

Analysis of Factors Influencing TPACK Abilities of University Teachers in Hunan Province

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Abstract: This study employs a combination of questionnaire surveys and interviews to explore the current development status and influencing factors of Technological Pedagogical Content Knowledge (TPACK) capabilities among university teachers in Hunan Province. The survey results indicate significant differences in TPACK capabilities among teachers with diverse background characteristics in Hunan Province, with teaching experience, educational attainment, and institution type having notable impacts on TPACK, whereas gender shows no significant influence. Additionally, teachers' motivation, self-efficacy, and the frequency of their participation in technology and pedagogy training are significantly correlated with their TPACK levels. Interviews provide further insights into teachers' understanding and application of the TPACK framework, their training experiences and outcomes, as well as the challenges they encounter, such as rapid technological advancements, insufficient teaching resources, and varying levels of student acceptance. To enhance teachers' TPACK capabilities, it is necessary to address multiple levels, including individual, institutional, societal, and technological aspects, to provide comprehensive support and ensure effective integration of technology in education.

Keywords: University teachers, TPACK abilities, influencing factors.

1. Introduction

With the rapid development of information technology, the professional development paradigm of university teachers is undergoing profound changes. This transformation is not only reflected in the deepening of subject content and continuous innovation in teaching methods but also in the effective integration of modern information technology into teaching practices, achieving a deep fusion of technology, pedagogy, and subject content. In this context, the TPACK (Technological Pedagogical Content Knowledge) framework, proposed by American scholars Koehler and Mishra in 2005, has quickly gained widespread attention and in-depth research in both academic and practical fields worldwide as a key benchmark for assessing teachers' ability to integrate information technology into teaching.

The TPACK model encompasses technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), and the interactions among these three elements, providing theoretical support and practical guidance for improving teaching quality and efficiency. In both domestic and international educational contexts, this model has been widely applied to primary, secondary, and university teachers, becoming a crucial tool for advancing educational modernization. Numerous scholars have conducted extensive research on the core issues of TPACK, including its connotation, structure, development pathways, and influencing factors. For example, Zhou Jiawei and Wang Zuhao [1] conducted teaching reasoning based on the TPACK model, Wei Lan and Chen Shilin [2] explored the role positioning of university teachers in the era of artificial intelligence from a TPACK perspective, Chen Jing and Li Danli [3] conducted a case study on the development of TPACK among university English teachers using sociocultural theory, Li Yaying [4] analyzed the structure of TPACK capabilities and proposed targeted development strategies, Zhang Fengjuan et al. [5] conducted an in-depth case study on foreign language teachers' TPACK, and Guo

Jianfei [6] analyzed the subjective factors influencing university English teachers' TPACK abilities.

Although the aforementioned studies have broad representativeness nationwide, in-depth research on the TPACK abilities of university teachers in specific regions remains insufficient, particularly in terms of comprehensive and systematic analysis of influencing factors. Therefore, this study focuses on university teachers in Hunan Province, aiming to systematically reveal the current development status, characteristics, and influencing factors of their TPACK abilities through large-scale questionnaire surveys, in-depth interviews, and case studies. By adopting a regional and empirical research approach, this study aims to collect comprehensive empirical data to ensure the reliability and generalizability of the findings, thereby providing a scientific basis and practical guidance for enhancing the TPACK abilities of university teachers in Hunan Province and beyond, further promoting the deep integration of information technology and subject teaching, and advancing the professional development of university teachers.

2. Research Design

2.1. Theoretical Framework

The TPACK model serves as the core theoretical foundation of this study, playing a crucial role in understanding and enhancing the professional capabilities of university teachers. This model not only integrates teachers' knowledge in subject content (CK), pedagogy (PK), and technology (TK) but also emphasizes how these elements interact and influence each other, forming teachers' comprehensive abilities in complex educational environments. Specifically, the TPACK model includes three core elements: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK), as well as three composite elements: technological pedagogical knowledge (TPK), technological content knowledge (TCK), and pedagogical content knowledge (PCK) [7]. These elements collectively

constitute the core framework of teachers' TPACK abilities, enabling them to flexibly use technology to enhance teaching effectiveness and promote student learning and development.

