



From Deep Learning to Digital Pedagogy: A Bibliometric Study of Artificial Intelligence in Music Education

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Abstract

Artificial intelligence is finding more and more applications in the field of music education in the form of automated performance feedback, adaptive practice systems, and online learning platforms. Since the sphere of this multidisciplinary approach that includes education, music, and computing is growing at a rapid pace, a bibliometric snapshot can be used to explain the trend of the literature development and reveal the areas of its focus. This paper presents a literature review on AI and music education and maps it with a Scopus-export dataset of 231 articles on that topic that were published between 2002 and 2025 in English. The analysis unites the increase in publications, leading journals, countries in which published papers have most of the authors, keywords primarily used, and the high-citation publications. The analysis indicates that there is a strong recent trend: 223 out of 231 publications have been released since 2021, and the trend is higher in 2024 (71 articles) and 2025 (52). Applied Mathematics and Nonlinear Sciences (23 articles), Computational Intelligence and Neuroscience (13), and Wireless Communications and Mobile Computing (11) are the most referred sources, meaning that there is a very strong representation of computational and engineering sources. The pattern of affiliation reveals that China is the leading contributor (183 papers) then South Korea (13) is followed by Malaysia (8). The topic of keyword frequency focuses on the music, music education, artificial intelligence, and deep learning, which indicates the field that is inclined towards AI-driven systems and modelling. The article with the highest number of citations in the data set is the article titled development and applications of artificial intelligence in music education (2023) which has 95 citations. In general, the literature is growing at a high rate and it is geographically and methodologically focused which means that it needs to be widely collaborated and well education-based assessment of learning outcomes in real classroom environments.

Keywords: *Artificial Intelligence; Deep Learning; Music Education; Bibliometric Analysis*

Introduction

Artificial intelligence (AI) has increasingly become integrated into creative and educational domains, revolutionizing how people interact with sound, language, and art. In recent years, AI has moved beyond industrial and computational use, finding significant applications in music composition, performance analysis, and

personalized learning environments. The blending of machine learning algorithms with music pedagogy has opened new avenues for enhancing creativity and accessibility in classrooms, enabling both students and educators to explore complex musical patterns and feedback systems without extensive technical training. Through these innovations, AI has introduced new methods of composing, analyzing, and teaching music, challenging traditional definitions of authorship and artistic originality. AI-led filters have a range of applications, beyond just music, that may result in improved sound processing capabilities for devices such as hearing aids and smartphones, while also providing new insights into existing methodologies in specialized areas like augmented reality (Cosme-Clifford, 2024). AI in music is the application of artificial intelligence technologies to assist in composition, thereby improving human creativity through collaborative processes (Gioti, 2021). Computer programs that can process language, images, and sounds are used to create artificial intelligence in music (Li, n.d.). The potential benefits of AI-generated music in the education sector include democratization of the creative expression and encouragement of innovative teaching methods whereas challenges include cultural bias, originality, equity, and an ethical application of artificial intelligence, thus the importance of strict regulatory control and evidence-based policy advice (Cheng, 2025). This integration results in some ethical issues, including the concerns about technological addiction, the reorganization of pedagogical functions, and data privacy vulnerabilities. The aim of technology enhancing art can be achieved by having good coordination between human operators and machine systems (Li et al., 2025). AI is transforming music education, but there is little analysis of how academic interest in AI-assisted music learning has evolved. No one has mapped the trend across genres, techniques (e.g., feedback vs generation), or target learners (kids, adults, neurodiverse individuals). While AI is rapidly transforming music pedagogy, there is a lack of research analyzing the historical evolution of academic interest in this domain. This study addresses the lack of systematic mapping across key research variables, including musical genres, specific AI techniques, and defined target learner groups.

Despite these developments, there is very little empirical research on the direction and future of AI-aided music learning. Although the extant literature is largely focused on technical developments, e.g., the use of AI to generate music or to analyze it, the development of scholarly focus on AI in the context of music education in relation to genres, methodological tools, or groups of learners is scarcely addressed. This gap in the literature is counterproductive to the holistic view of the macro-trends of this emerging field. As a result, the current research aims to fill the gap of a data-driven, systematic synthesis explaining the evolution of research focus in AI in music education.

Importance of the Study

AI has already surpassed its more classical limits of industrial and strictly computational scopes to affect the creative and educational worlds, such as music composition, performance analysis, and personalized learning environments. This paradigm shift promises to increase the availability of music education and create new pedagogical paradigms, however, it also provokes significant issues related to cultural bias, originality, equity, and the privacy of data. These problems increase the need of evidence-based advice and ethical implementation based on teaching settings. AI is transforming music composition and education through personalized musical composition, performance evaluation, and interactive learning systems. According to Zhao (2025), these technologies do not replace human creativity but rather correct the workflow of creativity, relationship with the audience, and stylistic novelty, and are used as collaborators.

Although the introduction of AI into the field of music pedagogy has increased faster, the academic environment is still divided. Most studies focus on tools development, and comparatively few studies question longitudinal changes in research focus or outline to variations between genres, AI method (e.g., feedback or generation) and student group (children, adults, neurodiverse learners). The research corpus in the field of AI in music education, as Zhang et al. (2024) note, remains infantile, with most of it being located in the context of teaching music to Chinese university students, with little analysis of genre differences, AI modalities, and various constituencies of learners. This inadequacy denies teachers, researchers, and policy analysts a concise summary of current areas of research interests, research gaps and future directions. The present study will enlighten areas of research interest, under-researched and possibly unmet collaboration gaps, thereby justifying both directed innovation and ethically equitable growth of AI-aided music education.

Methodology

Study Design and Data Sources

The research design applied in this investigation is the bibliometric, descriptive research design that is to be used to examine publication trends and thematic elements in literature that cross-examines artificial intelligence and music education. The data was retrieved out of the provided CSV/Excel file, which was exported out of Scopus, and consists of 231 entries categorized as journal articles, and all in English, with the range of 2002 to 2025. All of the records also include core bibliographic data (title, year, journal/source, DOI), citation data, authorship data, affiliation data, abstracts, and keyword sets (author keywords and index keywords), therefore providing the key information needed to conduct trend, productivity, and topic mapping analysis.

Measures and Analytical Procedures

Publication growth was looked into by summing papers per year and calculating numbers in order to see how the output changed with time. Influential works were detected by prioritizing papers based on their citation by scores and summarization of the entries that had the highest number of citation. The productivity of the journals was measured by the number of times each of the identified- Source titles was mentioned, which subsequently identified the publication sources that actively promoted the field. Authorship structure was measured through the calculation of the number of authors per paper using the author delimiter of the dataset, giving a simple view of the collaborative patterns, including the ratio between single-author paper and multi-author paper. The affiliation information was used to deduce geographic and institutional contributions. Since Scopus affiliation strings may include multiple records, the affiliation text was split into discrete parts and standardized with a simple heuristic, the final part was considered to be the country (e.g., Zhengzhou Normal University, Harbin, China, and Zhengzhou Normal University) and the first part was assumed to be the institution (e.g., Zhengzhou Normal University).

The country counts were then created at the paper level- a country was credited in case it was mentioned at least once in the affiliations of a paper, and thus this reduces the inflationary impact of many-affiliated papers. The totals of country and institution should therefore be regarded as indicative as opposed to definitive. Thematic trends were measured by the frequency of keywords by using the frequency of keywords Analysis, adding Author Keywords with Index Keywords and normalizing case and spacing and ranking the keywords by their occurrence. This process will enable determination of the prevailing ideas and methods of constructs in the literature. The current strategy has some weaknesses which should be noted.

The data is based on the coverage and indexing choices of Scopus and, as such, is likely to underrepresent research published in journals not indexed by Scopus. The nature of the affiliation parsing is approximative because of the differences in formatting and the fact that there could be more than one affiliation per record thus the number of countries and institutions should not be considered as accurate but rather indicative. Also, the frequency of keywords depends upon the labeling used by authors and indexers, and can spread related ideas across a number of terms.

Analysis

Co authorship and authors

With minimum no. of authors of a document as two and citations being zero, 14 authors met the threshold. The computer-aided algorithm proves to be more accurate in identifying features of short video images than the comparative algorithm by 19.99 percent and can accurately localize edge contours in short video images (Liu et al., 2023). The combination of artificial intelligence and mobile internet infrastructure turns the study of music into a new area of focus, as it invites high-level computer and information technologies into the realm of composition, performance, production and appreciation. This synthesis supports the impact of AI on music composition, performance, and listening by proposing an integrated use of musical theory, cognitive psychology, and signal processing. The final goal is to take pedagogical models and conceptual frameworks in the field of music education to a new level to push the sphere towards new levels with new methodologies and problem-solving solutions that are enabled by AI technology (Wang, 2022).

