an emphasis on the clear interaction between the actor and media (Ammirato et al., 2025). Researchers identify the use of video projections, augmented reality capabilities, 3D modeling tools, and other visual-digital practices (Schürmer, 2022). To determine the characteristics of the context of opera art, such actions have been studied in the scientific works of Vincent et al. (2017), who analyzed technological experiments and creative pursuits in contemporary productions. A key study is the monograph by Vincent (2021), which describes some examples of the synthesis of traditional vocal and stage practices with digital visual technologies.

From the perspective of cultural studies, the digitalization of opera is a particular response to transformations in the receptive behavior models of audiences. Some researchers have emphasized the importance of transitioning from the theater of presence to the theater of transmission (Avanzini et al., 2020; Webb, 2021). In the new reality, popular digital platforms (YouTube, Opera Vision, or other streaming services) have formed a new audience, opening opportunities for further global observation of the development of opera art (Cashman & Garrido, 2019). Under such circumstances, studies analyzing the cultural policy of institutions in the context of active digital transformations (Hviid et al., 2018) are also important.

The researchers paid special attention to the ethical dimensions of digital interventions in opera (Tuominen, 2025). Their research raised the issue of authenticity, adherence to intellectual property rights, the existence of the performer's digital corporeality, the application of AI, and the impact of search algorithms on the creative process. As a result of the increasing use of AI and deepfake technologies in the field of stage design, the discussion regarding the boundaries of authorship, the deepening responsibility in digital culture for preserving copyright, and even the brink of criminal offenses has intensified (Hasanova, 2024).

Expanding the use of digital tools in opera is not without "gaps" that will still require further research. For example, there is an absolute lack of study in the local context of using the achievements of digitalization in opera. Most researchers have focused on examples from developed countries of Western Europe and America (Kichurchak, 2020). On the other hand, regional practices (including those in Ukraine and other Central and Eastern European countries) have been almost entirely unexamined (Szostak, 2022). Such a gap has created a somewhat distorted impression of the global digital turn in contemporary opera. Moreover, this issue is compounded by the fact that most publications are theoretical and do not include analyses of specific opera productions, directorial decisions, or visual strategies. The lack of case studies (especially from Central and Eastern European countries) creates a significant gap in visual design analysis, multimedia presentations, or scenography of digital environments. Overall, the available scientific literature focuses on studying individual aspects of digitalization, using specific tools or ethical considerations. At the same time, there is an apparent lack of studies that comprehensively examine the cultural, technical, and ethical dimensions of the digital appearance of opera.

So, although contemporary scientific literature has demonstrated the impact of the digital turn on opera through the prism of the intersection of aesthetics, technology, cultural studies, and ethics, there is a need for a deeper analysis of the local context (for example, the Ukrainian context). It would allow further reflection on how global digital trends influence performing arts.

Methodology

Study design

The proposed study used a qualitative approach with the addition of case study elements. It allowed for a detailed exploration of the complex interaction between culture, digital technologies, and ethics in modern opera staging. Such an approach aims to further the multidimensional phenomena in the context of individual productions that have blended traditional stage practices with contemporary digital artistic interventions. Case studies indicated an immersion in the context of each opera production. It would open opportunities for further exploration of the artistic decisions made, assessing their impact on audiences and the professional community of artists. Qualitative methods, including interviews and content analysis, ensured the consideration of the subjective perspectives of creative workers, technical staff, and appreciative audiences.

Cases

Several opera productions were selected in the research, and various approaches to digital technologies were applied. Primarily, the following examples were analyzed:

1. Lviv National Opera (Ukraine), opera "Turandot" (2021). Lviv National Opera (Ukraine), opera "Turandot" (2021). The chosen example is a Ukrainian experience of using visual mapping combined with elements of augmented reality, which created the conditions for rethinking the staging of a classical opera.
2. Metropolitan Opera (USA), "Atlas" by Meredith Monk in VR format (2023). The proposed case has become a model for using virtual reality to create interactive audience experiences.
3. Geneva Opera (Switzerland), opera "Faust" (2022). Geneva Opera (Switzerland), opera "Faust" (2022). The mentioned production took place using AI-generated visuals that occurred in a non-stop mode and algorithmic scenography.

