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Retraction

Retracted: The Application of PCK Concept and Information Fusion-Oriented Multimedia Technology in Music Education

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Y. Yin, "The Application of PCK Concept and Information Fusion-Oriented Multimedia Technology in Music Education," *Advances in Multimedia*, vol. 2022, Article ID 8978742, 10 pages, 2022.

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Research Article

The Application of PCK Concept and Information Fusion-Oriented Multimedia Technology in Music Education

Yunzhi Yin

Xinyang Vocational and Technical College, Xinyang 464000, China

Correspondence should be addressed to Yunzhi Yin; yinyunzhi@xyvtc.edu.cn

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In order to improve the teaching effect of modern music, this paper combines the concept of PCK with information fusion-oriented multimedia technology to explore methods that can improve the quality of music education, and recharacterizes propositional subject knowledge in a way that students like to hear. Moreover, combined with the teaching practice of music teachers in colleges and universities, this paper sorts out the theoretical framework of this research, in order to establish a paradigm suitable for college music teachers to improve music PCK. In addition, this paper constructs an intelligent music teaching system based on multimedia technology and PCK concept. From the experimental research results, it can be seen that the PCK concept and information fusion-oriented multimedia technology have obvious application effects in music education, and can effectively improve the educational effect of modern music.

1. Introduction

Regarding the question of what are the differences in the training goals of the three different colleges, namely, professional music colleges, normal music colleges, and nonnormal colleges that offer a teacher-trained music education major, novice teachers believe that professional colleges mainly focus on professional performance and improving professional skills, normal colleges focus on cultivating music teachers and all-round talents, and nonnormal colleges and universities that offer normal music education majors focus on cultivating comprehensive quality [1]. In addition, expert teachers believe that professional music colleges take professional artistic level and skills as the development goal, normal colleges and nonnormal music education majors are based on the training of music teachers, and pay more attention to the cultivation of comprehensive quality, and the teaching of playing, singing, and dancing. That is to say, with regard to the curriculum orientation of the music education major, the experience of novice teachers and expert teachers are not very different, and their views are basically the same [2].

When asked, what type of music teachers these knowledge, skills, or attitudes are trained for in terms of the training objectives of the curriculum, novice teachers generally think that it is to train all-round music teachers, and expert teachers think that the ideal job, the target system of the former teacher's curriculum should be a system that combines professionalism and teaching, and should emphasize the professional orientation of teachers. Therefore, regarding course objectives, novice teachers pay more attention to the comprehensive training of professional skills, while expert teachers emphasize the combination of professional skills and teaching ability [3].

When asked, how these knowledge, skills, or attitudes should be set up and cultivated in college teacher education courses, and what course content should be highlighted, novice teachers believe that courses such as piano accompaniment, conducting, and teaching methods should be highlighted. Expert teachers believed that the teaching of playing and singing, the teaching of chorus skills, and the teaching practice should be emphasized. From this point of view, novice teachers still focus on traditional professional courses, while expert teachers have shifted their focus to the teaching conversion of specific professional content [4].

When asked what teaching strategies, procedures, or models should be adopted for an ideal music teacher education course, novice teachers suggested that they should adopt strategies such as self-presentation, group practice, and reference to foreign advanced teaching methods. I am not very interested in the model and think that there is no fixed method for teaching. We can learn from methods such as microteaching and flipped classroom, but we cannot rely too much on a certain model. The most important thing is to know how to teach students [5].

Through the analysis of the teaching experience of expert teachers, it is found that their professional knowledge of music, knowledge of teaching situation, knowledge about students, and knowledge of education and teaching are closely linked. After years of accumulation and integration, expert teachers have a wealth of teaching experience. They are very familiar with the psychological states of students of different ages and the problems that are easy to occur in music learning, and know how to teach students in accordance with their aptitude [6]. They are good at using educational and teaching knowledge to deal with and solve various situations that appear in specific situations, and will transform these sudden situations into teaching opportunities through their own wisdom. In addition, expert teachers also attach great importance to how to effectively carry out music activities and know how to flexibly use teaching modes in different teaching situations. Therefore, expert teachers no longer only focus on the accumulation and development of their own professional knowledge, but more on the coordinated development of professional knowledge and teaching ability. This comprehensive knowledge structure enables the knowledge elements in it to be acquired in-depth and breadth. A bigger extension [7].

In the interviews with novice teachers and expert teachers, teachers are generally aware of the importance of practical knowledge to music teacher education, and more and more researches are keen to change the existing mode or mechanism of educational practice. However, in interviews with expert teachers, we learned that increasing the practice time does not significantly improve the teaching level of interns, and even many expert teachers believe that although they have been teaching for more than ten years, their teaching ability has not been substantiated[8]. The teaching experience of excellent teachers is mostly tacit knowledge that can only be understood but cannot be expressed in words, which is difficult or impossible to express in words. Therefore, even following excellent teachers in practice may not necessarily be able to learn the essence of teaching methods., most of which are simulated in the form of "painting a scoop according to a gourd". Then, how to make music teacher education majors form an identity for the profession of music teacher in a short four-year career and acquire the ability to "produce and create new knowledge" [9].

A dedicated literature review has clarified that emerging and continuing knowledge of subject pedagogy provides a new framework for teacher education curriculum [10]. The findings and proposals of a special research on the knowledge growth of normal students in the process of teaching practice from trainee teachers to novice teachers. It refers to a kind of special knowledge representation of the actual ability of subject education and teaching developed by school teaching practitioners through education, training, and professional practice [11].

PCK is the abbreviation of English "Pedagogical Content Knowledge" (subject teaching knowledge). Pedagogical means pedagogy, and "Content" here refers to subject content, so, literally, PCK refers to both pedagogical knowledge and subject knowledge [12].

