YEGAH MUSICOLOGY JOURNAL
HTTP://DERGIPARK.ORG.TR/PUB/YEGAH
e-ISSN: 2792-0178

Makalenin Türü / Article Type : Sistematik Derlemeler ve Meta Analiz / Systematic Reviews and Meta Analysis
Geliş Tarihi / Date Received : 06.11.2024
Kabul Tarihi / Date Accepted : 03.12.2024
Yayın Tarihi / Date Published : 31.12.2024
DOI : https://doi.org/10.51576/ymd.1580213
e-ISSN : 2792-0178
İntihal/Plagiarism: Bu makale, en az iki hakem tarafından incelenmiş ve intihal içermediği teyit edilmiştir. / This article has been reviewed by at least two referees and confirmed to include no plagiarism.

RESEARCH STATUS, HOTSPOTS AND EVOLUTION IN THE FIELD OF ONLINE MUSIC EDUCATION: A BIBLIOMETRIC REVIEW

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ABSTRACT

As digital technology continues to advance, a global trend toward individualized learning paradigms and standardized educational frameworks has become evident. In this evolving landscape, the emphasis on collaborative learning and educational resource sharing has become increasingly prevalent. Online music education, within this context, emerges as a distinctive focal point. However, current research suggests that the development of online music education is still in its early stages, with a significant void in quantitative empirical analysis focusing on bibliometric indicators such as influential authors, trending topics, and evolutionary trends. To address this research gap, our study systematically identifies representative literature in the field by utilizing data from the Web of Science (WOS) database. Utilizing the data visualization tool VOSviewer, this research conducted an in-depth analysis of various metrics, including leading authors,

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geographical contributions, key journals, co-occurring keywords, and co-cited references. Our exploration aims to delineate the current status, frontier hotspots, and evolutionary trends within the domain of online music education. The insights garnered from this study aim to offer a robust reference point for scholars and educators in the field.

Keywords: Online music education, e-learning, VOSviewer, bibliometrics, visual analysis.

ÇEVRİMİÇİ MÜZİK EĞİTİMİ ALANINDAKİ ARAŞTIRMA DURUMU, AĞIRLIK NOKTALARI VE EVRİM: BİBLİYOMETRİK BİR İNCELEME

ÖZ

Dijital teknolojinin hızla ilerlemesiyle birlikte, bireyselleştirilmiş öğrenme yaklaşımlarına ve standart eğitim kriterlerine yönelik küresel bir eğilim gözlemlenmektedir. Bu değişen bağlamda, işbirlikçi öğrenmeye ve eğitim kaynaklarının paylaşımına verilen önem giderek artmaktadır. Bu bağlamda çevrimiçi müzik eğitimi kendine özgü bir odak noktası olarak öne çıkmaktadır. Ancak mevcut araştırmalar, çevrimiçi müzik eğitiminin gelişiminin hâlâ erken aşamalarda olduğunu ve etkili yazarlar, trend konular ve evrimsel eğilimler gibi bibliyometrik göstergelere odaklanan nicel ampirik analizlerde önemli bir boşluk bulunduğunu göstermektedir. Bu araştırma boşluğunu ele alan çalışmamız, Web of Science (WOS) veritabanından elde edilen verileri kullanarak alandaki temsil niteliğindeki literatürü sistematik olarak tanımlamaktadır. Veri görselleştirme aracı VOSviewer'ı kullanarak, bu araştırma önde gelen yazarlar, coğrafi katkılar, kilit dergiler, birlikte geçen anahtar kelimeler ve birlikte atıf yapılan referanslar gibi çeşitli ölçütlerin derinlemesine bir analizini gerçekleştirmiştir. Bu inceleme, çevrimiçi müzik eğitimi alanındaki mevcut durumu, öncü sıcak noktaları ve evrimsel eğilimleri tanımlamayı amaçlamaktadır. Çalışmadan elde edilen bulgular, alandaki akademisyenler ve eğitimcilere sağlam bir referans noktası sunmayı hedeflemektedir.

Anahtar kelimeler: Çevrimiçi müzik eğitimi, e-öğrenme, VOSviewer, bibliyometrik, görsel analiz.

INTRODUCTION

The essence of online music education is the integration of the Internet and teaching. As early as 1996, in Distance Education: A Systems View by Michael G. Moore and Greg Kearsley, it was mentioned that online education is realized through specialized curriculum design and by utilizing various technological tools and electronic devices (Kara, 2020). Online music education utilizes the Internet and digital technologies to enhance music instruction and training (Ismail et al., 2022; Piccoli et al., 2001; Trentin, 1997; Wang et al., 2020). While the nascent stages of research in this sector were seen in the early 21st century, it has burgeoned into a vibrant research field, characterized by a rich tapestry of interdisciplinary convergences (Katz, 2000, 2002; Tambouratzis et al, 2002; Teo, 2016; Wang et al, 2020), including but not limited to computer science, mathematics, and musicology (Dreamson and Park, 2023; Johnson, 2017; Rucsanda et al., 2021).

Utilising bibliometric analysis for scrutinizing literature pertinent to the field of music education offers a robust framework for inquiry. Originating in the early 20th century and maturing into a standalone discipline by 1960, bibliometrics encompasses the triad of foundational laws: Bradford's law, Zipf's law, and Lotka's law, to facilitate the statistical appraisal of the current status, frontier hotspots, and evolutionary trends in relevant disciplines or fields' (Hwang and Tu, 2021). By employing bibliometric indicators such as publication counts, citation metrics, and geographical distribution, researchers can effectively evaluate the performance and quality of research. This approach offers a methodical and empirical foundation for ensuring the rigor and relevance of studies (Diem and Wolter, 2013; Hicks et al, 2004).

The execution of a bibliometric analysis calls for the utilization of specialized software. VOSviewer, a complementary visualization tool developed by Neese Jan van Eck and Ludo Waltman in 2010 at Leiden University in the Netherlands, stands as a preeminent choice for constructing and examining bibliometric maps (Van Eck and Waltman, 2010). Esteemed as a cornerstone in bibliometric research, VOSviewer boasts superior precision in its clustering algorithms, facilitating the seamless generation of visual representations directly from input data (Song et al, 2020). In this research, these visualization maps will be further enhanced using graphic software tools such as Adobe Photoshop, Scimago Graphical, and RAW Graphs.

In summary, this study focuses on the core field of online music education. From the perspective of bibliometrics, this research systematically sorted out representative literature in this field. Using the VOS viewer visualization software, this research analyzed key authors, geographic distribution,

representative journals, co-occurring keywords, and co-cited references, presenting the current status, frontier hotspots, and evolutionary trends in this field.

