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Digital applications inject new vitality into art education—path analysis based on data of art teachers in basic education in China

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Introduction: This study investigates the current state of art education in China from the perspectives of teacher resource allocation and educational funding. The analysis reveals significant challenges, including a low proportion of highly qualified teachers, imbalances in professional disciplines, and uneven geographical distribution of faculty. Furthermore, disparities in per-student funding, with some provinces falling below the national average, are attributed to uneven economic development and varying student populations in basic education. To bridge the "teacher resource gap" and promote educational equity, this research explores the potential of a comprehensive digital education model to enhance teaching quality and foster equality.

Methods: A mixed-methods approach was employed, integrating literature review, policy analysis, and the interpretation of educational statistical reports. The study utilized surveys, the Delphi method, and the Analytic Hierarchy Process (AHP) to evaluate the current status and advantages of digitalization in basic art education. An evaluation framework based on the CIPP model was constructed, analyzing four dimensions: teaching resource allocation (X1), foundational teaching environment (X2), instructional process implementation (X3), and teaching effectiveness evaluation (X4). Expert authority was assessed, and an indicator weighting system was established.

Results: The expert authority coefficient (Cr) was determined to be 0.632, indicating a high level of reliability. The weighted evaluation indicator system was formulated as $\bar{Y} = 0.35X_1 + 0.15X_2 + 0.22X_3 + 0.28X_4$. The overall mean score for the surveyed subjects was $\bar{Y} = 2.726$. A comparative analysis between traditional and digital schools showed that Digital Demonstration School A achieved $\bar{Y} = 2.721$ (82.5 on a 100-point scale), while School B scored $\bar{Y} = 2.715$ (78.25 on a 100-point scale).

Discussion: The results indicate that the implementation of digitalization has a demonstrably positive effect on the development and advancement of basic art education. The higher scores in digitally-equipped schools suggest that comprehensive digital models can effectively mitigate existing resource disparities and improve educational outcomes. Based on these findings and the current context of educational development, this study proposes a series of targeted and rational recommendations for policy-makers and educational institutions to further leverage digital technology in promoting equitable and high-quality art education in China.

KEYWORDS

digital basic education, basic education, art education, teacher resources, educational equity

1 Introduction

The 2024 Chinese government work report proposes to strengthen the construction of a high-quality education system and adhere to high-quality development as the lifeline of education at all levels and types. Under the demand for high-quality education development, the optimization of educational resource allocation, scientific management of educational processes, and the verification and effectiveness of educational achievements are the main aspects of educational development. The level of basic education is often an important indicator of a country's comprehensive national strength and a necessary path to improving the overall quality of its citizens. The basic education stage is a critical period for children's character formation, habit formation, and intellectual development. The quality of education at this stage directly affects children's future learning ability and quality of life.

Basic art education plays an important role in improving the overall quality of the nation and cultivating innovative talents. With the continuous deepening of education system reform, the allocation of resources and the construction of teaching staff in basic art education have gradually become the central issues of concern for education management and academia. At present, China's basic art education is facing unbalanced and insufficient challenges in terms of teacher resource allocation, teaching quality, and regional balanced development, which limit the pace of comprehensive progress in art education.

1.1 Analysis of the imbalance in resource allocation of Chinese art education teachers

In the education statistics data of the Chinese Ministry of Education for 2022 and 2023, based on the statistical information of primary, middle, and high school education from multiple dimensions such as basic education teacher education background, teacher resource distribution, teacher education discipline, and school education level, it can be seen that higher undergraduate education is an important educational stage for basic education teachers, the proportion of high-level teachers with education background in basic education teachers is relatively low, the number of art teachers in compulsory education gradually decreases with the increase of education level, and the regional distribution of education teachers is relatively uneven.

1.1.1 Uneven proportion of teacher education

In the education statistics of the Chinese Ministry of Education in 2022 and 2023, the proportion of teachers with doctoral degrees in primary, junior high, and high school education will decrease from 0.011 to 0.008%; The proportion of people with a master's degree has increased from 3.780 to 4.218%; Undergraduate education remains the main source of teachers in the art category of basic education, increasing from 78.637 to 81.709%; The proportion of vocational education has decreased from 16.900 to 13.655% (Tables 1, 2). From the analysis of this data, it can be seen that undergraduate education in higher education is still the main source of teachers for basic education; the number of teachers with higher and master's degrees is on the rise, but the proportion is still very small. In the absence of higher education in basic education, the improvement of research abilities still needs to wait for a teacher team with higher education to be enriched.

TABLE 1 Analysis of the national teacher education proportion in 2022.

Diploma	Population	Total number of teachers	Percentage
Doctor's Degree	200	17,51,261	0.0114%
Master's Degree	66,206		3.7805%
Under-graduate	13,77,144		78.6373%
Associate Bachelor	2,95,961		16.8999%
High School Graduate	11,625		0.6638%
Below High School Graduate	125		0.0071%

Unit: Person.

TABLE 2 Analysis of the national teacher education proportion in 2023.

Diploma	Population	Total number of teachers	Percentage
Doctor's degree	157	18,84,927	0.0083%
Master's degree	79,513		4.2184%
Under-graduate	14,50,161		81.7092%
Associate bachelor	2,57,389		13.6551%
High school graduate	7,591		0.4027%
Below high school graduate	116		0.0006%

Unit: Person.

TABLE 3 Analysis of the proportion of three major art teachers in basic education in 2022.

Subject	Number of teaching staff	Total number of art teachers	Percentage
Art	5,48,021	17,51,261	31.2929369%
Fine Arts	4,55,968		26.0365531%
Music	7,47,272		42.6705100%

Unit: Person.

1.1.2 Uneven proportion of teaching staff and disciplines

From the perspective of professional disciplines, in the 2022 statistical data, the proportion of primary school art teachers is about 26.037% of the total number of art teachers, and the proportion of art teachers is relatively high; There are many art

teachers in junior high school; Although music teachers account for approximately 42.671% of the total number, their distribution in schools at different stages is relatively low. In 2023, the proportion of art teachers will increase from 31.293 to 50.155%, the proportion of music teachers will decrease from 42.671 to 25.296%, and the proportion of art teachers will decrease from 26.037 to 24.549% (Tables 3, 4), and there will be a phenomenon where art teachers are the main force in primary, middle, and high schools. From the data of the past 2 years, we can clearly see the phenomenon of unreasonable professional allocation structure in basic education (Wang and Yan, 2024).

1.1.3 Uneven distribution of teaching resources

From the distribution of basic education teacher resources in the past 2 years, the number of teachers in urban areas has increased from 43.548 to 44.710% of the total, the number of teachers in towns has increased from 38.592 to 39.504%, and the number of teachers in rural areas has decreased from 16.913 to 15.786% (Table 5). There is a significant gap in the distribution of teacher resources. The reason for the gap between the number of rural teachers and urban teachers may be related to China's urbanization process. This issue also has a certain universality in developing countries. Firstly, in the process of urbanization, a large number of rural population flows into cities, which changes the urban-rural population structure and may lead to a decrease in the number of students in rural schools, thereby reducing the demand for rural teachers. Secondly, in the process of urbanization, the economic development of urban areas is usually faster than that of rural areas. Cities can provide higher salaries and better working conditions, which makes it difficult for rural areas to attract and retain excellent teachers. Again, with the development of urbanization, high-quality educational resources (such as modern teaching facilities, more training opportunities, etc.) are often concentrated in cities, and the recruitment and training system for teachers may be more inclined toward cities, making cities the preferred place for teacher career development.

1.1.4 Unequal distribution of teacher education levels and stages

From the perspective of schools, the proportion of art teachers in primary schools has increased from 64.869 to 65.871%, while the proportion of art teachers in junior high schools has decreased from 25.699 to 25.010%. The proportion of art teachers in high schools has decreased from 9.432 to 9.120% (Table 6), and there is also a significant gap in the proportion of professional teachers. The sharp decrease in high school art teachers can be clearly seen from the data, which may be related to the curriculum design during the high school education stage. Schools tend to focus more on preparing for the college entrance examination, and students and parents generally prefer to choose subjects directly related to the exam. Art education is often positioned as part of interest cultivation or quality education, rather than professional education, so its position and proportion in the entire education system are relatively light.

TABLE 4 Analysis of the proportion of three major art teachers in basic education in 2023.

Subject	Number of teaching staff	Total number of art teachers	Percentage
Art	9,45,387	18,84,927	50.1550988%
Fine Arts	4,62,738		24.5493857%
Music	4,76,802		25.2955154%

Unit: Person.

TABLE 5 2022–2023 basic situation of art teachers' educational background in China basic education.

—	2022		2023	
	Total number of teachers	Percentage	Total number of teachers	Percentage
Total	17,51,261	—	18,84,927	—
Urban area	7,62,636	43.55%	8,42,742	44.71%
Counties and towns area	6,92,430	39.54%	7,44,623	39.50%
Rural area	2,96,195	16.91%	2,97,562	15.79%

Unit: Person.

TABLE 6 Analysis of teacher proportion in the three major education levels of basic education in 2022–2023.

Educational level	2022		2023	
	Total number of art teachers 17,51,261	Percentage	Total number of art teachers 18,84,927	Percentage
Primary education	11,36,019	64.87%	12,41,613	65.87%
Junior secondary education	4,50,062	25.70%	4,71,412	25.01%
Regular senior secondary education	1,65,180	9.43%	1,71,902	9.12%

Unit: Person.

1.2 Distribution of education funds

The comprehensive reform of basic education is the key link to comprehensively deepen the reform and promote Chinese path to modernization. In the process of systematic, holistic, balanced, fair, intelligent, and open education, as well as quality oriented and connotative development, educational resources have always been integrated into China's basic education (Chen and Li, 2024). Educational resources not only include traditional educational resources and human resources, but also digital educational resources, environmental and facility resources, policy and institutional resources, special education resources, etc. This time, according to the seven geographical regions of East China, North China, Central China, South China, Southwest, Northwest, and Northeast China, one province was selected from each region for the analysis of education funding. Through data analysis, it can be seen that there is also a significant gap in education funding between provinces, which has led to a balanced distribution of educational resources in education.

There is a significant gap in education funding investment in China (Ni et al., 2014). Economically developed provinces such as Guangdong and Jiangsu have high GDP and sufficient fiscal revenue, allowing them to invest more funds in education. In basic education, education funding in each province is not only related to the local economy, but also to the number of local students. It can be seen from the general public budget education funding for ordinary students in 2021, 2022, and 2023 that some provinces such as Henan, Hebei, Shaanxi, and Sichuan (Tables 7–10) have budgets per student that do not meet the national average requirements. To reduce regional disparities in education funding and achieve the goal of equalization of education services, it is necessary to promote regional economic growth, strengthen central financial investment in education in the central and western regions of the country, improve the comprehensive economic and social environment in these regions (Ni et al., 2014), and Macro adjustment student education funding.

TABLE 7 Provincial general public budget education funds.

	2021	2022	2023
Shan Xi Province	1,033.68	1,052.34	1,090.22
Si Chuan Province	1,741.24	1,856.26	1,929.1
Jiang Su Province	2,505.13	2,544.33	2,636.93
He Bei Province	1,621.01	1,754.6	1,802.24
Liao Ning Province	707.79	743.18	736.64
He Nan Province	1,743.09	1,845.65	1,939.85
Guang Dong Province	3,793.37	3,863.13	3,965.57

Unit: 100 million Yuan.

2 Research status

China's education is undergoing a rapid transformation from traditional knowledge transmission to comprehensive literacy cultivation. As an internationally recognized mature education evaluation system, the CIPP model has shown significant results in many countries. There is now a theoretical framework based on the CIPP model (background, input, process, outcome evaluation), which constructs a multi domain education evaluation index system, uses methods such as analytic hierarchy process, emphasizes the participation and monitoring of multiple subjects in the dynamic evaluation of the entire process, studies and solves the problems of single and fragmented evaluation, and achieves the optimization of education decision-making and process improvement using the CIPP model.

At present, research on the application of the CIPP model in China is related to Yang Tiantian (Yang et al., 2025) the construction of an evaluation index system for the integration of industry and education in vocational colleges, which involves the participation of multiple parties such as the government, schools, and society; Hou (2015) stated that the evaluation of vocational courses should cover the entire cycle of "development implementation results"; Yu et al. (2025) Research on labor education and traditional cultural education focuses on the evaluation system of labor education curriculum in primary and secondary schools and the construction of excellent traditional cultural education in China, forming an evaluation index system to optimize curriculum leadership decision-making; (Ma, 2021) Interdisciplinary research on optimizing resource allocation and improving project implementation effectiveness; Tan and Jiang (2022) focused on the issue of uneven regional economic and educational development, pointing out that basic education in rural and remote areas has always been a key focus of the Chinese government. They proposed strategies for balanced resource allocation, teacher training, and technological integration, strengthening regional collaboration, and optimizing resource allocation strategies

There are still some problems and learning needs for teachers in China, such as the desire to obtain knowledge and skills related to curriculum reform, improve and update technology assisted teaching skills, enhance teaching, and learn knowledge and skills related to teaching modes, methods, and strategies (Li and Dong, 2025), in order to serve the improvement of teachers' teaching abilities (Gu Xiaoqing, 2024).

Through literature review, it is found that the reform of digital teaching applications is an inevitable trend, and there is still a lack of research on the evaluation system for digital applications in basic art education. This study aims to improve the quality of art education and balance educational resources by studying the digitization of basic art education and increasing its coverage.

3 Digital equity: a catalyst for educational fairness

There may be some problems in the implementation of digital education, such as the vast amount of information and knowledge selection and the widespread problem of erroneous information cognition (Bo and Ruiji, 2024), but the gap in educational teachers can be adjusted and balanced to some extent through

TABLE 8 General public budget education funding per primary school student.

—	2021	2022	2023
	Ordinary primary school	Ordinary primary school	Ordinary primary school
National	12,380.73	12,791.64	13,057.14
Shan Xi Province	9,719.02	10,557.45	10,805.98
Si Chuan Province	11,418.09	11,546.53	11,156.46
Jiang Su Province	15,420.14	15,497.6	15,889.44
He Bei Province	7,099.14	7,339.47	7,611.08
Liao Ning Province	11,777.31	12,237.31	12,652.03
He Nan Province	13,495.17	13,418.12	13,633.54
Guang Dong Province	14,903.38	14,942.65	14,995.71

Unit: Yuan.

TABLE 9 General public budget education funding for ordinary junior high school students.

—	2021	2022	2023
	Ordinary junior high school	Ordinary junior high school	Ordinary junior high school
National	12,380.73	12,791.64	13,057.14
Shan Xi Province	9,719.02	10,557.45	10,805.98
Si Chuan Province	11,418.09	11,546.53	11,156.46
Jiang Su Province	15,420.14	15,497.6	15,889.44
He Bei Province	7,099.14	7,339.47	7,611.08
Liao Ning Province	11,777.31	12,237.31	12,652.03
He Nan Province	13,495.17	13,418.12	13,633.54
Guang Dong Province	14,903.38	14,942.65	14,995.71

Unit: Yuan.

TABLE 10 General public budget education funding for ordinary high school students.

—	2021	2022	2023
	High school	High school	High school
National	12,380.73	12,791.64	13,057.14
Shan Xi Province	9,719.02	10,557.45	10,805.98
Si Chuan Province	11,418.09	11,546.53	11,156.46
Jiang Su Province	15,420.14	15,497.6	15,889.44
He Bei Province	7,099.14	7,339.47	7,611.08
Liao Ning Province	11,777.31	12,237.31	12,652.03
He Nan Province	13,495.17	13,418.12	13,633.54
Guang Dong Province	14,903.38	14,942.65	14,995.71

Unit: Yuan.

digitization. In the current process of art education, in addition to the need to integrate the construction of teaching staff (Wang and Chin Nyuk, 2024), there are also situations such as limited educational resources, single teaching methods, and insufficient practical opportunities (Kunpeng, 2024), which can be balanced to a certain extent through digitization.

3.1 Establishment of CIPP evaluation model

The CIPP evaluation model mainly includes four parts: context evaluation, input evaluation, process evaluation, and product evaluation. Through the evaluation of the digital application of educational resources, the goal of achieving teacher balance is proposed. This study is based on the CIPP evaluation model and the basic elements that constitute educational activities in modern teaching theory (Tang, 2017). The evaluation of digital application of educational resources is divided into four aspects: teaching environment foundation, teaching resource allocation, teaching process implementation, and teaching effectiveness evaluation.

The assessment of teaching environment foundation is a diagnostic evaluation of the needs, obstacles, resources, and opportunities of digital applications, including defining the teaching implementation environment, student learning situation, teacher literacy, student psychology, etc., analyzing potential learning obstacles, clarifying the resources and support required to achieve specific teaching goals, selecting appropriate teaching opportunities, and evaluating the adequacy of achieving teaching goals (Xie et al., 2017). Through such assessments, decision-makers can clarify the gap between teaching objectives and actual impact based on a comprehensive understanding of the necessary background factors and the overall situation of the assessment subjects in digital application education, and make appropriate adjustments accordingly.

The allocation of teaching resources is the foundation and necessary condition for evaluating the human resources and implementation of digital utilization of basic education resources. Evaluation can be conducted from the aspects of student learning foundation, teacher teaching foundation, teaching management, and resource guarantee, which can comprehensively detect the real situation of digital utilization of educational resources.

The implementation of the teaching process is a diagnosis of the digital application evaluation of basic educational resources, mainly including student behavior, teacher behavior, and teaching content. By recording various problems that arise during the teaching process and the ways and methods to solve them, adjusting the teaching plan, and recording the teaching process.

Teaching effectiveness evaluation belongs to outcome evaluation, mainly including student ability cultivation, teaching effectiveness, and reproducible. Through the judgment of teaching effectiveness, actual value, and adjustment of teaching plans, the

TABLE 11 Digital application evaluation indicators in the field of basic art education.

Index classification	First level dimension	Secondary dimension
Context evaluation	Fundamentals of teaching environment	Student learning situation
		Teacher quality
		Student psychology
		Teaching environment
Input evaluation	Allocation of teaching resources	Learning based
		Teaching fundamentals
		Resource security and management
Process evaluation	Implementation of teaching process	Student behavior
		Teacher behavior
		Content of courses
Result evaluation	Evaluation of teaching efficiency	Student ability cultivation
		Teaching effectiveness
		Reproducible

reproducible of digital application evaluation of basic education resources is tested, which is the core of evaluation application.

3.2 Construction of evaluation mode

Based on the establishment of the CIPP evaluation model, this study designed an evaluation outline from four aspects: teaching environment foundation, teaching resource allocation, teaching process implementation, and teaching effectiveness evaluation. Ten education experts were selected, including five experts or researchers from universities and five executive teachers in basic education. Through literature review and learning of the CIPP evaluation model, specific evaluation content for the secondary dimension was initially constructed (Table 11).

In order to improve the evaluation indicators of digital applications in the field of basic art education, a survey was conducted through the questionnaire star method on 10 university experts and researchers, as well as 15 primary, middle, and high school teachers with experience in digital resource education from the front line of basic education. The main focus was on the rationality and modification of the first and second dimensions, evaluation points, and familiarity with the evaluation content. The observation points were increased from 43 to 59, and then further modified through research to 68. After the opinions of experts, the student learning situation project has been added, and the student development has been changed to student ability cultivation, and the promotion has been changed to reproducible, officially forming the digital application evaluation indicators in the field of basic education (Table 12).

The coefficient of expert authority (CR) is a quantitative indicator used to measure the level of authority of experts in a certain field. Used to determine the eligibility of experts to participate, evaluate the reliability of expert opinions, and guide the decision-making process. In the process of research and modification, the expert authority coefficient (Cr) is determined by the basis for expert judgment of the problem (Ca) and familiarity level (Cs) [$Cr = (Ca + Cs)/2$, $Cr \geq 0.6$ indicates reliable rating]. In this survey, $Cr = 0.632$, and the three expert authority coefficients (Cr) showed an upward trend ($0.667 > 0.641 > 0.632$), indicating that the credibility of the expert consultation results is high; the average value of the three items gradually increased ($0.4291 > 0.4141 > 0.4038$; $0.9055 > 0.8701 > 0.8600$), indicating that each indicator gradually became reasonable. The convergence of expert opinions is represented by the coefficient of variation CV ($CV = S/M$, where S and M represent standard deviation and mean, respectively). The smaller the value, the higher the consistency of expert opinions (Wang et al., 2020). After three rounds of investigation and evaluation, the coefficient of variation (CV) gradually decreased ($0.072 > 0.068 > 0.0604$; $0.0252 > 0.0248 > 0.0224$), indicating that expert opinions are gradually becoming unified (**The recruitment period for this study starts on August 25, 2024 and ends on January 1, 2025. Participants provided informed consent forms).**

In order to better ensure the rationality and feasibility of the indicator system construction, this study used the Likert 5-point scale to determine the identification survey questionnaire and conducted research on the evaluation indicators of digital applications in the field of basic education. A total of 250 questionnaires were distributed in this round, including 50 from university experts, 25 from teaching and research staff, 175 from executive teachers in basic education, and 241 questionnaires were collected after excluding invalid questionnaires. From the chart, it can be seen that university experts, teaching and research staff, and basic teachers hold a positive attitude toward the evaluation indicators of digital applications in the field of basic education, with a relatively high degree of agreement and strong agreement (Table 13). (**The recruitment period for this study starts on August 25, 2024 and ends on January 1, 2025. Participants provided informed consent forms)**.

The Analytic Hierarchy Process (AHP) is a decision analysis method that combines qualitative and quantitative methods. By decomposing the decision-making problem into multiple levels and factors, quantifying and analyzing each factor, the weight and priority of the decision-making solution can be obtained. By using the Analytic Hierarchy Process (AHP) to test various indicators, 12 experts (including 8 university experts or researchers and 4 executive teachers) who use digital applications in the teaching field were selected. If the CR value is less than 0.1, it is generally considered to have high consistency. After verifying that the scores of two experts did not pass the consistency test, the number of valid evaluators is 10 (Table 14).

By testing the expert weighting results, the weight coefficients for the four dimensions of teaching resource allocation (X_1), teaching environment foundation (X_2), teaching process implementation (X_3), and teaching effectiveness evaluation (X_4) were determined to be 0.3524, 0.1494, 0.2182, and 0.2801,

TABLE 12 Digital application evaluation indicators in the field of basic art education.

