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Design and Application of Intelligent Subject System Based on TPACK Framework

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ABSTRACT

With the continuous advancement of educational informatization deepening of teachers' professional development, educational technology ability has become a necessary quality and skill for college teachers. This article introduces the basic concept of the TPACK framework and the design concept of intelligent disciplinary systems and elaborates in detail on how to apply the TPACK framework to the design and development of intelligent disciplinary systems. Through case analysis, this article demonstrates the advantages of intelligent subject systems in improving teaching quality and promoting active learning among students. Finally, this article discusses the future development direction and application prospects of intelligent disciplinary systems. The intelligent subject system based on the TPACK framework provides a new teaching solution for the education field, which helps to promote the process of educational informatization and personalized teaching. Cultivate students' rigorous scientific literacy and good practice habits, and master standardized experimental analysis methods.

KEYWORDS

Quality and Skills, School-Based Training, Teaching Strategy, TPACK Framework

In the educational environment of the information age, professional development to enhance the teaching ability of teachers has become particularly important. The T-TPACK (Technical Pedagogical Content Knowledge) framework is widely recognized as the core professional knowledge that teachers need in the information age (Hartini et al., 2021). Effectively applying this knowledge and improving the information technology-based teaching ability of teacher trainees is crucial for cultivating students with innovative abilities. The goal of teacher professional development is to encourage teachers to have a lifelong awareness and ability to learn, continuously improve themselves, update knowledge in practice, and improve their teaching level. However, traditional education systems often struggle to meet personalized needs, especially in terms of intelligent teaching. This article combines the T-TPACK framework with an intelligent theme system to create a more effective and personalized teaching environment, fully considering the personalized needs of teachers and providing customized teaching resources and tools for each teacher. This article helps teachers effectively apply technology, teaching methods, and subject content knowledge, enhance their information technology-based teaching abilities, and better meet the learning needs of students in the information age.

The main contributions of this article are as follows:

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1. This article attempts for the first time to combine the TPACK framework with intelligent subject systems to create a more effective and personalized teaching environment. This combination deeply integrates technology, teaching methods, and subject content knowledge, providing teachers with more comprehensive and practical teaching support.
2. Traditional intelligent teaching systems often lack consideration for the personalized needs of teachers. The intelligent subject system proposed in this article not only considers the personalized needs of students but also fully considers the personalized needs of teachers, providing customized teaching resources and tools for each teacher.
3. By combining the TPACK framework with intelligent subject systems, this article successfully expands the application areas of the TPACK framework; instead of being limited to traditional teacher education and training, it is also applicable to practical teaching practices, improving teaching quality and student learning outcomes.

LITERATURE REVIEW

The improvement of teachers' information technology-based teaching ability is not only the trend of teachers' educational development, but also an important factor affecting students' development. Some studies even suggest that the information technology-based teaching ability of teachers is the key to the success or failure of education and teaching reform (Hernández-Ramos et al., 2023).

Stinken-Rösner et al. (2023) believe that design research pays attention to the design of the learning environment, which effectively integrates experiential education and theoretical drive and allows educational innovation to be put into practice. Guo (2021) thinks that DBR is a systematic and flexible method system. On the basis of cooperation between researchers and practitioners, DBR promotes educational practice through repeated cycles of analysis, design, development and implementation, and it refines the design principles and theories of real situations. This definition shows that DBR is the double development of theory and practice. The design, implementation, evaluation and improvement of educational intervention are the core elements of design research. It is used to solve practical problems, according to practical needs, using a variety of research methods and the joint efforts of many parties to form an effective design and realize the common development of theory and practice. Class (2023) focused on the influencing factors of TPACK and built the context factor model of TPACK. Based on the existing research conclusions, it was found that TPACK was influenced by many factors, but its mechanism and intensity is very different for different people. These conclusions are all subsequent correlations. Thyssen et al. (2023) put forward four meanings of blended learning in their articles, including: combining or mixing network-based technology models to achieve educational goals; combining different teaching methods to produce the best learning results; combining face-to-face teacher-guided training with different forms of teaching techniques; combining or mixing practical tasks with teaching techniques to coordinate learning and work. Huang (2021) believes that blended learning is a kind of ability for learners, including the ability of learners to choose available learning resources, methods, media, and more which are suitable for them to help them achieve their learning goals; for teachers and instructional designers, blended learning is the ability to organize, distribute, and utilize available teaching resources and equipment. For teaching managers, blended learning is the ability to organize and distribute all valuable teaching resources, equipment, media, and teaching materials (Garrido Abia et al., 2023). Velander et al. (2023) tried to explore the teaching strategy of integrating dynamic visual information technology, plane geometry content, and teaching under the framework of TPACK, and they applied this strategy to practical research and conducted teaching experiments to try to improve classroom teaching efficiency. Ghazali and Rahman (2023) will integrate dynamic information technology with subject teaching through visual teaching strategies, which can help students, with the support of a large number of materials, incorporate knowledge into images. This meets the needs of students' cognition, builds a

pillar of abstract thinking, and provides the basis for various abilities development, so as to cultivate students' thinking and literacy. Su et al. (2023) think that using technology to represent and present the subject content combined with teaching method knowledge is beneficial to teaching and to students' understanding of knowledge. The concrete presentation form of T-TPACK is that teachers choose appropriate teaching methods and properly integrate technologies in the teaching process according to the teaching content, so as to design teaching plans and use appropriate methods to represent and present subject knowledge, thus improving teaching efficiency and students' learning efficiency (Su et al., 2023). Elmaadaway and Abouelenein (2023) believe that, in the general teaching process, the application of technical knowledge to subject teaching does not interact with the subject content rationally. It may appear that technology is used for teaching in the whole class teaching activities, but whether it is suitable to use technology at a certain stage is not determined, and there is no interactive analysis of technology and subject content (Elmaadaway & Abouelenein, 2023).

Education informatization has led to a profound revolution of educational modes. Integrating teaching methods with knowledge of technology combines technical knowledge with teaching method knowledge (Listiawan et al., 2024). We need to integrate technology well on the basis of reasonable selection of teaching methods, which means applying technical knowledge in teaching and exploring the ability of technology to improve teaching methods and means; this will enhance teaching ability to the fullest extent (Maspul, 2024). Teachers should think more about the relationship between technology, subject content, and teaching methods in teaching design (Song et al., 2024), and they should combine their understanding of these three elements to integrate technology into teaching reasonably (Štuikys & Burbaitė, 2024). The inquiry teaching mode involves carrying out experiments centered on students' main activities, and this mode takes the content, tasks, or problems as the carrier, which triggers students' inquiry and thinking (Celik, 2023). This teaching mode highlights the exertion of students' subjectivity in the learning process, emphasizes the cultivation of students' practical ability and actively inquiring spirit, can fully mobilize students' consciousness, initiative, and creativity, and improves students' comprehensive quality and team consciousness (Elmaadaway & Abouelenein, 2023). This cultivates students' rigorous scientific literacy and good practice habits, and allows them to master standardized experimental analysis methods.

Information technology-based teaching has become a major trend in modern university teaching, alongside the the current global development trend in information technology education. Information technology is no longer just a teaching aid tool; the traditional teacher-centered teaching structure is essentially changed, and efforts are being made to cultivate compound talents with innovative spirit and practical ability. Because of this, vigorously promoting the integration of information technology into the curriculum has become the trend in educational reform.

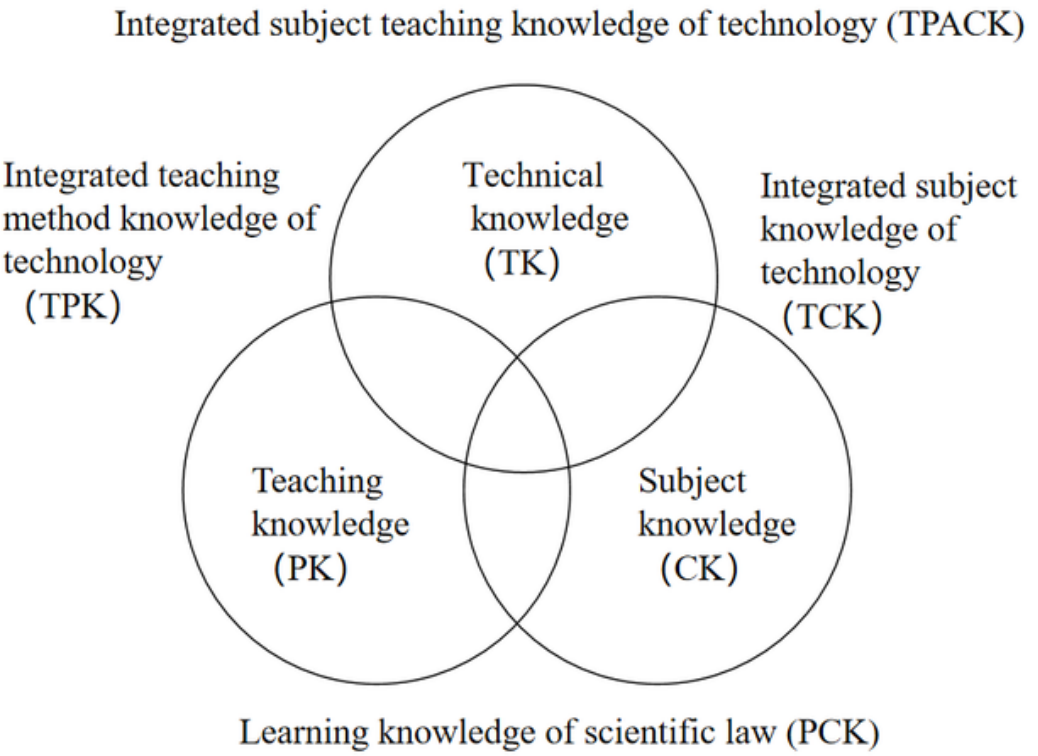
RELATED MATERIALS AND METHODS

TPACK Basic Framework

In classroom teaching, information technology teachers use traditional teaching media like ordinary teachers, such as blackboards, chalk, textbooks, and more (Shin, 2022). Modern teaching media are divided into hardware and software; hardware media include computers, projectors, slide projectors, and more, and software media include CD-ROMs, video tapes and courseware (Fahadi & Khan, 2022). The choice of teaching media is closely related to students' psychological states, which belong on a spectrum from unconscious psychological states to conscious states. For TPACK, the three core elements are TK, RK and CK, which include classroom environment, learners' cognitive ability, teaching objectives, and so on (Li, 2021). In the ICT-TPACK framework, technical knowledge, teaching method knowledge, subject content knowledge, learner knowledge, and context are integrated to teach specific subject content to students, as shown in Figure 1.

In TPACK, TPK can be regarded as instructional design knowledge, TCK as instructional resource knowledge, and PCK as subject teaching knowledge. TPACK is the sum of instructional design

Figure 1. TPACK Framework



knowledge and instructional resource knowledge, which can be regarded as educational technology knowledge, respectively emphasizing instructional design ability, resource application ability, subject teaching ability, and the comprehensive ability of information technology and curriculum integration (Chaipidech et al., 2022). This is also an important meeting point between TPACK and modern educational technology, so TPACK can be introduced into modern educational technology training (Ni et al., 2023). An important way to develop TPACK is to participate in a variety of teaching activities and build a long-term learning community. Promoting the sustainable development of TPACK in the continuous activities in the learning community will lead to avoiding the short-term effects of technology application. Improving the educational technology ability of full-time teachers in colleges and universities is also an important means of cultivating their TPACK knowledge. Teaching and learning activities cannot be separated from each other. The change of teaching situations will promote the change of teaching and learning activities. The TPACK framework is in line with this point, since the framework is a knowledge body that changes according to the need of a situation, which is mainly manifested in the characteristics of the interaction between teachers and students. This is closely related to the knowledge of subject content, teaching methods, and technical knowledge; and the change of an educational situation will have knock-on effects. Therefore, TPACK is inseparable from the experience gained by teachers in the actual teaching practice environment; that is, TPACK is not only constructed in practice but also related to practice. On the other hand, TPACK refers to the processing, transformation, and representation of specific subjects and their contents, which is closely related to specific subject topics. This demarcates it from more general methods such as technical support teaching. TPACK can be moderately developed in real teaching situations with design-based research methods. TPACK's modern educational technology training model is shown in Figure 2.

Figure 2. Modern Educational Technology Training Model Based on TPACK

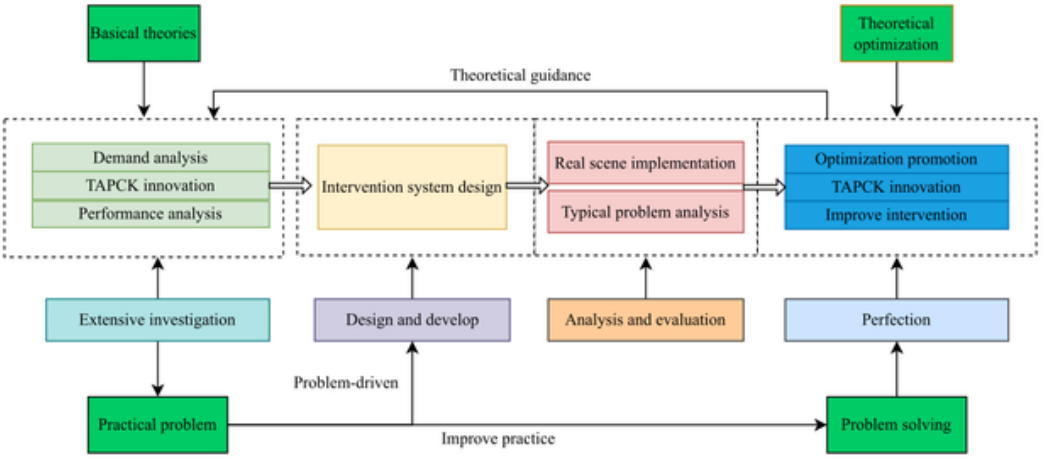


Table 1. Three Core Elements Under the TPACK Framework

TPACK element	Brief definition	Give an example
Subject content knowledge (CK)	Knowledge of subject content	Chinese, mathematics, English, history, and other disciplines
Teaching method (PK)	Knowledge about students' learning, teaching theory, teaching strategies, teaching evaluation, and more	According to educational teaching theory, change the teaching mode, such as the zone of proximal development theory, problem-solving teaching mode, situational teaching mode, and more
Knowledge (TK)	Knowledge of information technology (including hardware and software)	Using information technology software, using network resources, mobile phone application software, making videos, uploading videos, and more

As the three core elements of TPACK are in a dynamic state of balance, it is necessary to rebuild the balance when the situation changes. In this process, more attention is paid to the integration of teachers' knowledge and the creation of learning situations. The key to the development of TPACK is the creativity of teachers, that is, the creativity of teachers' consciousness, thinking, and ability to turn technical knowledge into content teaching knowledge. As suggested by Chaipidech et al. (2022), when teachers develop TPACK, they should integrate modern educational technology into their actual teaching, scientific research, and management practice, so that all parts of TPACK can develop harmoniously. This is consistent with the idea of modern educational technology training and also highlights the scientific nature and feasibility of introducing TPACK into modern educational technology training. Technology is constantly in the process of innovation and change, so teachers are required to have an open vision and awareness of lifelong learning to integrate innovative information technology environment into their teaching continuously. They should also have sufficient understanding and application awareness of information technology, as shown in Table 1.

Under the T-TPACK framework, the three core elements are cross-fused pairwise, forming four composite elements. Among the four composite elements formed, TCK refers to the use of information technology to characterize the specific knowledge of a certain discipline; it is the mutual integration of information technology and discipline knowledge. Teachers are often required to understand the taught content of the discipline fully and to know which information technologies are applicable to the corresponding content of the discipline according to the characteristics of the discipline

Table 2. Four Composite Elements under the TPACK Framework

TPACK element	Brief definition	Give an example
Subject pedagogy knowledge (PCK)	Using corresponding teaching strategies to teach the knowledge of specific content of a subject	Using models to explain atomic structure; explaining the properties of mathematical formulas by combining numbers with shapes
Integrated pedagogical knowledge of technology (TPK)	Knowledge of using appropriate information technology to support a teaching strategy or method	Using a data collector for scientific inquiry; a mathematical experiment with a graphic calculator
Integrated Subject Content Knowledge (TCK) of Technology	Knowledge about using the corresponding information technology to support the specific content of a certain discipline	An online dictionary, flash animation, and more
Integrated subject teaching knowledge of technology (TPACK)	Using the corresponding information technology to carry out the teaching of specific content of a subject	Using mathematical software to carry out mathematical discipline

knowledge. They are also often required to know how to apply information technology effectively, as shown in Table 2.

In teaching activities, teachers should know clearly which places are suitable for using technology in teaching. If teachers ignore technology, they may lose a chance to solve teaching problems, or if they use technology too casually, they may mislead students' understanding of subject knowledge. In the process of teaching design, teachers should pay attention to the effectiveness of technology in teaching activities. The core idea of the TPACK framework is to integrate technology in education and make it inseparable from the classroom. Teaching design based on the TPACK framework can form diversified teaching methods and flexible teaching strategies according to the characteristics of the TPACK framework and the design model of teaching system. The framework can conform to the idea of students as the main body and teachers as the leader. It embodies the thought of constructivism and meets the requirements of curriculum standards.

Intelligent systems have significant advantages when improving teaching quality. Intelligent systems can provide personalized learning support based on each student's learning needs, interests, and learning style. Through the analysis and feedback of intelligent systems, teachers can better understand the learning situation of each student, adjust teaching strategies accordingly, and thus improve teaching quality. Intelligent systems can monitor students' learning progress and performance in real time and provide timely feedback and evaluation. This helps teachers to identify students' learning difficulties and problems promptly, take corresponding teaching measures, correct learning directions in a timely manner, and improve learning effectiveness. Intelligent systems can integrate a variety of learning resources, including text, images, audio, video, and other forms, to provide students with a more vivid and intuitive learning experience. This helps to stimulate students' interest in learning, improving learning efficiency and quality. Intelligent systems can automatically adjust the learning path and content based on students' learning performance and feedback, aligning the learning path with their learning needs and levels. This helps to ensure that every student is able to learn at a pace that suits them, improving the effectiveness and quality of their learning. Intelligent systems can provide data support and decision-making references for teachers, helping them design and make teaching decisions better. Through the analysis and prediction of intelligent systems, teachers can develop teaching plans and strategies more scientifically and effectively, improving the quality and effectiveness of teaching. In summary, intelligent systems have advantages in improving teaching quality, such as personalized learning support, real-time feedback and evaluation, abundant learning resources, adaptive learning paths, and auxiliary teaching decisions, which can enhance teaching effectiveness and learning outcomes.

TPACK Model Teaching Evaluation Model Construction

The emergence and application of the TPACK framework has changed the instructional design accordingly. The instructional design model based on the TPACK framework not only pays attention to the application of information technology but also pays attention to the integration of educational ideas, teaching subjects, teaching content, and scenarios. Instructional design shows the TPACK framework's unique role in the cultivation of core literacy, the stimulation of students' learning potential, the creation of classroom atmosphere, and the completion of teaching objectives. The evaluation score of teachers is based on the average score formula of the class taught by the teacher, as shown in Equation 1:

$$x_{rt} = \frac{(\sum_{a_i=A_{rt}}(\sum_{n=1}^{mai} x_{ai}, n_{rt}))}{m_{ai}} \tag{1}$$

The scores of different classes will be different, so students' scores need to be preprocessed first, and the teaching evaluation scores of each class will be linearly transformed into the same score space. The specific preprocessing algorithm is described in Equation 2:

$$f(x, \overline{x}_{bi}, x_{bi}, x) = (m_2 - m_1) \cdot \left(\frac{x - x_{bi}}{\overline{x} - x_{bi}}\right) \tag{2}$$

The evaluation scores of classes are linearly transformed into the score range, and the evaluation data of teachers in each class are divided into different groups:

$$W = \sum_{i=1}^{k} \sum_{nrt} \| c_i - x_{bi} \| \tag{3}$$

Using clustering before association rule mining can group data into clusters for more targeted association rule mining within each cluster. Through clustering, similar data points can be grouped together, which helps reduce the complexity of the data and improve the efficiency of mining. Clustering can help with discovering the inherent structure and patterns of data, leading to better understanding of the dataset. This article groups teacher evaluation data through clustering and then conducts association rule mining within each cluster to obtain rules that describe the correlation between different teacher evaluations, such as the correlation between certain evaluation factors or the correlation between certain evaluation scores. These association rules can help with understanding teacher evaluation data and they can provide reference for further analysis and decision-making. One should start by setting the sample data to randomly generate cluster centers, averaging the data of the same cluster, and calculating a new cluster center. If it is judged that the difference between the new cluster center and the old cluster center is less than the error value, or the number of iterations exceeds the preset number, the iteration stops, and the evaluation score of the teacher is calculated as follows:

$$x_{ai,rt} = \frac{\sum_{i=1}^{k+1} c, l_{ci,rt}}{\sum_{i=j}^{k-1} c', l_{ci,rt}} \tag{4}$$

According to the class set of teachers' classes, the formula of teachers' total evaluation is shown in Equation 5:

$$x_{rt} = \sum_{bi \in Atr} \frac{x_{bi,rt}}{l_{rt}} \tag{5}$$

$$match = \frac{P(\overline{X}Y)}{P(\overline{X})} - \frac{P(XY)}{P(X)} \tag{6}$$

Equation 6 is deformed as shown in Equation 7:

$$match = \frac{P(\overline{X}Y) - P(X)P(Y)}{P(\overline{X})(P(\overline{X}) - 1)} \tag{7}$$

Then, meet the minimum confidence as shown in Equation 8:

$$match = \frac{P(\overline{X}Y) - P(X)P(Y)}{P(\overline{X})(P(\overline{X}) - 1)} \tag{8}$$

Then, one should get a new set of frequent itemsets, so that it is not necessary to consider those frequent itemsets that can only generate redundant association rules when generating rules. The efficiency of the algorithm is effectively improved. There are many researchers who screen the obtained teaching results through various measurement standards to obtain effective rules. The differences of sample test of teaching transcripts are shown in Equations 9 to 11:

$$U = \frac{\partial / \sqrt{1-n}}{X + \partial_0} \tag{9}$$

$$T = \frac{\partial / \sqrt{1-n}}{Y + \ell_0} \tag{10}$$

$$\alpha = P\left\{|C| \geq t_{2a}(n-1)\right\} \tag{11}$$

For the average comparison of teaching achievement samples, one should find that the two samples are independent of each other, and the samples are all from the normal population. Moreover, the average is a meaningful descriptive statistic for testing, which is similar to single sample testing. The new statistic is constructed as shown in Equation 12:

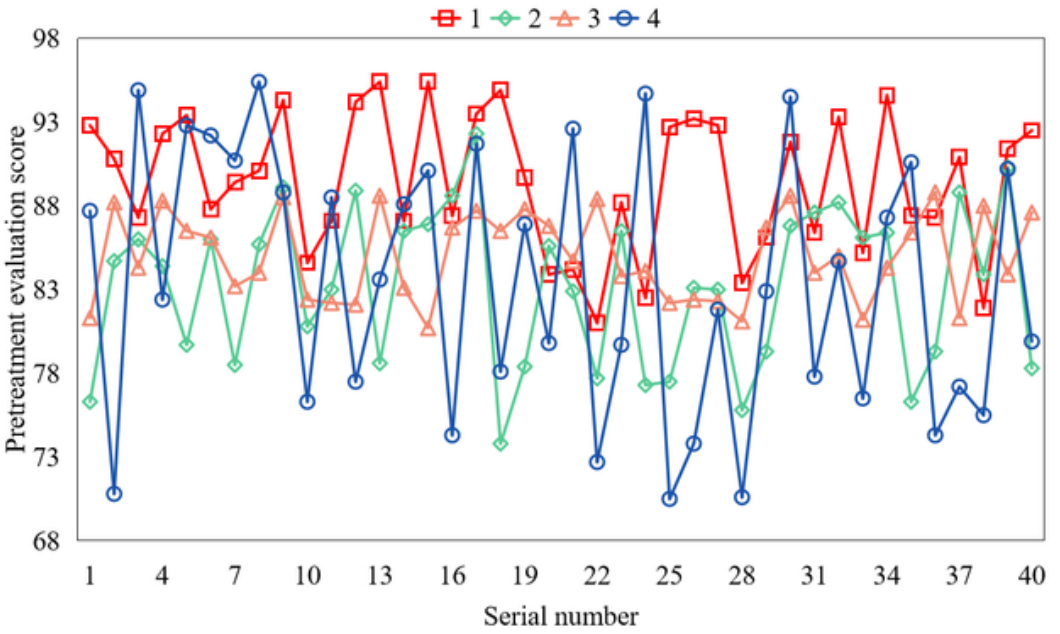
$$T = \frac{S_W \sqrt{\frac{1}{s_1} + \frac{1}{s_2}}}{X - Y} \tag{12}$$

The critical value that can be checked according to the sample distribution theorem of the sampled teaching achievement is shown in Equation 13:

$$T = \frac{s_z \sqrt{1-n}}{Z} \tag{13}$$

In order to better reflect the degree of influence of teaching achievement evaluation, one should compare its confidence with the expected confidence, as shown in Equations 14 and 15:

