Analysis and Design of Digital Transformation Factors in the Teaching Process of the "Wise Traditional Music Classroom"

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Abstract: This study aims to explore the digital technology-enabled traditional music classroom education and teaching ecological design based on cultural heritage protection and inheritance, in order to improve the efficiency of cultural heritage classroom teaching and digital reform. We chose the excellent traditional Chinese music culture "Poyang Fishing Song" as a case study for analysis and demonstration. Mathematical modelling methods, time series analysis, data mining and optimisation models were used to quantify the efficiency of cultural heritage transmission and the impact of digital reform. Meanwhile, the application of blockchain technology in music education, especially in the field of copyright management, is explored to support the digital transformation of the education ecosystem. By digging deeper and revealing the potentials and limitations of digital transformation, it provides tools for educational institutions, policy makers and researchers to learn from in order to better address new challenges and seize new opportunities.

Keywords: cultural digitalisation strategy, digital empowerment, traditional music, classroom design

1. Introduction

As an important part of the outstanding traditional Chinese culture, the development and application of digital technology hg z aas provided a new way of thinking for the overall protection of cultural heritage, the construction of cultural ecology and dissemination, and will surely open up new ways of inheritance, new ways of experience and new forms of dissemination.

This paper discusses the theme: analysis and design of digital transformation factors in the teaching and learning process of "Wisdom Tradition Music Classroom", and takes the provincial intangible cultural heritage "Poyang Fishing Song" as an example. It aims to deeply study the influence of digital factors on the education and teaching of music intangible cultural heritage.

As a representative of the third batch of provincial cultural heritage listed in the category of traditional music, "Poyang Fishing Song" was born in Song Dynasty, popular in Ming and Qing Dynasties, originated from Taoist "Taoist Love", and circulated in Poyang Lake Basin, which is adjacent to the provinces of Anhui, Hubei and Jiangxi, with hundreds of songs. With colorful forms and unique styles, it vividly carries the folk memories of human history, social labour, local customs

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and love and marriage in different times in Poyang Lake area, and is an important part of the ancient and splendid Chinese fishermen and woodcutters culture [1]. In this study, mathematical modelling methods, including time series analysis, data mining and optimisation models, will be used to quantify the transmission efficiency of cultural heritage and the degree of impact of digital reform. With the help of mathematical models and formulas, we will explore in depth how to better protect and pass on this valuable cultural heritage in school education and teaching.

This research will explore the application of blockchain technology in smart classrooms, particularly in the area of copyright management, to support the digital transformation of the educational ecosystem. We will develop a unified framework that introduces mathematical models and formulas to quantify the role of blockchain technology in educational improvement, copyright management and digital transformation.

2. Background and Value of the Cultural Heritage of Poyang Lake Fishing Songs

2.1. Background of Poyang Lake Fishing Songs

Poyang County originates from the period of Qin Shi Huang and has a history of more than 2,000 years, and this area is characterised by Poyang Lake. Poyang Lake was originally known as Peng Li Ze, and was later named after the ancient Poyang Mountain. The climate here is influenced by the south-east monsoon and has a humid monsoon type climate with annual precipitation of more than 1,000 millimetres, resulting in fertile land and abundant water resources. Poyang Lake, with its vast waters and long shoreline, is home to fishermen (See figure 1).

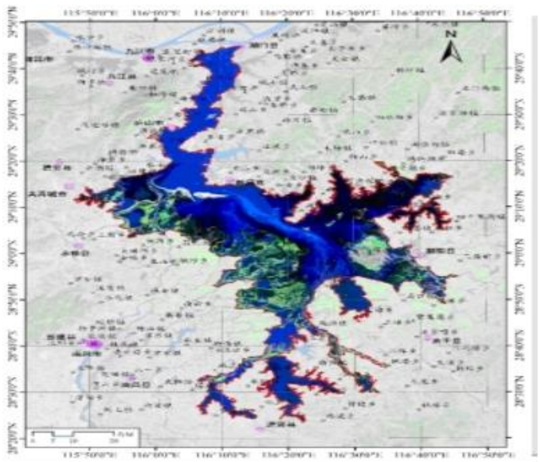

Figure 1: Poyang Lake Basin

2.2. Cultural heritage values

Firstly, Poyang fishing songs, as witnesses of history, record the long history of Poyang area, such as the Song Dynasty's "Poyang Lake Watching Fishing Song", which reflects the social life at that time, emphasising its role in cultural heritage and historical record [2]. Secondly, Poyang fishing songs also add bricks and mortar to the local cultural treasures, such as "Daily Fishing Song", which reflects the daily life of fishermen through simple lyrics, stimulates people's interest in local culture, and reflects its role in the local cultural treasures. Thirdly, the value of artistic expression and creative stimulation of Poyang fishing songs, such as the duet of "Half a catty Rhode Rhode not hooked" in 1980s, not only won awards, but also stimulated the creative enthusiasm of more music workers, which helped the prosperity of local music culture. Moreover, fishing songs are closely connected with production and community, for example, fishing songs in the form of horns, such as the

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Tiangnyan net yell horns, are often sung when fishermen go out to sea to fish, and these songs are related to the actual fishery operation, which becomes a way of community cohesion. Finally, Poyang Fishing Song, as an Intangible Cultural Heritage of Jiangxi Province, has very practical government support and protection [3] . This helps to ensure that this valuable cultural tradition can be passed on. For example, Zhao Nanyuan of the Cultural Centre of Poyang County collected and organised nearly 100 fishing songs in the 1950s and 1960s, and engraved and compiled them into a booklet, which laid a solid foundation for the inheritance of Poyang fishing songs. These endeavours have helped to protect and pass on the important cultural heritage of Poyang fishing songs [4].

3. Application of digital technology based on traditional music smart classroom

3.1. Basic Characteristics of a Smart Classroom

The smart classroom based on a new generation of new technologies such as big data, Internet of Things, virtual reality, mobile Internet, artificial intelligence, etc [5]., has the following characteristics compared with the traditional classroom:

In a smart classroom, student learning is personalised, three-dimensional, open, interactive and creative. This idea stems from the constructivist theory of learning, as early as the beginning of the 20th century, when educator John Dewey proposed that learning should be based on students' individual needs and backgrounds in order to promote more meaningful learning. Since then, successors such as Lev Vygotsky and Jean Piaget have deepened this theory, emphasising that learning is a socially constructed process. Their findings have provided the theoretical basis for the formation of the intelligent classroom.

From a technological perspective, smart classrooms utilise the modern theory of data-driven instruction. This concept, which came to prominence in the early 21st century, calls for the presentation of data on dynamic data such as student learning behaviours and outcomes. One of the founding fathers of this idea was educator Benjamin Bloom, who in the 1950s developed Bloom's Taxonomy, which emphasises the assessment of educational effectiveness. Smart classrooms have also been inspired by the theory of educational data analytics, especially in the late 21st century, when data-driven instruction began to lead the way in educational innovation with the rapid development of educational technology.

From a timeliness perspective, the smart classroom is an application of outcome-based assessment theory. This theory, which gained more attention in the late 20th and early 21st centuries, emphasises intelligent analysis and feedback on learning outcomes and attainment. Advocates of this theory include educators Robert Marzano and John Hattie, whose research helped shape the theory of outcome-based assessment in education. This theory calls for consistently tracking, documenting, and assessing students' core competencies in order to effectively improve instructional strategies.

Ultimately, the application of these traits is expected to facilitate student-athletes to reach learning and promote thinking development, which is in line with the theories of cognitive psychology. Cognitive psychology gained widespread attention in the first half of the 20th century, focusing on learning and thinking processes. Among the prominent cognitive psychologists such as Jean Piaget and Noam Chomsky provided a solid theoretical foundation for cognitive psychology.

3.2. Application of Blockchain Technology in Smart Classroom

Blockchain's decentralisation and security properties, the theory supports. This aspect of the theory relies on the data structure and consensus algorithms of blockchain [6]. As mentioned by Mavridis in their study, blockchain technology provides a solution for establishing highly transparent and traceable data records, which is crucial for applications in education. Furthermore, the concept of smart contracts provides a theoretical basis for the transparent distribution of scholarships and grants.

Relevant theories such as Ethernet smart contracts support the application of blockchain in establishing personalised learning processes.

These theoretical foundations help to realise various applications of blockchain technology in smart classrooms to improve the efficiency and transparency of education. Meanwhile, related dissertation studies provide practical examples and experiences, such as Sharma's research in healthcare, which inspired innovations in blockchain technology in smart classrooms.

3.3. Establishment of a Unified Intelligence Framework

Digital technology integration is a key element in the framework for building a smart classroom. We can draw on the SAMR model (Substitution, Augmentation, Modification, Redefinition), which proposes different levels of technological integration, ranging from simple substitution to a complete reinvention of the educational process. This approach encourages educators to use technology not just as a replacement for traditional tools, but to integrate it into educational practices to increase the depth and breadth of education.

In addition, intellectual property rights and copyright management are crucial in digital education. Using Digital Rights Management (DRM) technologies, we can ensure the copyright legitimacy of digital educational resources. This helps to maintain the legitimate dissemination and use of knowledge while protecting the rights of educators and students.

In order to provide a wide range of learning resources, knowledge sharing and Open Educational Resources (OER) are also an important component. The OER movement promotes educational equity by encouraging knowledge sharing and open access. This provides students with greater access to educational resources, thus promoting diversity and inclusion in smart classrooms.

Data analytics and personalised learning is another key aspect of the smart classroom. Through learning analytics, student data can be used to support personalised learning. This helps educators to better understand the needs of each student and provide them with personalised learning pathways that can improve learning outcomes.

Finally, ongoing training and support are critical to the successful adoption of new technologies. According to the technology adoption model, training and support help educators to better master and apply new technologies. This ensures that educators are able to realise their full potential in delivering high quality education within the smart classroom framework.

Taken together, a unified framework for building a smart classroom needs to take into account a number of elements, such as the integration of educational technologies, intellectual property and copyright management, knowledge-sharing and open educational resources, data analytics and personalised learning, as well as ongoing training and support, which will help to create a more inclusive, personalised and efficient learning environment. This integrated approach will help drive the development and continuous optimisation of the smart classroom to meet changing educational needs.

3.4. Introduction of mathematical models and formulas

(1) Learning analytics and trend forecasting

In Smart Classroom, we can use statistical modelling and time series analysis methods such as linear regression modelling or exponential smoothing to analyse student academic data in a quantitative way. By incorporating these methods into the framework, we can establish the following formula for learning analysis: academic performance = $\beta 0 + \beta 1$ * classroom engagement + $\beta 2$ * homework completion + ε. In this formula, $\beta 0$, $\beta 1$, and $\beta 2$ are regression coefficients that represent the impact of different factors on academic performance. By analysing historical and real-time data,

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we can predict students' future academic performance, which helps educators to take early intervention.

(2) Personalised Learning Pathways

In the framework, personalised learning paths can be implemented using models and formulas for recommender systems. These models compute learning materials that are appropriate for each student based on their learning history and interests. An example of this is collaborative filtering algorithms, which can be used to identify content that may be of interest to students in order to provide them with personalised recommendations.

(3) Academic interventions and support

Mathematical models can be used to develop formulas for academic interventions and support plans. By analysing student academic data, we can use classification models to determine which students may need additional support. A common categorical model is logistic regression, which can be represented by the following formula: p(needs support) = 1 / (1 + e^(-z))

In this formula, z represents a linear combination of a student's characteristics and weights. By setting appropriate thresholds, we can determine which students need special attention and support.

(4) Effectiveness evaluation

Evaluation of the effectiveness of smart classrooms can be quantitatively analysed using A/B tests or experimental design models. These models and formulas can be used to calculate the effects of different educational strategies. For example, the A/B test can be represented by the following formula: Effectiveness = (Experimental Group Performance - Control Group Performance) / Control Group Performance

This formula helps us to quantify the effects of reformed educational strategies and helps in the decision-making process of whether or not to continue with them.

By incorporating these mathematical models, formulas and theories into a unified framework for the smart classroom, we are able to gain a deeper understanding of student needs, improve the quality of teaching and learning, personalise learning, intervene earlier, assess the effectiveness of educational strategies, and introduce scientific quantitative methods in education. This helps smart classrooms to better meet changing educational needs.

4. Curriculum design

Based on the above model and calculation company, the next step is to take "Poyang Fishing Song" as the theme of classroom education and teaching activities, and design the strategy of smart classroom teaching activities.

4.1. Pre-lesson analysis of learning situation and identification of teaching strategies

Before the lesson, we push the audio, video, pictures and other multimedia resources of Poyang Fishing Song to the students, showing the style and technique of the non-heritage music through playing, so that the students can have a more intuitive feeling and understanding. At the same time, we push the course pre-test and test sheet, and require students to complete independent pre-test and test before class through the "Vocational Education Learning Platform", from which we understand and grasp the existing level and needs of students, and collect and analyse the learning characteristics and learning status data of the students in traditional music through the digital twin technology, so that we can grasp the diagnostic report of the students in the class initially. report, and by analysing historical and real-time data, we predict students' performance in the classroom, which helps educators to take early and personalised interventions. and learning pre-planning, and to further optimise and refine the learning tasks.

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During the pre-school academic analysis phase, we can use the learning analytics formula to assess students' academic data in order to better understand their academic performance. The formula is shown below:

Academic performance = β0 + β1 * class participation + β2 * homework completion + ε

Here, academic performance is the data to be analysed, while classroom engagement and homework completion are factors that affect academic performance. By analysing historical and real-time data, we can predict students' future academic performance, which helps educators to take early and personalised interventions.

This lesson was taught to second-year students majoring in music at Jiangxi Arts Vocational College, with a class size of 30, who already had some musical scoring skills after a number of hours of music class. The activity goal of this class is to cultivate students' skills of learning and singing about the Poyang fishing song and their appreciation of that traditional culture. The cognitive objective: to help students understand and master the knowledge of music theory, score knowledge and the protection and inheritance of non-heritage music of Poyang Fishing Song, and to guide students to better understand the historical origin and social significance of the non-heritage music; the affective objective: to enhance students' awareness and ability to actively participate in the learning of traditional culture, and to actively devote themselves to the protection and inheritance of China's outstanding traditional culture , to enhance cultural self-confidence, to enhance cultural confidence, to enhance the ability to appreciate this traditional culture, and to enhance the ability to learn and appreciate this traditional culture. In parallel,enhance cultural self-confidence, cultural identity and professionalism; its skill objective: to be able to independently sing and pass on the non-heritage music they have learnt, and with knowledge and skills, and cultural self-confidence, to be able to solve the basic problems of non-heritage music in different contexts, and to be able to adapt to the world's civilisations' mutual appreciation and exchange.

4.2. Construction of Interactive Activity Strategy for Teaching Poyang Fishing Song Based on Deep Learning

Based on the above, the activity category of this class is classified as migration and application activities, which mainly includes the video presentation of inheritors and famous non-heritage artists, teacher's guidance, communication and interaction, group mutual evaluation, sharing of results and other forms of classroom activities. The knowledge map of this class is relatively clear, mainly centred on learning to sing Poyang fishing songs, involving related knowledge points such as music literacy, music theory and fishing song culture. Therefore, dividing the whole class into 6 groups for cooperative learning, we divided the activities into 3 task modules: learning to sing, group chorus sharing, and group mutual evaluation, with the teacher responsible for leading students to complete the tasks, and the learning committee members and group leaders assisting the teacher.

4.2.1. Interactive Activity Design for Teaching Poyang Fishing Songs

This class is implemented in a smart classroom composed of cameras, multimedia teaching all-in-one machines, AI robots, VR glasses, mobile learning tools and other smart devices, and the NRM website, APP, and VET learning platforms provide students with all kinds of learning resources and interact with each other online on the learning platform.

① Scenario 1: Teachers firstly comment on and explain in detail the concentrated problems in students' learning before the class, and lead students to know more about the cultural and artistic values of non-heritage music, as well as the roles and significance of pitch, rhythm, chord, melody, modulation, and lyrics, and also create a virtual scene of the Poyang Fishing Song. Learning groups learn to sing and use props and costumes according to the learning tasks and scenes. On the premise of learning the repertoire, each group conducts group PK and mutual evaluation between groups. The learning analytics system captured the information of students' interactive activities through the camera, and showed the progress of task completion of each group to the teacher in a visual form, so as to facilitate the teacher to control the process of the activities in a reasonable way. The task mobilises the enthusiasm of group members to participate, enlivens the classroom atmosphere and enhances the friendship and sense of collective honour among members.

In that scenario, we can use the models and formulas of recommender systems to provide personalised learning paths for students. The formulas are as follows:

P(support required) = 1 / (1 + e^(-z))

In this equation, z represents a linear combination of a student's characteristics and weights. By setting appropriate thresholds, we can determine which students need special attention and support. This helps teachers determine which students need extra help in the classroom. Teachers calculate the appropriate learning materials for each student based on their learning history, pre-class learning and interests. Collaborative filtering algorithms are used to identify content that may be of interest to students so that they can be provided with personalised guidance and advice for differentiated training and personalised learning.

② Scenario 2: Teachers explain to students in the form of animation the video of Poyang fishing song inheritors singing, performance costumes and props, the expression of the inherited group, the inherited group body language and other fishing song figurative. On the one hand, students can provide the "teaching and learning" environment of knowledge visualisation through the augmented reality teaching (AR teaching) technology, i.e.: through the construction of AR scene (augmented reality scene), the three-dimensional, graphic and vivid explanation of non-heritage music knowledge points; teachers can also provide the service demand of multi-dimensional interactive experience through the virtual reality teaching (AR teaching) technology, and the learners can learn through the interactive experience of the virtual reality teaching. Interactive experience of the service demand, learners immersive participation in non-heritage music performance, feel the way of playing different instruments and music emotion expression, this immersive learning experience helps to stimulate students' interest and learning motivation. On the other hand, students are organised to watch relevant video cases of non-heritage music inheritors and famous artists to show students the charm of traditional culture, so that they can experience the profoundness of Chinese traditional culture, thus generating a sense of identity and increasing their attention. The students are prompted to think about how to transform and innovate the non-heritage music Poyang Fishing Song; how to make the non-heritage music come into common people's homes; how to make the traditional culture go out of the circle to the sea and participate in the mutual appreciation of the world's civilisations and other series of problems. And the thoughts, ideas or proposals put forward by students are posted on the learning platform for discussion with learning partners. In order to stimulate students' interest in learning, teachers also invite group representatives to wear VR glasses and independently choose their favourite traditional music scenes to communicate and interact with virtual inheritors. Teachers can guide students to use some online resources before and after class to expand their music knowledge and skills. In this scenario, we can use A/B test or experimental design model to evaluate the teaching effect. The formula is as follows:

Effect = (Performance of experimental group - Performance of control group) / Performance of control group.

This formula can be used to calculate the effectiveness of educational teaching strategies. In this context, we can use classification models by analysing students' academic data to determine which students may need to be scaffolded, provided with help, and need additional support and help. This helps teachers to better understand the effectiveness of teaching and learning activities and take appropriate measures.

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In addition, in the process of arranging the teaching content and interacting with activities, teachers should always connect the points of music theory knowledge such as the development of musical instruments and the flow of tuning of non-heritage music with the grand historical and cultural background and humanistic vein behind it. Integrating the course content with music anthropology, ethnomusicology, country music history, etc., leading students to feel the greatness of traditional music as the traditional language of mankind, not only expands the breadth and depth of students' cognition, but also sublimates to the positive guidance of values.

4.2.2. Analysis of the Effectiveness of Teaching Interactive Activities and Teaching Effects of Poyang Fishing Songs

With the help of the Learning Behaviour Analysis System, we carried out a comprehensive analysis and evaluation of the teaching interactions, and in the evaluation process, we focused on analysing whether the teaching had achieved the generation of students' knowledge, emotion and ability. Specifically: ① Diversified subject evaluation. In classroom activities, teachers, students and intelligent technology participate in evaluation together. Teacher evaluation in the classroom as well as students with outstanding classroom performance participate in evaluation, and group members conduct mutual evaluation. After the class, teachers use intelligent technology to conduct comprehensive evaluation of students' learning performance as well as task completion, and also organise students' self-evaluation such as student engagement scale on the learning platform. ② Three-stage evaluation method. Through diagnostic evaluation before class, formative evaluation during class, and summative evaluation after class, evaluation is carried out through all aspects of the teaching process. Before class: diagnostic evaluation of students' learning in terms of knowledge preview, online seminar, and pre-class evaluation. During the lesson: process evaluation from the active participation in the task, the quality of task completion, students' interaction with the teacher and group members, and students' body language. After the lesson: summative evaluation in terms of learning works submitted by students, learning tests taken, students' reflection reports, and contributions. ③ Open-ended evaluation content. As a public culture course, we conduct an all-round examination of students' learning evaluation from the dimensions of learning attitude, participation in classroom activities, communication and exchanges, creativity of thinking, quality of works, self-reflection, etc., to respect students' individual differences, stimulate students' motivation to learn, and enhance students' sense of fun and experience in learning.

5. Conclusion

This study provides new ideas and theoretical support for the preservation and transmission of cultural heritage in digitally-enabled traditional music education. Its multi-dimensional approach, the exploration of blockchain technology, the introduction of mathematical models, and the comprehensive unifying framework constitute the highlights of the study, which is expected to provide useful guidance for educational institutions, policy makers, and researchers. Currently, modern reforms in vocational education focus on the classroom as the main battleground, aiming to develop students' core literacy and competencies. Smart classrooms have emerged in this context, providing opportunities to tap into students' intelligence, self-development and self-evolution. Particularly in terms of pedagogical interaction, smart classrooms significantly enhance students' learning engagement and motivation by providing high-quality interactive content and insightful activities. However, there is still room for further exploration and reflection on the deeper integration of smart classrooms with the arts and new technologies, as well as student autonomy and deeper learning.

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