Table 1

author	documents	citations	total link strength
"chen, fan"	2	7	0
"chen, wei"	2	17	0
"cheng, lee"	2	2	0
"dai, dandan"	2	76	0
"gong, tianzhuo"	2	1	0
"li, huizi"	2	33	1
"peter, j. dinesh"	2	28	1
"seng, wenli"	2	3	0
"shan, xin"	2	0	0
"słowik, adam"	2	8	1
"wang, lei"	2	13	0
"wang, xin"	2	21	0
"zhang, chao"	3	30	1
"zhang, yiyao"	3	27	0

Figure 1

Co authorship and authors



Co authorship and countries

Based on co-authorship between countries, China stands out with the highest number of documents (183) and citations (1235), while the USA and Thailand had the least representation. China has formed clusters with all the other nations, including Malaysia, South Korea, India, and Thailand. India clustered with Thailand while USA had no clusters.

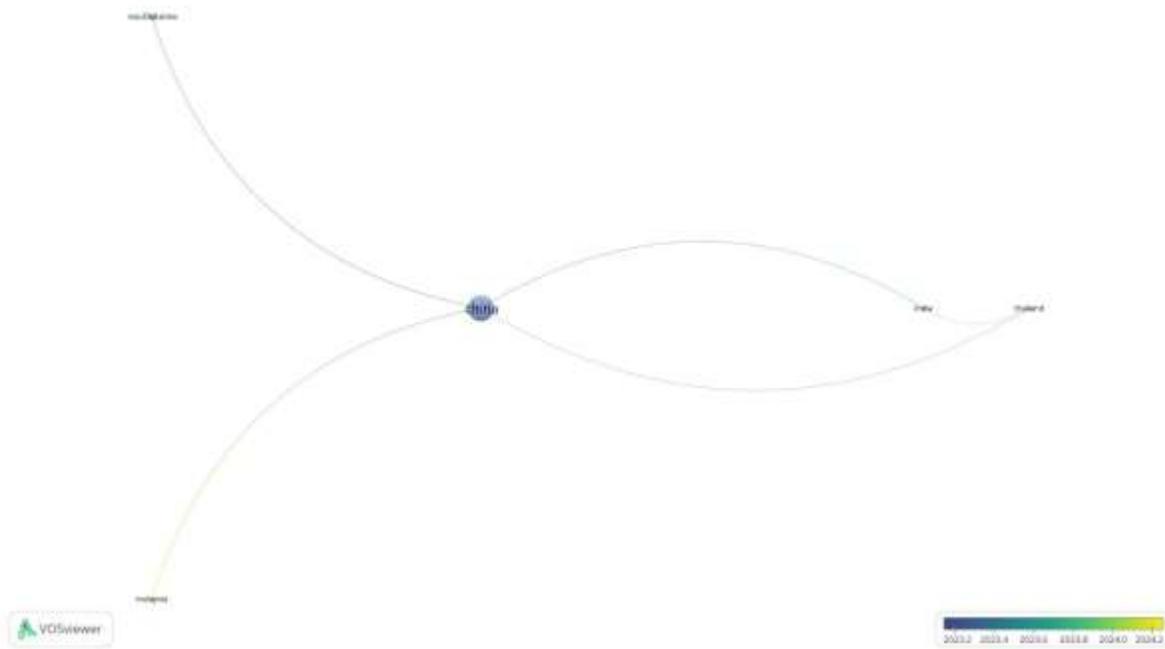
Table 2

Co authorship and countries

Country	Documents	Citations	Total Link Strength
China	183	1235	17
India	5	118	5
Malaysia	8	16	5
South Korea	13	53	6
Thailand	5	54	3
United States	5	52	0

Figure 2

Co authorship and countries



Co authorship and Organization

Based on the data, Communication University of China has the highest number of documents (5) and a total link strength of 1, showing some collaboration with other institutions. Zhengzhou Normal University produced the most papers overall (7) but did not show any collaboration links, suggesting its research was mostly independent. Harbin University had a high citation count (45), meaning its work was influential even though it wasn't part of collaborative networks. Hunan City University also received many citations (44), indicating strong research impact. From the co-authorship diagram, Beijing Normal University connects with both Hunan City University and Communication University of China, forming a small cluster of collaboration. Most of the other universities, including Karunya Institute of Technology and Sciences (India), Universiti Malaya (Malaysia), and Sangmyung University (South Korea), do not show visible links, meaning international collaboration is limited.

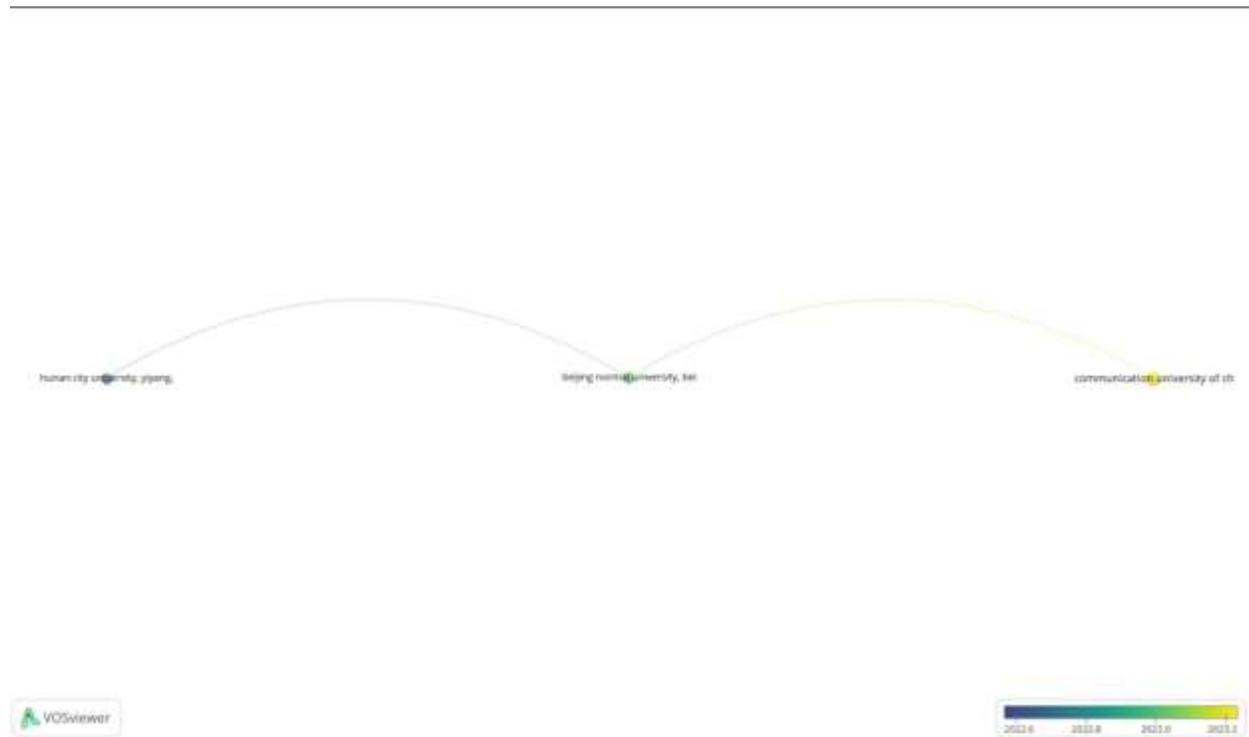
Table 3

Co-authorship and Organizations

Organization	Documents	Citations	Total Link Strength
Beijing Normal University, Beijing, China	3	27	2
Communication University of China, Beijing, China	5	39	1
Harbin University, Harbin, China	3	45	0
Hunan City University, Yiyang, China	3	44	1
Karunya Institute of Technology and Sciences, Coimbatore, India	3	34	0
Nanjing University of the Arts, Nanjing, China	3	21	0
Sangmyung University, Jongno-gu, South Korea	3	2	0
Universiti Malaya, Kuala Lumpur, Malaysia	3	14	0
Zhengzhou Normal University, Zhengzhou, China	7	32	0

Figure 3

Co-authorship and Organization



The table shows that music had the highest number of occurrences with the number 107 and total link strength of 320. Music education was next with 91 occurrences and a total link strength of 231. Artificial intelligence was third with 90 occurrences and a total link strength of 199.

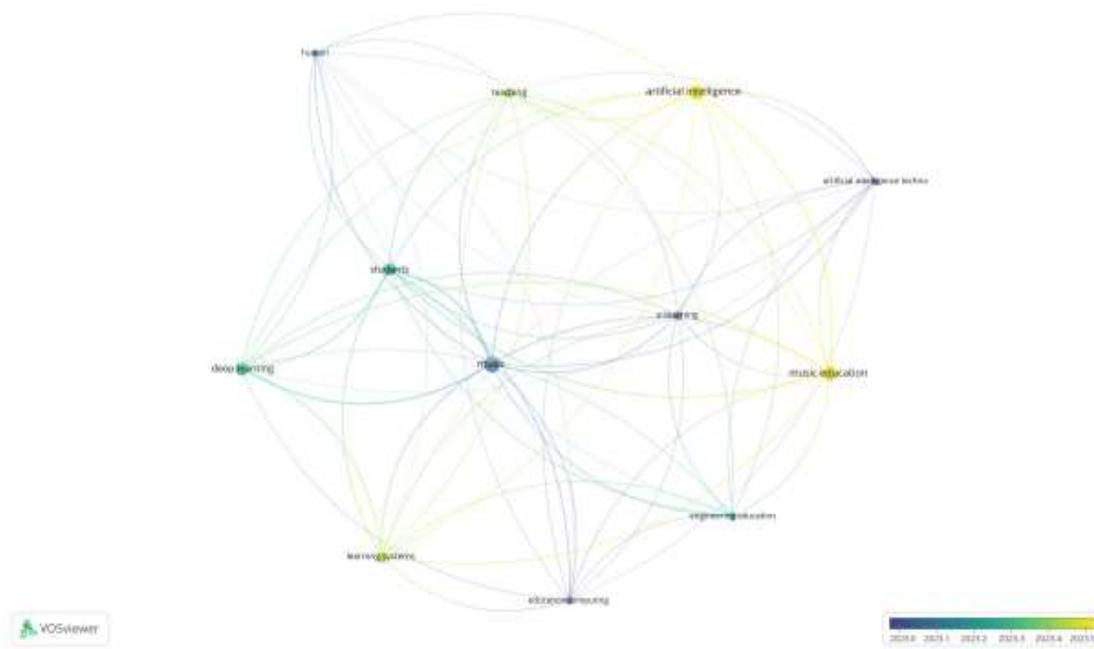
Table 4

Co-occurrence and Keyword Table

ID	Keyword	Occurrences	Total Link Strength
75	Artificial intelligence	90	199
83	Artificial intelligence technologies	24	93
354	Deep learning	74	203
434	E-learning	34	133
449	Education computing	26	124
508	Engineering education	27	122
665	Human	22	87
838	Learning systems	47	176
969	Music	107	320
987	Music education	91	231
1448	Students	64	244
1483	Teaching	40	162

Figure 4

Co-Occurrence and Keyword



In the first month of 2023, the research was focused on education computing and artificial intelligence techno. In the second month, the research focused on music, e-learning, and humans. In the third month, the research was focused on deep learning, students, and engineering education. In the fourth to sixth month, the research has shifted to music education and artificial intelligence.

Table 5

Citations and Document Table

document	citations
üzümcü (2024)	29
zhang (2024)	26
li (2024)	41
lv (2023)	32
yu (2023)	95
zhou (2023)	26
cui (2023)	36
hong yun (2022)	30
tang (2022)	23
wei (2022)	84
wang (2022)	31
dai (2021)	64
yang (2021)	32
du (2020)	23
pati (2018)	39

Highest citations were received by yu in 2023 with 95 citations.

Figure 5

Citations and Documents



Yu et al. argue that AI can make music education more personalized and effective by supporting intelligent instruments/software, online instruction, and autonomous learning tools (Yu et al., 2023). Yu and Zou discuss innovating music education through a blockchain-based digital platform (supported by AI), emphasizing blockchain's role in managing and sharing education resources more reliably (Yu & Zou, 2023).

Table 6

Citations and Authors Table

Author	Documents	Citations
Chen, Fan	2	7
Chen, Wei	2	17
Cheng, Lee	2	2
Dai, Dandan	2	76
Gong, Tianzhuo	2	1
Li, Huizi	2	33
Peter, J. Dinesh	2	28
Seng, Wenli	2	3
Shan, Xin	2	0
Slowik, Adam	2	8
Wang, Lei	2	13
Wang, Xin	2	21
Zhang, Chao	3	30
Zhang, Yiyao	3	27

Figure 6

Citations and Authors



Table 7

Citations and Organization Table

Organization	documents	citations
"beijing normal university, beijing, china"	3	27
"communication university of china, beijing, china"	5	39
"harbin university, harbin, china"	3	45
"hunan city university, yiyang, china"	3	44
"karunya institute of technology and sciences, india"	3	34
"nanjing university of the arts, nanjing, china"	3	21
"sangmyung university, jongno-gu, south korea"	3	2
"universiti malaya, kuala lumpur, malaysia"	3	14
"zhengzhou normal university, zhengzhou, china"	7	32

Figure 7

Citations and Organization



Table 8

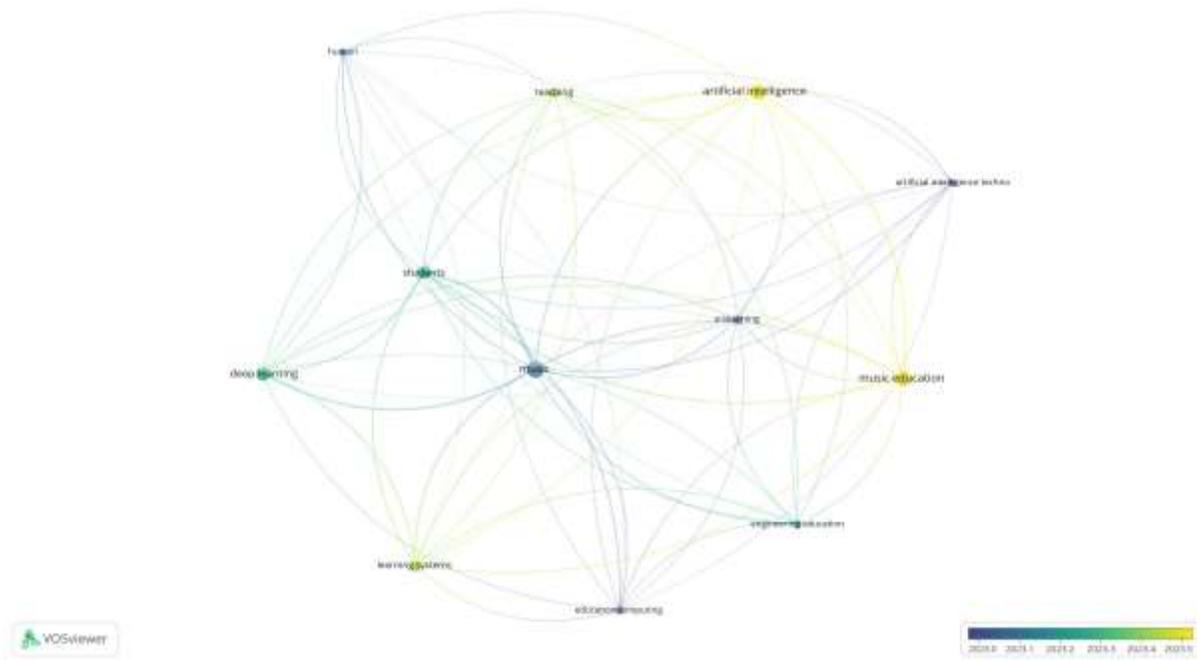
Co-occurrence and Keywords

“Music” had the highest occurrences, followed by “music education”, “artificial intelligence”, and “deep learning.

keyword	occurrences	total link strength
artificial intelligence	90	199
artificial intelligence technologies	24	93
deep learning	74	203
e-learning	34	133
education computing	26	124
engineering education	27	122
human	22	87
learning systems	47	176
music	107	320
music education	91	231
students	64	244
teaching	40	162

Figure 8

Co-occurrence and Keywords



Citations and author analysis

Last citation 76 according to Dai, Dandan, who tells about an intelligent music teaching model that moves via artificial intelligence technologies, including learning analytics and affective computing, to improve music education. The model focuses on individual assessment, responsive learning, and higher teaching efficiency to overcome the shortcomings of traditional methods of instruction (Dai, 2021).

The study designs an AI-mediated interactive instructional model of music performance, with the focus on new pedagogical practices, enhanced student interaction, and technological application to boost the level of music

education and nurturing of talents. The findings will lead to the improvement of the use of online intelligent human-computer systems in teaching music by filling existing gaps of traditional teaching methods (Zheng and Dai, 2022).

The paper discusses a distributed application system using AI and gesture interactive robots in music education, employing deep learning methods like DCCNN and two-stream CNN to enhance gesture recognition accuracy, ultimately improving student engagement in music perception teaching. Integration of artificial intelligence and gesture interactive robots can significantly enhance music perception education by providing multiple perception modes. (Zhang & Li, 2022)

The paper concludes that a large-scale online music education mechanism can be effectively driven by an edge cloud computing model. It emphasizes the construction of a deep learning music recommendation method that addresses the cold start problem in traditional recommendation systems (Xing et al., 2024).