Recently, the integration of technology and pedagogy has driven significant advancements in online music education. Pioneering strides, such as Metaverse education (Zhang et al., 2022), Augmented and Virtual Reality (AR/VR) (Xu and Zhao, 2021), and AI Electronic Learning (AIEL) (Jia et al, 2022), underscore the significant evolution of e-learning technologies. As novel technologies continuously emerge, online education progressively merges with and evolves alongside various disciplines (Kara, 2020; Martins and Kellermanns, 2004; Zhou, 2023). Artistic e-learning, with music as its vanguard, has become a focal point in the current e-education landscape. In contemporary online music classrooms, terms like MIDI interaction (Gelineau-Morel and Dilts, 2021), adaptive learning (Tambouratzis et al, 2008) and gamification (Oliveira et al., 2023) are prevalent, highlighting the symbiotic growth of music education in the digital realm and technological innovation.

The field of online music education requires more diverse research perspectives (Marín Suelves et al., 2021). Given the cross-cultural and collaborative characteristics of online music education, it Plays a prominent role in online arts education (Camlin and Lisboa, 2021). Therefore, studying online music education has crucial academic and practical value for the development of the music education field. However, existing research lacks a systematic and comprehensive literature review on online music education. ‘Bibliometrics can provide scholars with objective quantitative empirical research results, including specific quantitative information on authors, journals, countries, and keywords (Diem and Wolter, 2013). It fills the research gap in the development and evolution of online music education (Abramo et al, 2011).

Problem of Study

The knowledge map of this field is constructed through bibliometric analysis. By employing bibliometric methods, this research analyzes the literature of the selected period, extracting key information such as the year, authors, journals, countries, keywords, and references of academic publications. This forms a knowledge network graph, presenting the current status, frontier hotspots, and evolutionary trends in this field, providing a reference for relevant researchers and practitioners. Conse-quently, this study seeks to address the following research questions (RQ)

RQ1: Has a stable network of author collaboration been established in the field of online music education? Does the field of online music education have a Systematic body of publications system? What is the geographical distribution of research contributions in this field?

RQ2: What are the hot topics in the online music education field?

RQ3: What kind of evolutionary trends are evident in online music education?

METHOD

Data resource collection is carried out using WOS. This research mainly focuses on data (country, citations, co-citations, authors, keywords, etc.) from WOS for analysis. WOS is considered by many researchers to be the most reliable literature database and is deemed to be the most suitable for bibliometric analysis (Ding and Yang, 2022). To ensure the comprehensiveness and accuracy of the data, the study further selected three indexes: Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI), and Arts and Humanities Citation Index (A&HCI). Taking into consideration the combination of online education and music, the search strategy was TS = ((‘Music*’) AND (‘Educat*’) AND (‘Online’ OR ‘E-learning’)), spanning from January 1, 2000, to June 1, 2023, the search was limited to documents in English, specifically Articles and Review Articles. A total of 383 literature records were obtained. The relevant data are shown in Table 1.

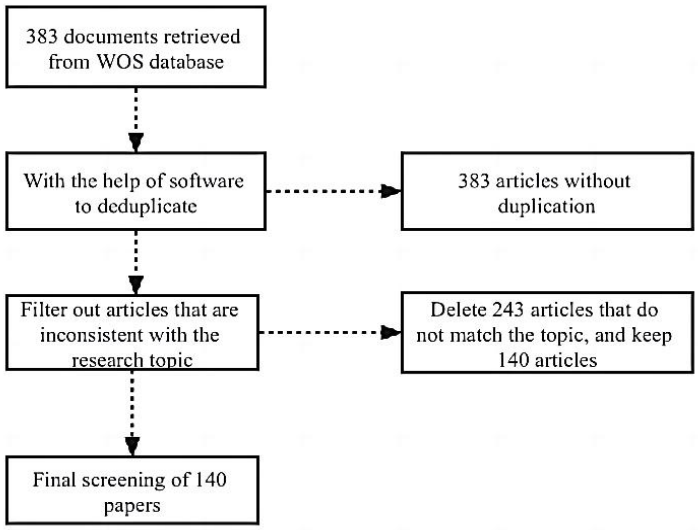
Category	Specific Standard Requirements
Research database	Web of Science core collection
Citation indexes	SCIE, SSCI, A&HCI
Searching keywords	(‘Music*’) AND (‘Educat*’) AND (‘Online’ OR ‘E-learning’)
Searching period	2000-01-01 to 2023-06-01
Language	‘English’
Document types	‘Articles’ or ‘Review Articles’
Data extraction	Full Records and Cited References in Plain Text File
Sample size	383

Table 1 .Summary of data source and selection.

To ensure the accuracy of the data, this study meticulously follows a data verification and filtering process, which is described in detail below (Scale 1):

- 383 articles were de-duplicated using software. After screening, there are articles with no repetition;

- this research members independently reviewed articles and selected articles that didn't match the research topic. These controversial articles were voted on by researchers to be eliminated. After screening, 243 articles that did not fit the topic were removed, and 140 articles were kept.



Scale 1. Screening steps

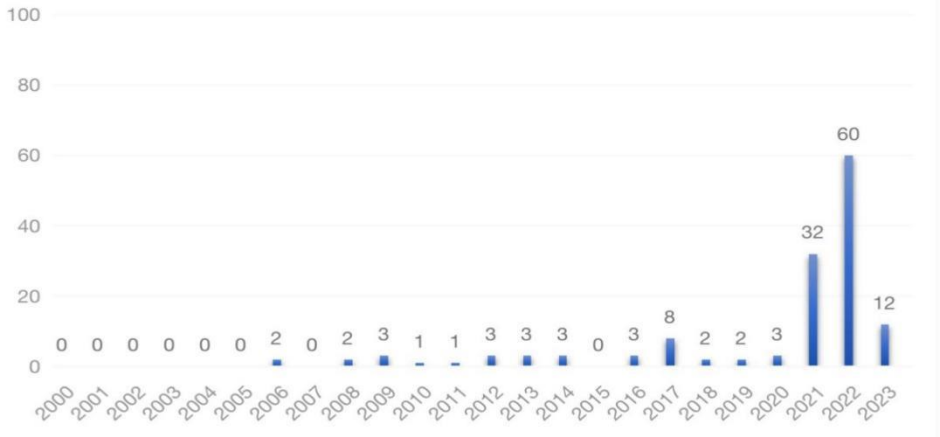
To ensure data consistency and accuracy, this research meticulously harmonized and processed all collected information according to a uniform standard. Variations in word forms, spaces, and abbreviations within author names, journal titles, and keywords can introduce biases into the results. To mitigate these potential biases, this study carried out data standardization across three key areas:

- Authors: Author names were standardized by identifying authors with identical names and then unifying variations arising from aliases, abbreviated names, and other differences.
- Journals: When standardizing journal names, the researchers used the full name and complete title of the journals. Additionally, the researchers verified whether these journals had changed their names over the past two decades.
- Keywords: The keyword standardization process ensures that for synonyms, less commonly used keywords are consistent with their more commonly used counterparts. This study prioritizes nouns in case of keywords with similar frequencies.