The proposed cases were selected due to their high relevance for further research on the digital turn in opera. They are relevant for identifying points of contact between traditional opera culture and the use of cutting-edge technologies. Another factor was identifying the potential for further analysis of ethical aspects, primarily authenticity, authorship, and accessibility.

Sources

The main sources for the research were primary data, specifically video recordings of the proposed opera productions, official broadcasts available in the public domain, or archival recordings. Semi-structured interviews were also conducted with directors, digital artists, software developers, set designers, and designers. Viewer feedback, comments, posts, and reviews on social platforms (specifically, X/Twitter, YouTube, Opera Wire) were evaluated.

Secondary data was also used to obtain the results. Important sources included scientific publications about opera art, stage design, and digital humanities. Individual critical reviews and theater studies notes were considered (including those in the form of reviews on social media).

Data collection methods

To collect empirical data, semi-structured interviews were conducted (10 people were surveyed: coded as Expert 1 – Expert 10) with those who had experience working with or viewing operas using digital technologies. Primarily, the interviewees

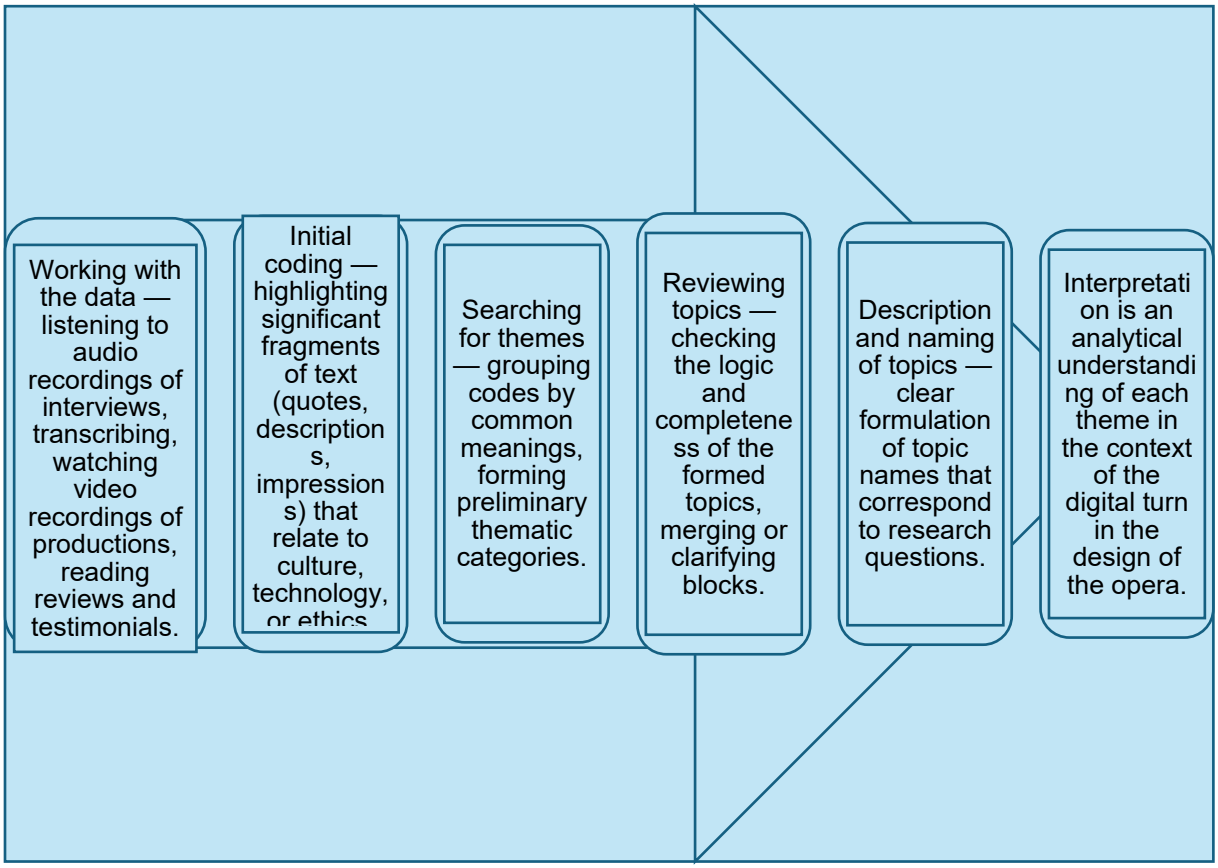
included directors and screenwriters, digital designers who worked with VR, AR, and AI systems, and viewers who attended or watched operas online. Content analysis of video recordings was used to identify various digital elements (including visual effects, VR/AR tools, and interactive projections) and specific aesthetic solutions integrated into the technological design.