In the context of higher education, the importance of TPACK abilities is particularly prominent. With the rapid development of information technology and the deepening of educational informatization, university teachers not only need to possess solid subject knowledge and teaching skills but also need to master advanced educational technology tools to meet the demands of modern education. Therefore, this study will explore the current development status, influencing factors, and enhancement strategies of TPACK abilities among university teachers in Hunan Province based on the TPACK model, providing valuable insights for promoting teachers' professional development and improving educational quality.

2.2. Research Objectives

This study aims to empirically investigate the current development status, key influencing factors, and effective enhancement strategies of TPACK abilities among university teachers in Hunan Province. Specifically, the research will first comprehensively reveal the overall level and distribution of TPACK abilities among university teachers in Hunan Province, then delve into the key factors influencing the enhancement of TPACK abilities, including personal characteristics (such as gender, teaching experience, educational background, and professional background), motivation and self-efficacy, educational technology training, and pedagogy training. To achieve these objectives, the study will focus on three core areas: first, designing a scientifically sound evaluation system based on the TPACK model to comprehensively assess the TPACK abilities of university teachers in Hunan Province; second, collecting data on personal characteristics, educational technology training opportunities, and the application of pedagogy through questionnaires and interviews, and analyzing the impact of these factors on TPACK abilities; third, based on the empirical findings, constructing a training model suitable for enhancing the TPACK abilities of university teachers in Hunan Province, providing strong support for their professional development.

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3. Research Methods and Data Collection

This study employs a combination of questionnaire surveys and interviews to comprehensively and deeply collect and analyze data. The questionnaire survey method is used to collect data on the TPACK abilities of university teachers in Hunan Province on a large scale, revealing the overall distribution characteristics and influencing factors. The interview method is used to gain in-depth insights into teachers' understanding and practical application of the TPACK framework, as well as the challenges they face and suggestions they offer in the process of developing information-based teaching abilities. These two methods complement each other, forming the data collection and analysis system of this study.

3.1. Questionnaire Design and Implementation

The questionnaire design follows the principles of scientific rigor and practicality, including sections on basic information, self-assessment of TPACK abilities, and investigation of influencing factors. The questionnaire items are designed to meet the needs of theoretical research while also considering the convenience of practical operations. To ensure the validity and response rate of the questionnaire, this study adopts various measures, such as providing detailed guidelines for filling out the questionnaire, setting time limits for completion, and distributing the questionnaire through multiple channels, including email, social media, and internal school notifications.

3.2. Interview Design and Implementation

The interview design is based on the results of data analysis, with the interview outline covering topics such as understanding and application of the TPACK framework, training experiences and outcomes, and challenges and suggestions. To ensure the diversity and comprehensiveness of the interview results, the study selects 20 representative teachers from different genders, teaching experiences, educational backgrounds, and institution types for in-depth interviews. The interview process adopts a combination of open-ended questions and follow-up questions, encouraging teachers to share their experiences and perspectives, and delving into the underlying reasons and motivations.

3.3. Data Collection and Preprocessing

After data collection, rigorous data cleaning and preprocessing are conducted. First, invalid questionnaires and abnormal data are removed to ensure the authenticity and reliability of the data. Second, missing values are either filled in or deleted to ensure data completeness. Finally, the questionnaire data are coded and standardized to facilitate subsequent data analysis. These data processing steps ensure the accuracy and reliability of the research data.

4. Questionnaire Data Analysis

After completing data collection and preliminary organization, this study successfully obtained 946 valid questionnaire responses, providing a solid foundation for in-depth exploration of the TPACK abilities of university teachers in Hunan Province.

4.1. Data Analysis

This study uses statistical software such as SPSS to conduct in-depth analysis of the questionnaire data. First, descriptive analysis is performed, including statistical measures such as minimum, maximum, mean, and standard deviation of university teachers' TPACK abilities under various influencing factors, preliminarily revealing the overall distribution characteristics of TPACK abilities among university teachers in Hunan Province and their differences under different influencing factors. Second, independent sample t-tests and one-way ANOVA are used to compare the impact of factors such as gender, teaching experience, educational background, and institution type on university teachers' TPACK abilities, further revealing the differences among these factors and their impact on the development of TPACK abilities. Finally, Pearson correlation coefficients and two-tailed significance tests are used to explore the correlations between influencing factors and TPACK abilities,

revealing the intrinsic relationships among these factors and their potential impact on the development of university teachers' TPACK abilities.

