Virtual Reality-Infused Machine Learning for Advancing Music Teaching Quality Evaluation Systems

Dawei Cao[1*] [ID] and Kwen Liew[2] [ID]

[1]College of Music, Changchun University, Changchun, China
wolan99286114745@163.com
[2]College of Information Science and Engineering, Management and Science University, Malaysia
kwenliew26@gmail.com

Corresponding Author: Dawei Cao, wolan99286114745@163.com

Abstract. As the quality of education improves, the quality assessment of music education becomes more and more important. This article uses machine learning algorithms for analysis and pattern recognition. By comparing the effects of traditional evaluation methods and machine learning evaluation methods in music teaching quality evaluation, this paper finds that the use of machine learning methods can obtain better evaluation results and is an effective evaluation method. In addition, we also found that in machine learning methods, the values of support and confidence fluctuate greatly, while the values of lift are relatively stable. The results of this study suggest that when using machine learning methods for evaluation, it should be based on more comprehensive data analysis and combined with professional knowledge for evaluation. This paper proposes a machine learning-based music teaching quality assessment method and compares it with traditional methods. The comprehensive use of multiple assessment methods can make the assessment results more comprehensive and accurate. At the same time, it is hoped that the results of this study can provide references for music educators and researchers so as to promote the further development and improvement of music education quality assessment.

1   INTRODUCTION

Music education quality evaluation is an important part of music education. With the improvement of the quality of education, the evaluation of the quality of music teaching is becoming more and

more important. Traditional music teaching quality evaluation methods mainly include: observation evaluation, student work evaluation, questionnaire evaluation, examination evaluation, teacher self-evaluation, and teaching effect evaluation [13]. These methods evaluate all aspects of music teaching through qualitative and quantitative means, so as to provide a basis for evaluating and improving teaching quality [5].

In the past few decades, many scholars have conducted extensive research on music teaching quality assessment. They focus on different evaluation methods, evaluation indicators, and evaluation tools in order to improve the accuracy and reliability of evaluation [20]. Liu C explored the mobile peer assessment method based on WSQ (Wavelet Scalar Quantization), so as to improve the vocal skills and learning cognition of college students [10]. Juhart P obtained a more comprehensive evaluation by studying the influence of music teachers' perceptions of music teaching in early adolescence [7]. In addition, Asmus E also tried to analyze from the perspective of motivation in music teaching, so as to improve the effect of music teaching quality evaluation [1].

However, with the continuous improvement of the quality of music education in China, the evaluation of the quality of music education in colleges and universities is also facing many challenges and limitations. Traditional evaluation methods have certain subjectivity and limitations, while machine learning methods require massive amounts of data and complex algorithms, so it is difficult to accurately evaluate the evaluation results. In response to this situation, this project intends to study the evaluation method of music teaching quality, combining traditional evaluation methods and machine learning methods, to build a more comprehensive, more accurate, and easier to implement music teaching quality evaluation system. This article will comprehensively analyze the advantages and disadvantages of traditional evaluation methods and machine learning evaluation methods, and propose a set of comprehensive evaluation methods based on machine learning evaluation methods to provide reference for music education practice in China. It is hoped that through the research of this paper, the quality evaluation system of music education in China can be further improved, so as to play a positive role in improving the quality of music education and teaching effect in China.

2　MUSIC TEACHING QUALITY ASSESSMENT

2.1　Music Teaching Quality

The quality of music education refers to the comprehensive evaluation of the content, methods and effects of music education. The quality of music teaching is directly related to the improvement of students' learning effect and music literacy [10]. The evaluation of music teaching quality should be carried out from five aspects: teaching content evaluation, teaching method evaluation, teaching environment evaluation, teacher quality evaluation and student performance evaluation. In music teaching, teachers should adopt a variety of teaching methods such as lectures, demonstrations, exercises, and interactions, and on this basis, combined with the actual situation of students, propose a new, targeted, and creative teaching method [17]. Music education requires a good teaching environment, such as classrooms, musical instruments, libraries, etc. ; at the same time, the teaching environment also includes a good atmosphere of interaction and collaboration between teachers and students [5]. The success of music education is inseparable from the professionalism of teachers. An excellent music teacher, in addition to profound theoretical knowledge, also needs to have a wealth of practical experience. While evaluating the quality of music teaching, the effect and performance of students' learning should also be considered. In the process of music teaching, the improvement of students' music knowledge, music skills and performance ability is an important indicator to measure the quality of their teaching [13],[15].

2.2 The Importance of Music Teaching Quality Assessment

Evaluating the quality of music teaching can detect problems and defects in the education process in a timely manner [8]. High-quality music teaching can effectively improve students' music literacy. Through evaluation, it can help schools and teachers meet the learning needs of students and improve students' learning motivation and learning effect [13]. By evaluating the quality of music education, we can find the problem of uneven distribution of educational resources and uneven teaching quality [11]. Through evaluation, we can discover the unfairness in the teaching process and take corresponding measures to ensure that every student can enjoy high-quality music education. Music education quality evaluation can provide a basis and reference for educational research and innovation [2]. In addition, we can clearly understand the successful experience and teaching mode in teaching, and provide some experience for reference for other schools and teachers, so as to promote the development and innovation of music education [16]. Through the evaluation of the quality of music teaching, teachers can realize their own shortcomings, and then promote teachers' professional learning and improvement. The evaluation results can be used as a reference for teachers' professional title evaluation, promotion, rewards and punishments, and promote teachers' professional growth and development [14].

Music teaching quality assessment plays an important role in improving teaching quality, promoting students' learning, ensuring educational fairness, promoting teaching research and promoting teachers' professional development. Through evaluation, the quality and level of music education can be continuously improved and enhanced [7].

2.3 Traditional Evaluation Methods

Traditional music teaching quality evaluation methods include observation evaluation, student work evaluation, questionnaire survey, examination evaluation, teacher self-evaluation, and teaching effect evaluation. Table 1 is the traditional evaluation methods and related descriptions.

Appraisal procedure	Describe
Observation and evaluation	The teacher evaluated students by observing students' performance in class, including playing skills, musical expression and sense of rhythm.
Student work evaluation	The musical works completed by the students are evaluated by the teachers, including the evaluation of technical level, musical expression and artistry.
Questionnaire survey	Teachers or students should fill in a questionnaire to evaluate students 'subjective feelings of music teaching content, teachers' teaching methods and learning effects.
Examination evaluation	Students take a music test, which is evaluated according to their content and criteria, including technical requirements, music theory, and listening tests.
Teacher self-evaluation	Teachers evaluate and reflect on their own teaching, including the evaluation of teaching methods, textbook selection and student response.
Evaluation of teaching effect	The teaching effect is evaluated through students 'academic performance, learning progress and learning motivation, including the changes in students' performance and learning attitude.

Table 1: Traditional evaluation methods.

These traditional evaluation methods can evaluate the quality of music teaching to a certain extent, but there are also some limitations. Observation evaluation and student work evaluation may be affected by subjective factors; student examination evaluation can only evaluate students' knowledge and skills, and it is difficult to comprehensively evaluate teaching effects; student questionnaire surveys may be affected by students' attitudes and opinions; teachers' self-evaluation may lack objectivity [18]. Therefore, modern education tends to comprehensively use a variety of evaluation methods, combined with qualitative and quantitative evaluation methods, to evaluate the quality of music teaching in a more comprehensive, objective and scientific way [1].

3 APPLICATION OF MACHINE LEARNING TECHNOLOGY IN MUSIC TEACHING QUALITY ASSESSMENT

3.1 Machine Learning Technology

Machine learning is a technology applied in the field of artificial intelligence that enables computers to extract rules from massive amounts of data so as to have the ability to learn autonomously and make decisions. The goal of machine learning is to allow computers to automatically predict, classify, and identify based on existing knowledge and data without programming. Machine learning is based on statistics and optimization theory. The key lies in constructing a set of systematic mathematical models and algorithms that can automatically learn from existing data and make predictions and decisions based on them. Representative and reliable mass data is a top priority for machine learning.

3.2 Music Teaching Quality Evaluation System Based on Machine Learning Technology

The music teaching quality assessment system based on machine learning technology is a system that uses machine learning algorithms and techniques to evaluate the quality of music teaching. It is an objective evaluation of the teaching process and effect through the collection, analysis and processing of relevant educational materials. Then, from the perspective of music education, this paper makes an empirical analysis of every aspect of university music education.

3.2.1 Machine Learning Analysis

With the continuous development of machine learning technology, this paper will use Apriori to analyze the potential correlation between the factors affecting the quality of music teaching. According to the correlation between data, the accuracy of support and confidence between data can be obtained value, thus providing application value for research. Correlation analysis mainly includes three aspects: support, confidence, and promotion.

The support degree is the proportion of the item set in all data, and the support degree corresponding to the association rule between A and B is analyzed as follows:

$$SUPPORT(A, B) = P(A, B) \tag{1}$$

Where P(A) is the probability of appearing in the A data set. Confidence indicates the probability of another data appearing after one data appears. This probability is a conditional probability. The formula for analyzing the conditional probability between A and B is as follows:

$$CONDIDENCE(A \rightarrow B) = \frac{SUPPORT(A,B)}{P(A)} \tag{2}$$

The lift degree indicates the probability of how much change can be made to the data containing B under the condition that A has already appeared. The formula is as follows:

$$LIFT(A \rightarrow B) = \frac{CONFIDENCE(A \rightarrow B)}{P(B)}$$ (3)

Where P(B) is the probability of appearing in the B data set.

3.2.2 Feature Extraction and Representation

In the data preprocessing stage, the system first preprocesses the data, and then processes the data with machine learning algorithms. From the perspective of music teaching, students' performance skills, musical expression ability and sense of rhythm are the main characteristics. The goal of music teaching quality feature extraction is to transform all aspects of music teaching quality into a form that computers can understand and process, so as to facilitate the application and evaluation of machine learning algorithms. Through the extraction of features, the content of various aspects of music teaching can be quantitatively described, so as to achieve the purpose of objectively evaluating and analyzing the quality of teaching. The quality of music teaching is closely related to factors such as students' playing skills, musical expression ability, and sense of rhythm. On this basis, this paper proposes a new teaching quality evaluation method.

In the process of feature extraction and expression, the system selects an appropriate machine learning model and uses the existing labeled data to train the model. The purpose of training is to enable the model to learn the laws and patterns of music teaching, so as to make correct evaluation and prediction of music teaching. After completion, the system can use this model to evaluate new music teaching materials. Based on the students' performance recordings, videos and other data, the system will use machine learning models to analyze and judge them, evaluate the quality of teaching, and give corresponding evaluation results and suggestions. Evaluation results and recommendations provide feedback to teachers, enabling them to understand their own effectiveness and make improvements accordingly. Based on the evaluation results, teachers can adjust teaching methods and curriculum settings to achieve the purpose of improving teaching quality and effectiveness.

3.3 Experimental Design

This paper mainly compares and analyzes the traditional evaluation method and the evaluation method based on machine learning. This project took a group of participants and divided them into two groups, one for traditional evaluation and the other for machine learning evaluation. In the traditional grading method, the teacher grades the students' music performance according to their own professional opinions and experience. The scoring procedure is to score the performance of the students in terms of performance skills, musical expression ability, sense of rhythm, etc., and put forward corresponding opinions. Students were objectively evaluated in terms of data collection and preparation, feature extraction and representation, model selection and training. Scoring covers performance skills, musical expression, sense of rhythm, etc. On this basis, through the comparative analysis of the overall score, each dimension score and recommended score of the two groups of students, the consistency and difference in the overall score, each dimension score and recommended score of the two groups of students are clarified.

4 SYSTEM DATA TEST

4.1 Data Collection

This article evaluates the students subjectively by collecting data on their performance skills, musical expression ability, sense of rhythm, etc. Evaluation methods include traditional methods and

machine learning methods to obtain more comprehensive and accurate evaluation results. Table 2 is a description of the collected data.

Evaluation indicators	Describe
Play skills	Students' technical ability and proficiency in playing musical instruments or singing.
Music expression ability	Whether the students can accurately express the emotion and intention of the music during the playing or singing process.
Rhythm sensation	Students' understanding and mastery of rhythm, including the accuracy and stability of rhythm.

Table 2: Evaluation data description.

According to the above description, this paper organizes the collected data for further analysis. The evaluation data of music teaching quality based on machine learning method is shown in Figure 1, and the evaluation data of traditional method is shown in Figure 2.
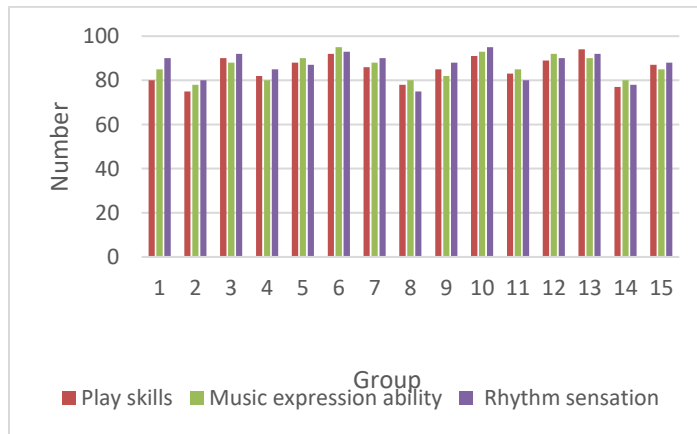

Figure 1: Data of music teaching quality assessment based on machine learning.

From Figure 1 and Figure 2, we can see that in the process of evaluating the quality of music teaching, there are some differences between the method based on machine learning and the traditional method, but the difference is not large. Compared with traditional evaluation methods, evaluation methods based on machine learning rely more on teachers' subjective evaluation and experience. However, there are certain differences in the evaluation results of the two, indicating that there are certain differences in the focus and preference of the two in the evaluation. Therefore, these two methods can be used in combination to obtain more comprehensive and accurate evaluation results to help teachers and students improve the quality of music teaching and learning.
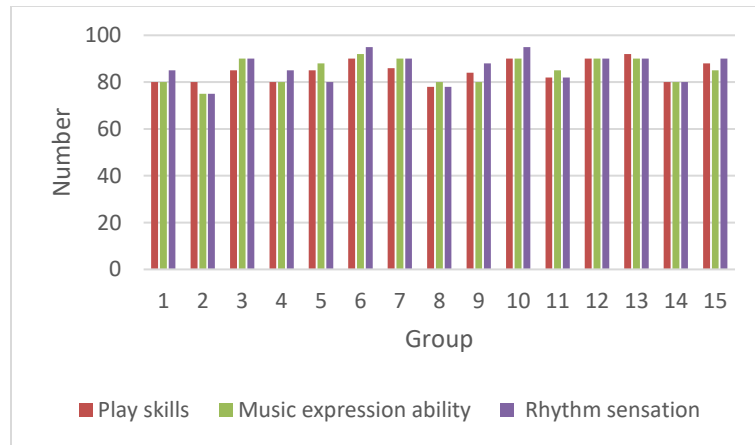
Figure 2: Traditional music teaching quality evaluation data.

4.2 Data Analysis

In this paper, the two sets of data are compared, and the comparison data of the score is shown in Figure 3.
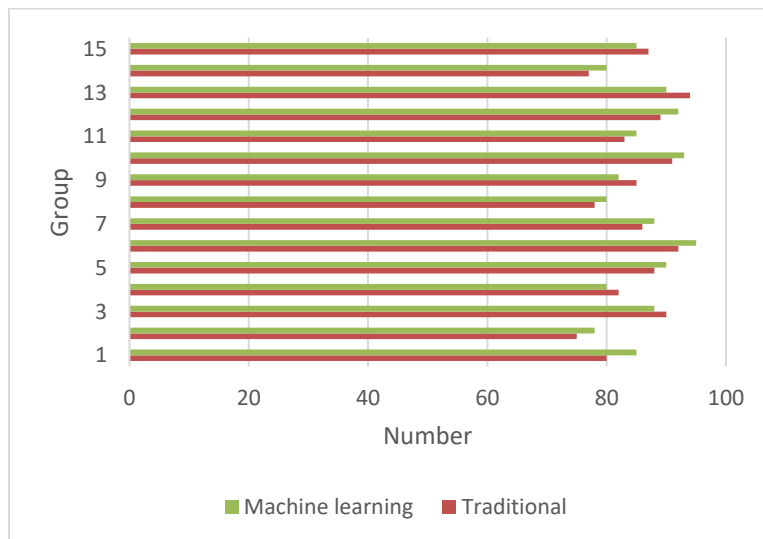

Figure 3: Comparison of scoring data.

Based on the scoring comparison data in Figure 3, it can be found that the assessment method using machine learning has a significant difference in assessment. Therefore, the use of machine learning methods can more accurately identify students' music performance. In contrast, the traditional scoring method is more subjective, so that the difference between the scoring results is not significant. When using machine learning methods to evaluate the quality of music education, there are significant score differences because it is based on massive data and algorithms. Machine learning methods can extract different types of music performance features from massive music

performance data, and score them accordingly. On this basis, an evaluation algorithm based on machine learning is proposed, which can evaluate students' music performance more objectively, thereby reducing the subjective influence of students. In contrast, the traditional marking method relies more on the teacher's subjective judgment and experience. Due to the existence of teachers' personal preference and subjective emotions, the differences between different grades are not significant. In addition, due to the constraints of time, cognition and other factors, the traditional scoring method cannot comprehensively analyze and compare massive music performance data.

Based on the scoring comparison data in Figure 3, we can conclude that machine learning methods may have more accurate and obvious scoring differences in music teaching quality assessment, and can better identify and distinguish students' musical performance levels. The comprehensive use of machine learning methods and traditional scoring methods can obtain more comprehensive and accurate evaluation results, provide teachers and students with more targeted feedback and improvement suggestions, and further improve the quality of music teaching and learning. Based on Figure 1 and Figure 2, this paper conducts a difference analysis on the collected data sets, and the data results are shown in Figure 4.
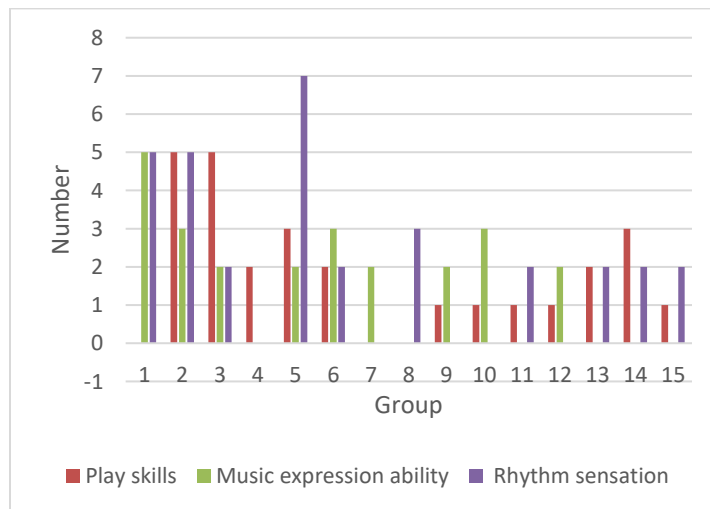

Figure 4: Difference data comparison.

It can be observed from Figure 4 that there is little difference between the evaluation results of the machine learning-based method and the traditional method in the evaluation of music teaching quality. The largest difference is only 7, while most of the differences are only 2, and even some evaluation results can reach zero difference. These results suggest that the machine learning-based approach has some accuracy and reliability in music teaching quality assessment. Although machine learning methods may be affected by factors such as data quality and algorithm choice, in general, they are able to provide evaluation results comparable to traditional methods. However, we also need to note that the differences in assessment results may stem from different assessment standards and methods, and different assessment methods may emphasize different musical elements and skills, thus leading to differences in assessment results. In addition, the differences in evaluation results may also be affected by the subjective judgment and personal preference of the evaluators. Although there is not much difference between machine learning-based methods and traditional methods in the evaluation of music teaching quality, we still need to comprehensively consider a variety of evaluation methods and standards to obtain more comprehensive and accurate

evaluation results. This ensures we have a more comprehensive understanding of students' musical performance and progress, and provides targeted feedback and guidance for teaching. Therefore, this paper calculates the support degree, confidence degree and promotion degree of the machine learning method, and the calculation results are shown in Figure 5.
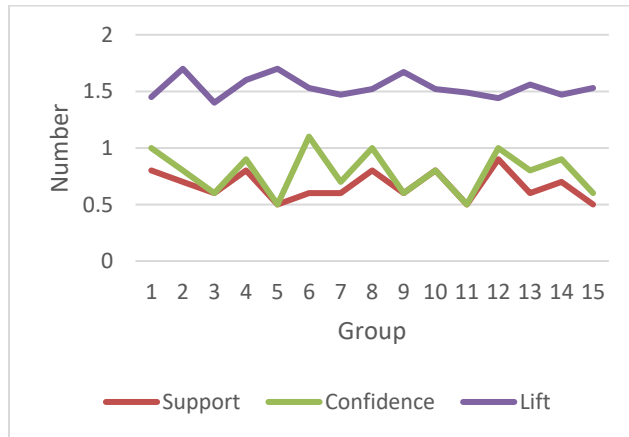

Figure 5: Linked data.

It can be observed from Figure 5 that the support and confidence data of the machine learning method fluctuate greatly, while the promotion is relatively stable at around 1.5. Support refers to the frequency of an item set appearing in the data set. The value of the support degree is around 0.7, which means that most itemsets appear more frequently in the data set; that is, these itemsets are more common in the evaluation of music teaching quality. However, due to large fluctuations in support, we need to analyze further and explain these fluctuations to understand whether the occurrence frequency of itemsets is affected by specific factors. Confidence refers to the frequency of a certain conclusion under certain preconditions. A confidence value of around 0.7 indicates that under the given preconditions, conclusions appear more frequently; that is, these conclusions are more reliable in the evaluation of music teaching quality. However, due to the large fluctuations in confidence, we need to explore further and explain these fluctuations to determine the extent to which the antecedent conditions affect the conclusion. The lift degree refers to the degree to which an item in an itemset increases the occurrence probability of another item. A stable lift at around 1. 5 indicates that there is a certain correlation between certain items, that is, the occurrence probability of these items is relatively high.

In order to better observe the associated data and make a more accurate analysis, this paper uses five sets of data as a set for mean analysis, and the analyzed data are shown in Table 3.

Group	Support	Confidence	Lift
1-5	0. 68	0. 76	1. 57
6-10	0. 68	0. 84	1. 542
11-15	0. 64	0. 76	1. 498

Table 3: Linked data grouping results.

Based on the data in Table 3, a support degree of 0. 68 indicates that the item set appears more frequently in the data set, that is, the item set is relatively common in the evaluation of music

teaching quality. A confidence level of about 0. 8 means that under the given preconditions, the frequency of this conclusion is relatively high; that is, this conclusion is relatively reliable in the evaluation of music teaching quality. A lift of 1. 5 indicates that there is a certain correlation. These results indicate that these itemsets and conclusions have certain importance and relevance in the assessment of music teaching quality. However, these results still need to be interpreted cautiously and combined with more comprehensive data analysis and domain knowledge for comprehensive evaluation.

5   CONCLUSIONS

This paper compares the traditional music education quality evaluation method with the machine learning-based music education quality evaluation method. Experimental results show that traditional evaluation methods and machine learning evaluation methods have similar results when evaluating the quality of music education. Therefore, comprehensive use of various evaluation methods can obtain more comprehensive and accurate evaluation results. At the same time, this project will also study data fluctuations in the three dimensions of support, confidence, and promotion. Most of the support and confidence are around 0.5, and the confidence is relatively stable, generally around 0.4. This value reflects the frequency of the item set, the reliability of the conclusion and the correlation between the items. The quality evaluation of music education is a very heavy task. Traditional evaluation methods are similar to machine learning evaluation results, but each has its own advantages and disadvantages. On this basis, by using different evaluation methods comprehensively and combining them with professional knowledge and expert judgment, more objective and comprehensive evaluation results can be obtained. Follow-up research can explore the combination of traditional evaluation methods and machine learning techniques to improve the accuracy and efficiency of evaluation results.Virtual Reality with machine learning holds the potential to revolutionize the evaluation and enhancement of music teaching quality. By creating immersive learning environments and leveraging intelligent algorithms for data analysis, this integration addresses the limitations of traditional evaluation methods, offering a more objective, personalized, and effective approach to assessing and improving music education. As technology continues to advance, the synthesis of VR and machine learning is poised to play a pivotal role in shaping the future of music teaching quality evaluation system.

Dawei Cao, https://orcid.org/0009-0004-1676-4360
Kwen Liew, https://orcid.org/0000-0001-9601-5343

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