The analysis of audience reactions is based on collecting and systematizing viewer reviews and individual comments on social platforms (X/Twitter, Facebook, Opera Wire). It made it possible to identify key assessments regarding the perception of innovations, cultural changes, and ethical dilemmas in the contemporary cultural space.

Data analysis

For further processing of the collected qualitative material (interviews, video content analysis, audience feedback), thematic analysis was used, a universal method for identifying, organizing, and interpreting key issues in textual materials. The analysis was conducted according to the established structure (see Figure 1).

Figure 1. Stages of analysis



Meanwhile, the study on the effectiveness of the BSED major in sciences aligns with the CHED's focus on educational quality and excellence, which is measured through objective indicators such as the graduation rate and the board examination passing rate. However, the data collected via the questionnaire to identify correlations and predictors were based solely on the students' subjective perceptions and self-reported experiences while taking the BSED major in sciences. It means that the constructions measured, such as students' views on the leadership practices of the school heads, performance of the science teachers, and the responsiveness of the curriculum, reflect how students personally experienced and perceived these elements, rather than being derived from direct or objective assessments of these factors. Consequently, the findings related to predictors of effectiveness are grounded in students' observable experiences and opinions, providing insight into their perspective rather than an external or empirical evaluation of the program's components.

Data from the survey questionnaire were analyzed using Spearman's and the Likelihood Ratio Test (LRT). Spearman was used to assess whether there are significant relationships between the level of accreditation, the leadership practices of school heads, the performance of science teachers, the responsiveness of the curriculum, the scientific abilities of students, and the effectiveness of the BSED Major in Sciences program in SUCs in Region III, specifically regarding graduation rate and board examination passing rate. LRT was used to determine which among the mentioned variables predict the effectiveness of the BSED major in Sciences in Region III, as measured by the graduation rate and the board examination passing rate. Also, throughout the process, the study prioritized ethical considerations. Upholding principles such as informed consent, confidentiality, and anonymity was crucial, particularly during data collection.

Results

Within the research framework, special attention was devoted to several key areas. Responses were organized thematically into three key areas: cultural, technological, and ethical. The use of case studies based on the noted three opera productions ("Turandot" at the Lviv National Opera (2021), VR-opera *"Atlas"* at the Metropolitan Opera (USA, 2023), and *"Faust"* at the Geneva Opera (2022)) provided the opportunity to compare different approaches to the contemporary digital understanding of opera art. Additionally, it became possible to identify certain standard features and existing differences in local and international contexts (See Table 1).

Table 1: Analysis of the cultural, technological, and ethical dimensions

Dimension	Key observations	Opinion of the respondents
Cultural	Digital projections were used to produce "Turandot," which occurred at the Lviv Opera. They had a distinct cultural role, incorporating elements of Eastern European applied arts, including Neo-Byzantine mosaics and Western Ukrainian Hutsul motifs—such decoration aimed to create a distinct aesthetic dialogue, bridging Western classicism and the Ukrainian visual tradition. At the same time, the VR opera "Atlas," staged in New York, did not have such an orientation; the directors deliberately rejected cultural specificity. The audience had the opportunity to independently navigate virtual spaces, experiencing the opera as a distinct individual aesthetic experience. Such an approach, while allowing for the discovery of new cultural horizons, has vividly demonstrated the reduction of cultural locality and the strengthening of the globalization process in art, particularly through the decontextualization of visual language. The Swiss directors of the opera "Faust" deliberately and actively used AI-generated images to appeal to post-humanist aesthetics. It would allow for pushing the existing classical boundaries of morality, creating a sense of detachment among the audience.	About "Turandot": Expert 1 on the production: "It was important not only to use the projection as a backdrop." We aimed for the audience to see the echo of their own culture in the European classical story. Audience feedback from Facebook: "The set design is incredible." The projections came to life in sync with the orchestra. Furthermore, what was most pleasant was that the visuals had a Ukrainian character. About "Atlas" Expert 4: "The opera 'Atlas' in VR format is a radical shift in the art of opera." The audience has become not a witness but a navigator, choosing their own optical and emotional trajectory. However, this is where the dilemma arises: does artistic unity remain if everyone has their own "direction"? Audience review from X network: "The new Atlas VR Opera is a dream." I chose where to look at myself and felt like a part of the world. However, there was a lack of the actors' live energy. Is this still opera? About "Faust" Audience review from the social platform X: "This Faust

