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Innovation of Interactive Dulcimer Teaching Mode Based on Digital Multimedia Technology

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Abstract: In today's digital development, digital multimedia technology has been seen everywhere in people's daily life. It is constantly changing the way students study, live and behave. The internal and external environment of learning is also affected by it. Nowadays, the traditional teaching mode of dulcimer has been unable to keep up with modern education, which makes dulcimer education unable to adapt to the new development trend. Based on digital multimedia technology, this paper studied the design of the interactive system of dulcimer learning and teaching entertainment. The necessity of the experiment, the method design, the specific implementation steps and the final experimental results were described in detail. According to the trial findings, the dynamic teaching approach based on digital multimedia has greatly increased its action recognition rate. The correct rate of using traditional video teaching method was 50.1%. The accuracy rate of dynamic teaching method based on digital multimedia was 83.6%. Compared with the traditional video-guided teaching method, the accuracy rate has been increased by 33.5%. It is verified that the method has good practicality.

1. Introduction

With the rapid development of digital multimedia technology, the society has an increasing demand for multimedia technical talents. Therefore, digital multimedia teaching has become a research hotspot in various schools. Besides, digital multimedia teaching has begun. With the changes of the times, many industries related to digital media have appeared. A new educational thought and method that is in line with the development trend of the times has also emerged. The quality of digital multimedia depends on the integration and construction of resources. The combination of network resources and information technology have improved the efficiency of teaching interaction. However, the current music teaching methods related to dulcimer are relatively

simple, which cannot adapt to the rapid development of the information age. At present, the classroom teaching of dulcimer teaching still remains in the traditional teaching methods such as dulcimer playing and blackboard. Teachers are talking, and students are listening. There is no lively demonstration, interaction, or practice. The traditional "cramming" teaching method has caused the boring in the classroom. It is not conducive to the generation of students' interest in learning, which also reduces students' learning efficiency. Therefore, in the current teaching environment, it is an issue worth discussing to improve teachers' music teaching skills and enrich their teaching methods so as to improve students' enthusiasm for learning. In short, there are many problems in the teaching of dulcimer. The improvement of the dulcimer teaching mode requires that the corresponding professional knowledge can be improved in accordance with the standards of the course. It can better meet their psychological needs and thus better complete the teaching goals. The teaching of dulcimer should actively explore new teaching methods and absorb new teaching experience under the premise of adhering to "education-oriented". In the field of digital multimedia, dulcimer education has a new situation. Taking into account the existing condition of dulcimer teaching, this paper proposes a novel idea for dulcimer classroom instruction that integrates digital multimedia technology with conventional teaching techniques. In this way, it is expected to enrich the teaching methods of dulcimer, the diversification of forms and the vividness of classroom teaching. In order to fulfill the goal of high-quality education, it can increase students' motivation for learning and allow them to use high-tech terminals for self-learning in their free time.

The innovation of this paper is: through the analysis of traditional teaching resources and digital multimedia technology, a teaching system of dulcimer based on digital multimedia is proposed. On this basis, the user evaluation of the body perception and entertainment interactive system based on digital multimedia technology is carried out. Depending on the content of the evaluation, different data collection and analysis are adopted.

2. Related Work

At present, in many university conservatories, digital multimedia music technology is an important means. Many schools have dedicated teaching and in-depth study in music departments. For example, Dai M analyzed the innovation and process optimization of wind music teaching mode based on multimedia classroom. He believed that multimedia could provide strong support for teaching, which could realize resource sharing with new methods, new ideas and new technologies [1]. Chi X studied a user vocal teaching model based on a computer platform, which would be able to fully utilize the benefits of multimedia education. Additionally, it could maintainably raise the standard of vocal music instruction, which helped students master vocal music skills [2]. Li H examined the creative approach used in the multimedia flipped classroom environment to teach music. Using the Internet's interactive features, teachers could conduct classroom teaching through video and multimedia PPT to improve students' interest in learning [3]. Jin C analyzed the innovation of music teaching mode based on intelligent classroom and multimedia system. It was believed that the multimedia music system had changed the traditional music teaching mode and made music teaching more vivid [4]. Fu L introduced the positive significance of the current reform and innovation of vocal music teaching in colleges and universities, as well as the specific reform and innovation strategies. By reconstructing the teaching mode, the quality and level of vocal music teaching was continuously improved [5]. It can be seen that the research scope of multimedia music teaching is more and more extensive. However, the above research lacks the support of experimental data and scientific methods for improving the practical application of multimedia music teaching, which is not convincing.

With the continuous development of human-computer interaction technology, this technology

has become an important subject in the field of computer. For example, Liang X made an in-depth summary and analysis of the English interactive teaching model based on the cloud computing artificial intelligence model. He explored the characteristics of smart classrooms and practiced the reform of interactive teaching mode [6]. Hu L proposed an algorithm based on human-computer interaction and face recognition which could efficiently assess students' classroom learning progress and human-computer interaction process when teaching online. According to the image background, the background was deleted, so that a spatiotemporal feature image that can express dynamic typical characteristics was obtained [7]. Duan R enhanced and examined the voice recognition algorithm based on artificial intelligence speech recognition technology by using the efficient algorithm as the system algorithm of the artificial intelligence model. At the same time, based on the phoneme-level speech error correction, on the basis of introducing the basic knowledge, construction and training of the acoustic model, the basic process of speech segmentation was expounded, including the front-end processing of speech and the extraction of feature parameters [8]. Sun Y thought that the integration of in-person instruction in the classroom with online self-learning, that is, human-machine combined teaching, was an ideal teaching mode, which was very popular among students and could improve students' English ability [9]. Many sectors, including the reform of education methods, have effectively used human-computer interface technology, emotion recognition, face recognition and so on. However, the field application used to study dulcimer teaching is not mature enough, which is worthy of further study.

3. Composition of Dulcimer Teaching Method Based on Digital Multimedia Technology

3.1. Classroom Teaching Interaction with Digital Multimedia as Auxiliary System

In multimedia digital teaching, the interaction among teachers, students and media is mainly carried out by these three. Through specific situations and teaching activities, "language interaction", "behavioral interaction", "emotional interaction" are formed. Finally, "thinking interaction" is realized [10]. In terms of time, interactions in classrooms using digital multimedia are usually real-time interactions. The relationship of each element is shown in Figure 1.

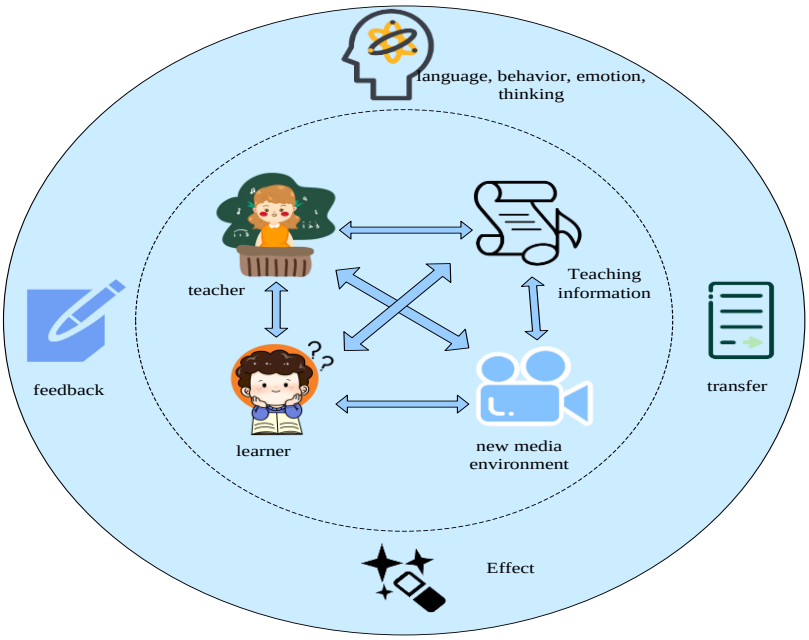


Figure 1. Interactive structure of classroom teaching in the digital multimedia environment

Specifically, with the support of digital multimedia, the physical components of classroom teaching interaction include learners, teaching groups (teachers or other tutors), media environment and teaching information [11]. Instructional information exists between the three elements, or which is generated during interaction. Visible human-computer interaction factors are dominant. The expected teaching effect is achieved through the interaction between subjects such as competition, mutual assistance, collaboration, and role-playing [12-13].

(1) Digital multimedia as an auxiliary system design principle

The basic principle of the auxiliary system with digital multimedia as the main content is accurate positioning. The functional modules and work requirements of six main users are determined. The design and implementation of the functional modules are completed [14]. Second, the scale needs to be defined. The usage of the system refers to the number of users, processing capacity, functional modules, etc. The size of the system has a great influence on the structure, software and hardware performance of the system. The larger the scale of the system, the higher the requirements for the overall structure. The smaller the size of the system, the worse the overall performance of the system. Third, good interaction is required [15]. Good interaction can make teaching go on smoothly and achieve a positive interaction between teaching and learning, which can transmit and exchange information from both sides in a timely manner. Of course, good interaction requires more intuitive interaction and easier system operation. Finally, sound technology is required. The rationality and practicability of the technology should be taken into account. Considering the system size, location and other factors, the rationality and practicability of the technology are comprehensively considered to obtain the best cost performance [16]. Technology can't be too good or too bad, it has to be the best. The system framework is shown in Figure 2. In the design of information systems, comprehensive consideration should be given to security, positioning, scale, interactivity, and technical rationality.

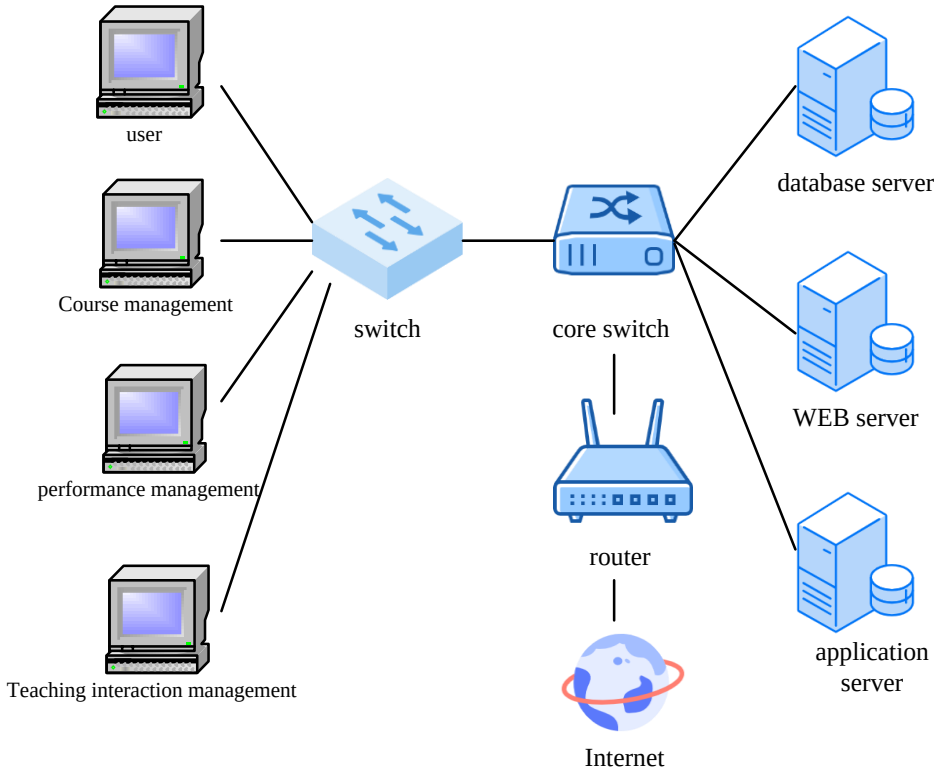


Figure 2. Overall system frame diagram

(2) System database design process

When designing the database, it is necessary to analyze the requirements [17]. The analysis of needs can be achieved through surveys, inquiries and research. Through inquiries and surveys, users' needs can be analyzed, that is, the final data needed. The implementation of this procedure is directly related to the rationality and practicability of the design [18]. The outcome of this phase can be represented by a flowchart and a use case diagram. The specific introduction is shown in Figure 3.

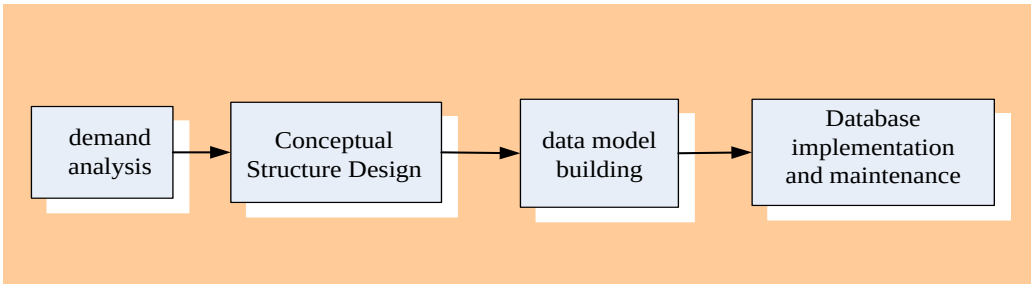


Figure 3. Design steps of the system database

When designing a conceptual model, the following points should be paid attention to: strong semantic expression, easy to understand, and convenient for communication between different users. Conceptual structures are transformed into relational schemas and optimized [19]. After the data model is established, the data model is transformed into a specific table. On this basis, an appropriate storage structure and access method are selected.

3.2. Real-time Interactive Multi-teaching Path Dynamic Teaching Method

In the professional and technical training attended by teachers, when the students make mistakes in the learning process, the teachers make targeted adjustments to the reasons for the mistakes based on the students' previous learning feedback. In a body-aware system, the learning status of trainees can be evaluated by collecting their field performance [20]. In theory, the real-time learning status of students can be collected. Based on this feature, it is possible to understand the state of the students when they are studying. This paper introduces a new "multi-channel dynamic" teaching mode and applies it to the "body sensation" teaching based on "multimedia".

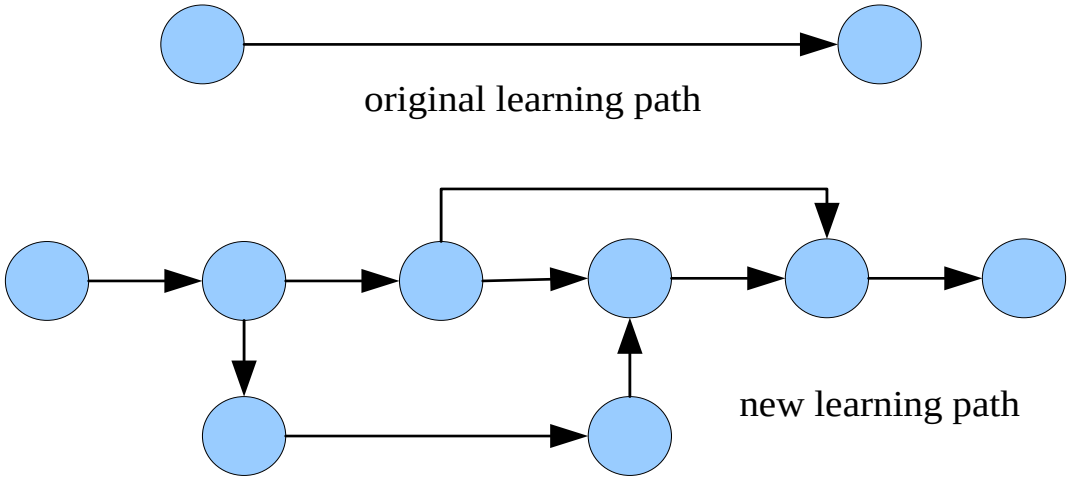


Figure 4. The original learning path and the new learning path model

As can be seen from Figure 4, several key nodes are set in the training content. The nodes divide the content into parts, and the training is evaluated on the nodes. After the evaluation, each node