Table 9

Citations and authors

Author	documents	citations	total link strength
"chen, fan"	2	7	0
"chen, wei"	2	17	0
"cheng, lee"	2	2	0
"dai, dandan"	2	76	0
"gong, tianzhuo"	2	1	0
"li, huizi"	2	33	0
"peter, j. dinesh"	2	28	0
"seng, wenli"	2	3	0
"shan, xin"	2	0	0
"słowik, adam"	2	8	0
"wang, lei"	2	13	0
"wang, xin"	2	21	0
"zhang, chao"	3	30	0
"zhang, yiyao"	3	27	0

Figure 9

Citations and Authors

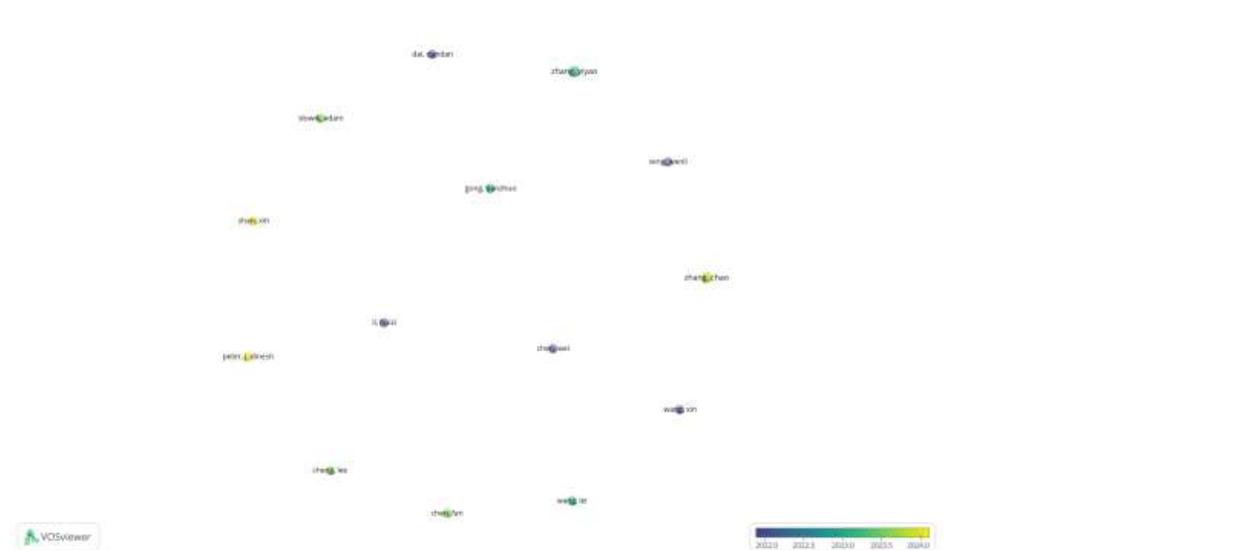


Table 10

Co-citations and cited authors

author	citations	total link strength
frontiers in psychology	6	1
plos one	9	1
proceedings - icassp	6	0

On the basis of co-citations and cited authors out of 647 authors 17 met the threshold. The minimum number of citations was taken as 6.