		lacks humanity – and that is exactly what makes you think."
Technological	In Lviv, the technologies were based on local capabilities: 3D mapping was applied to the decorations and stage floor, which transformed in real-time due to interaction with the musical accompaniment. Such a solution added visual dynamics without excessive financial costs. The VR opera interpretation at the Metropolitan Opera aimed for active audience participation. Each person received VR glasses, allowing them to independently shift the perspective, focusing either on the main character, the choral line, or the abstract visualization of the music. Such a model demonstrated a shift from personal directorial authorship to allowing viewers to work autonomously. In Geneva, during the opera, a powerful AI system was used that could generate visuals in real-time, corresponding to the emotional tone of the vocalists. Thanks to the clear visualization, the effects were projected onto a semi-transparent screen in front of the stage, creating the illusion of a living visual organism.	About "Turandot": Expert 5: "The budget for an expensive LED screen was lacking, but 3D mapping allowed us to create dynamics." About "Atlas": Expert 7: "The VR opera production at the Metropolitan Opera is a technological breakthrough that transforms the architecture of the audience experience." Technology no longer supports the stage. Furthermore, it is reshaped anew in the imagination of each user. Viewers from platform X: "For the first time in my life, opera is about choosing what I see." You find yourself inside the music or on the stage. Brightly, but you get a bit lost... About "Faust": Expert 9: "The work with visual effects was so digitized that no one knew what they would see the next minute."
Ethical	All three proposed cases raised relevant ethical questions. First and foremost, authenticity was noted. All productions had concerns that the effects of technology overshadowed human performance. Some AI visuals were criticized as "cold" and "artificial." Not everyone liked the 3-D mapping in "Turandot." Another challenge is the issue of accessibility. For example, a VR headset is required to register	Opinion of the OperaWire contributor: "Inhuman visuals, when instead of the soul in opera, a strict algorithm." Comment on Facebook: "My father listened to opera for 40 years but could not 'see' it because he did not have VR."

	in advance for the VR opera at the Metropolitan Opera. It significantly reduced the number of viewers, not to mention the cost of the equipment. The next question is the issue of intellectual property. The opera in Geneva was based on the use of MidjourneyLab algorithms. It enabled the generation of stage design, but it has not been established who specifically owns such visuals: the theater, the developers of the AI system, or the AI itself.	Expert 3: "It was felt that the production of 'Turandot' lacked resources, and the directors were unable to utilize its potential fully." Expert 8: "As of today, there are no clear legal answers regarding who owns generative AI content."

So, comparing all the cases, it is worth noting that each of the three proposed opera productions demonstrated a unique balance between adhering to cultural, technological, and ethical elements. For example, in *"Turandot,"* visual technologies were integrated with the local Ukrainian context, without losing traditional meanings. The production received positive audience reviews and became a particular example of a harmonious combination of innovation and repertoire classics in the Ukrainian context.

"Atlas" in VR format symbolizes a new type of personalized operatic stage experience. Such a production sparked heated discussions regarding accessibility and directorial control over the content. At the same time, modern technological solutions were also proposed, which indicated the following markers of the development of opera art. Instead, *"Faust"* in Geneva turned into an aesthetically significant experiment. In its design, AI technologies became a full-fledged artistic act that adorned opera production. However, the generative AI content raised specific ethical considerations regarding authorship and alienation.