evaluates the adjustment of the teaching content. It jumps to new teaching content if needed. After the training, the various links that the training subjects pass through are connected to form a customized teaching route.

3.3 Multi-path Dulcimer Teaching Method Based on Double-layer Hidden Markov Chain

This paper adopts a multi-path teaching method based on two-layer hidden Markov chain. First, the model is described as follows:

The general expression of a hidden Markov chain is:

$$\lambda = (N, M, A, B, \pi) \tag{1}$$

Among them, N is the sum of states in λ. M represents the total number of different types of events in λ state. A is a spatial probability $N \times N$ matrix in λ.

$$A = \{a_{ij}, a_{ij} = p(q_{t_{n+1}=j} / q_{t_n=i})\} \tag{2}$$

Among them,

$$1 \le i, j \le N, a_{ij} \ge 0; B = \{b_j(k)\} \tag{3}$$

$$b_j(k) = P[o_t = v_k / q_t = j](1 \le i \le M) \tag{4}$$

$b_j(k)$ is represented as the v_k probability of the event o_t corresponding to the j state. The probabilities that can be obtained from observation events in different forms form a matrix B of $N \times M$:

$$\pi = \{\pi_i\} \tag{5}$$

Among them,

$$\pi_i = P[q_1 = i](1 \le i \le N) \tag{6}$$

In a sequence of random processes, the initial state takes the probability value of i, and all π_i are combined to form a matrix π of $1 \times N$. The action decomposition diagram of the double-layer hidden Markov teaching constructed in this paper is shown in Figure 5.

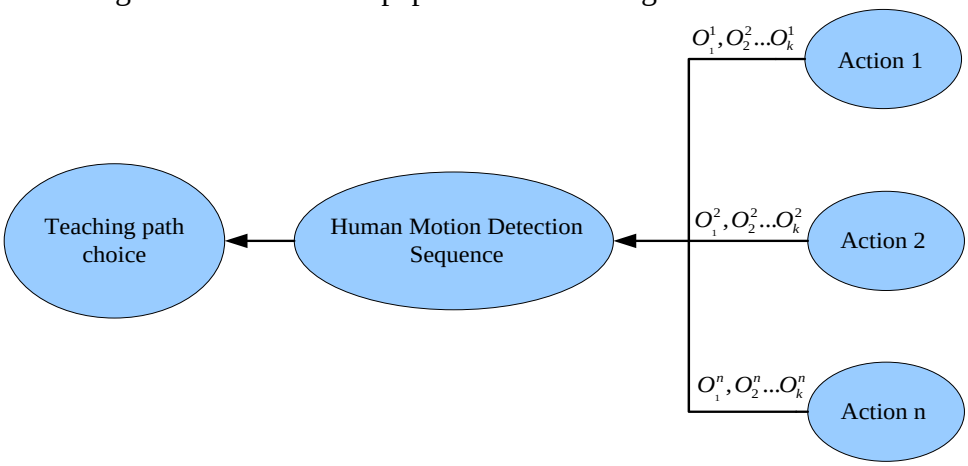


Figure 5. Decomposition diagram of teaching action

As can be seen from Figure 5, a teaching segment in the lower level consists of multiple hidden Markov action recognition modules. Each decomposed action recognition module can identify the corresponding segment action in the action sequence. Within each time horizon, the model with the greatest similarity in each action module is identified. Then, a set of identification data results of complex actions are obtained through combination. The recognition results from the bottom level are pushed to the top level.

Using the data results of the bottom-level action recognition as a high-level observation sequence, the identification of the teaching path selection model is obtained. The bottom-level sequence is represented as:

$$o(t)=\left\{o^1(t),o^2(t),...,o^N(t)\right\} \tag{7}$$

In the Formula, $o^N(t)$ is the number obtained after action recognition.

The forward and backward variables in the discrete model are adjusted, and the resulting formulas are:

$$a_{t+1}=\left[\sum_{i=1}^{k}a_t(i)a_{ij}\prod_{f=1}^{N}b_j\left(o^f(t+1)\right)\right] \tag{8}$$

$$\beta_{t+1}=\left[\sum_{i=1}^{k}\beta_t(i)a_{ij}\prod_{f=1}^{N}b_j\left(o^f(t+1)\right)\right] \tag{9}$$

In the Formulas, $a_t(i)$ is the output probability of the sequence of the forward variables in the model t at a certain time. $\beta_t(i)$ is the probability obtained by the sequence output of the backward variable at model t. $o^f(t)$ represents a sequence variable. The modified formula of confusion matrix B is:

$$\overline{b_j^f}(k)=correct\left(k^f/j\right)/correct(j) \tag{10}$$

Among them, $correct\left(k^f/j\right)$ is the correct number of motion recognition in teaching content s_j. $correct(j)$ is the expected value of the correct number of actions in the recognition process.

3.4. Principle of Fuzzy Comprehensive Evaluation

The principle of fuzzy transformation is combined with the principle of maximum subordination. The weighting coefficient and fuzzy correlation matrix are used for comprehensive calculation, and the final evaluation result is obtained.

The set of evaluation factors is determined as:

$$U=\left\{u_1,u_2,...,u_m\right\} \tag{11}$$

Among them, $u_1(i=1,2,...,m)$ is the evaluation factor. This collection is the teaching evaluation framework. The set of evaluation results is determined as:

$$V=\left\{v_1,v_2,...,v_n\right\} \tag{12}$$

Among them, $v_j(j=1,2,...,n)$ is the evaluation result. n is the number of elements, such as the number of evaluation levels or the number of grades. This set defines the scope of the evaluation

results.

It is supposed that a single-factor evaluation is performed on the i-th evaluation factor u_1 to obtain a fuzzy vector R_1 relative to V_j:

$$R_1 = (r_1, r_2, \ldots r_m), i = 1,2,\ldots m,\ j = 1,2,\ldots, n, 0 \le r_{ij} \le 1 \tag{13}$$

r_{ij} means that factor u_1 has a degree scale of v_j. The determined weight vector is:

$$A = (a_1, a_2, \ldots, a_n) \tag{14}$$

Among them, $a_1(i = 1,2,\ldots,n)$ is the importance of factor u_1, that is, the weight of $u_1(i = 1,2,\ldots n)$, which satisfies:

$$\sum_{i=1}^{n} a_1 = 1, 0 \le a_1 \le 1 \tag{15}$$

The final evaluation result B is:

$$B = A \circ R = (b_1, b_2, \ldots b_m) \tag{16}$$

Among them:

$$b_j = \sum_{i=1}^{n} a_1 \text{ or}_{ij},\ j = 1,2,\ldots m \tag{17}$$

3.5. Dulcimer Teaching from the Perspective of Digital Multimedia

The questionnaire survey approach is used in this study to collect data on 100 dulcimer majors and 30 dulcimer teachers in order to make the innovation of the dulcimer teaching mode more successful in accordance with the characteristics of technical teaching. According to the obtained data and survey results, corresponding solutions are proposed. The paper also discusses the design of the questionnaire and the goal and the processing of the data, so as to make the research of this paper more scientific and reasonable.

(1) Satisfaction of teachers and students with teaching methods

The current state of dulcimer instructors' classroom practices at colleges and universities is examined in this essay. Teachers and students are surveyed on their satisfaction with this type of teaching method, as Table 1.

Table 1. Satisfaction with the current dulcimer teaching method

Topic	Options					
Are you satisfied with the current dulcimer teaching method?	Identity	Satisfy	Quite satisfied	Generally	Not very satisfied	Dissatisfied
	Student	17%	26%	34%	18%	5%
	Teacher	30%	43%	16%	7%	4%

As shown in Table 1, the proportion of students who are "satisfy" with the current teaching method of dulcimer is 17% and the proportion of teachers who think "satisfy" is 30%. 26% and 43% are "quite satisfied" with the current teaching methods, respectively. 34% of students think the

current education method is "generally", and 16% of teachers think it is generally. 18% of students are "not very satisfied" with current teaching methods. 5% of students feel dissatisfied with the current teaching methods, while 4% of teachers express dissatisfied. According to the questionnaire data, the degree to which teachers and students are satisfied with the dulcimer teaching approach differs significantly. Therefore, teachers and students need further communication and improvement in the correct use.

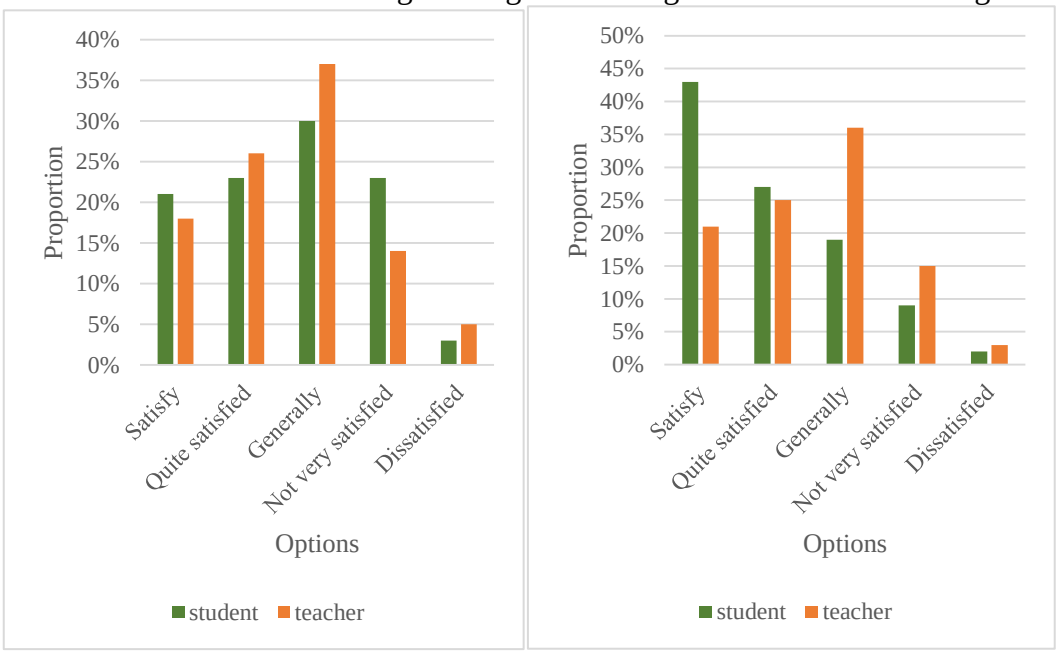
(2) The teaching methods used by teachers

Table 2. Teachers' common teaching methods

Topic	Options					
What do you think are the teaching methods currently in use?	Identity	Teaching method	Practice method	Demonstration	Practice law	Discussion method
	Student	42.8%	22.6%	15.2%	12.3%	7.1%
	Teacher	39.7%	26.3%	16.3%	13.4%	4.3%

According to the statistics in Table 2, 42.8% of students and 39.7% of teachers think that using instructional methods in the classroom is a very typical occurrence. 22.6% of the students and 26.3% of the teachers believe that the practice method is more common in dulcimer learning. 7.1% of the students and 4.3% of the teachers think that the discussion method is common.

(3) Satisfaction of traditional teaching and cognition of digital multimedia teaching methods



(a) Satisfaction with traditional classroom teaching methods

(b) Satisfaction with digital multimedia teaching methods

Figure 6. Satisfaction with traditional teaching and digital multimedia teaching methods

It can be seen from Figure 6(a) that 21% of students and 18% of teachers are "satisfy" with the effect achieved by the teaching method. 23% of the students and 26% of the teachers are "quite satisfied" with the results achieved by the teaching method. 30% of students and 37% of teachers rated the effectiveness of teaching methods as "generally". 23% of students and 14% of teachers are "not very satisfied" with the effectiveness of teaching methods. 3% of students and 5% of teachers

are "dissatisfied" with the results achieved by the teaching method. From the analysis of the survey data in Figure 6(b), it can be concluded that there are a large number of students who need to use new media in classroom teaching. 75% of the students express their willingness to accept teachers' use of new media to transfer knowledge. It can also be seen that the use of new media provides a new thinking direction for traditional teaching methods, which also increases students' desire and demand for new media teaching methods. From the data analysis above, it is clear that one important element to increase the efficiency of teaching is students' need for instructional approaches. Teaching methods need to be combined with students' will to further enhance students' enthusiasm for learning.

(4) The purpose of teachers' use of teaching methods

Table 3. The main purpose of teachers using teaching methods

Identity	Options			
	Cultivate students' professional ability	Complete teaching purpose	Impart knowledge to students	Promote the all-round development of students
Student	21.5%	42.3%	24.4%	11.8%
Teacher	27.5%	15.3%	24.3%	32.9%

As can be seen from Table 3, 21.5% of students and 27.5% of teachers indicated that the main purpose of using this teaching method is to cultivate students' dulcimer skills. The proportions of students and teachers who considered it to be done for teaching purposes are 42.3% and 15.3%, respectively. The information above shows that the majority of educators and students are aware of how learning styles affect academic success. This not only affects the interest and attitude of learning, but also affects the enthusiasm and effect of learning. However, some teachers and students do not have a thorough understanding of learning styles. They believe that this way of learning has little effect on students' learning.

4. Evaluation of Dynamic and Interactive Dulcimer Teaching Methods with Multiple Teaching Paths

4.1. User Questionnaire Design and Results

Students are users of the dulcimer teaching platform, receivers of music knowledge content, and experiencers of interactive teaching. Therefore, students play a decisive role in the rationality and success of system design. Only by letting students feel the desired effect on the system platform can students like this dulcimer.

This system platform is mainly aimed at students in school. Therefore, this survey selects the first, second, and third students of junior high school and records them as groups 1, 2, and 3 respectively. 35 people in each group are subjected to the same survey design. The purpose of the method is to enable each student of the experience to participate in the testing of the same items. The survey results are shown in Figure 7.

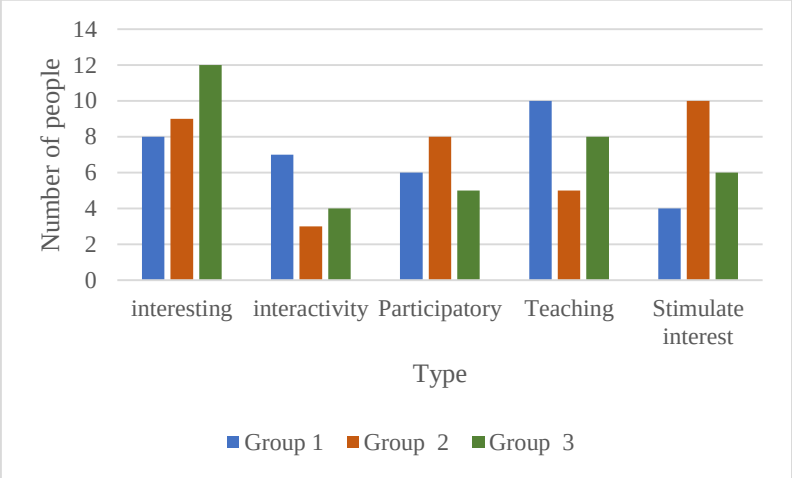
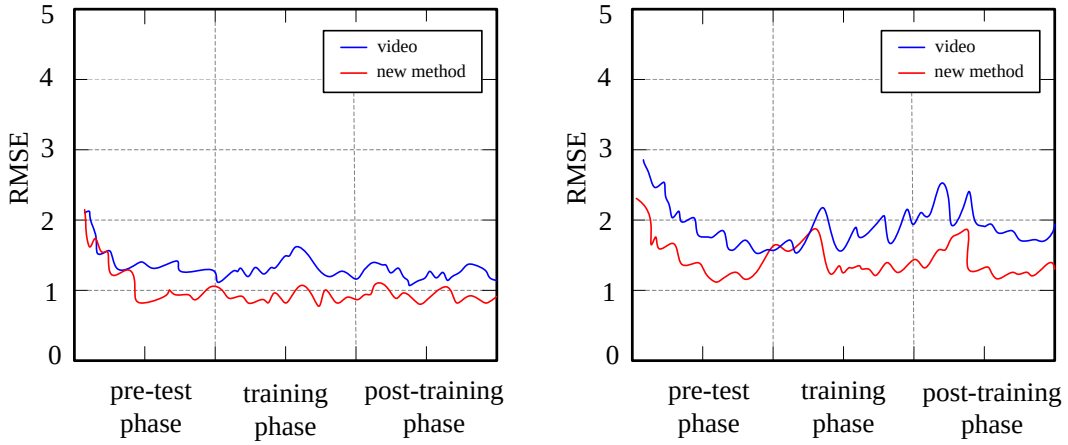


Figure 7. Questionnaire survey statistics

Figure 7 shows that the first-year students believe the system platform has the most educational. The students of the second year of junior high school think that the system platform can stimulate the interest of learning, but the interaction is average. The third-year students think the platform is the most interesting.

4.2. Teaching Method Evaluation Process

This paper compares the dynamic multi-path somatosensory teaching approach with the conventional teaching method based on video in its investigation on student user usage. The results of each system's training test are utilized as experimental data to compare the multimedia technology teaching strategies that are discussed in this paper. The test selects 10 students (5 males and 5 females), because the performance of dulcimer is a more professional skill. Therefore, on the basis of the basic performers, an expert judge is added to evaluate the performance of each student. A variance error (RMSE) analysis is performed, as shown in Figure 8.



(a) RMSE for simple music *(b) RMSE for complex music*

Figure 8. Student's RMSE plot in each case

From Figure 8(a), it can be seen that the pre-training and post-training changes are significant ($F_{(1,9)}=9.98 \quad p=0.02$). The strumming score of the method used in this paper is improved by an average of 1.10 points. The average score based on traditional video conditions is improved by 0.55 points. The effect of playing type on the score is not significant ($F_{(1,9)}=0.24 \quad p>0.4$). From Figure 8(b), it can be seen that the change of the style of playing to the use of learning actions is not obvious ($F_{(1,9)}=0.23 \quad p>0.7$). It can be seen that the effectiveness of the dynamic path teaching method based on digital multimedia does not depend on the difficulty of the action.

4.3. Evaluation Results of Interactive Dulcimer Teaching Method

After each participant completed a five-minute practice session, their academic performance is tested. The acceptance content is to review the actions learned by watching a demonstration video, and complete five actions on this platform. Then, the behavior of each student during the performance is identified, and the corresponding data is obtained.

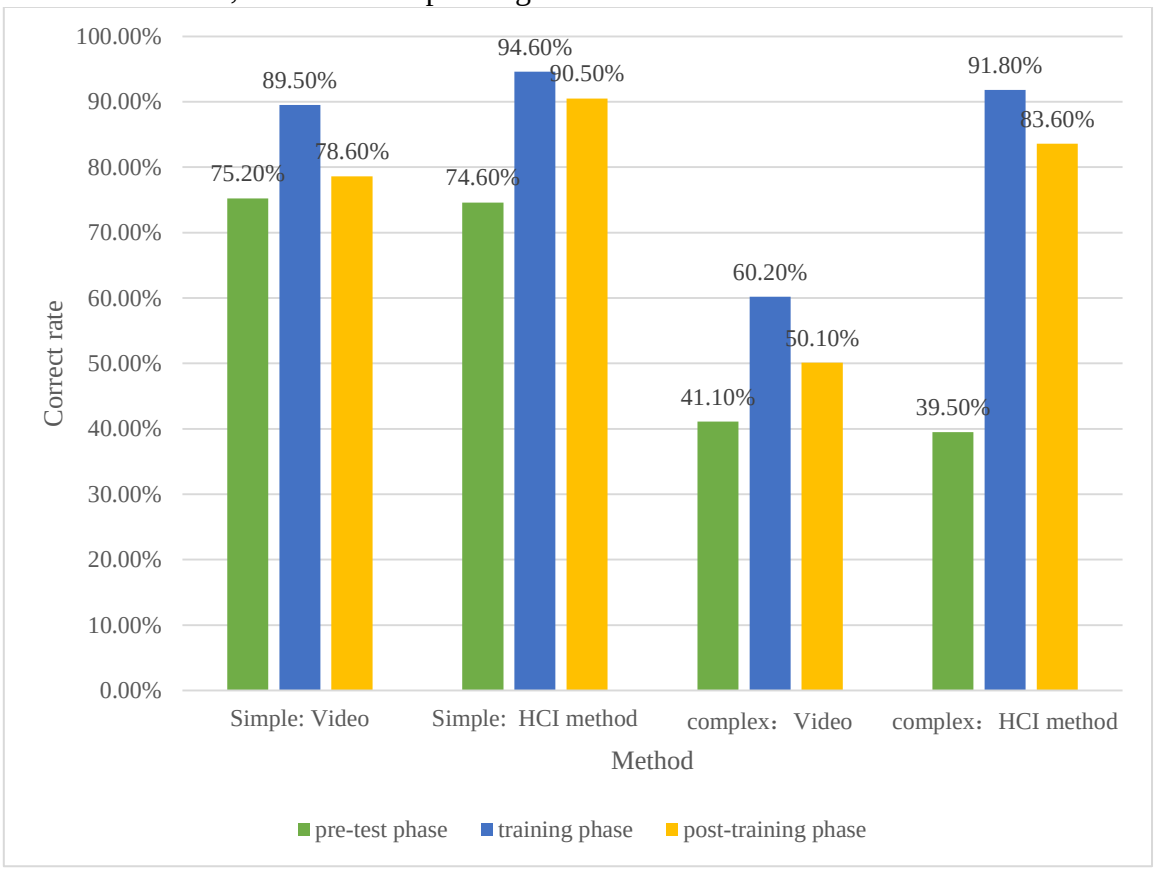


Figure 9. The correct rate of actions learned by 10 students in different ways and under different conditions

Figure 9 shows that during the prediction test phase, for each operation type, the recognition rates of the two training methods are almost indistinguishable. In the training stage, the students whose behavior recognition rate is improved significantly with the dynamic teaching based on

digital multimedia. In the post-training stage, based on the correct recognition of complex musical movements, the traditional video teaching method is adopted, and the correct rate is 50.1%. Using digital multimedia for dynamic teaching, the accuracy rate reaches 83.6%, which is 33.5% higher than the traditional video teaching method. Therefore, the use of digital multimedia technology for dynamic teaching has more advantages than traditional video teaching in terms of accuracy and effectiveness.

4.4. Innovative Dulcimer Teaching Techniques from a Digital Multimedia Perspective

Based on the survey data, this paper summarizes and analyzes the characteristics of the three levels of teaching methods and proposes solutions from these three aspects.

Table 4. Innovative strategies for dulcimer teaching methods

Level	Object problem	Features	Example
Principle	1. The relationship and status of teachers and students 2. The interaction between professors and students, as well as the nature of the content 3.teaching value orientation.	1. abstract 2. applicable to various contents and forms 3. no fixed procedure	1. heuristics 2. discovery 3. design pedagogy 4. injection
Technical	1. the relationship between teachers and students and content of different natures 2. media issues 3. teaching value orientation	1. the abstract and the concrete are unified 2. applicable to content of the same nature 3. there are general procedures 4. technical	1. teaching method 2. demonstration method 3. practice method 4. discussion method 5. discovery 6. practical law
Operability	1. interrelationship between the teaching process and the learning process Tie 2. the time structure of content and means.	1. specificity 2. there are fixed procedures 3. operability	1. sight singing in music lessons 2. listening and speaking in foreign language classes 3. sketching in art class

Base on the conventional dulcimer teaching method, this study utilizes digital multimedia technology and the benefits of this technology. Combined with the results of the questionnaire survey, some suggestions on how to innovate teaching methods are put forward. It can be seen from Table 4 that this paper gives specific teaching methods from three levels, namely "principle", "technical" and "operational", which can better improve the effectiveness of dulcimer teaching.

5. Conclusion

The study and daily lives of people have been profoundly altered by the rapid development of digital multimedia technology, which has also presented opportunities and difficulties for the

development of contemporary education. This study employed a questionnaire survey to examine and evaluate how the dulcimer teaching method is now being used. From the survey data, it was found that the current dulcimer students had new demands for teaching methods and practical applications in the digital multimedia age. At present, the teaching mode of dulcimer has certain limitations in terms of teaching content and talent cultivation. In today's rapidly developing digital multimedia era, the teaching method of dulcimer can no longer meet this requirement well. Therefore, it is necessary to combine the two organically. To implement the novelty of the interactive dulcimer, digital multimedia has been improved for using in classroom instruction. The necessity of using digital multimedia technology to teach dulcimer professional skills has been also expounded. A new approach to real-time and dynamic change of learning route and individualized teaching has been presented. However, some theoretical issues have not been discussed in depth in this paper, which is only a superficial study. In order to better take appropriate action in future work, it is required to increase the study and investigation of this knowledge.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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