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**| RESEARCH ARTICLE**

# An Investigation into the Information-based Teaching Ability of English Teachers in Chinese Vocational Colleges from the Perspective of TPACK Theory

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**| ABSTRACT**

Grounded in the TPACK framework, this study examines the current state and influencing factors of information-based teaching ability among 176 English teachers from seven vocational colleges in Anhui Province through a questionnaire survey. Findings reveal that while teachers demonstrate strong content knowledge (CK) and pedagogical knowledge (PK), their instructional flexibility and exploration of diverse teaching styles remain limited. Although initial alignment between technological tools and instructional goals has been achieved, the deeper role of technology in reshaping teaching paradigms is underutilized. A lack of motivation for technological advancement is evident, with teachers having ≥16 years of experience lagging in technological knowledge (TK). Additionally, a significant gap exists in data-driven student learning analysis within pedagogical content knowledge (PCK). The weakest aspect is the reflective integration of TPACK, with a general trend of low-level homogeneity, indicating insufficient teacher collaboration and technology-sharing awareness. Notably, the enhancement of TPK significantly contributes to TPACK development, while self-efficacy emerges as a critical determinant. Based on these findings, the study proposes strategies to enhance information-based teaching ability, aiming to foster comprehensive improvement among vocational college English teachers.

**| KEYWORDS**

TPACK; Anhui higher vocational colleges; English teachers; Information-based Teaching Ability

**| ARTICLE INFORMATION**

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## 1. Introduction

The Technological Pedagogical and Content Knowledge (TPACK) framework systematically explains the multidimensional knowledge structure that teachers need to effectively teach in an information-based educational environment. Foreign language teachers are pioneers in the field of educational technology, as they were among the first to adopt modern educational tools such as multimedia classrooms[1]. Existing empirical research on TPACK mainly focuses on primary and secondary school teachers or those in general undergraduate institutions. However, due to the dual impact of regional industrial structures and the uneven distribution of educational resources, the teaching context of teachers in Chinese higher vocational colleges is unique and has not been fully incorporated into the analytical framework. It remains to be verified whether existing research findings are applicable to the development of vocational education teachers. Therefore, this study, viewed through the lens of the TPACK theory, aims to reveal the current performance, challenges, and potential development directions of English teachers in higher vocational colleges regarding technology-integrated teaching. The study also provides empirical evidence and strategic recommendations for improving the information technology competence of English teachers in Chinese vocational colleges.

## 2. Literature review

In 2005, American scholars Koehler and Mishra further developed and proposed the TPACK theoretical framework. This framework is built upon three core domains of knowledge: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). Through multidimensional interactions, it forms four integrated knowledge systems: pedagogical content knowledge (PCK), which serves as the foundation for instructional practice; technological content knowledge (TCK),

which represents the logical pathway of technology permeating subject matter; technological pedagogical knowledge (TPK), which reveals the synergy between technology and instructional strategies; and ultimately, technological pedagogical content knowledge (TPACK), which embodies the comprehensive integration of technology into subject instruction[2][3]. Subsequent iterations of the theory introduced the contextual element into the framework[4], effectively bridging the gap between theoretical assumptions and real-world teaching environments. TPACK theory particularly emphasizes the leading role of teachers in educational reform. Koehler and Mishra (2006) highlighted that teachers are the key participants in instructional design and implementation, and their ability to integrate technology, pedagogy, and subject content directly impacts teaching effectiveness and innovation. This perspective underscores the central role of teachers in the digital transformation of education. TPACK has thus become an essential knowledge framework for teachers to effectively integrate technology into classroom teaching[5], enhancing both their technological proficiency and instructional outcomes.

Since 2011, Chinese scholars have increasingly engaged in TPACK research, shifting from conceptual introduction to disciplinary integration. The research focus has gradually transitioned from theoretical discussions to empirical investigations. Two main research directions have developed in this field. The first focuses on Assessing TPACK Competence, where mixed-method approaches are commonly used, combining quantitative surveys with case studies to examine the current status of teachers' TPACK competencies and the factors influencing them[6][7]. These studies offer essential data to inform the development of future intervention strategies. The second direction is TPACK-Oriented Teacher Professional Development, which explores the content and pathways for professional development of teachers within the TPACK framework. Scholars have adopted longitudinal tracking and intervention experiments to reveal the staged transformation of teachers from "technology tool operators" to "technology-empowered educators." For instance, Wei Zhihui et al. (2021) conducted an eight-year longitudinal study on teaching contexts, exploring the evolution of teachers' TPACK from MOOCs and blended learning to fully integrated online-offline instruction[8]. Their findings provide an operational paradigm for designing tiered training programs and planning teachers' self-directed development pathways.

## 3. Survey on the Information-based Teaching Ability of English Teachers in Higher Vocational Colleges

### 3.1 Survey Participants and Methodology

This study surveys English teachers from seven higher vocational colleges in Anhui Province, a region that is leading in the development of higher vocational education in China[9]. The survey covers teachers of different genders, teaching experience, academic titles, and educational backgrounds. A total of 184 questionnaires were distributed, with 176 valid responses, yielding a response rate of 95.65%. The survey was conducted from March 15 to July 20, 2024, and data were analyzed using SPSS 26.0, including reliability and validity tests, descriptive statistics, and multiple regression analysis.

### 3.2 Questionnaire Design

3.2.1 Questionnaire Structure and Content:

Based on Schmidt's TPACK scale, the survey was revised to include both classical and custom items, forming a 35-item scale. The first part gathers basic demographic information such as gender, teaching experience, and education level. The second part measures TPACK competence using a 5-point Likert scale, evaluating the seven dimensions: CK, PK, TK, PCK, TCK, TPK, and TPACK. The third part investigates factors influencing TPACK, such as school policy and teacher self-efficacy.

3.2.2 Questionnaire Reliability and Validity:

The Cronbach's alpha for the second section of the questionnaire was 0.874, indicating good internal consistency. Exploratory factor analysis yielded a KMO value of 0.942, suggesting high construct validity.

### 3.3 Survey Questions

This study aims to answer the following questions:

(1) What is the current level of information-based teaching ability among English teachers in higher vocational colleges in Anhui?

(2) What factors influence the information-based teaching ability of these teachers?

### 3.4 Analysis of Survey Results

#### 3.4.1 Overall Analysis of Information-Based Teaching Ability of English Teachers in Anhui Higher Vocational Colleges

The mean scores for the seven TPACK dimensions of English teachers in Anhui vocational colleges are as follows: CK > PK > PCK > TCK > TPK > TK > TPACK. The mean scores for all dimensions range from 3.6 to 4.4, indicating that the overall TPACK level and each dimension are at an intermediate level. Teachers performed well in CK and PCK, with CK having the highest mean score, indicating solid expertise in subject knowledge. However, TPACK, as a composite dimension, scored the lowest.

**Table 1. Descriptive Statistics of Information-Based Teaching Ability of English Teachers**

| Measurement Indicator | N | Mean | Standard Deviation |
|---|---|---|---|
| TK | 176 | 3.80 | 0.69 |
| CK | 176 | 4.42 | 0.33 |
| PK | 176 | 4.37 | 0.46 |
| PCK | 176 | 4.27 | 0.55 |
| TPK | 176 | 3.87 | 0.62 |
| TCK | 176 | 3.98 | 0.67 |
| TPACK | 176 | 3.69 | 0.60 |

#### 3.4.2 Analysis of Information-Based Teaching Ability by Demographic Variables

The results of demographic variable analysis reveal significant differences in some dimensions based on gender, educational background, academic title, and teaching experience. For example, male teachers performed significantly better than female teachers in the dimensions of TK, PCK, TPK, TCK, and TPACK ($p < 0.05$), while no significant gender differences were found in CK and PK. Teachers with higher educational levels generally scored higher across all TPACK dimensions. Additionally, teachers with higher academic titles showed better performance in CK and PK ($p < 0.05$), while no significant differences were found in other dimensions. Teaching experience mainly affected TK, CK, and TCK, with teachers who had less teaching experience performing better in technology integration, while teachers with 16 or more years of experience tended to lag behind in the use of technological tools.

**Table 2. Descriptive Statistics of Demographic Variables of English Teachers' Information-Based Teaching Ability**

| Survey Content | Sample | TK | | CK | | PK | | TPK | | TCK | | PCK | | TPACK | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | P | Mean | P | Mean | P | Mean | P | Mean | P | Mean | P | Mean | P |
| Gender | | | | | | | | | | | | | | | |
| Male | 41 | 4.28 | .000 | 4.19 | .182 | 3.96 | .246 | 4.07 | .000 | 4.31 | .000 | 4.17 | .000 | 3.92 | .000 |
| Female | 135 | 3.88 | | 4.25 | | 4.07 | | 3.76 | | 3.92 | | 4.09 | | 3.71 | |
| