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# A study of factors influencing the quality of music education based on structural equation modeling

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**SUMMARY:** *Enhancing the quality of music education carries profound implications, not only for restructuring and reforming the music discipline system but also for nurturing music professionals who can meet the demands of a rapidly evolving era. This study identifies teachers, students, and the teaching environment as the three primary factors shaping the quality of music education, and adopts structural equation modeling as the core analytical framework. Research hypotheses were developed around these three dimensions, from which eight specific variables were derived: professional level, teaching design, teaching attitude, volume of subject knowledge, learning capacity, learning attitude, teaching space, and teaching facilities. Corresponding measurement scales were constructed for each variable. Representative research samples were selected, and both demographic information and variable data were systematically organized. A structural equation model was then established to examine how these eight variables influence the quality of music education. The estimated path coefficients were 0.989, 1.414, 1.341, 0.806, 1.259, 1.248, 0.903, and 0.911, respectively. Each coefficient demonstrated statistically significant differences to varying degrees, confirming the validity of all proposed hypotheses. These findings carry clear practical implications. Future efforts to develop and strengthen music education should treat a well-resourced teaching environment as a foundational support, while directing primary attention toward elevating teachers' disciplinary expertise and pedagogical competence. Equal emphasis should be placed on understanding students' developmental characteristics and fostering sustained academic engagement. A coordinated approach across these dimensions offers a viable path toward meaningful and lasting improvement in the quality of music education.*

***KEYWORDS:*** *structural equation modeling; music education quality; influence path; research hypothesis*

# 1 Introduction

Music education occupies a distinctive place within the broader educational landscape. It serves as a primary channel through which music professionals are cultivated to meet the evolving demands of musical development. Institutions bear a particular responsibility in this regard. As key forces in preserving musical heritage and driving pedagogical reform, they must ground their work in the soil of traditional music culture, rigorously explore pathways for instructional innovation, and bring to light the spiritual and artistic dimensions embedded within music itself. Only through such efforts can the vitality of music education be sustained, high-caliber musical talent be produced, and the overall quality of music education be

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meaningfully advanced [1-5]. Music education also functions as a core component of holistic quality education. The standard of its instruction bears directly on the effectiveness of broader quality-oriented educational reform [6, 7]. Yet the actual delivery of music education faces considerable constraints. Teaching quality remains visibly uneven, shaped in large part by disparities in educational resources and facilities between urban and rural settings. The adequacy of educational infrastructure, too, differs substantially across regions [8]. Considering such a reality, it is no longer just a scholarly undertaking to determine the factors that affect the quality of music education by using sound and systematic approaches. It is a fact. This improved knowledge of these factors will allow institutions to engage in reform with increased precision and effectiveness and eventually to create an environment where the true development of students musical abilities can be achieved.

Literature [9] indicated with statistical analysis that urban and rural music education resources (types of musical instruments, music activity programs, and excellent teachers) showed significant differences, and this difference led to different student motivation, music skills, and long-term academic outcomes. Literature [10] reported that students' gender, age, family background, length of musical training, as well as musical music activities, instrument type, training method, absolute pitch, and home instrument content affect students' academic achievement, side by side reflecting the effect of music on educational efficiency. Based on the technology acceptance model, a research [11] explored the main factors affecting the effectiveness of teachers in Chinese music training institutions, and the study found that cognitive load, training time costs, and the perceived usefulness of music among students and its ease of use are the central variables. In another study [12], independent samples t-tests were used together with regression analyses to indicate that mixed learning methods in music education add value to students musical achievement. It was concluded that it had worked via the mediation of student attitudes and motivation indicating how differences in teaching styles may impact academic performance and thus quality of teaching overall. There is an increasing interest in the influence of digital technology on the work of scholars. An article [13] evaluated the impact of digital devices on the effectiveness and quality of music education, revealing that it promotes student involvement, arouses interest in the subject, helps to learn information, inspires creativity, and assists in the conservation of musical resources. In the boundary of artificial intelligence, another research [14] explored the effect of AI technology on the quality of vocal music lessons by using high-quality lite instruction set machines as well as annealing and probabilistic algorithms. The research indicated that there was an impact rate of 56.42 percent which was mediated by the improvement in the performance of teachers in their instructions. Switching to process-oriented factors, studies that have used both quantitative and qualitative approaches [15] indicated that the concept of motivation in vocal education is determined by factors such as pre-course preparation by both the teacher and the students, the psychological and physical state of the learner, the quality of the chosen repertoire, and the type of teacher assistance. Another research paper [16] involved the use of descriptive statistics, correlation analysis, and multiple linear regression to show that music teacher professionalism, curriculum design, available activity resources, student motivation, and development of educational facilities are all significant influences on student satisfaction with instruction. The teacher-related characteristics have also come up as an important field of research. One set of literature [17] determined that a large cluster of instructor characteristics, such as self-esteem, resilience, professional competence, self-efficacy, occupational motivation, attitudes towards teaching and learning, previous training history, and teacher-student interaction quality, were all found to be related to music instruction effectiveness. To support this, a mixed-method study [18] also revealed that there was a strong positive relationship among teachers self-efficacy, student engagement, and classroom performance, which can be considered as a significant measure of the quality of instruction. Nevertheless, when taken collectively, the current literature presents some significant gaps. The systematic studies on various aspects that affect the quality of music education are limited. Regression-based methods have been found to be ineffective in dealing with the complexity of multivariate relationships, and much of the data used in most studies are not sufficiently comprehensive, with many analyses focusing on a single aspect alone.

Structural equation modeling (SEM) is a multivariate statistical method that can be used to explore complex connections between variables. Its distinctive advantage is that it can accommodate several causal relationships at a time and take into consideration the interaction between latent constructs and the observable indicators of those constructs [19]. The framework has two parts, which are combined into one: a measurement model, which defines the connection between latent variables and the observed variables that are used to measure them, and a structural model, which represents the causal pathways within the latent variables themselves [20, 21].The use of SEM has proven useful in music education studies. In one study [22] path analysis and SEM were used to examine the role played by modern world music on national music education programs and concluded that the integration of global musical elements into the school curriculum makes the students learn more about their culture. Another study [23] used SEM to investigate the determinants of teaching effectiveness in a given course, structuring its discussion on three dimensions of teachers, instructional cases, and students. The results showed that the three dimensions have some common effect on teaching performance and the size of this effect decreases sequentially on the three dimensions in the given sequence. SEM is chosen as the analytical instrument to explore the factors affecting the quality of music education in the present study. In this manner, the goal is to improve the current model of assessing the quality of education, facilitate a better rational utilization of the education resources, eliminate the differences between urban and rural music education, and establish a better foundation to ensure the balanced and sustainable development of music education in various settings.

The paper will be conducted in a number of steps. First, it outlines how three general factors, i.e., teachers, students and teaching environment can exert their effect on music education quality to form the theoretical basis on which the next stage of the analysis is based. The introduction of the concept of structural equation modeling as the main research and analytical tool. The model structure, its principles, calculation of parsimony fitting indices and estimation procedures are considered in turn. On top of this methodological basis, the three dimensions of influence are hypothesized and the relevant research variables and measurement scales are established based on the existing situation of music professional education. Then comes the research sample. The basic features of the sample population are described using descriptive statistics, and then the descriptive analysis of each research variable is performed. The variable scale reliability and validity are also analyzed to make sure that the data adhere to the criteria necessary to conduct rigorous inquiry. Finally, a structural equation model is built to describe the factors contributing to the quality of music professional education. The goodness-of-fit of the model to the sample data is measured by the computation of various fitting indicators. Further path coefficients of each variable are calculated to assess the size and direction of their effect on the quality of education. The obtained path coefficient outputs are visualized, and the research hypotheses stated initially are validated using the empirical results.

# 2 Main dimensions influencing the quality of music education

Music education cannot be defined by any one element alone; rather it occurs through the interaction of several contributing factors. In this research, the researcher has divided up the relevant factors into three general categories- teacher, student, and teaching environment. The precise details of each dimension are listed below.

(1) Teachers

Teaching music, especially vocal singing and instrument playing, is by nature specialized, and it takes teachers many years of hard work and prolonged practice to achieve the necessary degree of proficiency and practice to be effective instructors. Teachers are the main actors of music teaching and have a direct and significant impact on the results of teaching due to their pedagogical skills, methodological preferences, and professional attitude. Effective music education goes beyond technical expertise and a well-organized body of subject knowledge. It also involves the requirement that teachers should have high-level instructional abilities, such as the ability to think and articulate musical concepts clearly, the ability to plan and synthesize materials effectively, the ability to communicate in an organized and logical manner, and the ability to recognize and correct student errors accurately.

(2) Students

Students are in the main position as the primary recipients in the process of teaching music, and their features have a strong impact on the results of education. Two aspects are especially important here: what background the students come from and what cultural literacy they possess. The first one represents the natural musical ability of students and their general cultural development whereas the second one indicates their general understanding of music and general intellectual readiness. Students in rural or remote areas are especially educative. They often join music courses not because of their passion but rather as a stepping stone towards higher education, and a significant proportion has not been exposed to formal music instruction before joining. Limited economically and limited in terms of educational opportunities, they often come unprepared in terms of solfège, ear training and the basics of music theory. This means that they experience different levels of challenge in understanding, memorizing, and implementing the material covered in special music classes, and such gaps in preparation cannot help but detract from the entire level of music education.

(3) Teaching environment

In professional music courses, professional rehearsal/performance halls and formal concert halls are indispensable. The teaching environment not only caters to students' music practice needs, but also provides music teachers with preparation and rehearsal space. In other words, a sufficient number of rehearsal/performance halls and concert halls can provide professional space for students at the learning level, and assist music teachers at the teaching level to prepare and improve their teaching. The teaching and learning environment plays both direct and indirect roles in the quality of music education, both for students and teachers.

# 3 Research methodology

## 3.1 Structure of the equation model

Structural equation modeling can be used to describe two different kinds of relationship in one analytical system. The first is the relationships between observable indicators and their theoretical counterparts, the underlying latent variables. The second involves the relationships among the latent variables. In conventional methodology language, the measurement model, which is controlled by measurement equations, refers to the former, whereas the structural model, described by structural equations, refers to the latter. Since the associations between latent variables are the central focus of most research questions, this overall analytical process has gained universal recognition as structural equation modeling analysis. Practically speaking, therefore, the methodology has two interacting elements: measurement equations, associating measured indicators with their corresponding latent constructs, and structural equations, defining the interrelationships between these constructs.

### 3.1.1 Measurement equations

For example, the equations for measuring the quality of music education are Eqs. (1)-(8):

$$X_1 = \lambda_{x11}\xi_1 + \delta_1 \tag{1}$$

$$Y_1 = \lambda_{y11}\eta_1 \tag{2}$$

$$Y_1 = \lambda_{y11}\eta_1 \tag{3}$$

$$X_2 = \lambda_{x21}\xi_1 + \delta_2 \tag{4}$$

$$Y_2 = \lambda_{y21}\eta_2 + \varepsilon_2 \tag{5}$$

$$X_3 = \lambda_{x31}\xi_1 + \delta_3 \tag{6}$$

$$Y_3 = \lambda_{y31}\eta_2 + \varepsilon_3 \tag{7}$$

$$X_4 = \lambda_{x42}\xi_2 \tag{8}$$

The matrix representation of the above measurement equations is shown in Eqs. (9)-(10):

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & \lambda_{y32} \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} - \begin{bmatrix} 0 \\ \varepsilon_2 \\ \varepsilon_3 \end{bmatrix} \tag{9}$$

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ \lambda_{x21} & 0 \\ \lambda_{x31} & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ 0 \end{bmatrix} \tag{10}$$

are usually expressed as in Eqs. (11)-(12):

$$X = \lambda_x \xi + \delta \tag{11}$$

$$Y = \lambda_y \eta + \varepsilon \tag{12}$$

where:

$X$ -A vector that is a product of exogenous indicators;

$Y$ -A vector of endogenous indicators;

$\lambda_x$ - The relationship between exogenous indicators and exogenous latent variables, represented as the factor loading matrix of exogenous indicators on exogenous latent variables;

$\lambda_y$ - tThe relationship between endogenous indicators and endogenous latent variables; the factor loading matrix of endogenous indicators on endogenous latent variables.

$\delta$ , $\varepsilon$ -Error term associated with exogenous indicator $X$ and endogenous indicator $Y$ .

### 3.1.2 Structural equations

The structural equations for the quality of music education are Eqs. (13)-(14):

$$\eta_1 = \Gamma_{11}\xi_1 + \Gamma_{12}\xi_2 + \zeta_1 \tag{13}$$

$$\eta_2 = B_{21}\eta_1 + \Gamma_{21}\xi_1 + \Gamma_{22}\xi_2 + \zeta_2 \tag{14}$$

Expressed as a matrix as in equation (15):

$$\begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ \beta_{21} & 0 \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_2 \end{bmatrix} \tag{15}$$

It is usually expressed as in equation (16):

$$\eta = \beta\eta + \Gamma\xi + \zeta \tag{16}$$

where:

$\eta$ -A vector containing endogenous latent variables;

$\xi$ -A set of exogenous latent variables;

$\beta$ -A matrix used to describe relationships between endogenous latent variables;

$\Gamma$ - A matrix showing the effect of exogenous latent variables on endogenous latent variables;

$\zeta$ -The structural equation residual vector is a part of the residual that is not explained by the equation.

## 3.2 Fundamentals of structural equation analysis

Current literature sometimes summarizes the core principle of structural equation modeling as the notion of three pairs: two types of variables, which include exogenous variables and latent variables; two types of model, which are the measurement model and structural model; and two types of paths, which are the paths that connect the latent variables with exogenous indicators and the paths that link the latent variables among themselves. This formulation offers a brief summary of structural equation analysis. E.g., performance and emotion may be considered observable indicators, whereas knowledge of music theory is a latent variable. The relationship between knowledge of music theory and performance, emotion, etc. is part of the measurement model, the relationship between knowledge of music theory and basic learning ability lies in the structural model. Structural equations make estimates of the presumed path coefficients based on covariance between exogenous indicators.

A fully-fledged structural equation model, in addition to containing the four parameter matrices $\lambda_x$, $\lambda_y$, $B$, and $\Gamma$ that appear in both the measurement equation and the structural equations, it also contains $\Phi$ (the covariance matrix for the latent variable $\xi$), $\Psi$ (covariance matrix of the latent variable $\eta$), $\Theta_\varepsilon$, and $\Theta_\delta$ (covariance matrix of the exogenous indicator measurement error terms $\varepsilon$, $\delta$), i.e.: the structural equation model contains eight parameter matrices: $\lambda_x$, $\lambda_y$, $B$, $\Gamma$, $\Phi$, $\Psi$, $\Theta_\varepsilon$, and $\Theta_\delta$. How to find these 8 parameter matrices (path coefficients in the model)? This concerns the fitting principle involved in structural equation analysis.

In practical application, structural equation analysis obtains the covariance matrix $S$, or correlation matrix, for exogenous indicators directly from the sample data, and then estimate the parameters in the above parameter matrix from the sample data to the set model, and find out the “new” covariance matrix (or correlation matrix) $\Sigma(\theta)$ of the exogenous indicators when the model is set up, and then compare the difference between $S$ and $\Sigma(\theta)$ by statistical methods. A good model should make the difference between $S$ and $\Sigma(\theta)$ as small as possible, i.e., a structural model with a good fit can back-calculate the covariance array $\Sigma(\theta)$ between the exogenous indicators based on the $\Sigma(\theta)$ parameter matrices estimated by the model, and this 8 should minimize the difference with the “true” covariance array $S$ of the exogenous indicators.

## 3.3 Simple fitting indices

Under certain conditions, the $\chi^2$ asymptotically obtained by commonly used estimation methods obeys a chi-square distribution, and the larger the $\chi^2$ value, the larger the difference between $S$ and $\Sigma(\hat{\theta})$. Although the $\chi^2$ value is an index to test the fit of the model, the chi-square value is too much affected by the sample and thus is not suitable for a good judgment of the fit of the model. To minimize the effect of sample size on the test of fit, the ratio of the chi-square value $\chi^2$ to the degrees of freedom $df$ can be examined, and if $\chi^2/df$ is between 2.0 and 5.0, the model is acceptable.

Model fit measures include standardized root mean square residual (SRMR), which is commonly used as one representative index, and root mean square error of approximation (RMSEA).

The standardized root mean square residual, which is shortened to SRMR, may be expressed as Equation (17):

$$SRMR = \left\{ 2\sum_{i=1}^{p+q}\sum_{j=1}^{i}\frac{(s_{ij}-\hat{\sigma}_{ij})^2}{(s_{ii}s_{jj})} / [(p+q)(p+q+1)] \right\}^{\frac{1}{2}} \tag{17}$$

where $s_{ij}-\hat{\sigma}_{ij}$ is the sample residual of the covariance of $x_i$ and $x_j$ and $s_{ii}$ is the sample variance of $x_i$. Similar to it is the residual mean square and square root (RMR), defined as equation (18):

$$SRMR = \left\{ 2\sum_{i=1}^{p+q}\sum_{j=1}^{i}\frac{(s_{ij}-\hat{\sigma}_{ij})^2}{[(p+q)(p+q+1)]} \right\}^{\frac{1}{2}} \tag{18}$$

If the correlation coefficient matrix is applied to the analysis, then SRMR is equal to RMR. The value of SRMR does not depend on the units of measurement of variables, and it ranges between 0 and 1. An SRMR of less than 0.05 is generally regarded as acceptable when fitting a model.

The asymptotic root mean square residual, RMSEA is given directly in equation (19):

$$RMSEA = \left\{ \max[(\chi^2 - df)/(N-1), 0]/df \right\}^{\frac{1}{2}} \tag{19}$$

RMSEA is one of the model fit measures with some stability regarding changes in the samples sizes, greater responsiveness to misspecification of models, and higher penalty for over-complex structures, which is why it is sometimes considered to be a better goodness-of-fit measure. As a rule, an RMSEA value of greater than 0.10 implies poor model fit, an RMSEA of 0.08 - 0.10 implies a good but not perfect fit, an RMSEA of 0.05 - 0.08 indicates a reasonable fit, and a value less than 0.05 indicates a very good fit. Furthermore, numerous indices that are commonly used in recent academic practice such as GFI, CFI, NFI, NNFI, and AGFI are typically considered adequate when they are higher than 0.9 in large samples indicating that the theoretical model is well-fitting with the empirical data.

## 3.4 Methods of estimation

The parameter estimation procedure in structural equation modeling differs substantially from conventional statistical approaches. Its objective is not to reduce the discrepancy between fitted and observed values, but to minimize the gap between the sample covariance matrix $S$ and the covariance matrix predicted by the model $\Sigma(\hat{\theta})$. Therefore, the basis of parameter estimation is to find parameters that minimize the "gap" between the sample covariance matrix $S$ and the model-estimated covariance matrix $\Sigma(\hat{\theta})$, which can be expressed as a fit function. Here, the fitting function is denoted by $F(\Sigma(\hat{\theta}), S)$, and the best parameter estimate is the parameter value that minimizes the function $F(\Sigma(\hat{\theta}), S)$.

Structural equation modeling includes various parameter estimation methods, each suited to particular conditions and possessing distinct advantages. Among them, maximum likelihood estimation, or ML, is the most widely applied. The commonly used likelihood fitting function is presented in Equation (20):

$$F_{ML}(\hat{\theta}) = \log|\Sigma(\hat{\theta})| - \log|S| + \mathrm{tr}(S\Sigma(\hat{\theta})^{-1}) - (p+q) \tag{20}$$

where $tr(A)$ denotes the trace of matrix $A$, $\log|A|$ denotes the logarithm of the determinant of matrix $A$, $S$ and $\Sigma(\hat{\theta})$ are the sample covariance matrix and the model-estimated covariance matrix, respectively, and $p+q$ is the number of observed variables in the model. In general, it is assumed that $S$ and $\Sigma(\hat{\theta})$ are positive definite and there exists an inverse matrix of $\Sigma(\hat{\theta})$, otherwise this process is unsolved. The fitted likelihood function $F_{ML}(\hat{\theta})$ is a logarithmic modification of the great likelihood method function, and thus requires the assumption that the indicator vectors obey a multidimensional normal distribution. The parameter estimate $\hat{\theta}$ that minimizes $F_{ML}(\hat{\theta})$ is called the great likelihood estimate, or ML estimate for short, and it has several important properties as follows:

(1) The ML estimates are unbiased. In large samples, they are neither biased to overstate nor understate the appropriate population parameters on average.

(2) ML estimates are also consistent. As the sample size continuously increases, the estimated values that are achieved using ML slowly converge on the actual values of the population parameters. In such a case, ML estimates can be viewed as almost unbiased with the large enough sample.

(3) ML estimation has been shown to be asymptotically valid. With increasing sample size, the standard error of the parameter estimate will decrease. At the point where the sample has reached a sufficient size, the standard error resulting from ML estimation is at minimum not larger than that given by alternative estimation methods.

(4)The ML estimate is asymptotically normal. The distribution of estimates of parameters converges to normal as the number of observations increases. This property is used to test the hypothesis significance and compute confidence intervals of parameters.

(5) The ML function does not depend on the measurement scale of variables. So, the introduction of various measurement scales will not affect the outcomes of ML estimation.

Due to these benefits, maximum likelihood estimation has been the most commonly used estimation technique in structural equation modeling. ML estimation is also the default choice in LISREL. Even though this approach requires that indicators be normally distributed, numerous studies have demonstrated that ML estimation is rather robust. To put it differently, ML estimation is able to provide results that are both reasonable and trustworthy even in case the normality condition is not completely satisfied.

# 4 Research hypotheses and variable setting

## 4.1 Research hypotheses

This paper develops a structural equation model based on the quality of music education, which yields the following research hypotheses:

(1) The hypothesis of the relationship between teachers' teaching ability and music education quality

This paper defines the teaching ability of music teachers from three aspects: professional level, teaching design and teaching attitude. Professional level refers to music teachers' own theoretical knowledge reserve and practical performance ability, while theoretical knowledge reserve links to the breadth of teachers' actual teaching content, and practical performance ability affects the depth of teachers' teaching. Teaching design refers to the teacher's educational arrangement. An excellent teaching design should start from the students' needs, effectively select, reorganize and expand the knowledge system in teaching, and give the students sufficient space for independent play and corresponding methodological guidelines in practice and interaction, so as to promote the double enhancement of the students' learning efficiency and the quality of education. Teaching attitude refers to the teacher's behavior during the teaching process, which is more related to the students' learning outcomes. Positive, interesting and correct teaching attitude can activate the students' enthusiasm and vitality for learning, and promote the students' understanding and absorption of knowledge.

Accordingly, the research hypotheses are proposed:

Music teachers are capable of teaching and this is correlated with good quality music education.

(2) Hypotheses regarding the connection between student attributes and quality of music education

Students' level consists of the amount of expertise they harbor along with their learning ability and learning attitude. The amount of self-embodied specialized knowledge is determined by the educational environment in which the students grow up and the amount of learning, as described in Chapter 2, and also influences the students' learning ability to a certain extent. Learning ability is not only affected by the amount of self-embedded expertise, but is also attributed to the student's ability and level of understanding of musical knowledge. Learning attitude, on the other hand, refers to the amount of time students spend studying music with. The combination of a higher level of specialized knowledge and music learning ability with a good learning attitude is what produces high quality music learning outcomes.

Accordingly, the research hypothesis is formulated:

H2: Student characteristics positively impact the quality of music education.

(3) Hypotheses about the connection between the teaching environment and the quality of music education

Teaching environment factors include teaching venues and teaching facilities. Teaching venues are divided into professional rehearsal/performance halls and formal concert halls, and in terms of main purpose, they should be divided into those used for teaching and research and those used for learning and practicing, and reasonable teaching venues can take into account the needs of teachers and students for learning and improvement. The construction of excellent teaching settings not only has a wealth of musical instruments related to music teaching, etc., but also should be combined with the Internet + era, with a variety of multimedia teaching equipment.

Accordingly, the research hypothesis is proposed:

H3: The teaching environment has considerable positive influence on the quality of music education.

## 4.2 Variable settings

The music major education quality is denoted by K in the given research. The analysis model consists of 8 structural variables which are presented here: teacher professionalism (K1), instructional design (K2), teaching attitude (K3), student professional knowledge resources (K4), learning ability (K5), attitude towards learning (K6), venue of teaching (K7) and teaching facilities (K8). As the eight constructs are latent variables that do not lend themselves directly to quantification, a specific scale was created to operationalise each one using a number of observable indicators. Each observable indicator relates to a single survey item and each item is scored using a five-point Likert scale.

The scale structure and item content of the teaching competence dimension are given in Table 1, consisting of a total of ten items. The music teachers professionalism in terms of four aspects: theoretical knowledge, performance ability, stage presence, and musicianship is assessed within this dimension. Three domains are used to measure instructional design, namely course planning and program structure, integration of theoretical content with practical applications and extension and complementation of teaching materials. Three additional aspects represent the views of teachers on instruction, such as their attitude towards preparing lessons and delivering them in the classroom, the extent to which they pay attention to each student in particular, and their overall interest in music education.

*Table 1: The explicit indicators of the teaching ability dimension*

| Dimensionality | Variable | Explicit indicators |
|---|---|---|
| Teaching ability | (K1) Professional level | (K11) Rich theoretical knowledge |
| | | (K12) A high level of musical expression ability |
| | | (K13) A relatively high level of musical performance |
| | | (K14) A variety of musical techniques and their reasonable application |
| | (K2) Instructional Design | (K21) Reasonable teaching plan setting |
| | | (K22) Emphasize the combination of theory and practice |
| | | (K23) Expansion of teaching materials |
| | (K3) Teaching attitude | (K31) The teaching attitude is correct and the lesson preparation is thorough |
| | | (K32) Attach great importance to students' learning feedback and guidance needs |
| | | (K33) Passionate about music teaching |

The scale structure and content of the student level dimension are shown in Table 2, and there are six items under this dimension scale. Students' professional knowledge was assessed through the knowledge skill reserve, students' learning ability was presented using comprehension and learning methods, and students' attitude towards learning was measured using three indicators: attitude towards learning, time commitment to learning, and seeking guidance.

*Table 2: The explicit indicators of the student level dimension*

| Dimensionality | Variable | Explicit indicators |
|---|---|---|
| The students' musical proficiency | (K4) Professional knowledge volume | (K41) Rich theoretical knowledge and reserve of singing skills |
| | (K5) Learning ability | (K51) High comprehension ability |
| | | (K52) Learning methods based on one's own situation |
| | (K6) Learning attitude | (K61) Positive learning attitude |
| | | (K62) A considerable amount of time is devoted to study |
| | | (K63) Actively seek guidance from teachers |

The scale structure and content of the teaching environment dimension are shown in Table 3, which contains a total of 6 items. It assesses the construction of teaching venues from a total of three perspectives: quantity, usage and site layout, and measures the construction of teaching facilities from a total of three perspectives: types of musical instruments, number of musical instruments and functions of multimedia teaching equipment.

*Table 3: Explicit indicators of the teaching environment dimension*

| Dimensionality | Variable | Explicit indicators |
|---|---|---|
| Teaching environment | (K7) Teaching venue | (K71) A sufficient number of concert halls and performance halls |
| | | (K72) Meets the needs of teaching and learning |
| | | (K73) Professional venue arrangement |
| | (K8) Teaching facilities | (K81) There is a wide variety of Musical Instruments |
| | | (K82) There is an adequate number of Musical Instruments |
| | | (K83) The multimedia teaching equipment is fully functional |

# 5 Empirical Analysis of Factors Influencing the Quality of Music Education

The study sample was made up of 1,536 music major students taking their first year up to their fourth year of study at L colleges and universities. The sample was used to create the model that considered the variables that affect music education quality, wherein structural equation modeling was used to calculate the path coefficients between the variables, and to examine the formulated research hypotheses. Demographic and background data were collected using both online and off-line surveys. Out of the 1,536 questionnaires that were given out, only 1,479 were found to be valid after going through the evaluation process, thus giving an effective response rate of 96.29%.

## 5.1 Data quality analysis

### 5.1.1 Descriptive statistics of the sample

Table 4 presents descriptive statistics on the valid sample. Female students represent 62.61 percent of all music majors at College L, and male students represent the other 37.39 percent, which means that there is a significant gender imbalance in the number of females enrolled. There are four music specializations offered by the institution: music performance, music conducting, music education, and music production. Music performance is the most common track with 754 students, or about half of the overall music major population of 50.98 percent. The four years groups have fairly even student distributions, with the proportions lying between 22.04 and 27.79 percent. Students in their first year make up the largest group (411), and those in their fourth year make up the smallest group (326).

*Table 4: Basic information of the sample*

| Category | Option | Number of people | Proportion(%) |
|---|---|---|---|
| Gender | Female | 926 | 62.61 |
| | Male | 553 | 37.39 |
| Major | Musical performance | 754 | 50.98 |
| | Musical conductor | 157 | 10.62 |
| | Music education | 258 | 17.44 |
| | Music production | 310 | 20.96 |
| Grade | 1 | 411 | 27.79 |
| | 2 | 364 | 24.61 |
| | 3 | 378 | 25.56 |
| | 4 | 326 | 22.04 |

### 5.1.2 Descriptive statistics for each variable

The five-point Likert scale was used to evaluate the performance of the sample on the 22 research variables, and the scores were rated as follows: excellent (5), good (4), fair (3), pass (2) and fail (1). All 22 items descriptive statistics are presented in Table 5. The average score of the dimension of teaching level was 3.895 and the average of the dimension of student level was 3.218 which are both considered as average. Teaching and learning environment dimension had a mean of 4.137 and was classified under good grade. A finer-grained analysis of the mean of individual items in the teaching level and student level dimensions reveals a number of interesting findings. The music teachers who work at College L were rated as having good grades in terms of their professional competence (K1) and their attitude towards teaching (K3), each receiving a score higher than 4.00. They however scored low in instructional design (K2), which had a range of 3.13-3.53. Of student-related variables, professional knowledge volume (K4), learning attitude (K6), and instructional venue (K7) were all measured to have average-grade scores, but each had a very high standard deviation, indicating that there were substantial differences in these aspects between individual students.

*Table 5: Descriptive statistics of 22 items*

| Dimensionality | Variable | Items | Mean value | Standard deviation | Overall mean |
|---|---|---|---|---|---|
| Teaching ability | K1 | K11 | 4.41 | 0.59 | 3.895 |
| | | K12 | 4.49 | 0.92 | |
| | | K13 | 4.04 | 0.41 | |
| | | K14 | 4.41 | 0.51 | |
| | K2 | K21 | 3.29 | 0.77 | |
| | | K22 | 3.53 | 0.42 | |
| | | K23 | 3.13 | 0.12 | |
| | K3 | K31 | 3.15 | 0.84 | |
| | | K32 | 4.16 | 0.77 | |
| | | K33 | 4.34 | 0.49 | |
| The students' proficiency | K4 | K41 | 3.52 | 1.06 | 3.218 |
| | K5 | K51 | 3.18 | 1.31 | |
| | | K52 | 3.07 | 1.49 | |
| | K6 | K61 | 3.25 | 0.23 | |
| | | K62 | 3.25 | 0.62 | |
| | | K63 | 3.04 | 0.23 | |
| Teaching environment | K7 | K71 | 4.21 | 0.61 | 4.137 |
| | | K72 | 4.37 | 0.22 | |
| | | K73 | 4.01 | 0.08 | |
| | K8 | K81 | 4.16 | 0.83 | |
| | | K82 | 4.01 | 0.62 | |
| | | K83 | 4.06 | 0.27 | |

### 5.1.3 Reliability analysis

The results of the reliability analysis of the music education quality scale developed in this paper are presented in Table 6. Reliability means the ability of a measurement tool to provide consistent and stable results and it is traditionally measured through a Cronbach alpha coefficient which measures the consistency of items that compose a scale. A larger coefficient value implies a higher level of internal consistency between the variables, which means higher intercorrelations amongst the items per dimension. In this study, a threshold of 0.8 is used, beyond which a scale is considered highly reliable. The eight variables that made up the Music Education Quality Scale all surpassed this threshold with Cronbach alpha coefficients of 0.823, 0.858, 0.896, 0.874, 0.821, 0.809, 0.834 and 0.862 respectively. These figures indicate that the scale as a whole has adequate internal consistency and may therefore be deemed reliable when used in subsequent analyses.

*Table 6: Reliability analysis of the scale*

| Variable | Items | Cronbach's α coefficient |
|---|---|---|
| K1 | K11 | 0.823 |
| | K12 | |
| | K13 | |
| | K14 | |
| K2 | K21 | 0.858 |
| | K22 | |
| | K23 | |
| K3 | K31 | 0.896 |
| | K32 | |
| | K33 | |
| K4 | K41 | 0.874 |
| K5 | K51 | 0.821 |
| | K52 | |
| K6 | K61 | 0.809 |
| | K62 | |
| | K63 | |
| K7 | K71 | 0.834 |
| | K72 | |
| | K73 | |
| K8 | K81 | 0.862 |
| | K82 | |
| | K83 | |

Before conducting the factor analysis on the scale to check the validity, it is necessary to evaluate whether the survey data is appropriate to conduct the factor analysis. This research used the KMO test and the Bartlett test of sphericity as the measurement tools. The findings in SPSS 20.0 are given in Table 7. The KMO of the sample data was found to be 0.936 which is greater than 0.900, and the significance level was 0.000 which is less than 0.05, implying that the data satisfied the assumptions of factor analysis.

*Table 7: KMO and Bartlett's Test of Sphericity Results*

| KMO | | 0.936 |
|---|---|---|
| Bartlett's test of sphericity | Approximate chi-square | 1525.637 |
| | *df* | 1485 |
| | Sig. | 0.000 |

The principal component analysis was used to derive the common factors in the scale, and the number of factors and the rates of variance contribution are tabulated in Table 8. The combined cumulative variance contribution rate of the eight common factors found was 79.38, which means that these factors might explain the majority of the information included in the scale and their explanatory power was enough.

*Table 8: Explain the total variance*

| Ingredient | Initial eigenvalue | | | Extract the sum of squares and load it | | | Rotate the sum of squares to load | | |
|---|---|---|---|---|---|---|---|---|---|
| | Contribution rate | | | Contribution rate | | | Contribution rate | | |
| | Total | Variance (%) | Cumu Lative (%) | Total | Variance (%) | Cumulative (%) | Total | Variance (%) | Cumulative (%) |
| 1 | 13.67 | 30.86 | 30.86 | 13.67 | 30.86 | 30.86 | 5.93 | 15.64 | 15.64 |
| 2 | 2.57 | 13.28 | 44.14 | 2.57 | 13.28 | 44.14 | 5.34 | 14.04 | 29.68 |
| 3 | 2.17 | 9.47 | 53.61 | 2.17 | 9.47 | 53.61 | 4.89 | 12.82 | 42.50 |
| 4 | 2.05 | 8.53 | 62.14 | 2.05 | 8.53 | 62.14 | 4.58 | 10.65 | 53.15 |
| 5 | 1.69 | 7.04 | 69.18 | 1.69 | 7.04 | 69.18 | 3.16 | 9.48 | 62.63 |
| 6 | 1.59 | 4.57 | 73.75 | 1.59 | 4.57 | 73.75 | 2.82 | 8.97 | 71.60 |
| 7 | 1.52 | 3.38 | 77.13 | 1.52 | 3.38 | 77.13 | 1.66 | 4.93 | 76.53 |
| 8 | 1.19 | 2.25 | 79.38 | 1.19 | 2.25 | 79.38 | 1.42 | 2.85 | 79.38 |
| 9 | 0.47 | 0.17 | 79.55 | | | | | | |

Afterward, maximum variance rotation technique is applied to the factor loading matrix, and the outcomes are shown in Table 9. The factor loading is the correlation coefficient between a variable and a common factor. As viewed by a particular variable, a factor having a higher absolute loading value is more closely associated with that variable, and hence is more representative. All the factors in the rotated factor matrix employed in this research had the loading coefficients above 0.50, which corresponded to the demands of the research analysis. To be more specific, the professional level variable (K1) consists of four items, the instructional design (K2) has three items, the attitude toward teaching (K3) has three items, the quantity of professional knowledge (K4) has one item, the learning ability (K5) has two items, the attitude toward learning (K6) has three items, the instructional space (K7) has three items, and the instructional facilities (K8) have three items. These findings are in line with the modeling assumptions suggested in this paper, suggesting that the scale is of good structural validity.