Figure 10

Density Visualization of co-citations and cited authors

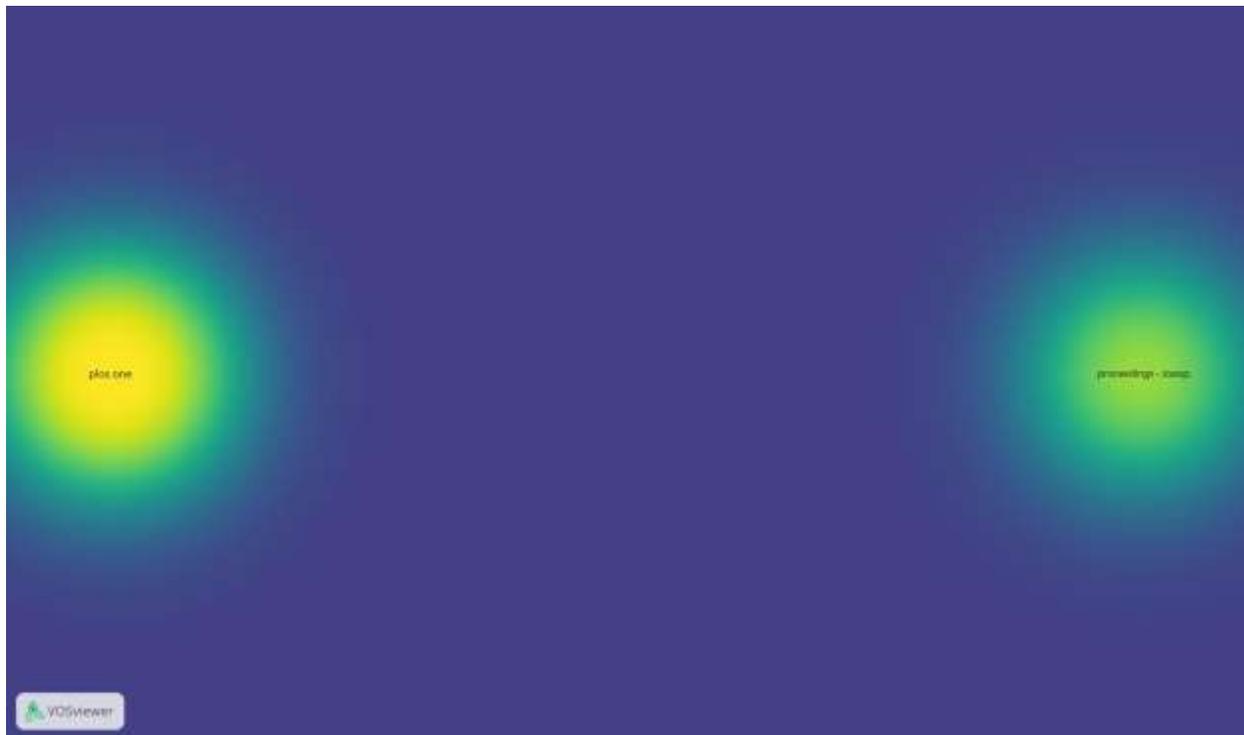


Table 11

Bibliographic Coupling and countries

country	documents	citations	total link strength
china	183	1235	246
india	5	118	56
malaysia	8	16	79
south korea	13	53	88
thailand	5	54	47
united states	5	52	4

Research Dynamics

Cross-cultural negotiation and learning are fostered by non-Western groups like Turkish and Afro-Caribbean groups, creating interstitial spaces where traditional music adapts and evolves. This fosters deep learning and a pluralistic approach to music education. Students from Western music backgrounds faced both learning difficulties and adaptation challenges when studying non-Western music styles, particularly in terms of aural learning methods. Indigenous educators created a context for culturally sensitive education, connecting classical and modern music (Biernoff & Blom, 2002). Ferm Thorgersen (2010) and others (2008) highlight the importance of relational dynamics between professors, trainees & content in quality learning. According to the didaktiktriangle model, deep learning is characterized by a relationship-based learning pattern that is dependent on the educational environment's quality of interactions. Learning is facilitated by embodied cognition, which employs natural body language and movement (Vass, 2018). DNNs are shown to be more effective than baseline models in terms of performance across all assessment criteria by using input representations at varying levels of abstraction. Also model analysis techniques are used to gain useful insights into the assessment process (Pati et al., 2018). A multi-institutional initiative utilizing reflection and collaboration to enhance one-to-one music instruction, improve teachers' professional competence, and promote deep learning among music students is discussed in the paper (Carey et al., 2018).

Conclusion

Based on Scopus-export data set containing 231 peer-reviewed journal articles published in 2002-2025, it is shown that the scholarly discussion on the topic of artificial intelligence (AI) and music education is not only growing steadily but is characterized by a noticeable and recent explosion. The large distribution of the output, 223 out of 231 publications in total, is concentrated in the 2021-2025 range where the peak is in 2024 (71 articles). This time contingency indicates that the research field is at an expansionary stage, at which normative formative, evidentiary, and theoretical debate are yet to be built. The review of the places of publication and the number of key words additionally show that the intellectual seriousness of the field is directed towards technical issues. The journals that the most often appear in the dataset are computational or engineering-oriented, and most keywords focus on AI methodologies, especially deep learning, and system-level concepts, including learning systems and e-learning, but also the name of a profession, namely music, and music education. As a result, the research is overly invested in the design and implementation of AI-powered learning tools and platforms provision of feedback, assessment, or content generation instead of conducting systematic reviews of the effects of education using longitudinal classroom research. Measures of affiliation show that there is an intense geographic concentration as authors based in China contribute the majority of the 231 papers (183) by comparison with relatively low input of authors based in South Korea and Malaysia and other regions are poorly represented. Even though this type of concentration is not harmful in itself, it implies some concerns of the external validity of findings. The different music pedagogy and classroom interactions, access to technology, and evaluation practices in various regions indicate that the outcomes and pedagogical instruments produced in one contextual setting might not be easily transferred to others without conscious contextual modification. Moving in the direction will necessitate harmonizing the technology invention and the validation. The evidence base should be strengthened in future studies with additional testing of AI tools in the context of authentic classroom learning, observation of learning curves over longer durations as opposed to the immediate results of learning, comparison of AI-enhanced instruction with non-AI controls, and concern of interpretability, bias, privacy, and agency in AI-mediated classroom learning. Overall, though the scientific base is growing at a significant pace and has managed to build a solid technical base, the subsequent step should justify the efficacy of interventions, define the conditions in which they are effective, and clarify the limitations of the real-life environment.

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