PCK is at the intersection between its "subject knowledge" and "general educational knowledge", and its core is to transform subject knowledge into something that students can learn, such as examples, strategic knowledge, etc. [13]. Subject pedagogical knowledge is not static, but dynamically generated. It actually belongs to "knowing-in-action", which is inseparable from the special cognitive process of the teacher knower. That is to say, in the actions of music educators, music subject knowledge, and pedagogy knowledge are always in the process of "dynamic synthesis", and what is expected to be finally generated is the special "compound" of "music subject pedagogy knowledge" (compound), but the existing curriculum system and environment cannot promote the generation and transformation of music PCK, which requires us to innovate the music teacher education curriculum and promote the pedagogical knowledge of music subjects, which truly determines the generation of music teachers' professional knowledge and development [14].

There has always been a voice and appeal that subject knowledge and pedagogical knowledge needs to be integrated in the education world, but it was not until the emergence of PCK that the knowledge after the integration of pedagogy and subject knowledge was given a definite name and a justifiable existence, and then from the academic theory. It has been proved that it is the professionalism of the teaching profession and the core content of teacher education [15]. If the PCK concept just names a kind of knowledge and proves the importance of this kind of knowledge to the teaching profession theoretically, then it becomes a point of view among many lukewarm educational theories. To be honest, what is lacking most in the field of pedagogy today is theoretical viewpoints, and what is lacking is the practical path to realize theoretical viewpoints [16]. The reason why PCK has become the world's leading research in the field of teaching and teacher education and is enduring not only the theoretical proof of the marking and importance of this knowledge after the integration of pedagogical knowledge and subject knowledge, but also its impact on education revealing the fusion mechanism of academic knowledge and subject knowledge, this fusion mechanism is the practical path of education, and it is a really scarce research in the field of education [17].

This paper combines the concept of PCK and information fusion-oriented multimedia technology to explore methods that can improve the quality of music education, and to improve the quality of modern music education through intelligent methods.

2. Information Fusion of Rough Sets of Music Information

2.1. Classic Rough Set. Rough set theory is a theory that uses upper and lower approximations of sets to describe uncertain phenomena. In the algebraic rough set model, the upper and lower approximation sets are defined by the algebraic inclusion relation of equivalence classes.

An information system can be represented as $S = \{U, R, V, f\}$. Among them, $U = \{x_1, x_2, \cdots, x_n\}$ is the universe of discourse, the attribute set is $R = C \cup D$, C is the condition attribute, and D is the decision attribute. We set RcC, and the indistinguishable relation is $\mathrm{IND}(R) = \{(x, y) \in U^2 | \forall a \in R, f(x, a) = f(y, a)\}$. The inseparable relation is the equivalence relation, and the UIR is a division of U based on the equivalence relation R. It contains the equivalence relation of object x, usually denoted as $[x]$.

Definition 1. X is set as a subset of the universe of discourse U, then the lower approximation set $\underline{\mathrm{apr}}(X)$ and the upper approximation set $\overline{\mathrm{apr}}(X)$ of X are defined as follows: [18]:

$$\underline{\mathrm{apr}}(X) = \left\{x \middle| x \in U \wedge [x]_R \in X\right\}, \tag{1}$$

$$\overline{\mathrm{apr}}(X) = \left\{x \middle| x \in U \wedge [x]_R \in X \neq \Phi\right\}. \tag{2}$$

Among them, $[x]_R$ represents the equivalence class formed on the relation R, denoted as $[x]$. Among them, x is the representation element of $[x]$. According to formulas (1) and (2), the universe of discourse U is divided into two disjoint positive domain $\mathrm{POS}(X)$, negative domain $\mathrm{NEG}(X)$, and boundary domain $\mathrm{BND}(X)$ regions, which are defined as:

$$\mathrm{POS}(X) = \underline{\mathrm{apr}}(X), \tag{3}$$

$$\mathrm{MEG}(X) = U - \overline{\mathrm{apr}}(X) = (\overline{\mathrm{apr}}(X))^c, \tag{4}$$

$$\mathrm{BND}(X) = U - \overline{\mathrm{apr}}(X) - \underline{\mathrm{apr}}(X). \tag{5}$$

The schematic diagram of $\mathrm{POS}(X)$, $\mathrm{NEG}(X)$, and $\mathrm{BND}(X)$ are shown in the figure below.

As shown in Figure 1 and formulas (3), (4), and (5), we can see that the positive field $\mathrm{POS}(X)$ can be judged according to the attribute set, and it is composed of objects that must belong to the universe of discourse U. The negative field $\mathrm{NEG}(X)$ is composed of objects that can be determined not to belong to the universe U. Correspondingly, the boundary domain $\mathrm{BND}(X)$ represents the composition of objects that may belong to the universe of discourse U according to the attribute set.

When the positive and negative fields are equal, that is, $\mathrm{POS}(X) = \mathrm{NEG}(X)$, the boundary field at this time is empty, and X is the exact set of R. When the positive and negative fields are not equal, that is, $\mathrm{POS}(X) \neq \mathrm{NEG}(X)$, the boundary field is not empty at this time, and X is the rough set of R.

It is precisely because of the uncertainty of the boundary domain that the set has uncertainty. If the boundary field is large, the positive field and the negative field are small, and the overall accuracy of the set is low. Correspondingly, if the boundary field is small, the sum of the positive field and the negative field is large, and the overall accuracy of the set is high. This allows us to quantify and analyze rough sets with some mathematical tools.