4.2. Results Discussion

In this study, TPACK abilities are divided into PK (pedagogical knowledge), CK (content knowledge), TK (technological knowledge), and their integrated abilities, such as PCK (pedagogical content knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and overall TPACK abilities. The results show that PK scores are the highest (4.05), followed by CK (4.03) and TK (3.98), while integrated abilities such as PCK, TCK, TPK, and overall TPACK abilities gradually decrease. Based on the data results, this section will discuss in detail the impact of personal characteristics (gender, teaching experience, educational background, institution type), motivation and self-efficacy, educational technology training, and pedagogy training on university teachers' TPACK abilities.

4.2.1. Personal Characteristics

This study uses independent sample t-tests to analyze the impact of gender on teachers' TPACK abilities based on feedback from 946 teachers. The results show no significant differences in PK, CK, TK, and integrated abilities (PCK, TCK, TPK, and overall TPACK abilities) between male and female teachers. This finding indicates that gender does not significantly influence the development of teachers' TPACK abilities, with male and female teachers demonstrating similar levels of knowledge mastery and application in these areas. Therefore, it can be reasonably inferred that, within the scope of this study, gender is not a significant factor influencing teachers' TPACK abilities.

Teaching experience significantly impacts TPACK ability scores, particularly in integrated abilities and overall TPACK abilities. The study covers a wide range of teaching experience from 2 to 30 years, finding that as teaching experience increases, teachers' scores in integrated abilities such as PCK, TCK, and TPK gradually improve. This indicates that with the accumulation of teaching experience, teachers can better integrate subject content, pedagogy, and technological knowledge, forming more effective TPACK abilities. At the same time, overall TPACK abilities also improve with increasing teaching experience, further demonstrating the important role of teaching experience in the development of TPACK abilities.

This study divides teachers' educational backgrounds into three levels: bachelor's, master's, and doctoral degrees. Educational background significantly impacts TPACK ability scores, particularly in integrated abilities. The study finds that teachers with higher educational backgrounds score significantly higher in integrated abilities such as PCK, TCK, and TPK compared to those with lower educational backgrounds. Although there are no significant differences in PK, CK, and TK among teachers with different educational backgrounds, teachers with higher educational backgrounds demonstrate stronger abilities and deeper understanding in integrating these knowledge areas to form TPACK abilities. This result suggests that higher educational attainment helps enhance teachers' TPACK abilities, particularly in integrating different knowledge areas into teaching practices.

This study divides institution types into public and private universities and explores their impact on TPACK ability scores. The results show significant differences in TPACK

ability scores based on institution type. Specifically, teachers in public universities score higher in PK (content knowledge), CK (pedagogical knowledge), TK (technological knowledge), and integrated abilities such as PCK (pedagogical content knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and overall TPACK abilities compared to teachers in private universities.

4.2.2. Motivation and Self-Efficacy

In the field of education, teachers' motivation and self-efficacy are crucial for their professional growth and ability enhancement, particularly influencing TPACK ability scores. This study explores this in depth. In terms of motivation, teachers with strong intrinsic motivation tend to actively explore and apply new technologies in teaching, thereby enhancing their TPACK abilities. They are curious about new technologies, willing to experiment and practice, and use these experiences to test and improve themselves. At the same time, extrinsic motivations such as school incentive policies and promotion opportunities also positively influence the development of teachers' TPACK abilities. When these incentives are closely related to teacher development, teachers are more motivated to enhance their TPACK abilities. Self-efficacy also plays an important role in the development of TPACK abilities. Teachers with high self-efficacy are more confident in their ability to integrate teaching and technology, more willing to try new methods and technologies, and believe they can successfully overcome challenges. The study finds that self-efficacy is positively correlated with TPACK ability scores, with teachers with high self-efficacy being more willing to face challenges, improve their abilities through practice, and accumulate more TPACK knowledge and skills.

4.2.3. Educational Technology Training and Pedagogy Training

This study explores the combined impact of educational technology training and pedagogy training on teachers' TPACK abilities. Regression analysis shows that the number of educational technology training sessions teachers attend each year is significantly positively correlated with their TPACK ability assessment scores ($\beta=0.25$, $p<0.01$), indicating that educational technology training effectively enhances teachers' TPACK abilities. At the same time, the number of pedagogy training sessions teachers attend is also positively correlated with their TPACK ability scores ($\beta=0.18$, $p<0.05$), although the impact is slightly weaker. Further analysis reveals that educational technology training and pedagogy training independently and significantly influence the enhancement of TPACK abilities, with no significant interaction effect ($p>0.05$). Therefore, both types of training have significant and independent impacts on enhancing teachers' TPACK abilities.