Post this rigorous data curation and verification, our study settled on 140 articles, a contribution of 256 authors across 176 establishments located in 30 nations, featured in 30 unique journals, and cumulatively referenced in 4893 pieces by 2989 different journals.

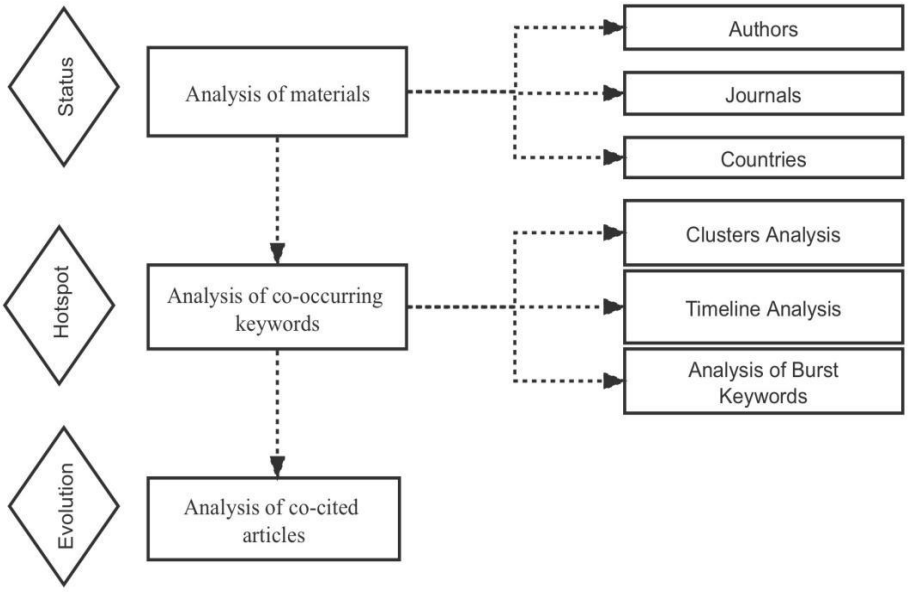
RESULTS

This study has performed an initial analysis of the search results, providing an overview of the general trend in article publications within the field of online music education. The general publication trend in the field of online music education is illustrated in Scale 2. Overall, there is an upward trend. Between 2016 and 2018, there was a slight increase, but after 2020, there was an explosive growth in the number of publications. The total number of articles published in 2020 and 2022 reached 107, indicating that an increasing number of scholars have begun to pay attention to this field in recent years. On the whole, online music education has been in its early stages of development, but in the past three years, it has begun to mature. This section will further present the Status, Hotspots, and Evolution of the field using specific data and case analysis.



Scale2. 2000 to 2022 of overall trend chart of article publishing in the field of music online education.

The research results are interpreted and analyzed in three sections: Status, Hotspots, and Evolution. For the Status section, the foundational analysis of literature materials is primarily conducted, which includes three subsections: Authors, Countries, and Journals. The Hotspots section is presented through co-occurring keyword analysis, encompassing Cluster Analysis, Timeline Analysis, and Burst Analysis. In the Evolution section, analysis is directly based on the content of co-cited references, organizing the origins of the current hot topics. The detailed steps are illustrated in Scale 3.



Scale 3. Analysis flow chart

Analysis of Status

(1) Author

By analyzing the authors of the literature, we can identify the emblematic scholars and the nucleus of research strength in this study domain. Price noted that half of the papers concerning a singular topic are authored by a cohort of prolific writers, the count of which equates to the square root of the aggregate number of all authors.

$$\sum_{m+1}^{I} n(x) = \sqrt{N} \tag{1}$$

In formula (2), n(x) stands for the count of authors that have published x articles, I = nmax is indicative of the article count of the most prolific author in this domain (identified to be nmax = 8 via VOS viewer), N denotes the overall count of authors, and m designates the minimum publication tally for the core authors.

$$m = 0.749 \times \sqrt{n_{max}} \tag{2}$$

After final calculations, m≈2.11. Therefore, this study identifies authors who have published 2 or more papers (including 2) as core authors in this field. Table 2 lists prolific authors who have published more than 2 papers in this domain. There are a total of 13 core authors, collectively

contributing 36 papers, which represents 26% of the total papers. This fails to meet the 50% threshold proposed by Price. As a result, the field of online music education has yet to establish a stable author collaboration group. This study further proceeded with a case analysis of the top 10 authors in this domain.

Rank	Author	Documents	Citations	Average Citation/Publication
1	Biasutti Michele	8	217	27.16
2	Schiavio, andrea	3	13	8
3	Marolt, matija	3	13	4.33
4	Pesek, matevz	3	13	4.33
5	Savli, peter	3	13	4.33
6	Partti, heidi	2	56	28
7	Seddon, frederick	2	49	24.5
8	Crawford, renee	2	25	12.5
9	Philippe, roberta antonini	2	24	12
10	V, hua zhen	2	15	7.5

Table 2. Top 10 author in the field of online music education.

Table 2 showcases the top 10 most productive authors in the domain, each having authored more than 2 articles. Among the key authors, Biasutti Michele stands out as the author with the highest number of publications (8 papers), with 217 citations, averaging 27 citations per paper. Biasutti Michele serves as the head of the Experimental Education Department and is a full professor at the University of Padua. ‘He places significant emphasis on online teaching outcomesand student experiences’(Habe et al, 2021). Following him is Partti, Heidi, a professor of music education at the Sibelius Academy of the University of the Arts Helsinki in Finland. Although she ranks sixth, she boasts the highest average citations per paper 28 citations. ‘Her research primarily focuses on community network music education’(Partti and Karlsen, 2010).

(2) Journals

This research scientifically validated the distribution of the number of articles in the publishing journals and further summarized the content of articles in representative journals. ‘Bradford's law indicates that the distribution of professional articles in corresponding journals is highly asymmetric or skewed, representing a type of random number set’ (Brookes, 1985). Each sector

encompasses a similar count of articles, and the numerical correlation between journals in the principal zone and their ensuing zones is $1:a:a^2$.

Zone	Publications/Journal	Journals	Publications
First Zone	⩾10	3	37
Second Zone	3-9	11	51
Third Zone	1-2	39	44

Table 3. Journal partition

The segmentation of journals in the field of online music education is illustrated in Table 3. The number of articles in the three areas is roughly the same, with the journal ratio approximating 1:4:16 (or more precisely, 1:4:42). This indicates that the distribution of scientific research articles in this field basically adheres to Bradford's Law formula, signifying the establishment of a stable journal publication system. Further analysis revealed that the top authors in this domain have a relatively low collaboration radiance, and there's a palpable shortfall in foundational articles. This suggests that the field hasn't garnered extensive research attention. To get a clearer picture of the current research status in the online music education domain, this study further offers an overview of the research themes in the top 10 journals.

Rank	Source	Publications	Citations	Average Citation/Publication
1	**International journal of music education**	14	140	10
2	**Music education research**	13	249	19.15
3	**Mobile information systems**	10	2	0.2
4	**Frontiers in psychology**	9	40	4.44
5	**Interactive learning environments**	9	9	1
6	**Education and information technologies**	8	33	4.13

7	**Wireless communications and mobile computiong**	7	17	2.43
8	**Scientific programming**	5	10	2
9	**Computational intelligence and neuroscience**	5	6	1.2
10	**Bulletin of the council for research in music education**	4	9	2.25

Table 4. Top 10 journals in the field of music online education

An overview of the current research topics was conducted based on the content of the top 10 journals. The journals ranked in the top 10 in terms of publication quantity (with a publication count ≥10) are shown in Table 4. The 'International journal of music education' has the highest volume of articles (14 papers), while 'Music education research' has the highest number of citations (249 times) and average citations per paper (19.15 times). Both of these journals are widely recognized in the online music education domain. These journals primarily publish empirical research, with articles on computer technology and curriculum design standing out as highly cited contributions. A further summary of the overall content of the top 10 shows that the keywords center on the technological advancements in music education, remote music perception training assessment, research on instrumental/vocal teaching methods, and the design and development of educational platforms. As evident, in the past two decades, most of the papers published in this domain have been themes related to the development of online music education platforms and curriculum content design.

(3) Countries

This study highlights the contributions of various countries to the field, based on geographical distribution. Using VOSviewer, the research analyzed data from a total of 52 countries and created a world map illustrating regional contributions. As can be seen from Table 5 and Scale 4, Chinese scholars have made the most significant contribution to this field with a total of 60 papers, cited 124 times, and averaging 2.07citations per paper. The United States ranks second with 22 papers, 285 citations, and an average of 12.95 citations per paper. What's particularly striking is Canada: while published a mere 3 papers, the average citation count stands at 32.67 times per paper, making it emblematic of a nation producing high-impact papers in the domain.

Rank	Country	Publications	Citations	Average Citation/Publication
1	China	60	124	2.07
2	USA	22	285	12.95
3	England	14	76	5.43
4	Itraly	9	220	24.44
5	Australia	7	114	16.29
6	Spain	5	50	10
7	Slovenia	5	42	8.4
8	South Korea	4	5	1.25
9	Austria	3	24	8
10	Canada	3	98	32.67

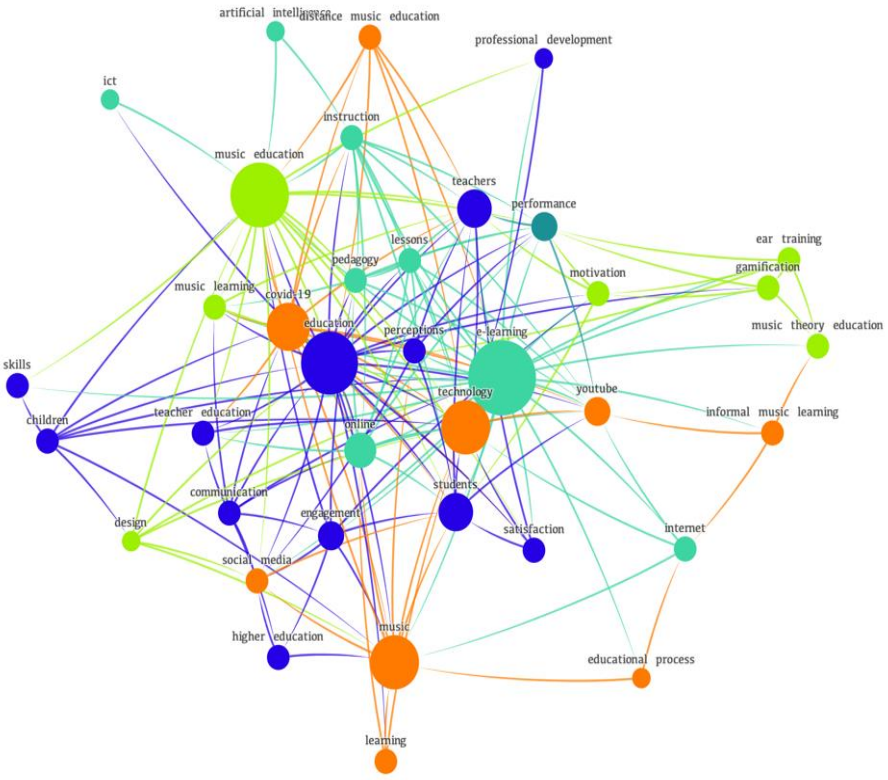
Table 5. Top 10 countries in the online education of online music education

Scale 4. Countries map illustrating regional contributions

Analysis of Hotspots

(1) Clusters analysis

The research hotspots are illuminated through a cluster analysis of high-frequency co-occurring keywords. In this research carefully selected high-frequency keywords after standardization, generated a co-occurrence network visualization, and conducted a comprehensive visual analysis. As depicted in Scale 5, the size of the dots corresponds to the frequency of occurrence: larger dots signify the more prominent hotspots within the field. Lines connecting nodes signify the strength of keyword associations, with brighter lines reflecting stronger interconnections.Various colors distinguish nodes representing different clusters, essentially delineating distinct research themes. To enhance the effectiveness of keyword analysis, this research classified them into core categories. As outlined earlier in Formula 2, the threshold for high-frequency keywords was determined to be 3, resulting in a total of 37 keywords. Scale 5 offers insight into the prominent high-frequency keywords within the current field, revealing four distinct clusters.



Scale 5. 2012 to 2022 of Keyword co-occurring.

A deeper analysis of the content within each cluster was undertaken. This study organized all the hot keywords from the 4 clusters (Table 6) and summarized them into four research hotspot themes: target audiences of online music education, phased development, curriculum content design, and technological advancements.