Index classification	First level dimension	Secondary dimension	Observation
Context evaluation	Fundamentals of teaching environment	Student learning situation	Students are curious about digital technology and have a high enthusiasm for learning.
			Being able to quickly master some basic numerical skills.
			Students have the basic ability to learn new knowledge and can use digital resources to preview new lessons.
			Students have a willingness to learn in a digital environment and are confident in the new knowledge they are about to learn.
			Students are willing to increase opportunities for digital teaching platform operation and situational experience, and believe that this is more conducive to self-directed learning.
		Teacher quality	Teachers have solid subject knowledge and teaching skills, such as being able to clearly explain the basic concepts, theories, and knowledge systems of the subject.
			Teachers can comprehensively use traditional technology (blackboard, chalk, slide), information technology (multimedia, Internet, computer) and digital intelligence technology (big data, cloud computing, virtual reality, learning analysis, artificial intelligence, etc.) for teaching.
			Pay attention to the latest research achievements in the digital field, constantly update the knowledge system, and improve one's own abilities in application.
			Be brave to try innovative teaching methods, stimulate students' interest in learning and creativity.
		Student psychology	Interest and curiosity in digital technology.
			Maintain a positive attitude toward digital education and be willing to invest time and effort in learning.
			Students have the willingness to actively utilize digital resources for learning.
			Learning numbers helps stimulate students' learning motivation and improve learning efficiency.
		Teaching environment	A united, supportive, and positive learning atmosphere is conducive to optimizing students' psychological environment.
			Equipped with advanced teaching equipment such as high-performance computers, intelligent projectors, and interactive whiteboards, the classroom has a good network signal.
			The classroom is clean and tidy, with tables and chairs that can move freely. It adopts an open or semi open layout and has intelligent adjustment functions.
			The classroom is equipped with a variety of digital teaching software and programming tools.
			The classroom layout is reasonable and meets the safety needs of students, such as electrical safety, fire safety, etc.
			Teachers can treat every student equally and get along well with them.
Input evaluation	Allocation of teaching resources	Learning based	Students are able to utilize online resources for self-directed learning and are familiar with online learning platforms and tools.
			The school has a rich library of synchronized course resources, and students can choose their own preview materials.
			A good learning environment and facilities, such as computer laboratories, libraries, etc.
			The preview tasks assigned by teachers are of moderate difficulty, and students can use digital resources to independently complete or collaborate with classmates to acquire corresponding knowledge.
		Teaching fundamentals	The school has intelligent learning resources, and teachers can carry out teaching design based on big data, learning analysis, etc.
			The teaching design of teachers reflects the concept of core competencies in the subject, with clear teaching objectives, key and difficult points, and a complete and logical teaching process.
			Teachers can proficiently choose different teaching strategies based on the analysis results of intelligent data, promoting personalized learning for students.
		Resource security and management	Pay attention to the combination of software and hardware, and improve the application level of information resources.
			The intelligent equipment, Internet and digital teaching platform software configured in the digital classroom can operate normally.

(Continued)

TABLE 12 (Continued)

Index classification	First level dimension	Secondary dimension	Observation
			We have established a comprehensive teaching management system, including teaching management, student management, teacher management, etc., to ensure the orderly conduct of teaching activities.
			Teachers can check and prepare necessary teaching materials according to the teaching design, such as experimental materials and multimedia equipment that will be used soon.
			A teaching quality monitoring system has been established to regularly evaluate the teaching process and outcomes, ensuring the quality of teaching.
			Teachers can use digital teaching platforms to stimulate students' learning enthusiasm, making them feel happy and relaxed.
Process evaluation	Implementation of teaching process	Student behavior	Students have shown high interest and enthusiasm for digital education, believing that digital technology has broad development prospects and strong learning motivation.
			Students are able to clearly perceive the goals and content of classroom teaching.
			Students can solve problems related to classroom content on the basis of teacher guidance and intelligent learning.
			Students can allocate their study time reasonably to ensure the learning effectiveness of digital courses.
			Students are able to engage in collaborative learning and acquire comprehensive and cutting-edge knowledge.
			Students are able to take digital courses seriously and actively participate in classroom discussions and practical operations.
			Students are able to actively provide feedback to teachers on the problems encountered during the learning process, promoting mutual growth between teaching and learning.
			Students can experience a sense of achievement in mastering knowledge in the digital classroom.
		Teacher behavior	Teachers can fully prepare teaching content, including lesson plan design, courseware production, case collection, etc., to ensure the smooth progress of teaching activities.
			During classroom teaching, the teaching instructions issued by teachers through digital teaching platforms are clear and executable.
			Teachers can use diverse teaching methods, such as case analysis, project driven, flipped classroom, etc, to stimulate students' interest and participation in digital courses.
			During classroom teaching, teachers can pay attention to students' learning needs expressed through digital teaching platforms and provide opportunities for students to express, question, and respond.
			During the classroom teaching process, teachers can provide appropriate guidance on acquiring learning methods and inspiring problem-solving ideas.
			In the process of classroom teaching, teachers can maintain a learning atmosphere, maintain classroom order, and provide timely feedback on students' problems.
			In the process of classroom teaching, teachers should correctly utilize the auxiliary functions of digital teaching platforms without increasing students' learning burden in the classroom.
		Content of courses	The selection of teaching content not only closely follows the core concepts of the subject, but also is closely related to daily life and has fun.
			The design of teaching content closely follows the key and difficult points of teaching.
			Diversified teaching content, adding cutting-edge subject knowledge that reflects the characteristics of the times on the basis of textbook content.
			The teaching content includes the cultivation of professional ethics, teamwork, communication skills and other professional qualities, and the development of students' learning adaptability.
Result evaluation	Evaluation of teaching efficiency	Student ability cultivation	The students' grades have improved.
			Students have developed a consciousness of lifelong learning.
			Students have acquired knowledge through digital education, laying a theoretical foundation for their future learning and development.
			Students keep up with the latest technologies and developments in the digital field, and have strong learning and adaptability abilities.
			Students demonstrate innovative consciousness in their learning practice.

(Continued)

TABLE 12 (Continued)

Index classification	First level dimension	Secondary dimension	Observation
			Students have developed integrity, sense of responsibility, and teamwork spirit during the learning process, demonstrating high self-management abilities.
			Students are able to think independently when solving problems.
			Students' expression and communication skills have been exercised.
			Students' information literacy has been improved.
		Teaching effectiveness	The learning content presented in the digital classroom is of moderate difficulty.
			The process of digital classroom teaching can continuously attract students' attention and greatly increase their classroom participation.
			The teaching content covers the core knowledge learned.
			Improved students' practical and innovative abilities.
		Replicability	Digital education has strong universality.
			The digital classroom teaching path and mode can be promoted and applied.
			The sustainable development of artificial intelligence education.
			The digital classroom teaching mode has been well received by students.

respectively. The expression for the evaluation index system of digital applications in the field of basic education obtained is $Y = 0.35X_1 + 0.15X_2 + 0.22X_3 + 0.28X_4$ (rounded to two decimal places). (**The recruitment period for this study starts on August 25, 2024 and ends on January 1, 2025. Participants provided informed consent forms**).

4 Verification of digital application evaluation index system for basic art education based on CIPP evaluation model

In order to further verify the scientific nature and effectiveness of the digital application evaluation system for basic art education, this study selected two high schools and developed a questionnaire based on the "Digital Application Evaluation Indicators for Basic Art Education". The questionnaire mainly surveyed the digital effects of art education from four dimensions and a small scope. The questionnaire uses a Likert 5-point scale to rate 68 observation points, with higher scores indicating more advantageous digital applications.

4.1 Analysis of survey subjects and overall level

This study selected two high schools, one is a digital education school (referred to as A school) and the other is a non-digital education school (referred to as B school). The main teaching content tested in the compulsory course of "Music Appreciation" in the ninth grade textbook "Music" published by People's Education Press for ordinary high schools. A total of 100 questionnaires were distributed in this round of survey, and 100 valid questionnaires were collected, including 50 from A school and 50 from B school, with a questionnaire collection rate of 100%.

According to the evaluation index system $Y = 0.35X_1 + 0.15X_2 + 0.22X_3 + 0.28X_4$, the weighted mean Y is obtained by adding the product of the weight coefficients and the corresponding dimension mean. Y is used to measure the performance of the digital application evaluation system for basic art education.

After calculation, the overall Y score of the survey subjects is 2.726 (with 3 decimal places), which is converted to 82.65 on a percentage scale. It is preliminary believed that the overall situation of the digital application evaluation system for basic art education is good. The scores for each dimension of A school are 2.804, 2.705, 2.771, and 2.606, respectively, while the scores for each dimension of B school are 2.845, 2.706, 2.706, and 2.602, respectively (Table 15). From the data, it can be clearly seen that A school has relatively high scores in teaching resource allocation and teaching process implementation, indicating that there is still a lot of room for improvement in the two dimensions of teaching environment foundation and teaching process implementation.

4.2 Differential analysis

This time, the use of digitalize in schools was tested using an equal number of samples T from the same grade level in different schools, and the current situation of using digitalize in basic art education was examined. As shown in the data (Table 15), as a digital demonstration school A, the average Y is 2.721, which is equivalent to 82.5 points on a hundred point scale and has reached a good level; B school Y average = 2.715, converted to 78.25 points on a percentage scale. This indicates that digitalize has a certain impact on the development and promotion of basic art education. From the data, it can be seen that there is still a lot of room for

TABLE 13 Identification of digital application evaluation indicators for basic art education.

	Strongly agree	Identification	Neutrality	Disagree	Strongly disagree
University experts	30.00%	62.00%	8.00%		
academic staff	28.00%	52.00%	20.00%	8.00%	
Basic teacher	37.95%	46.39%	14.46%	1.20%	

TABLE 14 Expert empowerment results.

Expert	Teaching resource allocation X_1	Teaching environment foundation X_2	Teaching process implementation X_3	Teaching effectiveness evaluation X_4	CR
Expert 1	0.3217	0.1379	0.2395	0.3009	0.0407
Expert 2	0.3251	0.2421	0.1873	0.2455	0.0638
Expert 3	0.3305	0.1062	0.2570	0.3064	0.0018
Expert 4	0.3737	0.1100	0.2302	0.2861	0.0460
Expert 5	0.2716	0.1631	0.2818	0.2834	0.0737
Expert 6	0.3600	0.1345	0.2197	0.2857	0.0707
Expert 7	0.3737	0.1473	0.2163	0.2628	0.0077
Expert 8	0.3894	0.1540	0.1987	0.2580	0.0626
Expert 9	0.3798	0.1418	0.1676	0.3108	0.0840
Expert 10	0.3987	0.1565	0.1838	0.2610	0.0773
Average	0.3524	0.1494	0.2182	0.2801	—

improvement in the implementation convenience of non-digital basic art education in the teaching process. The reason may be due to the lack of digital educational concepts, insufficient attention to digital teaching methods and digital education, and a tendency to rely more on textbooks and knowledge sorting in the implementation process, which cannot effectively enhance students' consciousness and attractiveness in absorbing knowledge, and also leads to relatively low scores in teaching effectiveness evaluation.

The difference in the allocation of teaching resources and environmental foundations may be due to the lack of a new model of digital education. In order to better integrate and allocate teaching resources, the breadth and depth of traditional teaching resources have been increased, which may lead to an increase in teaching difficulty and make students learn more content, making learning more difficult. Teachers may engage in the phenomenon of "cramming" and "lecturing" in order to complete teaching tasks in the classroom, leading to a lack of cultivation of students' autonomous learning and innovation abilities.

Digital education has certain advantages over traditional education models in many places. In the process of digital education, enriching teaching content and innovating teaching methods (Shengchuan and Zhangluo, 2025) and changing (Wei et al., 2025) can optimize teaching resources (Gaofeng, 2025). Of course, this requires teachers to master advanced digital technology (Feng, 2024), and the state, society, and schools to build intelligent platforms (Yingling and Shiyu, 2024) to ensure sufficient teaching resources and teaching quality (Xie, 2024).

Previous studies have shown that digital teaching has better teaching effects compared to traditional teaching, such as expanding the coverage of art education (Shuai, 2023), enhance the comprehensiveness of art (Yong, 2023) and interdisciplinary knowledge and skills (Shanshan, 2023), improving the quality of art education (Pereverzeva Marina et al., 2021), and enhancing students' artistic design creativity (Jianhui, 2024). Compared with existing research results, this study is consistent with existing research findings.

Overall, the results presented in this questionnaire are consistent with the actual investigation of the digital application evaluation indicators for basic art education, indicating the feasibility and effectiveness of the digital application evaluation indicator system for basic art education based on the CIPP framework.

5 Summarize

This study is based on the CIPP evaluation model and has initially constructed digital application evaluation indicators in the field of basic art education. The indicator system has been revised and weighted through survey methods, Delphi method, analytic hierarchy process, etc., ultimately forming digital application evaluation indicators for basic art education (including 4 primary dimensions, 13 secondary dimensions, and 68 observation points). The results indicate that the evaluation index has certain scientific nature, effectiveness, and practicality, and can be used to evaluate the effectiveness of digital

TABLE 15 Statistical table of digital education used in basic art education.

Statistic	A school	B school	Mean of each dimension T	Difference p
Teaching resource allocation	2.804	2.845	−1.057	0.042
Teaching environment foundation	2.705	2.706	−0.597	0.002
Teaching process implementation	2.771	2.706	−1.309	−0.064
Teaching effectiveness evaluation	2.606	2.602	−1.12	−0.003
Y average	2.721	2.715	−1.021	−0.002

application evaluation in the field of basic art education. By establishing and applying a digital application evaluation system, the effectiveness of digital teaching in basic art education can be tested, while also reflecting educational equity, so the digital transformation of art education is an inevitable trend (Shuai, 2023).

In order to better promote the effectiveness of digital application evaluation indicators in the field of basic art education, the author believes that the following aspects can be expanded:

- Promote the digital application of basic art education, identify schools and teachers with good digital levels from application evaluation indicators, and explore their main advantages and characteristics from four dimensions: teaching resource allocation, teaching environment foundation, teaching process implementation, and teaching effectiveness evaluation, in order to provide guidance and guidance for other schools.
- Reduce regional and educational resource inequality. At the government level, efforts should be made to increase the coverage of digitalize in areas lacking educational resources. By popularizing and applying digitalize, we can improve the quality of education, expand the coverage of digital education, and promote educational equality.
- Increase digital training for teachers. Digitization can better showcase teaching content and enrich teaching methods. Increasing the digitization of teaching staff can help teachers access teaching resources, change traditional learning methods, and enhance students' creativity and innovation abilities.

This study is based on the CIPP evaluation model and adopts multiple research methods to systematically examine the four core dimensions of digital school art education: teaching resource allocation, teaching environment foundation, teaching process implementation, and teaching effectiveness evaluation. Empirical analysis shows that art education in digital schools has achieved relatively ideal results, and the evaluation results are intuitive and effective. More importantly, research has found that digital teaching methods are an effective path to solving the problem of uneven teacher resources and achieving educational equity.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

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