*Table 9: Rotating component matrix*

| | Ingredient | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| K11 | 0.59 | | | | | | | |
| K12 | 0.57 | | | | | | | |
| K13 | 0.93 | | | | | | | |
| K14 | 0.98 | | | | | | | |
| K21 | | 0.71 | | | | | | |
| K22 | | 0.68 | | | | | | |
| K23 | | 0.89 | | | | | | |
| K31 | | | 0.65 | | | | | |
| K32 | | | 0.68 | | | | | |
| K33 | | | 0.72 | | | | | |
| K41 | | | | 0.65 | | | | |
| K51 | | | | | 0.87 | | | |
| K52 | | | | | 0.51 | | | |
| K61 | | | | | | 0.72 | | |
| K62 | | | | | | 0.89 | | |
| K63 | | | | | | 0.92 | | |
| K71 | | | | | | | 0.62 | |
| K72 | | | | | | | 0.79 | |
| K73 | | | | | | | 0.79 | |
| K81 | | | | | | | | 0.68 |
| K82 | | | | | | | | 0.73 |
| K83 | | | | | | | | 0.72 |

## 5.2 Tests of structural equation modeling

### 5.2.1 Model construction, fitting

Based on the eight research variables, structural equation modeling is used in this research to calculate the path coefficients of every relationship and to test the stated hypotheses. The model that represents the factors that contribute to the development of the quality of music education is shown in Fig. 1. In the figure, the directional arrows show the impact pathway between the research variables and the relevant influencing factors. The teacher teaching ability factor and the student level factor are linked together with a two way arrow, meaning that the two factors affect each other, not just in one direction.

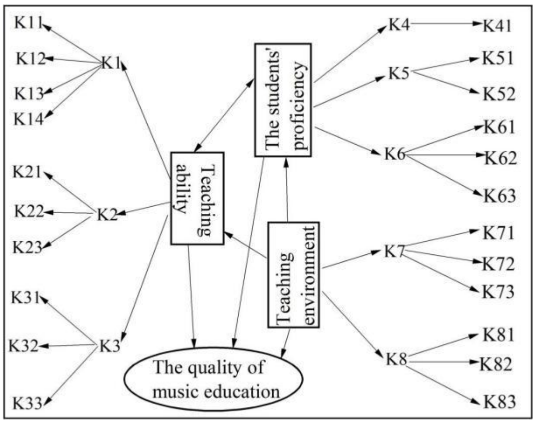


*Figure 1: Model of Influencing Factors of Music Education Quality*

The relationship between the theoretical model and the real sample data was tested based on the absolute fit indices, incremental fit indices and parsimonious fit indices as given in Table 10. Generally speaking, it is assumed that GFI and AGFI should be greater than 0.9 and the values near 1 represent good fit. The RMSE index must be less than 0.8. The five popular incremental fit indices such as CFI, NFI, RFI, TLI, and IFI are also expected to be greater than 0.9. At the same time, PGFI and PNFI must be over 0.9 and NC value should be between 1-3. The findings indicate that the parameter estimation tests of the model meet the necessary standards and therefore the research data are well fitted into the theoretical model.

*Table 10: The fitting degree index of the initial model*

| | Statistical test quantity | Inspection result |
|---|---|---|
| Absolute compatibility index | GFI | 0.902 |
| | AGFI | 0.913 |
| | RMSEA | 0.685 |
| Value-added compatibility index | CFI | 0.958 |
| | NFI | 0.931 |
| | RFI | 0.947 |
| | TLI | 0.965 |
| | IFI | 0.912 |
| Simplicity and compatibility index | PGFI | 0.956 |
| | PNFI | 0.948 |
| | NC | 2.451 |

### 5.2.2 Model Path and Hypothesis Testing

According to the suggested way of creating the quality of music professional education, and within the context of the influencing factor model of music education quality, the analysis of the model path coefficients was continued. Table 11 shows the parameters associated with the path coefficients of the factors that influence the quality of music professional education as well as the results of the relevant statistical tests.

*Table 11: Path coefficient estimation in the model*

| Path | Path coefficient | Statistical test | | | |
|---|---|---|---|---|---|
| | | S.E. | C.R. | P | Standardized path coefficient |
| K11→K1 | 1.179 | 0.044 | 9.832 | *** | 0.973 |
| K12→K1 | 1.143 | 0.114 | 10.668 | *** | 0.963 |
| K13→K1 | 1.083 | 0.135 | 5.644 | *** | 0.951 |
| K14→K1 | 0.972 | 0.092 | 13.739 | *** | 0.834 |
| K21→K2 | 1.235 | 0.143 | 6.674 | *** | 0.995 |
| K22→K2 | 1.041 | 0.065 | 9.459 | *** | 0.987 |
| K23→K2 | 1.164 | 0.162 | 6.414 | *** | 0.913 |
| K31→K3 | 1.197 | 0.122 | 6.325 | *** | 0.924 |
| K32→K3 | 0.945 | 0.069 | 5.386 | *** | 0.863 |
| K33→K3 | 1.086 | 0.094 | 8.496 | *** | 0.981 |
| K41→K4 | 0.984 | 0.103 | 10.343 | ** | 0.805 |
| K51→K5 | 1.229 | 0.186 | 5.609 | *** | 0.975 |
| K52→K5 | 0.947 | 0.104 | 12.104 | *** | 0.743 |
| K61→K6 | 0.949 | 0.088 | 11.274 | *** | 0.823 |
| K62→K6 | 1.486 | 0.102 | 14.969 | *** | 0.978 |
| K63→K6 | 0.913 | 0.034 | 7.896 | *** | 0.808 |
| K71→K7 | 1.246 | 0.161 | 7.849 | *** | 0.928 |
| K72→K7 | 1.037 | 0.181 | 13.822 | *** | 0.946 |
| K73→K7 | 0.995 | 0.074 | 13.114 | *** | 0.859 |
| K81→K8 | 1.034 | 0.113 | 10.745 | *** | 0.963 |
| K82→K8 | 1.172 | 0.081 | 10.456 | *** | 0.906 |
| K83→K8 | 1.021 | 0.075 | 11.016 | *** | 0.910 |
| K1→K | 0.989 | 0.198 | 13.11 | *** | 0.813 |
| K2→K | 1.414 | 0.116 | 4.971 | *** | 0.908 |
| K3→K | 1.341 | 0.099 | 12.62 | *** | 0.932 |
| K4→K | 0.806 | 0.088 | 9.483 | ** | 0.757 |
| K5→K | 1.259 | 0.172 | 7.695 | *** | 0.932 |
| K6→K | 1.248 | 0.183 | 12.884 | *** | 0.921 |
| K7→K | 0.903 | 0.069 | 13.582 | ** | 0.939 |
| K8→K | 0.911 | 0.117 | 5.326 | ** | 0.921 |

Note:***P<0.01,**P<0.05,*P<0.1

The coefficient of teacher professional knowledge (K1), instructional design (K2), and teaching attitude (K3) affecting the quality of music professional education are 0.989, 1.414, and 1.341 respectively with respect to the dimension of teachers teaching ability. Each path was found to be statistically significant at the P <0.01 level, which implies that they are significantly different. Hence, Hypothesis H1 was confirmed by the empirical findings. In the dimension of student level, influence coefficients of the size of professional knowledge (K4), the size of learning ability (K5), and the size of learning attitude (K6) on music professional education were found to be 0.806, 1.259, and 1.248 respectively. Professional knowledge amount (K4) had a significant effect on the music professional education at P=0.05, meaning there is a particular amount of statistical difference. Learning ability (K5) and learning attitude (K6) also attained P=0.01, which indicates very significant statistical differences. Hence, Hypothesis H2 was confirmed using the empirical observations. Teaching site (K7) and teaching facilities (K8) had influence coefficients of 0.903 and 0.911 respectively on the quality of music professional education and both were significantly different at P<0.05. Hypothesis H3 was thus supported.

Conclusively, all model paths were statistically significant and all hypothetical hypotheses were true. Figure 2 displays the plotted model paths. Each arrow thickness is the magnitude of the impact of each variable on the quality of music professional education. Instructional design (K2, 1.414), teaching attitude (K3, 1.341), learning ability (K5, 1.259), and learning attitude (K6, 1.248) were among the variables with relatively high influence. The measured item variables effects were mostly within the range of 0.900 -1.300. There was only one exception to this trend, where students learning time investment (K62) of learning attitude (K6) was greater, at 1.486, indicating a large influence.

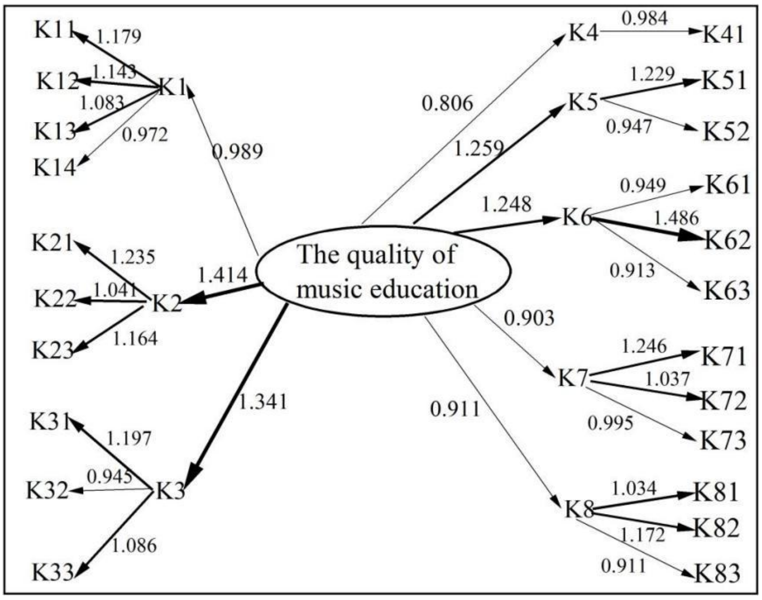


*Figure 2: Model path*

# 6 Conclusion

The research developed in this paper is about the factors that influence the quality of music education along three dimensions, i.e., teacher, student and teaching environment. On this premise, eight research variables and their respective scales were identified as; professional competence, instructional design, teaching attitude, quantity of professional knowledge, learning ability, learning attitude, teaching venue, and teaching facilities. These variables served to build a structural equation model of the factors that influence music education quality. All the variables were reliable and they met the requirements of research analysis. In particular, the coefficients of Cronbachs alpha of the eight variables were 0.823, 0.858, 0.896, 0.874, 0.821, 0.809, 0.834 and 0.862 respectively. Rotated factor loading matrix also coincided with the assumptions of the proposed model. The structural equation model designed on music education passed all the tests of parameter estimation. The path coefficients of the eight research variables used to determine the quality of music education were 0.989, 1.414, 1.341, 0.806, 1.259, 1.248, 0.903, and 0.911 respectively. These findings indicated statistically significant differences thus confirming that all the research hypotheses were supported.

The instructional design and teaching attitude of teachers and the learning ability and learning attitude of students are crucial factors in determining the quality of teaching and enhancing teaching results in music programs. Consequently, it is postulated in this paper that, within the modern evolution of the music field of professional discipline, teachers and learners must be seen as the co-subjects of educational progress. Lectures, training, and other professional development opportunities may be used to enhance teaching abilities and quality of instruction. Meanwhile, it is necessary to create an effective evaluation and reward system that could encourage student learning motivation and involvement. When advancing both these two aspects in parallel, one will be able to improve the quality of music education more efficiently.

# About the Author

Yuyang Sun was born in Yantai, Shandong Province, China in 1989. He studied at Voronezh State Pedagogical University in Russia from 2015 to 2019 and obtained his doctoral degree in 2019. At present, he works in Mount Taishan College. Published 7 papers and 2 monographs, of which 3 have been included in the Russian BAK. Research direction: Musicology, music education, teaching methods, etc.

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