2.2. Probabilistic Rough Set Model. In order to overcome the shortcomings of low fault tolerance of the classic Pawlak rough set, based on the extension of probability theory, rough set models have been proposed one after another, and the probability rough set model is one of them. $S = \{U, \mathrm{Atr} = C \cup D, V, f\}$ is set to be an information table, and there is $\forall x \in U, X \in U$. Then for object x, its equivalence class is $[x]$.

$$P(X|[x]) = \frac{|X \cap [x]|}{|[x]|}. \tag{6}$$

Definition 2. The conditional probability function of equivalence class $[x]$ is defined as:

By introducing two thresholds α and β, we assume that $\alpha \geq \beta$, and construct a probabilistic rough set model. The upper and lower approximate sets of the probability model are defined as follows:

Definition 3. The upper and lower approximate sets of the (α, β)-probabilistic rough set model are:

$$\overline{\mathrm{apr}}_{\alpha,\beta}(X) = \{x | x \in U, P(X|[x]) > \beta\}, \tag{7}$$

$$\underline{\mathrm{apr}}(X) = \{x | x \in U, P(X|[x]) \geq \alpha\}. \tag{8}$$

It can also be divided into three regions, POS domain, NEG negative domain, and BND boundary domain:

$$\mathrm{POS}_{\alpha,\beta}(X) = \underline{\mathrm{apr}}_{\alpha,\beta}(X) = \{x | x \in U, P(X|[x]) \geq \alpha\}, \tag{9}$$

$$\mathrm{NEG}_{\alpha,\beta}(X) = U - \overline{\mathrm{apr}}_{\alpha,\beta}(X) = \left(\overline{\mathrm{apr}}_{\alpha,\beta}(X)\right)^c = \{x | x \in U, P(X|[x]) \leq \alpha\}, \tag{10}$$

$$\mathrm{BND}_{\alpha,\beta}(X) = \overline{\mathrm{apr}}_{\alpha,\beta}(X) - \underline{\mathrm{apr}}(X) = \{x | x \in U, \beta < P(X|[x]) < \alpha\}. \tag{11}$$

By comparing the size relationship between the conditional probability of the equivalence class $[x]$ and the threshold, it can be divided into corresponding regions.

2.3. Bayesian Formula and Decision Process

Definition 4. If there is event $A_1, A_2, \cdots, A_n$, if $A_1, A_2, \cdots, A_n$ is incompatible with each other, and there is $A_1 \cup A_2, \cdots, A_n = \Omega$, event $A_1, A_2, \cdots, A_n$ is called a division of sample space Ω.

We set n events $A_1, A_2, \cdots, A_n$ as a division of the sample space, and B is also an event. When there is $P(B) > 0$, i = 1

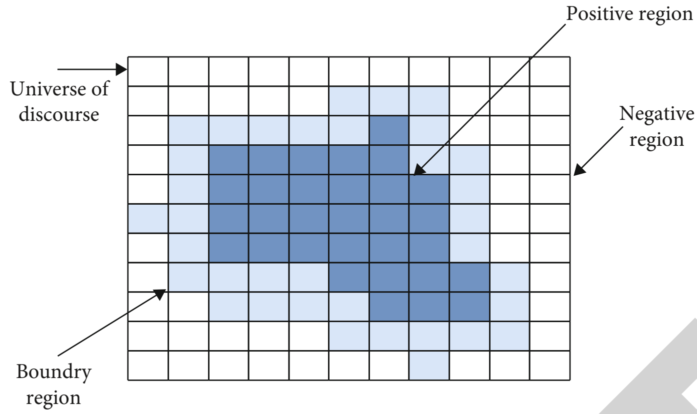


FIGURE 1: Schematic diagram of the positive domain, negative domain, and boundary domain.

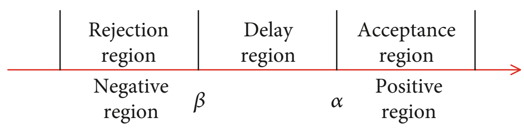


FIGURE 2: 3 regions in decision rough set theory.

, ⋯, n, then there is

$$P(A_i|B) = \frac{P(A_i)P(B|A_i)}{\sum_{j=1}^{n} P(A_j)P(B|A_j)}. \quad (12)$$

This formula is called Bayesian formula, and it is a conditional probability.

Definition 5. For an object x, there are m possible states $\{w_1, w_2, \cdots, w_m\}$, and the set of states is a finite set.

Object x has n possible behaviors $\{a_1, a_2, \cdots, a_n\}$, and the set is also finite. We set $P(w_j|x)$ to represent the probability that x is in the w, state, and the corresponding cost function is $\lambda(a_i|w_j)$, which represents the cost or risk value that the object x needs to bear when taking the a_{i} behavior when the object x is in the w_j state.

In the Bayesian decision process, the most important thing is the cost function. The cost function can reflect the costs and risks that need to be taken when taking a certain behavior, it has a good semantic explanation, and it also conforms to the actual situation that people encounter in reality. The cost function refers to all the values in different states and different behaviors. It can be represented by a two-dimensional matrix whose size is $m \times n$. Rows represent different states, there are m possible states, and columns represent different behaviors, and there are n possible behaviors.

Definition 6. For an object x, when it takes a, behavior, the expectation of the cost it needs to bear is:

$$R(a_i|x) = \sum_{j=1}^{m} \lambda(a_i|w_j)P(w_j|x). \quad (13)$$

According to formula (13), when the cost function and probability are given or known, we can quickly calculate the cost expectation of taking a certain action. At the same time, if we know the cost functions and probabilities of all behaviors, we can compare the cost expectations of all behaviors and calculate the behavior with the smallest cost expectation.