Figure 3. Model for Improving Teachers' IT Application Ability



$$Correlativity(XY) = \frac{P(X|Y)}{P(X)P(Y)} \tag{14}$$

$$Interest(X \Rightarrow Y) = P(X|Y) - P(X) \tag{15}$$

The effectiveness of the support degree influenced by teaching achievement is shown in Equation 16:

$$Validity = (P(XY))/P(X)) - (P(X\overline{Y}))/P(\overline{X}) \times P(X)) \tag{16}$$

Teachers' Information-Based Teaching Ability Needs

The construction of the curriculum system is the basic work of training. Achieving the curriculum system's preset goals requires the collection, collation, analysis, and comparison of the evaluation information of the curriculum system. The improvement, adjustment, and continuous improvement of the curriculum system must also be based on the results of evaluation through the analysis of the position, construction links, and constituent elements of the training curriculum system in training. One should establish an index system that can be oriented to the overall systematic evaluation of training courses. Next, guide the setting of training courses to the idea of systematic design and realize the systematic effect of training courses in training activities. TPACK emphasizes that teachers are the designers and leaders of the classroom, but at the same time, they attach importance to students; this is also the teaching concept of mixed teaching mode.

In this paper, from the perspective of solving practical problems, based on TPACK theory, a model for improving teachers' IT application ability is designed, as shown in Figure 3.

In the transmission of learning tasks, this study will comprehensively consider the adaptability of teaching contents and forms and the complexity of tasks, so as to determine the appropriate transmission path and form. Based on diversified teaching resources, students can learn independently or collaboratively, and in the process, they can obtain instant supporting materials so as to complete the corresponding tasks and give feedback on the completion of the tasks as individuals or groups. By comparing the self-evaluation scores of students' knowledge and ability before and after the training, it can be found that the students have improved their information technology ability and completed the teaching objectives set by the training. Based on these two points, the implementation process of this study can verify the effectiveness of the hybrid training model and scheme for teachers' IT ability. At the same time, however, through deep excavation and reflection on the survey data, this study proposes that the training program can be further revised, including the reorganization and arrangement of some unit contents, the continuous provision of support resources after the training, and the reduction of training tasks.

RESULTS AND ANALYSIS

Analysis of Experimental Results

On the basis of theoretical construction, this study takes the information technology ability evaluation scale of teachers as a tool, investigates and obtains the feedback information of pre-samples, and makes a preliminary evaluation of the curriculum content system based on this information to further verify and enhance the applicability and scientific nature of the training curriculum system. The purpose of this study is to test the homogeneity of the items and to explore the differences between high and low score subjects in answering different items, so as to screen individual items in the questionnaire. In the project analysis, this study adopts various methods such as extreme group comparison, the relationship between items and total scores, and the homogeneity test.

During the instruction stage in class, students can accurately analyze the knowledge points and the information technology they use from the teaching examples, which shows that they have a good understanding of the application of information technology in teaching. When designing information-based teaching for the whole class, teachers will supervise and guide the whole design process, give timely feedback to their existing problems; they find that students can complete the information-based teaching design, and under the repeated emphasis of teachers, they are also conscious of integrating information technology into teaching. This epitomizes TPACK context innovation and optimization promotion. These five stages exist in the same system, and they influence and promote each other and jointly restrict the final results of design research. In this paper, students are randomly divided into Class 1 and Class 2, with 40 students in each class, which basically ensures that the initial level of students is equal. Among them, Class 1 implemented the model and intervention system designed by this research as an experimental class; Class 2 implemented the original plan, and other conditions are consistent with those of Class 1, which ensures the scientific viability and accuracy of the research.

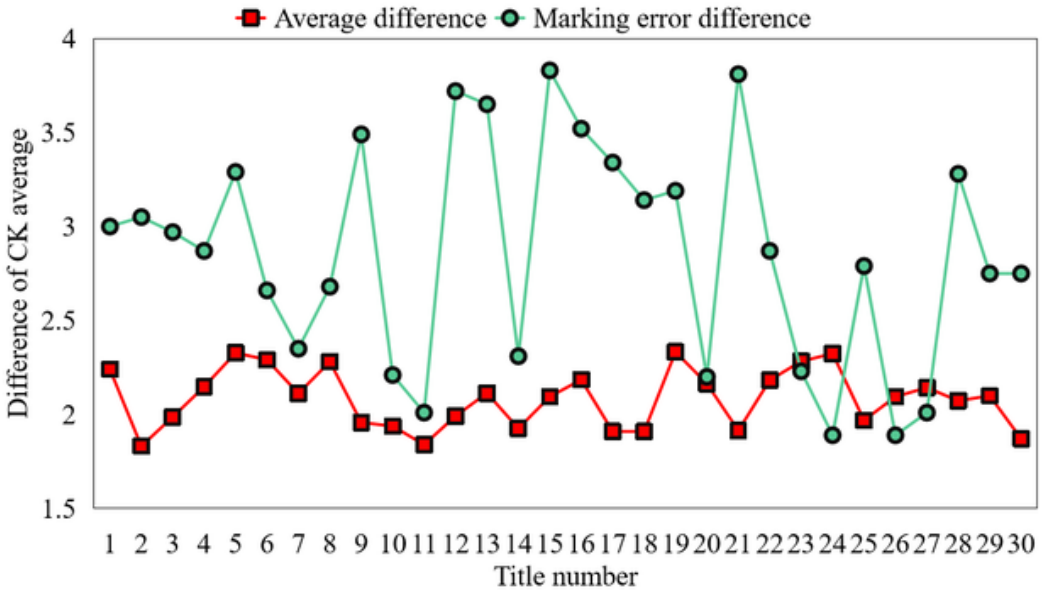
The effectiveness of the algorithm is verified by the evaluation scores of four teachers in two classes in a school. The ranking of the algorithm is shown in Figure 4.

It can be seen from Figure 5 that the teachers' teaching quality level and ranking are indeed reflected by the evaluation of class attendance and the examination of various teaching materials, and the effectiveness of this algorithm is also verified. The algorithm proposed in this paper can fairly evaluate the teaching quality of teachers to a certain extent.

As the basis of item modification, the comparison results of extreme groups of CK dimension questions are shown in Figure 6.

Because this study is based on the mature existing scale, and its internal structure remains unchanged, it uses the total score relationship between items and corresponding dimensions to judge its homogeneity when analyzing the relationship between items and total scores. Based on the reliability test, commonality and factor load data, this paper judges the rationality of the item setting.

Figure 4. Original Evaluation Score and Linear Transformation Pretreatment Evaluation Score



G11, G21, G12 and G22 are used to represent the average scores of the experimental and control classes before and after the test, respectively. The results are shown in Table 3.

The values of seven elements in two classes were tested by a paired t-test, and the results are shown in Figure 7 to Figure 9. This article conducted a paired t-test on the values of seven elements in two classes. This means that each element has a value in both the experimental group and the control

Figure 5. CK Dimension Mean Equality Test

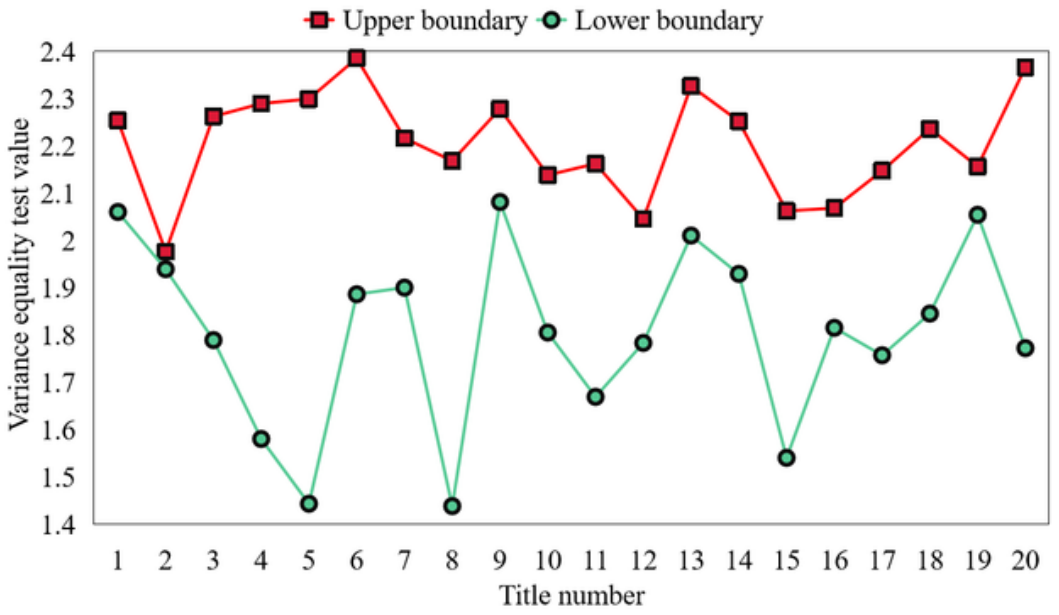


Table 3. Paired Sample Statistics of TPACK in Experimental Class and Control Class

Group	Before and after measurement	Average/mean value	N	Standard deviation	Standard error
Experimental class	G11	29.52	40	2.883	0.43712
Experimental class	G12	32.46	40	1.638	0.38321
Control class	G21	28.19	40	2.468	0.44281
Control class	G22	34.87	40	1.655	0.37428

group, with a total of seven elements. Therefore, a total of 14 values need to be paired t-tests. The 28 elements appearing in Figures 7, 8, and 9 are because each element has two values: one from the experimental group and one from the control group. This design allows each data pair to contain two values, resulting in a total of 14 paired data pairs, totaling 28 numerical values. By comparing the differences between these paired data pairs, the impact of teaching intervention on teachers' teaching ability can be evaluated, and conclusions and inferences can be drawn.

This promotes the renewal and modernization of teachers' educational ideas, the change of teaching methods, the reform of education and teaching, the application of information technology in teaching, and the informatization process of teachers' education. Teachers' educational technology training can effectively improve teachers' educational technology literacy and ability in a short time, which promotes teachers' professional development. With the support of teachers' professional development, people should strengthen management and gradually build a team of teachers with modern educational ideas, rich professional knowledge, innovative spirit and creative ability, excellent quality, and vitality, so as to promote the sustainable development of schools.

Figure 6. 95% Confidence Interval of CK Difference

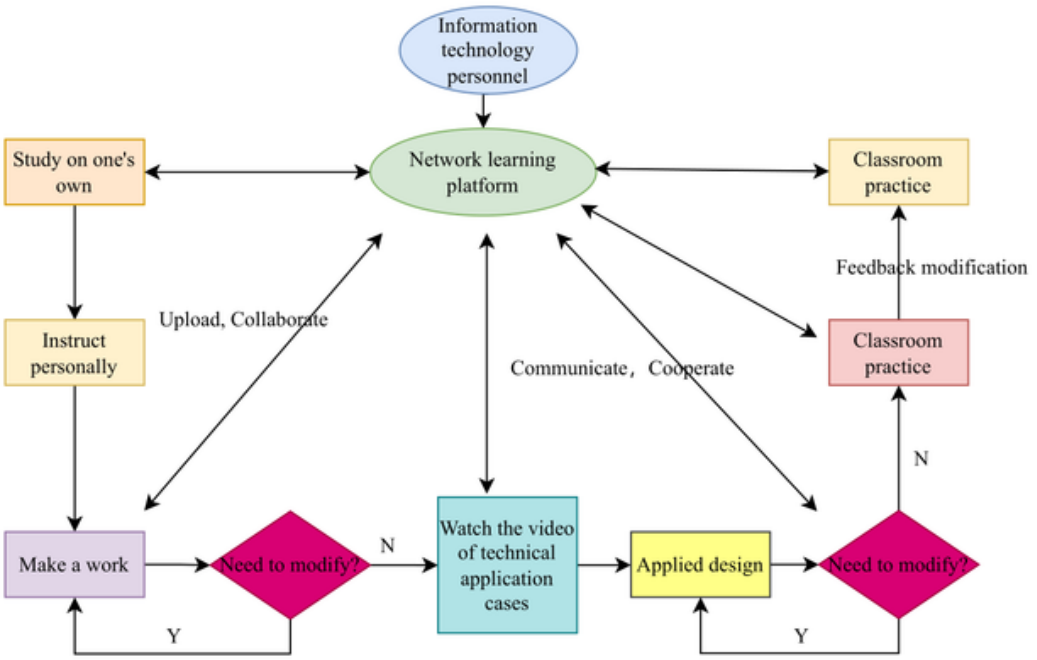
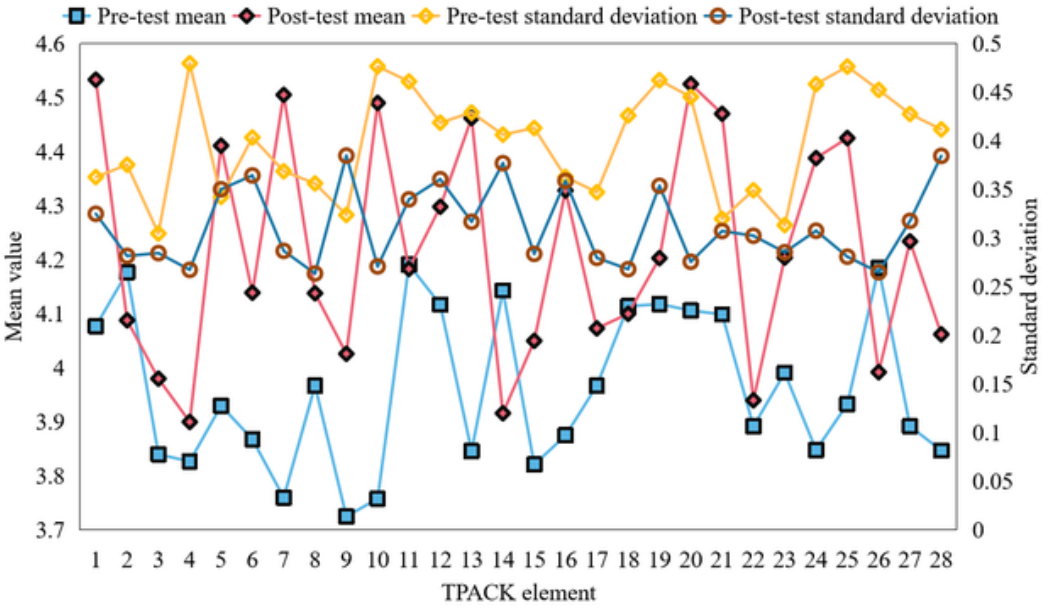


Figure 7. T-Test Results of TPACK Element in Experimental Class



Analysis of Practical Applications

Traditional education systems often seem inadequate in meeting personalized needs. In response to this issue, this article attempts to combine the T-TPACK framework with intelligent theme systems.

Figure 8. T-Test Results of TPACK Element in Control Class

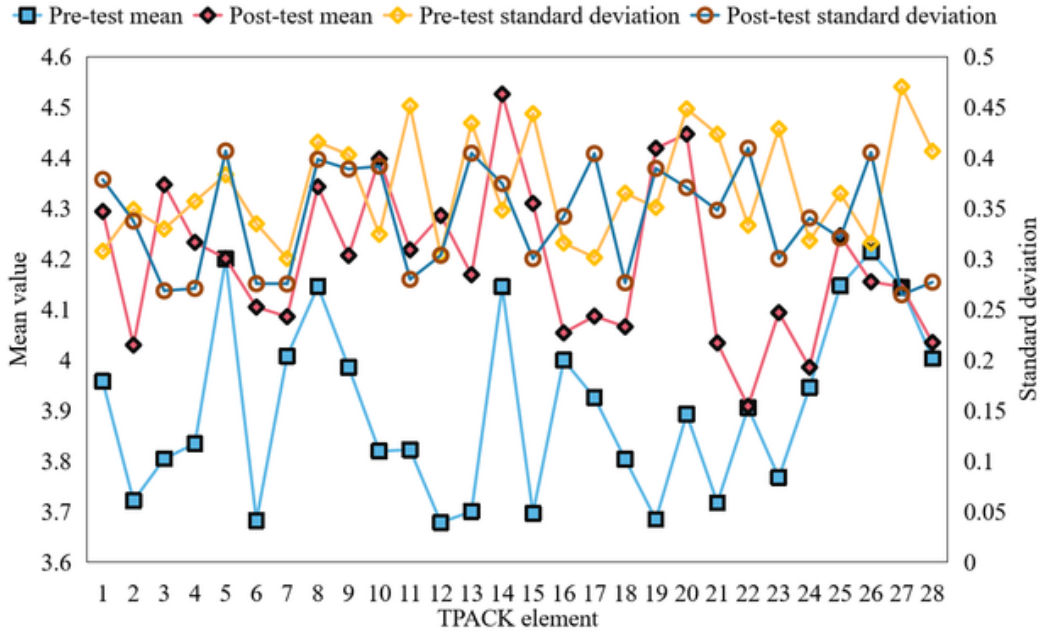
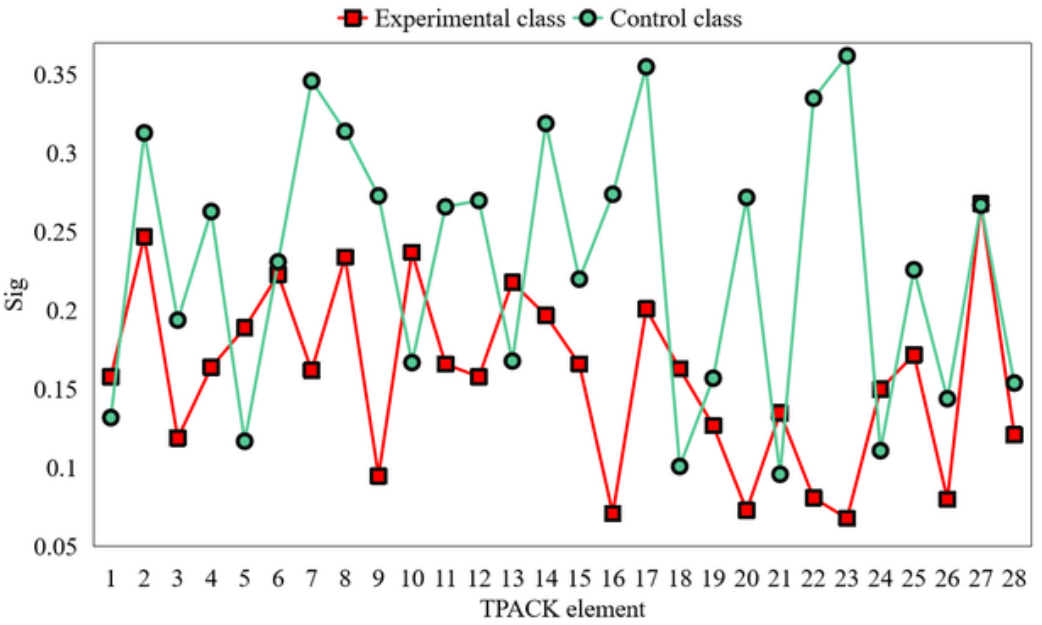


Figure 9. Sig Comparison Between Experimental Class and Control Class



However, although this article proposes innovative methods, it also faces some limitations that need to be carefully considered and solved.

1. Sample limitation: This study is only based on a limited number of samples, which may limit the generalization ability of the research results. If the sample is insufficient or not representative enough, the conclusion drawn may not have universal applicability. Expanding the size of research samples and ensuring their representativeness and diversity will improve the generalization ability of research results. In addition, mixed methods can be used to combine quantitative and qualitative research to obtain more comprehensive data.
2. Long term effects: Although this article may provide short-term training and evaluation of teachers' information technology teaching abilities, its long-term effects are still unclear. The professional development of teachers is an ongoing process, and long-term tracking and evaluation are crucial for understanding the sustained effectiveness of this method. Long-term follow-up research can be conducted to evaluate the sustained effectiveness of the proposed methods in teacher professional development, and timely adjustment and optimization training programs can meet the needs of different stages.
3. Technology dependency: The method proposed in this article is highly dependent on technical support, including the stability of intelligent topic systems and the proficiency of teachers in technical tools. If technology malfunctions or teachers lack necessary technical training, the implementation of this method may be affected. Regular technical training and support could be provided to ensure that teachers can fully utilize intelligent thematic systems and other technical tools, while developing backup solutions to address technical failures and other unforeseeable issues.
4. Subject applicability: This article focuses on specific subject areas or educational stages of research, and the results may not be applicable to other subjects or educational stages. The differences in educational environments may affect the effectiveness and applicability of this method. The research scope could be expanded to cover multiple disciplines and educational

stages, to verify the universality and applicability of the proposed methods, and customized adjustments could be made based on the characteristics of different disciplines and educational environments.

By taking these response measures, the proposed methods can be further improved and their operability and effectiveness in educational practice can be enhanced. The following are the practical applications studied in this article:

1. Teacher training and professional development: This involves utilizing intelligent theme systems to provide personalized professional development training for teachers. The system can generate targeted training courses and resources based on the subject background, teaching experience, and student needs of teachers, helping them improve their teaching ability and educational technology application level.
2. Curriculum design and teaching practice: Teachers can use intelligent theme systems to design and implement personalized courses and teaching activities. The system can automatically generate teaching resources which meet teaching needs, such as courseware, teaching cases, homework, and more, based on course objectives and student characteristics. This will help teachers to improve classroom teaching effectiveness and student academic performance.
3. Student learning assistance: Teachers can use intelligent topic systems to provide personalized learning assistance services for students. The system can recommend suitable learning resources and activities based on the learning needs and levels of students, helping them better understand and master knowledge, improving learning efficiency and grades.
4. Teaching evaluation and feedback: Teachers can use intelligent thematic systems for teaching evaluation and feedback. The system can collect student learning data and feedback, helping teachers understand teaching effectiveness and student learning situation and adjust and optimize teaching strategies in a timely manner. This will improve teaching quality and effectiveness.

Through the above practical applications, intelligent theme systems can effectively support the professional development and teaching practice of teachers, improve teaching quality and student learning performance, and promote innovation and development in education and teaching. In the future, the following development directions can be considered:

1. Personalized education services: Intelligent theme systems can be further developed to provide more personalized education services. Based on students' learning needs, interests, and learning styles, customized teaching resources and learning activities can be generated to help students achieve personalized learning goals.
2. Intelligent teaching assistance tools: Intelligent topic systems can combine more advanced artificial intelligence technologies, such as machine learning and natural language processing, to develop more intelligent teaching assistance tools that can analyze students' learning status and feedback in real-time, providing teachers with more accurate teaching suggestions and feedback.
3. Interdisciplinary knowledge integration: Intelligent thematic systems can further develop into platforms that can integrate knowledge and resources across disciplines, helping teachers better integrate across disciplines in teaching design and implementation. This will promote interdisciplinary integration and innovation.
4. Education big data analysis: Intelligent theme systems can combine big data analysis technology to analyze the teaching process and student learning data, explore potential teaching laws and learning modes, and provide more scientific teaching decision support for teachers.

CONCLUSION

In the educational environment of the information age, professional development to enhance teaching ability is crucial. However, traditional education systems often struggle to meet personalized needs, especially in terms of intelligent teaching. This article aimed to combine the T-TPACK framework with intelligent thematic systems to create a more effective and personalized teaching environment. Traditional intelligent teaching systems often overlook the personalized needs of teachers, while our proposed intelligent subject system fully considers this and provides customized teaching resources and tools for each teacher, deeply integrating technology, teaching methods, and subject content knowledge. It thereby provides more comprehensive and practical teaching support for teachers. In this study, an in-depth analysis and discussion were conducted on the evaluation of teacher information technology capabilities and training programs. Firstly, through the analysis of experimental results, we found that implementing mixed training models and programs has a significant effect on improving teacher information technology capabilities. The experimental group's self-evaluation of knowledge and skills significantly improved after training, indicating that the training program is effective in enhancing teachers' information technology skills. Secondly, during the experiment, we found certain correlations and regularities between different teacher evaluations through clustering and association rule mining of teacher evaluation data. The discovery of these association rules provides us with a deeper understanding of the inherent relationship between teacher evaluation data, which helps guide the optimization and improvement of teacher training and evaluation systems.

In addition, the experimental results also indicate that the teaching quality and information technology application ability of teachers are closely related in the training of their information technology abilities. Through real-time analysis and feedback systems, teachers can better understand the learning situation of each student, adjust teaching strategies, and thus improve teaching quality. Therefore, in future teacher training and development, emphasis should be placed on enhancing information technology capabilities, while also emphasizing the improvement and optimization of teaching quality. This article provides important reference and inspiration for the improvement of teacher information technology training and evaluation system. The intelligent subject system proposed in this article provides more personalized teaching support for teachers, which helps to stimulate their learning interest and motivation and promote their professional development. This has positive significance for building a teacher team with innovative capabilities and ability to adapt to information technology education.

DATA AVAILABILITY

The figures and tables used to support the findings of this study are included in the article.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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