Rank	Colore	Keywords
1	●	Children, education, professional development, skills, communication, engagement, higher education, teacher education, perceptions, satisfaction, students, teacher
2	●	educational process, informal music learning, learning, music, YouTube, COVID-19, music education, technology, distance music education, social media
3	●	ear training, gamification, motivation, music theory education, music education, design, music learning
4	●	Artificial intelligence, instruction, lessons, online, pedagogy, Information and Communication Technology（ICT）, internet, e-learning

Table 6. Cluster of keywords in the Online Music education research field

Cluster 1. This cluster reflects the target audience of online education, encompassing terms such as children, education, and professional development. Studies within this cluster particularly emphasize learning outcomes and prospects for professional development. For example, such research places a significant value on modern technological means like ICT and online learning, with a focus on nurturing the musical potential of children and supporting the career development of students (Dorfman et al, 2021; Paule-Ruiz et al, 2017). These studies also prioritize feedback from both students and teachers during remote learning processes, with special attention to surveys and assessments of satisfaction levels in online learning experiences (Biasutti, 2011).

Cluster 2. This cluster reflects the societal focal points within the field of online music education, encompassing terms such as the educational process, informal music learning, and COVID-19. It underscores how online music education has innovatively responded and evolved alongside these societal trends and challenges. In the early stages of online music education, social media platforms served as a means of informal music learning for music enthusiasts. Platforms such as YouTube and other music teaching websites provided opportunities for social interaction and collaboration, enriching the landscape of music education (Partti and Karlsen, 2010). Following the onset of the

COVID-19 pandemic, the models of education and the utilization of technology within these extraordinary circumstances became prominent topics of discussion. Research and discussions delved into how music teachers could effectively utilize ICT for instrument instruction (Ignacio Pozo et al, 2022), how music educators could maintain meaningful connections with students in an online environment, and how to provide personalized guidance (De Bruin, 2021).

Cluster 3. This cluster reflects the fine details of curriculum content design, including terms such as sight-singing, ear training, gamification, and music theory. Research in this area emphasizes the incorporation of comprehensive educational elements, with a specific emphasis on enhancing the enjoyment and engagement of the learning process. For example, there is a notable focus on the development of gamified music theory learning platforms. 'These platforms not only enable the teaching of music theory through automated gamified exercises but also facilitate activities like sight-singing and ear training'(Pesek, Vucko, et al, 2020).

Cluster 4 examines the integration of Artificial Intelligence (AI) in online music education, with key terms like ICT, the Internet, and e-learning. Research in this domain is geared towards the transformative potential of AI in shaping pedagogical methodologies. For example, 'intelligent online learning platforms leveraging big data can equip educators with a diverse array of instructional techniques while simultaneously providing students with tailored and adaptive learning experiences'(Dai, 2021).

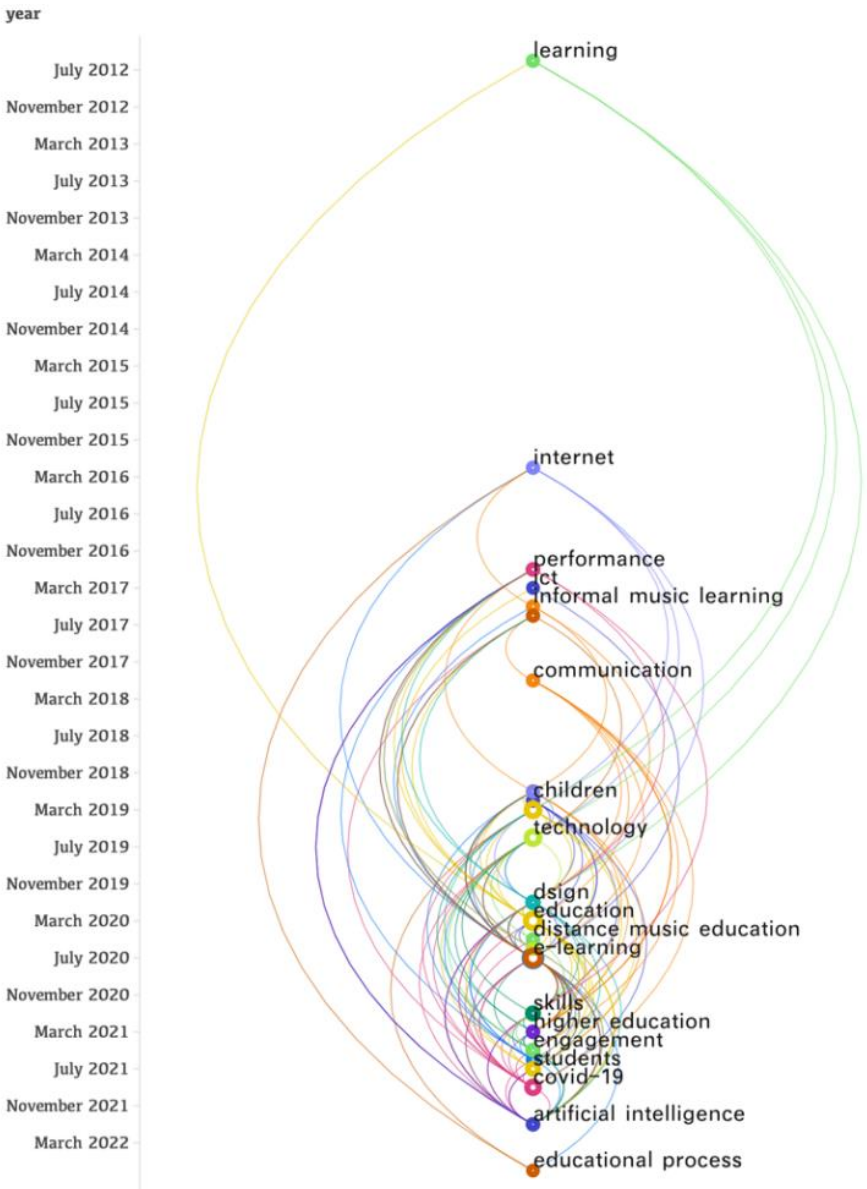
(2) Timeline analysis

The timeline analysis of hot topics reveals distinct developmental stages within the field. As delineated in Scale 6, the onset of the COVID-19, changing the global education landscape divide the time distribution into two different periods:

2012-2020: During this period, research primarily revolved around social media learning and the development of online education platforms. The primary focus was on knowledge and experience exchange through specialized websites and forums (Bernard et al, 2018). For instance, platforms like Troubadour, designed specifically for music listening and communication training (Pesek, Vucko, et al, 2020), relied on advanced computer technology to assist in music online education (Dammers, 2009). This form of online music education, emphasizing specialized platforms and computer-assisted learning, was predominant during this period.

2021-2022: This timeframe marked a transformative shift in research priorities, with the primary objective being the surmounting of temporal and spatial technological impediments. In response to

the adversities presented by the COVID-19, online music education pivoted towards establishing remote, immersive musical teaching environments for educators and learners alike (Y. Zhang et al, 2022). A salient feature of this period was the blossoming and assimilation of AI, coupled with AR/VR innovations, within online music classrooms (Pike, 2017). This era also heralded the rise of avant-garde teaching strategies, including MIDI-driven interactions and adaptive music appraisals (Y. Xu, 2022). A hallmark of these times was the harmonious fusion of cutting-edge technology with pedagogical content.



Scale 6. Timeline map from 2012 to 2022

(3) Burst keywords analysis

Keyword	Year	Strength	Begin	End	2016-2020
Music theory education	2017	1.35	2017	2020	
Higher education	2021	1.31	2021	2022	
Professional development	2018	1.3	2018	2019	
Informal music learning	2017	1.12	2017	2018	
Student	2021	0.87	2021	2020	
Teacher education	2021	0.87	2021	2020	
Online learning	2018	0.84	2018	2019	
Technology	2021	0.7	2021	2022	
Gamification	2020	1.21	2020	2020	
Ear training	2020	1.21	2020	2020	

Table 7. Top 10 keywords with the bursts

Conduct a burst analysis of keywords to illustrate hot topics with actual examples. Table 7 presents the top ten bursting keywords identified in this study. Further analysis revealed that their burst time corresponds to the two time phases mentioned earlier. Therefore, this study discusses examples of bursting words based on the two time phases:

2012-2020: During this period, the four keywords music theory education, informal music learning, professional development, and online learning are significant representatives. The initial focus was on enhancing the vibrancy of music theory courses to ignite students' enthusiasm. Goncharova from Spain proposed music theory materials supported by mobile technology, incorporating elements of games and competition in the course, making the music theory curriculum more engaging (Luo and Hong, 2022). Next is the exploration of the characteristics and benefits of

informal music learning Carol Johnson and Scott H. Hawley pointed out that informal music learning allows participation in musical activities with other music enthusiasts, sharing musical experiences and exchanging insights, deriving inspiration and motivation from it and providing students with flexible time and location (Biasutti, 2018). The next topic is the role of online education in professional development and its potential benefits to music teachers. The impact of music online education on career progression was also explored, with Bernard et al. emphasizing the professional growth music educators achieved (Bernard et al, 2018). Lastly, the technical application of online music education was discussed. Pike's study suggested that teaching piano through internet technology could provide instructional services to people in remote areas (Crawford, 2017).

2021-2022: During this timeframe, six predominant keywords emerged: higher education, student, teacher education, technology, gamification, and ear training. The triad of higher education, student, and teacher education primarily underscores advancements in students aesthetic, analytical, expressive and collaborative proficiencies (Goncharova and Gorbunova, 2020; Sala, 2021). Concurrently, they highlight refined methodologies in the integrated management, streamlined retrieval, and resource-sharing mechanisms tailored for teachers instructional resources (González-González et al, 2020). The latter trio of keywords offers insights into technological innovations within online music education. Specifically, the field has capitalized on voice recognition capabilities to refine vocal music pedagogical evaluations (Gudoniene and Rutkauskiene, 2019; Koutsoupidou, 2016), harnessed big data analytics to surveil and curate educational resources, and employed sophisticated image processing modalities to enhance instructional immersion (Dammers, 2009). As technological paradigms persistently advance, online music education platforms are poised to rejuvenate and broaden traditional pedagogical frameworks (Goncharova and Gorbunova, 2020; Pesek, Suhadolnik, et al., 2020).

(4) Evolution Analysis

The analysis of co-cited references provides valuable insights into the evolution of hot topics. Table 8 highlights the top 10 co-cited references, which, upon analysis, can be grouped into two core themes: curriculum content design and the integration of music education with technology.

- Curriculum Content Design: This theme revolves around the enhancement of instructional effectiveness, with a specific focus on the crafting of specialized content (Johnson and

Hawley, 2017). This theme underscores the significance of tailoring educational materials to meet the unique demands of online music education (Dehghanzadeh et al, 2024).

- Integration of Music Education with Advanced Technology: As opposed to the preceding theme, this narrative pivots towards the integration of emerging technologies such as AI and VR into the realm of music education (Dammers, 2009). It places considerable emphasis on the development of immersive and interactive online instructional environments that leverage these cutting-edge technologies to enrich the learning experience.

Rank	Title	Year	Citations
1	Online composition: strategies and processes during collaborative electroacoustic composition	2021	13
2	Remote Learning in School Bands During the COVID-19 Shutdown	2021	13
3	Rethinking teaching and learning pedagogy for education in the twenty-first century: blended learning in music education	2017	11
4	Utilizing Internet-based videoconferencing for instrumental music lessons	2009	11
5	Online music learning: informal, formal and STEAM contexts	2017	11
6	Creative approaches in music teaching: Possibilities of Web 2.0 technologies	2020	10
7	Strategies adopted during collaborative online music composition	2018	10
8	Creative pedagogies in the time of pandemic: a case study with conservatory students	2021	9
9	Skype music lessons in the academy: Intersections of music education, applied music and technology	2013	9

10	Instrumental music educators in a COVID-19 landscape: a reassertion of relationality and connection in teaching practice	2021	8

Table 8. Top 10 highly cited references

CONCLUSION

In this research conducted a bibliometric analysis of literature in the field of online music education from 2000 to 2023. The data were analyzed and combined with a knowledge graph to quantitatively describe the current status, frontline hotspots, and evolutionary trends in the field of online music education. The findings of this research are presented in three sections:

- Status： This section quantitatively describes and provides statistics on foundational elements such as authors, journals, and countries. Further dissects this data into three specific areas:

  a) The 256 authors: By leveraging Price's validation, this study analyzed the authorship data of the papers, identifying 13 core authors. Collectively, these authors authored 36 articles, accounting for 26% of the total publications. The analysis indicates that a stable collaboration group of authors in this domain has yet to be established. The study also detailed an analysis of the top 10 high-quality, high-output authors in this field, including Professors Biasutti Michele and Partti Heidi. They highlighted the benefits of online learning for professional development, particularly in terms of flexibility and creating a community of practice. The blended design of the course, integrating online and face-to-face components, was identified as a key factor in its success (Biasutti, 2019).

  b) The 53 journals: With the help of VOSviewer, this study analyzed the publishing data of 53 retrieved journals and found that the top 10 journals have high academic quality and influence in the field, indicating that the publishing system in the field of online music education is stable, and the data also conforms to the distribution pattern of Bradford's law. All of the above shows that a relatively systematic publishing system has been formed in the field of online music education.

  c) The 52 countries: Through an analysis of the top 10 prolific countries, it was determined that China and the USA are the primary contributors in this domain. A further assessment

of the quality of publications from various countries revealed that while China leads in terms of the number of publications, Canada stands out in terms of the quality of publications.

- Hotspot: This research conducts a quantitative analysis of keywords, segmented into three main parts: clusters, timeline, and burst keywords.

  a) Clusters Analysis: Using VOSviewer, the study created a co-occurrence network visualization based on 37 high-frequency keywords. These are further divided into four clusters (keyword groups). Delving deeper into the clusters' content, four major themes emerge: target audience for online music education, phased developmental trends, curriculum content design, and technological advancements (Ismail, 2022).

  b) Timeline Analysis: Using VOSviewer, a temporal map of keywords is constructed to analyze keyword evolution from 2000 to 2023. The findings reveal a pivotal shift in the domain marked by the onset of COVID-19. Prior to COVID-19, research revolved around 'internet and technological studies. COVID-19, curriculum content design became the focal point of research (Wang et al, 2020).

  c) Burst Keywords Analysis: The analysis of the top 10 bursting keywords categorized them into two phases, each reflecting a major surge in research focus The two central emerging themes are: 'how to make online music education more engaging' and 'how online music education can better integrate with modern technology (Gudoniene and Rutkauskiene, 2019).

- Evolution: Through an analysis of 4,893 co-cited references, this study traces the origins of the hotspot topics. Commencing from an examination of the ten most frequently cited references, two predominant themes emerge: 'curriculum content design in online music education' and 'the integration of music education with technology.' These findings further underscore the continuous and cutting-edge evolution of these two themes(Xu and Zhao, 2021).

Online music education, evolving in tandem with the times, has garnered significant attention from relevant scholars and experts. This study utilizes the VOSviewer visualization analysis software to search the SCIE, SSCI, and A&HCI core databases in the WOS database, and selects high-quality

relevant papers published between 2000 and 2023. Further, an analysis was conducted on 140 papers written by 256 authors from 30 countries and published in 30 journals, revealing the current state of research in this domain. An analysis of 542 co-occurring keywords using 'high frequency,' 'timeline,' and 'burst' methodologies identified research hotspots in this area. An outbreak case analysis of 4893 co-cited references mapped the evolutionary trends of the field. The research findings are summarized as follows:

- **Status：** Although the field has not yet formed a stable author collaboration network, it has established a scientific literature system. In terms of geographical distribution, while China emerges as a major contributor in terms of volume, Canada stands out as a high-quality, high-output country.
- **Hotspot：** Four clustered hot topics have emerged: educational targets, developmental phases, content design, and technological support. This reflects the comprehensive and holistic development trend in the online music education domain, which is gradually moving towards a mature stage.
- **Evolution：** Research in the online music education domain is showing a consistent growth trend. Most studies focus on two evolutionary trends: 'innovation in content design for online music education environments' and 'augmented optimization of online music education leveraging diverse technologies.

The integrated topic of online music education has immense potential for development, though its growth is still awaiting maturity, leading to inevitable research gaps. This study suggests that future research should primarily focus on the development of online education platforms, evaluation of learning outcomes, and the technical application of combining the metaverse with music education in three key directions. Originating from bibliometrics and presenting research visually, this study holds value.

LIMITATIONS

This study has certain limitations, mainly divided into two aspects: the database and language. Firstly, by choosing only the WOS database for data analysis, the diversity of research results is limited at the data source. Although the WOS Core Collection is one of the recognized search databases in academia, some publications are not included in this database, inevitably research to

the omission of some relevant literature. Moreover, this research only selected English literature for analysis. Given the broad scope of the topic chosen for this paper, this research only searched for English literature in the WOS Core Collection, inevitably missing other high-quality articles in languages. Subsequent research will focus on the limitations of these two aspects and conduct more systematic and comprehensive statistics and research on this field.

ACKNOWLEDGEMENTS

The authors express their deep gratitude to Kyonggi University for their valuable support throughout the project. Special thanks to Professor Weijia Yang for her valuable comments on this study. This study provided important research support for Yuchao Yan application for a doctorate degree at Kyonggi University. All authors contributed to this study. There are no conflicts of interest in this study.

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GENİŞLETİLMİŞ ÖZET

Çevrimiçi müzik eğitimi alanındaki araştırmalar, dijital teknolojilerin hızlı gelişimi ile birlikte giderek daha fazla dikkat çekmektedir. Bireyselleştirilmiş öğrenme yaklaşımları ve eğitimde işbirlikçi öğrenme süreçlerine yönelik küresel eğilim, bu alanın önemini artırmaktadır. Ancak, mevcut çalışmalar çevrimiçi müzik eğitiminin henüz erken bir gelişim aşamasında olduğunu ve bu alandaki nicel bilimetrik analizlerin eksik olduğunu göstermektedir. Özellikle etkili yazarlar, trend konular ve evrimsel eğilimler gibi bilimetrik göstergeler üzerine yapılan araştırmalar sınırlıdır. Bu bağlamda gerçekleştirilen çalışmamız, Web of Science (WOS) veritabanından elde edilen veriler aracılığıyla bu alandaki önemli literatürü sistematik olarak incelemekte ve VOSviewer gibi veri görselleştirme araçlarıyla bu alanın mevcut durumu, odak noktaları ve evrimsel eğilimleri hakkında derinlemesine bir analiz sunmaktadır. Çalışmamızın elde ettiği sonuçların, çevrimiçi müzik eğitimi alanındaki akademisyenler ve eğitimcilere değerli bir referans noktası sunması amaçlanmaktadır.

Bu araştırmanın ilk bölümü, çevrimiçi müzik eğitimi alanındaki makaleleri yazarlar, dergiler ve ülkeler bazında inceleyerek bu alanın temel özelliklerini ortaya koymaktadır. Örneğin, Çin, ABD ve Kanada, bu alandaki yayın sayısı açısından en fazla katkı sağlayan ülkeler arasında yer almaktadır. Ancak yayınların kalitesi değerlendirildiğinde, Kanada'nın daha az sayıda yayına rağmen yüksek bir etki düzeyine sahip olduğu görülmektedir. Bu, Kanada'nın çevrimiçi müzik eğitimi alanında yüksek etkili çalışmalar ürettiğini göstermektedir. Yazarlar açısından incelendiğinde, Biasutti Michele, bu alanda en fazla yayına sahip olan ve makaleleri sıkça atıf alan bir araştırmacı olarak öne çıkmaktadır. Yayın sayısına göre incelenen dergiler arasında ise "International Journal of Music Education" ve "Music Education Research" dergileri ön sıralarda yer almakta ve bu dergilerde yayımlanan çalışmalar alandaki eğilimleri belirlemektedir.