2.4. Decision Rough Sets. Probabilistic rough set extension models include 0.5-probabilistic rough set model, variable precision rough set model, Bayesian rough set model, and so on. If these models relax the condition $p(X[x]) = 1$ to $p(X|[x]) \geq \alpha$, only certain parameters or threshold requirements need to be met.

Decision rough sets are subject to Bayesian decision theory and hypothesis testing. From the theoretical point of view, it systematically gives how to calculate the threshold value in the probabilistic rough set model under the premise of given cost function value.

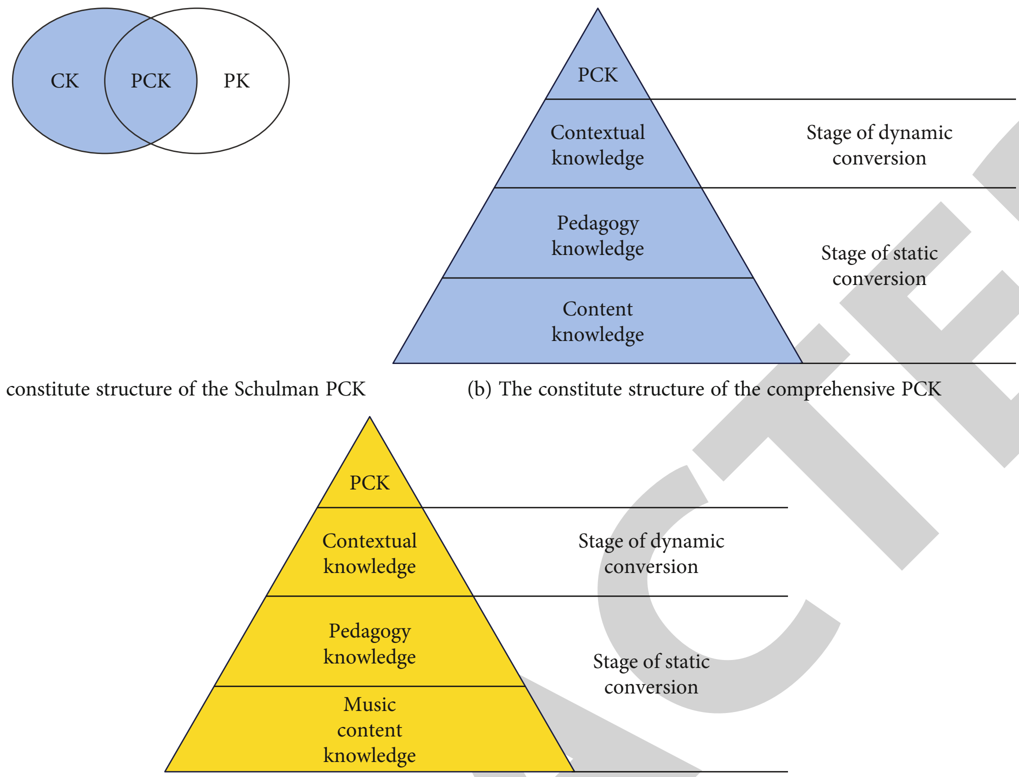
Definition 7. The state space is set as $\Omega = \{x, \neg x\}$, and the equivalence class $[x]$ indicates whether it belongs to the decision class x, then the object x belongs to the decision class X, which is represented as $P(X|[x]) = |X \cap [x]|/|[x]|$, and does not belong to $p(\mathrm{XI}[x]) = 1 - p(\mathrm{XI}[x]])$.

Definition 8. For an object x, the set of all possible decisions is $A = \{ap, ay, az\}$, which are the decision behaviors of dividing it into the POS domain, the NEG domain and the BND domain, respectively.

If we set $P(X|[x]) = p$, the costs that need to be borne when three different actions a_p, a_N, and a_B are adopted can be, respectively:

$$\begin{cases} R_p = R(a_p|[x]) = \lambda_{pp}p + \lambda_{PN}(1-p) \\ R_B = R(a_B|[x]) = \lambda_{Bp}p + \lambda_{BN}(1-p) \\ R_N = R(a_N|[x]) = \lambda_{Np}p + \lambda_{NN}(1-p) \end{cases}. \quad (14)$$

According to the Bayesian decision process, the plan with the least expected cost to bear is regarded as the optimal plan. Thus, the following three rules are derived:



(a) The constitute structure of the Schulman PCK

(b) The constitute structure of the comprehensive PCK

(c) The constitute structure of music PCK

Figure 3: The constitute structure of PCK.

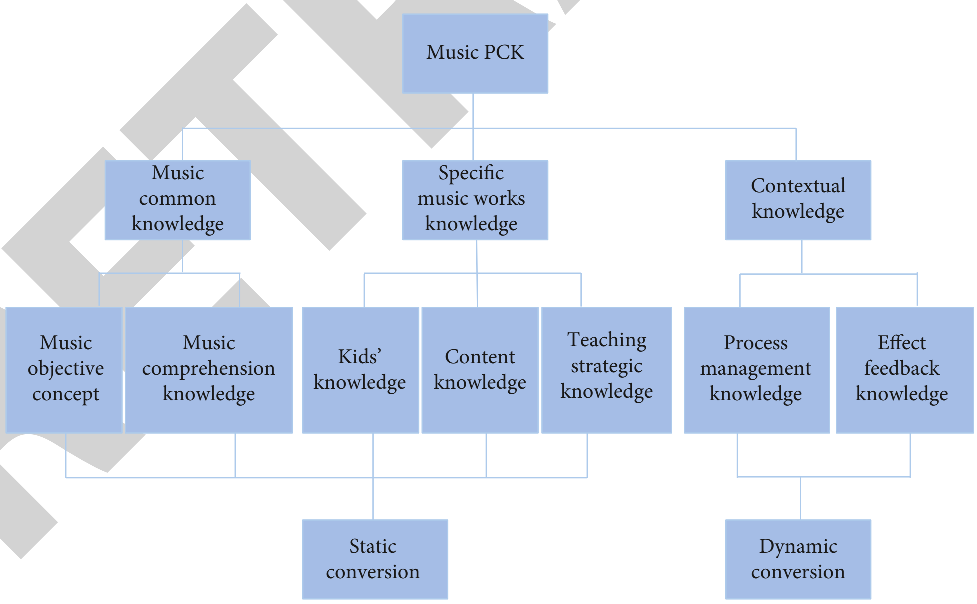


Figure 4: Paradigm of music PCK.

