

On the Construction of Cultivating Model and Enhancement Strategies for University Teachers' TPACK Competency in the Context of Educational Informatization

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Abstract: With the rapid development of information technology, educational informatization has become a significant trend in global educational reform. As the primary practitioners of educational informatization, the level of university teachers' information-based teaching competency directly impacts the progress and quality of educational informatization. The TPACK framework, integrating technology into subject teaching, provides a new perspective and methodology for enhancing university teachers' information-based teaching competency. This study focuses on the application of the TPACK framework, aiming to explore and construct a model suitable for cultivating university teachers' TPACK abilities, thereby upgrading their information technology-enhanced teaching capabilities and ultimately optimizing the quality of talent cultivation. By comprehensively utilizing various research methods such as literature reviews, questionnaires, and interviews, this study conducts an in-depth analysis of university teachers' information-based teaching capabilities and proposes targeted capability enhancement strategies based on the constructed TPACK ability cultivating model.

Keywords: TPACK competency, university teachers, educational informatization, cultivating model.

1. Introduction

With the rapid advancement of information technology, educational informatization has become a significant trend in the field of education. Traditional teaching models are gradually being replaced by digital and online teaching methods. In this context, the enhancement of teachers' information-based teaching competency has become crucial. Improving information-based teaching competency not only helps teachers better cope with the challenges posed by the digital educational environment but also promotes the improvement of teaching quality, stimulates students' interest in learning, and fosters innovation. TPACK (Technological Pedagogical Content Knowledge), as an essential core competency for teachers in the information age, plays a vital role in enhancing teaching quality and advancing educational informatization. The TPACK framework emphasizes the integration of technology, pedagogy, and content knowledge, requiring teachers to flexibly apply information technology and innovate teaching methods to achieve deep integration of content and technology. However, the development of university teachers' TPACK competency still faces numerous challenges, such as incomplete training systems, uneven resource distribution, and limited practical opportunities. Therefore, constructing a scientific model for developing university teachers' TPACK competency and proposing effective strategies are of great significance for enhancing teachers' TPACK competency and advancing the process of educational informatization.

2. Overview of the TPACK Framework

The TPACK framework is a teacher knowledge framework that integrates technology, pedagogy, and subject knowledge, including three core elements: TPK (Technological Pedagogical Knowledge), TCK (Technological Content

Knowledge), and TPAK (Pedagogical Technological Content Knowledge) [1]. TPK refers to the knowledge of integrating technology, subject, and pedagogy, TCK refers to the knowledge of the interrelationship and influence of technology, subject, and pedagogy, and TPAK refers to the knowledge of the interaction of specific subject content, technology, and pedagogy [2]. The TPACK framework encompasses technological knowledge, subject knowledge, pedagogical knowledge, and their intersections, emphasizing teachers' ability to integrate technology into subject and pedagogical knowledge in information-based teaching.

The application of the TPACK framework in education primarily focuses on teacher education, training, and practice to enhance teachers' information-based teaching competency [3]. Through the TPACK framework, teachers can better understand and apply the relationships among technology, subject, and pedagogy, optimize instructional design, and improve teaching effectiveness. The TPACK framework provides teachers with a framework for assessing their information-based teaching competency, helping them identify their shortcomings and develop improvement plans.

3. Analysis of the Current Status of University Teachers' TPACK Competency

Currently, university teachers' TPACK competency varies significantly. Some teachers have already developed a certain level of TPACK competency and can proficiently use various teaching technologies and tools, such as multimedia courseware and online teaching platforms, for instructional design and implementation [4]. However, some teachers still lack the necessary technological knowledge and application skills, making it difficult for them to adapt to the demands of information-based teaching. The following sections discuss the current status of university teachers' information-based

teaching competency training systems, resource distribution, and practical opportunities:

Currently, the training of university teachers' TPACK competency primarily relies on internal university teacher training centers and external educational technology training institutions. These training institutions typically offer a series of courses, lectures, and workshops aimed at enhancing teachers' TPACK competency. However, the training systems face the following issues: First, the training content is singular and lacks systematicity. Current training mainly focuses on technical aspects, such as the use of multimedia teaching software and the operation of online teaching platforms, with less emphasis on the integration of pedagogy and content knowledge. Second, the training methods are singular and lack flexibility. Current training primarily employs centralized lectures, lacking personalized and flexible training methods, making it difficult to meet teachers' individual needs. Third, there is insufficient evaluation of training effectiveness. Current training lacks a scientific evaluation system, making it difficult to accurately assess training outcomes, resulting in uneven training effectiveness.

The development of university teachers' TPACK competency requires sufficient resource support, including hardware facilities, software resources, and human resources [5]. However, current resource distribution faces the following issues: First, there is a lack of hardware facilities. Due to limited funding, some universities cannot provide teachers with adequate hardware support, such as high-performance computers and multimedia teaching equipment. Second, there is a shortage of software resources. The market currently lacks high-quality software resources for developing university teachers' information-based teaching competency, such as course libraries and teaching case libraries. Third, there is a shortage of human resources. Universities currently lack professional training teams for information-based teaching, resulting in uneven training quality.

The development of university teachers' TPACK competency requires abundant practical opportunities to test and enhance teachers' TPACK competency. However, current practical opportunities face the following issues: First, practical opportunities are limited. Universities currently provide few practical opportunities for teachers, such as teaching competitions and teaching observations, and these opportunities are often confined to the campus, lacking external exchanges and collaborations [6]. Second, practical platforms are inadequate. There is currently a lack of online practical platforms for developing university teachers' TPACK competency, making it difficult for teachers to access rich practical resources and guidance. Third, there is insufficient feedback from practical experiences. Current practices lack a scientific feedback mechanism, making it difficult for teachers to promptly identify their shortcomings in information-based teaching and make targeted improvements.

In response to the current issues in developing university teachers' TPACK competency, this study constructs a model for developing university teachers' TPACK competency based on literature review and data analysis. This model aims to enhance teachers' TPACK competency and advance the process of educational informatization by integrating training content, training methods, resource distribution, and practical opportunities into a systematic and personalized training

system.

4. Construction of Cultivating Model for University Teachers' TPACK Competency

This study conducted a comprehensive analysis of university teachers' TPACK competency in Hunan Province through questionnaire surveys and interviews. The questionnaire data analysis revealed that university teachers' TPACK competency in Hunan Province generally demonstrates a certain level, but significant differences exist among teachers with different background characteristics. Specifically, teaching experience, educational background, and institution type significantly impact teachers' TPACK competency, while gender does not show a significant influence. Additionally, teachers' motivation, self-efficacy, and the frequency of participation in educational technology and pedagogy training are significantly correlated with TPACK competency. The interview results further revealed teachers' understanding and application of the TPACK framework, their training experiences and outcomes, as well as the challenges they face and suggestions for improvement. Teachers face challenges such as rapid technological advancements, insufficient teaching resources, and varying levels of student acceptance in the process of developing information-based teaching competency, which limit the further enhancement and application of their TPACK competency. Based on these findings, this study constructed a model for developing university teachers' TPACK competency, as shown in Figure 1.

As shown in the figure, this cultivating model integrates internal and external factors, constructing a relatively comprehensive TPACK competency development framework through their interactions. The framework highlights the following key points: First, the external factors include TPACK training that closely integrates theory and practice (referred to as "training") and an evaluation system and incentive mechanism aimed at promoting TPACK competency growth (referred to as "evaluation and incentive mechanism"). The "training" not only includes theoretical guidance based on the TPACK framework but also incorporates teaching practice, fully reflecting the teaching philosophy of integrating theory and practice. The "evaluation and incentive mechanism" runs through the entire process of TPACK competency development, continuously stimulating and enhancing university teachers' TPACK competency through ongoing evaluation, timely feedback, and effective incentives. Second, the internal factors primarily focus on internal motivation and self-efficacy, which are closely connected to external factors. Specifically, the "evaluation and incentive mechanism" in external factors can effectively stimulate university teachers' internal motivation, encouraging them to actively improve their TPACK competency. Conversely, when teachers' internal motivation and self-efficacy are fully activated, they can enhance the positive effects of external factors on TPACK competency development, creating a virtuous cycle. Specifically, the external factors of this model also include four aspects: training content, training methods, resource distribution, and practical opportunities. Each aspect contains several sub-elements, collectively forming a comprehensive training system.

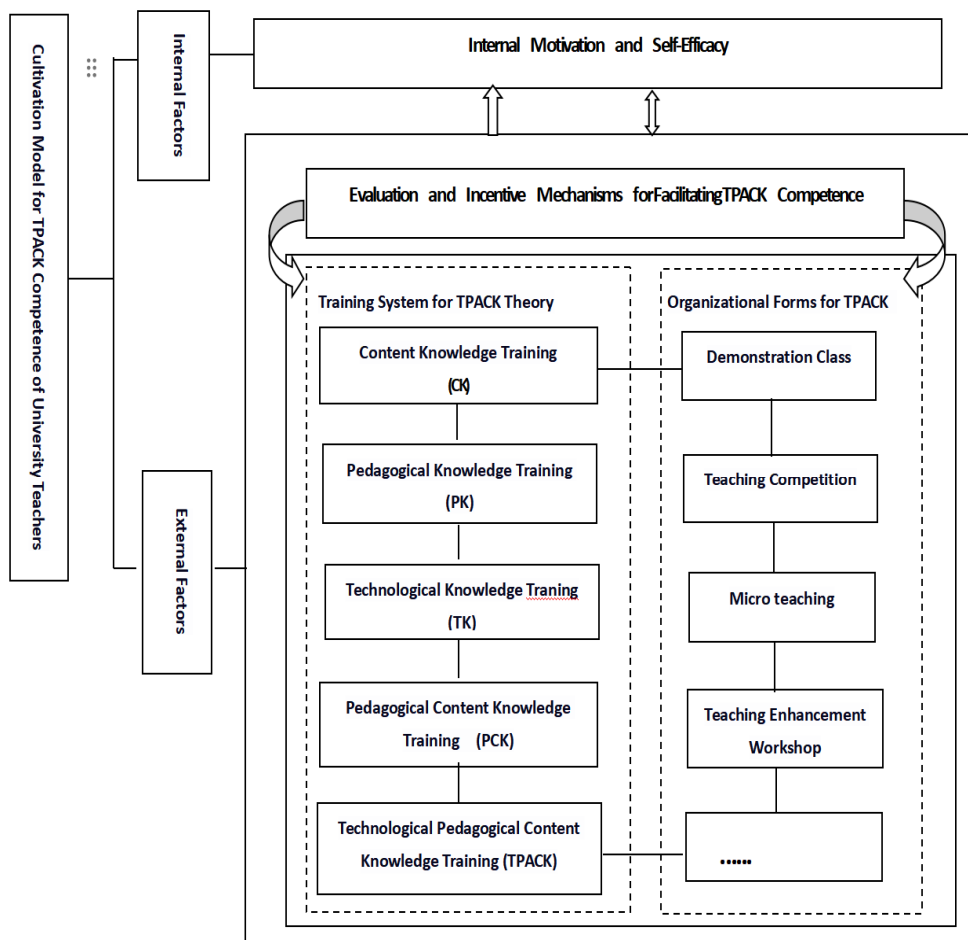


Figure 1. TPACK Competency Cultivating Model

Training content is the foundation of developing teachers' TPACK competency. This model divides training content into three modules: technological knowledge, pedagogical knowledge, and content knowledge, each containing several sub-modules. The technological knowledge module includes basic information technology, the use of multimedia teaching software, and the operation of online teaching platforms. The pedagogical knowledge module includes instructional design, teaching evaluation, and teaching reflection. The content knowledge module includes subject frontiers, course development, and teaching resource integration. Through the integration of these three modules, the model achieves a deep integration of technology, pedagogy, and content knowledge. Training methods are the key to developing teachers' TPACK competency. This model adopts a combination of online and offline methods to provide personalized training services. Online training includes online courses, teaching videos, and teaching forums, offering teachers flexible learning times and spaces. Offline training includes workshops, lectures, and seminars, providing teachers with face-to-face communication and guidance. By combining online and offline methods, the model meets teachers' individual needs and enhances training effectiveness. Resource distribution is the guarantee of developing teachers' TPACK competency. This model integrates hardware facilities, software resources, and human resources to provide teachers with sufficient resource support. Hardware facilities include high-performance computers and multimedia teaching equipment. Software resources include TPACK course libraries and teaching case libraries. Human resources include professional TPACK training teams and teaching experts. By integrating