In summary, gender does not significantly influence university teachers' TPACK abilities; teaching experience is positively correlated with TPACK abilities, particularly in integrated abilities and overall TPACK abilities; teachers with higher educational backgrounds score higher in integrated abilities; and teachers in public universities generally score higher than those in private universities. Additionally, teachers with strong intrinsic motivation and high self-efficacy are more likely to actively explore and apply new technologies, thereby enhancing their TPACK abilities. In terms of training impact, the number of educational technology training sessions is significantly positively correlated with TPACK ability assessment scores, while the

number of pedagogy training sessions is also positively correlated with TPACK ability scores, although the impact is slightly weaker. These data provide empirical support for the impact of different background characteristics on teachers' professional development and emphasize the importance of institution type in promoting teachers' participation in educational technology training.

5. Interview Results Analysis

This section provides an in-depth analysis of interview feedback from 20 university teachers with diverse backgrounds, focusing on their understanding and application of the TPACK framework, training experiences and outcomes, and challenges and suggestions for improvement.

5.1. Understanding and Application of the TPACK Framework

The interviews reveal that most teachers have some understanding of the TPACK framework, but the depth of their understanding varies. Some teachers believe that the TPACK framework emphasizes the deep integration of technology, pedagogy, and subject content, serving as an important pathway for achieving information-based teaching. Others focus more on the application and effectiveness of technology in teaching, lacking a comprehensive and systematic understanding of the TPACK framework. In actual teaching, teachers generally attempt to integrate the TPACK framework into their classrooms, but the degree of integration and effectiveness vary. Some teachers can flexibly use technological tools and pedagogical strategies to effectively deliver subject content and enhance student learning abilities, while others struggle to fully implement the TPACK framework due to limitations in technology, resources, or teaching experience.

5.2. Training Experiences and Outcomes

Teachers generally agree that participating in pedagogy and educational technology training positively impacts their TPACK abilities. Through training, they not only acquire more teaching techniques and methods but also deepen their understanding of the TPACK framework. However, some teachers report that certain training content is disconnected from actual teaching needs, lacking relevance and practicality. For example, some teachers note that the training courses they attended were too theoretical, lacking practical exercises and case studies, making it difficult for them to apply the knowledge gained in actual teaching after the training. Additionally, some teachers suggest that training should focus more on practical exercises and case studies to improve relevance and effectiveness.

5.3. Challenges and Suggestions

The main challenges teachers face in developing information-based teaching abilities include rapid technological advancements, insufficient teaching resources, and varying levels of student acceptance. Rapid technological advancements require teachers to continuously learn new technologies and methods to maintain the relevance and effectiveness of their teaching. However, due to limitations in teaching resources, such as teaching equipment and software, some teachers struggle to obtain adequate technological support. Additionally, varying levels of student acceptance

pose a significant challenge. Different students have different levels of acceptance and interest in technology, making it difficult for teachers to meet all students' needs when implementing information-based teaching. To address these challenges, teachers suggest that universities should increase investment in information-based teaching, provide more teaching resources and technological support, and enhance teacher training to improve teachers' information-based teaching abilities and innovative awareness. Furthermore, teachers recommend establishing platforms for teacher collaboration and experience sharing to collectively promote the development of information-based teaching.

This study employs a variety of research methods, including literature review, questionnaire surveys, in-depth interviews, and data analysis, to conduct a thorough analysis of the factors influencing the TPACK abilities of university teachers in Hunan Province. The findings reveal that the TPACK abilities of university teachers in Hunan Province are influenced by multiple factors, which interact and collectively affect the development of teachers' TPACK abilities. Therefore, to enhance teachers' TPACK abilities, it is necessary to address multiple levels, including individual, institutional, societal, and technological aspects, to provide comprehensive support and ensure effective integration of technology in education. Only in this way can we promote the development of educational informatization in Hunan Province, improve educational quality, and cultivate more talents who can meet the demands of future society.

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