(P): If $R_P \leq R_N$ and $R_P \leq R_B$ are established at the same time, then there is $x \in \text{PoS}(X)$

(B): If $R_B \leq R_P$ and $R_B \leq R_N$ are established at the same time, then there is $x \in \text{BND}(X)$

(N): If $R_N \leq R_P$ and $R_N \leq R_B$ are established at the same time, then there is $x \in \text{NEG}(X)$

It can be seen from formula (14) that the above three decision rules are only related to the probability $P(X|x)$ and the corresponding loss function. In general, when there is $x \in X$, the cost of being divided into the positive domain is less than or equal to the cost of dividing it into the boundary. Moreover, the cost of being divided into the

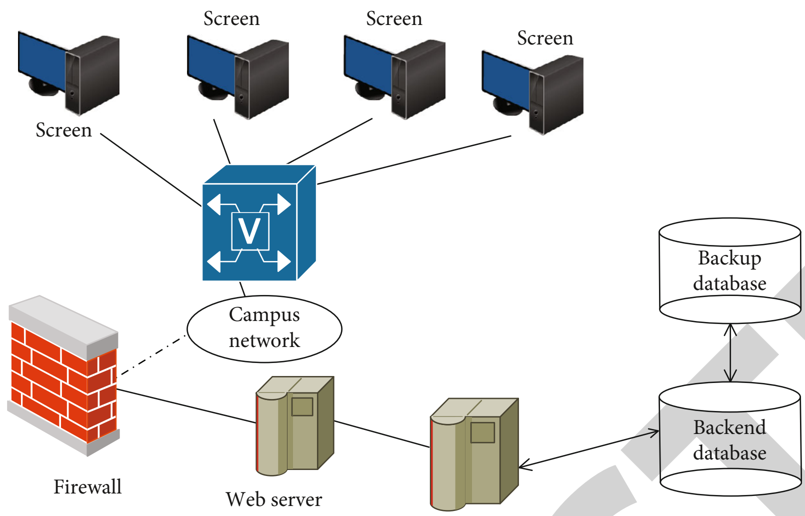


Figure 5: System topology diagram.

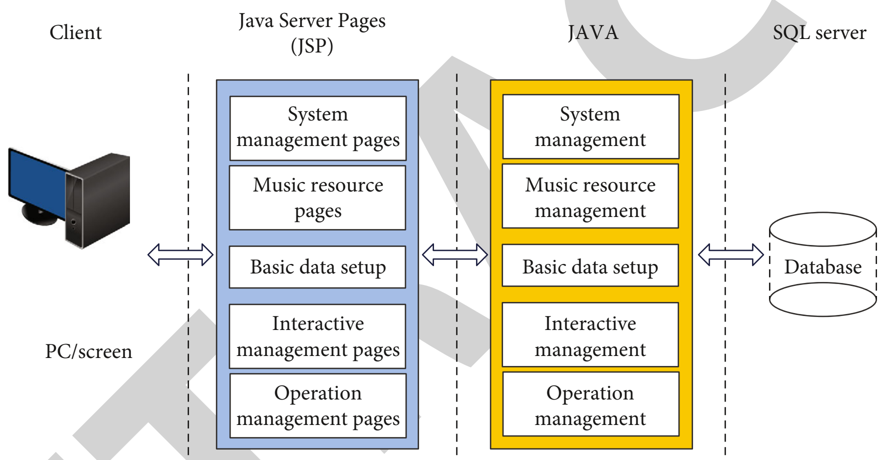


Figure 6: The architecture diagram of the system.

boundary domain is less than or equal to the cost of dividing it into the negative domain. The cost of being divided into the negative domain will be less than or equal to the cost of dividing it into the boundary domain, and the cost of dividing it into the boundary domain will be less than or equal to the cost of dividing it into the positive domain. Therefore, a reasonable assumption $0 \le \lambda_{PP} \le \lambda_{BP} \le \lambda_{NP}$, $0 \le \lambda_{NN} \le \lambda_{BP} \le \lambda_{PN}$ can be obtained. Therefore, the required conditions of rules (P), (B), (N) can be derived as:

For rule (P), there is:

$$R_P \le R_B \Leftrightarrow p \ge \frac{(\lambda_{PN} - \lambda_{BN})}{(\lambda_{PN} - \lambda_{BN}) + (\lambda_{BP} - \lambda_{PP})}, \quad (15)$$

$$R_P \le R_N \Leftrightarrow p \ge \frac{(\lambda_{PN} - \lambda_{NN})}{(\lambda_{PN} - \lambda_{NN}) + (\lambda_{NP} - \lambda_{PP})}. \quad (16)$$

For rule (B), there is:

$$R_B \le R_P \Leftrightarrow p < \frac{(\lambda_{PN} - \lambda_{BN})}{(\lambda_{PN} - \lambda_{BN}) + (\lambda_{BP} - \lambda_{PP})}, \quad (17)$$

$$R_B \le R_P \Leftrightarrow p \ge \frac{(\lambda_{BN} - \lambda_{NN})}{(\lambda_{BN} - \lambda_{NN}) + (\lambda_{NP} - \lambda_{BP})}. \quad (18)$$

For rule (N), there is:

$$R_N \le R_P \Leftrightarrow p < \frac{(\lambda_{PN} - \lambda_{NN})}{(\lambda_{PN} - \lambda_{NN}) + (\lambda_{NP} - \lambda_{PP})}, \quad (19)$$

$$R_N \le R_B \Leftrightarrow p < \frac{(\lambda_{BN} - \lambda_{NN})}{(\lambda_{BN} - \lambda_{NN}) + (\lambda_{NP} - \lambda_{BP})}. \quad (20)$$

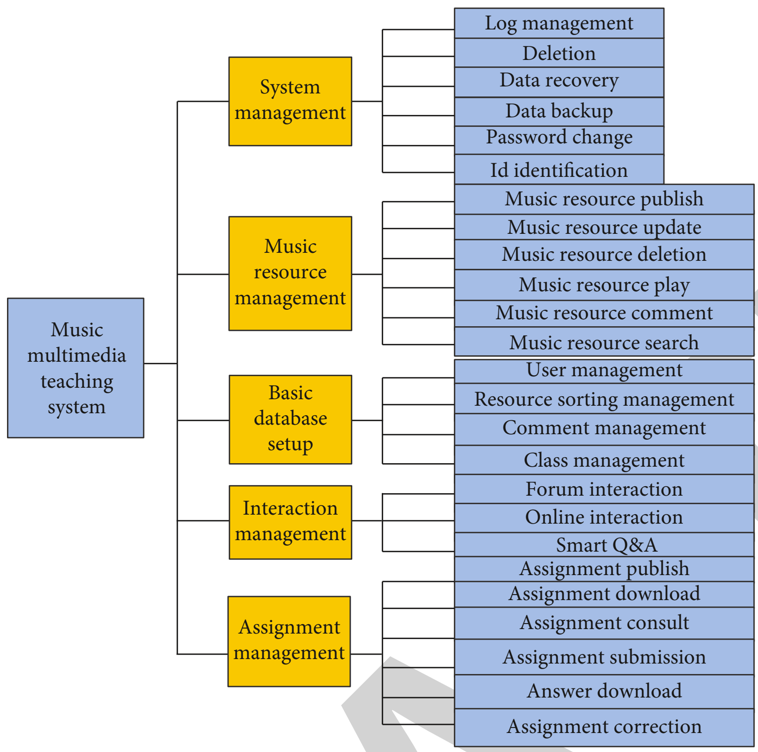
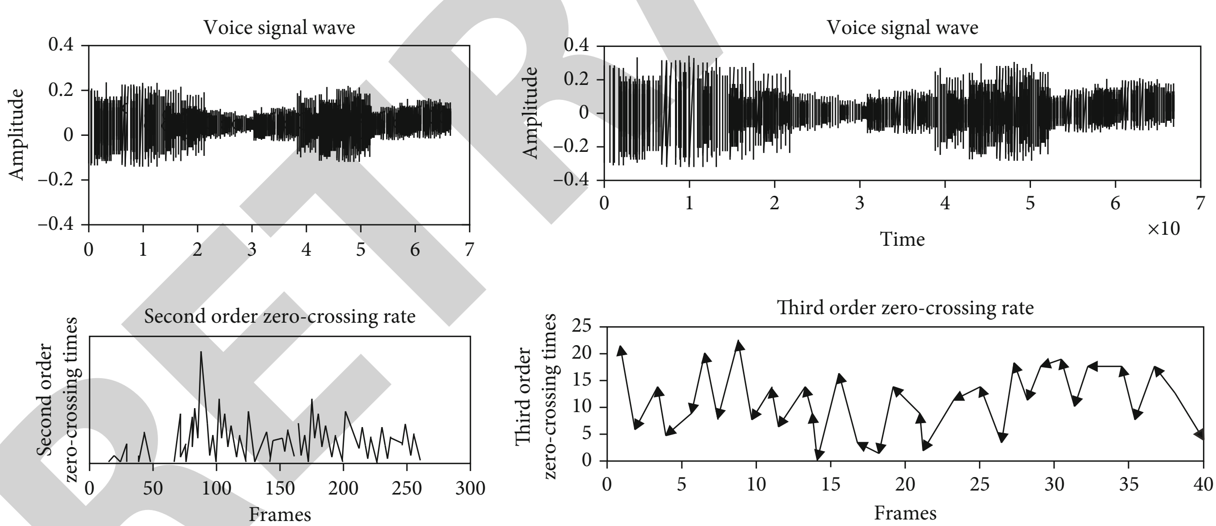


Figure 7: Functional structure diagram.



(a) Second-order zero-crossing rate of music signal

(b) The third-order zero-crossing rate of the music signal

Figure 8: Effect diagram of music signal processing.

Table 1: The application effect of PCK concept and information fusion-oriented multimedia technology in music education.