Çalışmanın ikinci bölümü, çevrimiçi müzik eğitimi alanında sıcak konuları belirlemek amacıyla anahtar kelime analizi yapmaktadır. Anahtar kelime analizinde dört temel tema öne çıkmaktadır: hedef kitle, gelişim aşamaları, içerik tasarımı ve teknolojik ilerlemeler. Hedef kitle olarak öğrenciler, öğretmenler ve profesyonel gelişim arayan bireyler önemli bir yer tutmaktadır. Gelişim aşamaları, çevrimiçi müzik eğitiminin sosyal medya platformları ve gayri resmi öğrenme süreçlerinden, COVID-19 pandemisinin ardından daha yapısal ve akademik bir hale gelmesine kadar olan süreci yansıtmaktadır. Özellikle pandemi sonrasında çevrimiçi müzik eğitimi, eğitim süreçlerini iyileştirmek için yapay zeka ve sanal gerçeklik gibi teknolojik yenilikleri içerecek şekilde genişlemiştir. İçerik tasarımında ise, müzik teorisi eğitimi, kulağa dayalı eğitim ve oyunlaştırma gibi unsurlar öne çıkmakta, eğitimin daha etkileşimli ve öğrenci odaklı olması hedeflenmektedir. Bu bağlamda geliştirilen oyunlaştırılmış müzik eğitimi platformları, müzik teorisi, kulak eğitimi ve ritim dikte gibi alanlarda öğrencilere daha eğlenceli ve motive edici bir öğrenme deneyimi sunmaktadır.

Çalışmanın üçüncü bölümü, çevrimiçi müzik eğitimi alanında evrimsel eğilimleri analiz etmektedir. Bu analiz, 2012'den günümüze kadar olan süreçte bu alandaki anahtar konuların nasıl değiştiğini ve bu değişimlerin temel etkenlerini ortaya koymaktadır. 2012-2020 yılları arasında, çevrimiçi müzik eğitimi, sosyal medya ve çevrimiçi platformlar aracılığıyla gayri resmi öğrenme süreçlerine odaklanmıştır. Bu dönemde, YouTube gibi platformlar, müzikseverlere müzik eğitimi konusunda etkileşim ve iş birliği yapma fırsatları sunmuştur. Pandemi sonrasında ise, çevrimiçi müzik eğitiminde daha karmaşık teknolojik uygulamalara olan ilgi artmıştır. Yapay zekâ, artırılmış gerçeklik ve sanal gerçeklik gibi yenilikler, çevrimiçi müzik eğitiminin kapsamını genişletmiş ve

eğitim süreçlerinin daha kişiselleştirilmiş ve uyarlanabilir hale gelmesini sağlamıştır. Bu dönemde öğretmenler ve öğrenciler arasındaki etkileşimi artırmayı hedefleyen MIDI etkileşimli öğrenme ve adaptif müzik değerlendirme uygulamaları da öne çıkan konular arasındadır.

Sonuç olarak, çevrimiçi müzik eğitimi, dijital teknolojilerin hızla gelişmesiyle birlikte genişleyen bir alan olarak, eğitimde yeni bakış açıları ve yöntemlerin ortaya çıkmasına katkıda bulunmaktadır. Çevrimiçi eğitimde özellikle bireyselleştirilmiş öğrenme olanaklarının artması ve metaverse gibi yenilikçi teknolojilerin entegrasyonu, öğrencilere daha etkileşimli ve zenginleştirilmiş deneyimler sunarak onların öğrenme sürecini daha ilgi çekici ve etkili hale getirme potansiyeline sahiptir. Bu bağlamda, çalışmada kullanılan bilimetrik analiz yöntemleri ve VOSviewer gibi veri görselleştirme araçları, çevrimiçi müzik eğitiminin mevcut durumunu, araştırma odaklarını ve bu alanın evrimsel dinamiklerini kapsamlı bir şekilde ortaya koymaktadır. Çalışmanın sonuçları, çevrimiçi müzik eğitiminde öncelikli olarak teknolojinin etkin kullanımına ve eğitim platformlarının geliştirilmesine dikkat çekerek, bu platformların kullanıcı ihtiyaçlarına daha uygun ve kişiselleştirilmiş şekilde tasarlanması gerektiğini vurgulamaktadır. Ayrıca, bu alanın gelecekteki gelişimi için metaverse ve yapay zekâ destekli uygulamalar gibi yeni teknolojilerin eğitime entegrasyonunun büyük bir potansiyele sahip olduğu görülmektedir. Çalışmanın sunduğu bulgular, öğrenme çıktılarının ölçülmesi, platformların geliştirilmesi ve çevrimiçi müzik eğitiminin çeşitli eğitim süreçlerinde uygulanabilirliğinin artırılması adına gelecekte yapılacak araştırmalara değerli bir temel oluşturmaktadır.

Bu çalışma, çevrimiçi müzik eğitiminde özellikle metaverse teknolojilerinin eğitim süreçlerine entegrasyonu gibi konuların gelecekteki araştırmalar için önemli bir yol gösterici niteliğe sahip olabileceğini ortaya koymaktadır. Metaverse, sanal ve artırılmış gerçeklik gibi dijital ortamların etkileşimli ve çok boyutlu bir öğrenme deneyimi sunması nedeniyle çevrimiçi müzik eğitiminde yeni bir dönemi başlatma potansiyeline sahiptir. Bu teknoloji sayesinde, öğrenciler ve öğretmenler fiziksel olarak aynı mekânda olmasalar bile, aynı sanal alanı paylaşarak enstrüman eğitiminden müzik teorisine kadar geniş bir yelpazede uygulamalı eğitim alabilirler. Çalışma ayrıca, çevrimiçi müzik eğitiminin etkili bir biçimde değerlendirilmesi ve öğrenme çıktılarının nesnel ve geçerli ölçütlerle analiz edilmesi gerektiğini vurgulamaktadır. Bu amaçla, teknolojik ilerlemelerin sunduğu olanaklarla daha dinamik ve öğrenci merkezli bir eğitim ortamı tasarlanabileceği belirtilmektedir. Özellikle yapay zekâ destekli analiz ve geribildirim sistemleri, öğrenci performansını bireysel olarak değerlendirip yönlendirebilecek, böylece öğrenme süreçlerini daha

etkili ve verimli hale getirebilecektir. Çalışmanın sonuçları hem akademik literatürdeki boşlukları dolduracak hem de çevrimiçi müzik eğitimine ilişkin pratik çözümler sunarak bu alanda yapılacak yeni araştırmalara ve eğitim uygulamalarına sağlam bir zemin hazırlayacaktır.