these resources, the model provides comprehensive resource support for teachers, enhancing their TPACK competency. Practical opportunities are the test of developing teachers' TPACK competency. This model provides abundant practical opportunities to test and enhance teachers' TPACK competency. Practical opportunities include teaching competitions, teaching observations, and online teaching practices. Through these practical opportunities, teachers can apply the TPACK knowledge they have learned to actual teaching, testing and enhancing their TPACK competency. At the same time, through a practical feedback mechanism, teachers can promptly identify their shortcomings in TPACK competency and make targeted improvements.

5. Strategies for Enhancing University Teachers' TPACK Teaching Competency

Based on the results of the questionnaire survey and interviews, and in line with cultivating model constructed, university teachers should improve their competency in the following areas.

5.1. Strengthening Technical Training and Learning

In response to the shortcomings of some university teachers in technical application, technical training and learning should be strengthened. Schools and educational institutions can organize specialized training courses, seminars, and other activities, inviting experts to provide lectures and guidance to help teachers master emerging teaching technologies and

tools. At the same time, online learning platforms and MOOCs can be utilized to provide teachers with convenient and efficient resources for information-based teaching. Through systematic training and learning, teachers' technical application competency can be enhanced, laying a solid foundation for information-based teaching.

5.2. Updating Teaching Concepts and Methods

In response to the outdated teaching concepts of some university teachers, teaching concepts and methods should be updated. First, teachers should adopt a student-centered teaching philosophy, focusing on students' learning processes and needs, and emphasizing the cultivation of students' innovation and practical abilities. Second, teachers should actively explore and experiment with new teaching methods and models, such as project-based learning and flipped classrooms, to meet the demands of information-based teaching. At the same time, schools and educational institutions can organize teaching seminars and exchange activities to promote communication and collaboration among teachers, sharing teaching experiences and outcomes, and collectively enhancing teaching concepts and methods.

5.3. Enriching Information-Based Teaching Resources

In response to the lack of information-based teaching resources among some university teachers, information-based teaching resources should be enriched. Schools and educational institutions can increase investment to build and improve information-based teaching resource libraries and platforms, providing teachers with rich and high-quality information-based teaching resources. At the same time, teachers can be encouraged to independently develop and produce teaching resources, such as multimedia courseware and teaching videos, to enrich the teaching resource library. Additionally, collaboration and exchanges with other universities and institutions can be strengthened to share high-quality teaching resources, achieving complementary advantages and shared utilization of resources.

5.4. Optimizing Instructional Design and Implementation

Based on the Cultivating Model for University Teachers' TPACK Competency, teachers should optimize instructional design and implementation. First, teachers should clarify teaching objectives and content, develop reasonable teaching plans and schemes based on students' actual situations and learning needs. Second, teachers should flexibly use various teaching technologies and tools, such as multimedia courseware and online teaching platforms, for instructional design and implementation. At the same time, teachers should emphasize the interactivity and practicality of the teaching process, encouraging students to actively participate in

classroom discussions and practical activities, enhancing students' interest and engagement in learning. By optimizing instructional design and implementation, the quality and effectiveness of information-based teaching can be improved.

5.5. Strengthening Teaching Reflection and Evaluation

Teaching reflection and evaluation are essential components of enhancing teachers' information-based teaching competency. Teachers should regularly engage in teaching reflection, summarizing experiences and lessons from the teaching process, identifying problems and shortcomings, and developing improvement measures. At the same time, schools and educational institutions can establish information-based teaching evaluation mechanisms to assess and provide feedback on teachers' information-based teaching competency. Through evaluation and feedback, teachers can recognize their shortcomings and develop improvement plans, promoting the continuous enhancement of information-based teaching competency.

Therefore, for the development of university teachers' TPACK competency, it is necessary to address both external conditions and internal motivation, allowing internal and external factors to interact and form a virtuous cycle, jointly driving the continuous progress and development of university teachers' TPACK competency.

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