Number	Educational effect	Number	Educational effect	Number	Educational effect
1	80.86	16	87.85	31	82.72
2	90.20	17	87.59	32	89.65
3	85.33	18	82.86	33	83.80
4	82.19	19	88.87	34	82.72
5	83.85	20	81.25	35	86.05
6	87.16	21	83.71	36	79.28
7	86.15	22	90.02	37	82.99
8	88.94	23	89.52	38	84.65
9	86.88	24	90.28	39	87.88
10	85.43	25	79.65	40	86.20
11	88.86	26	82.71	41	88.67
12	80.04	27	86.27	42	81.14
13	80.90	28	86.86	43	83.34
14	85.67	29	80.98	44	88.58
15	89.34	30	85.39	45	87.17

At this point, we set:

$$\begin{cases} \alpha = \dfrac{(\lambda_{PN} - \lambda_{BN})}{(\lambda_{PN} - \lambda_{BN}) + (\lambda_{BP} - \lambda_{PP})} = \left|1 + \dfrac{\lambda_{BP} - \lambda_{PP}}{\lambda_{PN} - \lambda_{BN}}\right|^{-1} \\ \beta = \dfrac{(\lambda_{BN} - \lambda_{NN})}{(\lambda_{BN} - \lambda_{NN}) + (\lambda_{NP} - \lambda_{BP})} = \left|1 + \dfrac{\lambda_{NP} - \lambda_{BP}}{\lambda_{BN} - \lambda_{NN}}\right|^{-1} \\ \gamma = \dfrac{(\lambda_{PN} - \lambda_{NN})}{(\lambda_{PN} - \lambda_{NN}) + (\lambda_{NP} - \lambda_{PP})} = \left|1 + \dfrac{\lambda_{NP} - \lambda_{PP}}{\lambda_{PN} - \lambda_{NN}}\right|^{-1} \end{cases}. \tag{21}$$

From rule (B), we can conclude that $a > \beta$, there is $\lambda_{BP} - \lambda_{PP}/\lambda_{PN} - \lambda_{BN} < \lambda_{NP} - \lambda_{BP}/\lambda_{BN} - \lambda_{NN}$ and $b/a > d/c \Rightarrow b + d/a + c > (d/c)(a, b, c, d > 0)$, and there is $\lambda_{BP} - \lambda_{PP}/\lambda_{PN} - \lambda_{BN} < \lambda_{NP} - \lambda_{PP}/\lambda_{PN} - \lambda_{NN} < \lambda_{NP} - \lambda_{BP}/\lambda_{BN} - \lambda_{NN}$. $0 \le \beta < \gamma < \alpha \le 1$ can be further derived from formula (21). Thus, the rule (P1), (B1), and (N1) can be rewritten as:

$$(\mathrm{P1}):\ if\, P(X|x) \ge \alpha, x \in \mathrm{POS}(X), \tag{22}$$

$$(\mathrm{B1}):\ if\, \beta < P(X|x) < \alpha, x \in \mathrm{BND}(X), \tag{23}$$

$$(\mathrm{N1}):\ if\, P(X|x) < \beta, x \in \mathrm{NEG}(X). \tag{24}$$

In decision rough set theory, the threshold pair (a, B) divides the universe of discourse into 3 distinct regions. Therefore, the three regions correspond to three rules, that is, the (P1), (B1), and (N1) rules, which constitute the rules of three decision-making, as shown in Figure 2:

The object is divided into the delay region. The three-way decision is more in line with people's decision-making habits. People put things on hold temporarily and wait for more information to make clear judgments.

It can be known from formula (21) that the thresholds α, β and γ can be calculated from $\lambda_{PP}, \lambda_{BP}, \lambda_{NP}, \lambda_{NN}, \lambda_{BN}$ and λ_{PN}. In the general case, we set the decision cost that people need to bear for correct classification to be 0, which is $\lambda_{PP} = \lambda_{NN} = 0$. In this way, the three thresholds α, β, and γ are only related to the four loss functions of ${}_{BP}, \lambda_{NP}, \lambda_{NN}, \lambda_{BN}$. Formula (21) is deduced in the reverse direction, which is represented by the thresholds α, β, γ, and λ_{PN} as follows:

$$\begin{cases} \lambda_{PP} = \lambda_{NN} = 0 \\ \lambda_{NP} = \dfrac{1-\lambda}{\lambda}\lambda_{PN} \\ \lambda_{BN} = \dfrac{\beta(\alpha-\gamma)}{\gamma(\alpha-\beta)}\lambda_{PN} \\ \lambda_{BP} = \dfrac{(1-\alpha)(\gamma-\beta)}{\gamma(\alpha-\beta)}\lambda_{PN} \end{cases}. \tag{25}$$

Now, in order to simplify the discussion, we consider only one common case. We assume the domain $U = \{x_1, x_2, \cdots, x_n\}$ of the decision table S and its decision class has only 2 classes. The conditional probability of $x \in X$ is denoted, which can be calculated by the equivalence class method or the Bayesian method. We set $p = A$ and $n = O$, then the sum of the risk and loss costs that the entire decision table S needs to bear when making a decision is:

$$\begin{aligned} f = &\sum_{x_i \in \mathrm{POS}(X)} \lambda_{\mathrm{PN}} \cdot (1 - p_i) + \sum_{x_j \in \mathrm{NEG}(X)} \lambda_{\mathrm{PN}} \cdot p_j \\ &+ \sum_{x_k \in \mathrm{BND}(X)} (\lambda_{\mathrm{BN}} \cdot (1 - p_k) + \lambda_{\mathrm{BP}} \cdot p_k). \end{aligned} \tag{26}$$

According to Bayesian decision theory, the smaller the value of this function, the better. We assume apx = 1. From formula (25), formula (26) can be deduced as:

$$f = \sum_{p_i \geq \alpha} (1 - p_i) + \sum_{p_j \leq \beta} \frac{1 - \gamma}{\gamma} (1 - p_i) + \varepsilon \cdot \sum_{\beta < p_k < \alpha} \left[\frac{\beta(\alpha - \gamma)}{\gamma(\alpha - \beta)} (1 - p_k) + \frac{(1 - \alpha)(\gamma - \beta)}{\gamma(\alpha - \beta)} \cdot (1 - p_k) \right]. \quad (27)$$

In order to prevent too many samples from being classified into the boundary domain, we introduce a penalty factor ε. We set $\varepsilon \geq 1$. Among them, there is $0 \leq \beta < \gamma \leq \alpha \leq 1$. At this time, the total risk loss that needs to be assumed in the entire decision table is only determined by the threshold (a, B, r) and the conditional probability p of each object x. In this way, the problem of solving the optimal threshold can be transformed into the problem of solving the decision risk minimization.

3. The Application of PCK Concept and Information Fusion-Oriented Multimedia Technology in Music Education

The connotation of CK can be understood from two dimensions. From the dimension of knowledge components, it refers to the teacher's knowledge of how to teach a subject, and it is the integration of pedagogical knowledge (PK) and subject knowledge (CK). It consists of three components: subject knowledge (CK) that is usually taught in the subject area, knowledge about how students understand these subjects (PK), and knowledge (PCK) after studentization this subject knowledge. From the perspective of knowledge fusion, the mechanism or condition for the fusion of CK and PK into PCK is to characterize the subject knowledge with analogies, metaphors, examples, demonstrations, etc. that are easy for students to understand. In short, PCK refers to the recharacterization of propositional subject knowledge in a way that students like to hear. The revealing of the Schulman PCK connotation can be represented by Figure 3(a). The comprehensive PCK composition structure can be represented by Figure 3(b) (planar model).

When we analyze the quality of music teacher training through the concept of PCK, we can add the word "music" to Figure 3(b) above and turn it into Figure 3(c).

According to the teaching practice of music teachers in colleges and universities, this paper sorts out the theoretical framework of this research to establish a paradigm suitable for college music teachers to improve the paradigm of music PCK (Figure 4).

The constructed music multimedia teaching system must match the needs of the school, otherwise it cannot be applied to deal with the actual business.

When deploying the system, the scalability of the network structure should be improved as much as possible. In particular, when software and hardware need to be expanded, they must be effectively compatible with existing software and hardware and do not require a university to add too much cost, so as to keep the system advanced.

The mainstream high-speed network technology is selected to provide sufficient bandwidth to prevent music students from a certain university from being unable to obtain effective bandwidth guarantees when downloading resource files, which affects efficiency.

A large number of music resources are stored in the music multimedia teaching system, and users need to use it frequently. In this context, the system must maintain long-term stability. In addition, data backup measures must be introduced to solve the problem of database failure, so as to improve the data reliability of the system.

This paper adopts firewall technology and anti-intrusion technology to protect the system and important server system from intrusion. Moreover, this paper sets routing restrictions on the access layer routers to further ensure the security of the entire large network. Because a lot of private information is stored in the music multimedia teaching system, the system should take measures, such as firewall technology, to resist attacks from the external network and prevent the information in the system from being destroyed or stolen. At the same time, it is necessary to take data backup and recovery measures to deal with database failures.

The music multimedia teaching system contains many pages, all pages must maintain a uniform style, and the system operation prompts must be friendly. The system network topology design is shown in Figure 5.

The music multimedia teaching system is designed and implemented based on the J2EE platform, and developers can assemble the commonly used codes in the system to form reusable codes, which can be reused. The architecture diagram is shown in Figure 6.

The music multimedia teaching system consists of five parts: music resource management, system management, homework management, interactive management, and basic data setting. Music resource management consists of functions such as music resource release, music resource deletion, music resource update, music resource search, music resource comment, and music resource playback. The functional structure diagram is shown in Figure 7.

This paper verifies the music information fusion processing effect of the system proposed in this paper. The change of the short-term average zero-crossing rate can be judged by the second-order difference zero-crossing rate. When the sound intensity of the music changes frequently, it often corresponds to a higher music progress speed. At this time, the amplitude of the zero-crossing rate changes frequently, and the value of the second-order differential zero-crossing rate is relatively high, and the melody of such a song has a faster rhythm, and vice versa. Similarly, the third-order difference zero-crossing rate can be used to judge the changing trend of music rhythm. When the third-order differential zero-crossing rate is high, it means that the second-order differential zero-crossing rate changes rapidly, and the music signal has a stronger trend of change. Moreover, the speed of the music will continue to increase for a certain period of time in the future, to achieve the purpose of prediction. After that, this paper takes a piece of music signal to calculate the second-order zero-crossing rate and the third-order zero-crossing rate, and the results are shown in Figure 8.

Based on the above, the application effect of PCK concept and information fusion-oriented multimedia technology in music education is studied, and the results shown in Table 1 below are obtained.

From the above experimental research, the application effect of PCK concept and information fusion-oriented multimedia technology in music education is obvious, which can effectively improve the educational effect of modern music.

4. Conclusion

The music education in the new era puts forward new and higher requirements for teachers' professional knowledge structure. The fusion of music subject knowledge and pedagogy knowledge is the same as the fusion of Chinese and Western cultures. Music teachers are not the ones who directly teach the knowledge of music to the students and present the musical works directly to the students, but the ones who reinterpret the musical works in a way that the students can understand and present them to the students in a new way of interpretation. From the perspective of students, reinterpreting, and presenting musical works in a way that students can understand is the concentrated expression of the creativity and professionalism of music teachers. This paper combines the concept of PCK and information fusion-oriented multimedia technology to explore methods that can improve the quality of music education, and improve the quality of modern music education through intelligent methods. From the experimental research results, it can be seen that the PCK concept and information fusion-oriented multimedia technology have obvious application effects in music education, and can effectively improve the educational effect of modern music.

Data Availability

The labeled dataset used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declare no competing interests.

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