In this context, it is also worth mentioning the influence of the Ukrainian school of scenography, which retains a deep attention to figurative thinking, color, and symbolism, combining academic tradition with modern challenges. Based on a delicate balance between content and form, its approaches can be compared with the work of outstanding foreign scenographers such as Josef Svoboda, Robert Wilson, Tadeusz Kantor, Jacques Cooper, Jan Versweifelt, and others. They all sought new ways of stage language, introduced technology as a means of dramatic expression, and transformed space per the idea of the work. Thus, Ukrainian interpretations confidently enter the global dialogue of modern opera design, preserving their identity and opening new horizons for innovation.

Discussions

The development of modern opera is linked not only to the evolution of this art form but also to the general trends in the development of the arts. The proposed study aimed to analyze the impact of digital technologies on the development of opera production design through the lens of culture, technology, and ethics, with particular attention to the Ukrainian context. It was proposed to focus on issues related to the impact of digital technologies on cultural identity and aesthetic expression in the design of contemporary opera productions, key technological tools used in digital opera design, ethical dilemmas arising from the integration of digital tools into opera art, and the peculiarities of Ukrainian productions against the backdrop of global trends.

The proposed results demonstrated that digital technologies in opera productions are not a neutral tool but actively influence contemporary opera's cultural content, artistic form, and ethical aspects. For example, the case of the opera "Turandot" at the Lviv National Opera demonstrated that digital projections have transformed into a means of preserving and transmitting the features of Ukrainian cultural identity. As a result of using such visual allusions, it was possible to advance Ukrainian art significantly, adapting not only the European artistic canon to the needs of the Ukrainian audience but also to create a tangible cultural dialogue between traditions and contemporary reality. On the other hand, the directors of the VR opera "Atlas" at the Metropolitan Opera consciously avoided local or national specifics. Accordingly, technologies are still dependent on the organizers of operatic performance, and although they can enhance the impression of artistic execution, they are specific to cultural contexts. Such results generally confirm the conclusions of other scholars who believed that the concept of opera is entirely in the hands of the directors, and modern technological solutions are unable to change cultural codes (da Rocha Gonçalves, 2020; Lindell, 2024). At the same time, some scholars believe that modern technologies manifest globalization, which also erodes national cultures (Twarowski et al., 2024). It is not easy to agree with such a remark. As Ford and Mandviwalla (2020) proved, AV, VR, and other modern technologies are merely tools, and if they are directed towards emphasizing national cultural codes, they will continue to serve them. Expert reviews and feedback from ordinary viewers on social media demonstrated enthusiasm for the idea of "Turandot" bringing the realities of China (the action took place in this country) closer to Ukrainian ones. Such steps contribute to developing the Ukrainian context in the art of opera.

The analysis of technological solutions used in contemporary opera art has shown that much depends on the financial and technological capabilities of the opera

directors. Only 3-D mapping with musical accompaniment was implemented at the Lviv Opera. The VR opera interpretation at the Metropolitan Opera relied on VR technologies, while in Geneva, a powerful AI system was used that could generate visuals in real time. Feedback from experts and audiences indicates mixed feelings about such innovations. The remarks about the creation of a detached, post-humanist aesthetic space confirm the future challenges that will arise for opera directors using digital tools. The results correlate with other scholars' views who have analyzed contemporary digital performances (Hayes, 2018; Lavery & Zandieh, 2024). In particular, the "digital stage" concept, developed by Vincent (2021), envisaged a radical shift in theater from stable structures to visual-technical flexibility. Under such circumstances, the productions of the operas "Atlas" and "Faust" are examples of the implementation of such a shift. At the same time, the case of "Turandot" represented an attempt at *"balanced digitalization,"* where innovation does not displace cultural heritage. According to other scholars, such an approach also has a right to exist (Chaika et al., 2024; De Marchi, 2023). Especially considering the limited capabilities of contemporary Ukrainian productions. Overall, as rightly noted by Pletsan (2021) and Tukova (2023), the uniqueness of the Ukrainian context is manifested in the desire to combine digital technologies with the visual codes of Ukrainian culture. It indicates the uniqueness of the Ukrainian practice against the backdrop of contemporary global trends, where universalism or some aspects of technological abstraction prevail (Berehova & Volkov, 2020).

The proposed results indicate that the application of technologies is associated with certain ethical risks that will require a response. From the experts' comments, it has been determined that no one knows who should own the AI-generated visual. The ethical status of the applied content is particularly emphasized in the case of using generative AI in the opera "Faust." It raises questions about authorship and control over content and its impact on audience perception. Thematic analysis also demonstrated that technological limitations on the part of viewers could become additional obstacles to further development of opera digitization. Moreover, in VR opera, control over the visual and narrative focus is transferred to the viewer, transforming traditional opera consumption into an individualized experience. Other researchers have noted similar ethical challenges (Bellini, 2021; Nyman, 2022). At the same time, scientific literature notes that digitalization is an integral part of contemporary art development, and therefore, it is necessary to continue considering its impact (Rixon, 2024). The digitalization of opera has opened new horizons, ranging from virtual audience engagement worldwide to flexible scenography forms and the application of cutting-edge visual design (Weintritt & Barta, 2022; Zhang & Negus,

2021). Legal issues will gradually be resolved alongside the subsequent examination of the legal aspects of AI application in all spheres of public life (Kavathatzopoulos, 2023; Köpsell & Oertel, 2024). Discussions on the humanistic perspective of the digitalization of art indicate that the coexistence of the digital and the human in art will soon become a subject of debate. The researchers' views align with the philosophical perspectives of transhumanism – with a belief in the possibility of combining human nature and the widespread implementation of technologies (Peters et al., 2020).

The proposed methodology has certain limitations that may affect the further interpretation of the results. In particular, the small number of experts surveyed will require scaling in the future, which will help avoid a somewhat limited basis for the conducted textual analysis. Similarly, the case sample will require further expansion. Considering that the use of digital tools will only continue to increase, the growth of samples will also rise.

Conclusion

The modern development of opera art combines digital technologies, significantly transforming contemporary art. In particular, the influence of digital technologies on the design of opera productions has been traced through the prism of culture, technology, and ethics, with special attention to the Ukrainian context, using the example of the Lviv production of "Turandot," the VR-opera "Atlas" in New York, and the opera "Faust" in Geneva.

The research results confirmed that digital technologies have become a decisive factor that has significantly influenced opera productions' content, forms, and ethics. Their application changed the visual language of the performances and allowed for a rethinking of audience experiences, opening new possibilities for artistic expression.

The analysis of the Lviv opera "Turandot" demonstrated that digital technologies can preserve and transform cultural identity. Thanks to visual references to Ukrainian art, creating a local artistic context that does not dissolve in the globalized scene was possible. Instead, the cases of the productions "Atlas" and "Faust" pointed to a clear trend towards the globalization of stage space art. The VR interpretation gave viewers autonomy in perceiving the opera, but the shared artistic code was lost in return.

The use of generative AI in "Faust" created a powerful aesthetic effect, but the notion of the "depersonalization" of art spread among the audience.

Based on the analysis, it has been determined that technological innovations in production largely depend on theaters' financial and infrastructural capabilities. At the

same time, there are a few ethical dilemmas. For example, there is the opaque authorship of AI-generated content, and the challenge of technological inequality among viewers. Viewers and experts also noted the issue of content control in the context of individualized perception.

Digital innovations should be implemented as enrichment, not to replace the operatic tradition. Maintaining a balance between technical capabilities and accessibility for a broad audience is recommended. For example, using 3D mapping, as in Lviv's "Turandot," can be an effective alternative solution in case of a limited budget. At the same time, it is important to avoid excessive complexity or isolation, as demonstrated by the VR opera "Atlas," considering the technical equipment requirements. Theatres should implement hybrid formats that allow the inclusion of audiences with varying levels of technical access.

Based on the results obtained, specific recommendations can be made. In the political sphere, there is a need to establish stable mechanisms for funding digital art in Ukraine, including opera, a possible option, and institutional grants to develop local technological solutions. For theatrical institutions, it is important to continue implementing digital innovations, but it is recommended to maintain a balance between technical capabilities and accessibility for a broad audience.

A promising direction for further research is the analysis of the demographic profile of the audience for digital opera productions. Such an approach will enable a better understanding of the innovative demands of the audience. It is also important to increase the quantitative analysis of audience engagement and the number of empirical calculations regarding the impact of various digital formats on viewers' emotional and cognitive engagement.

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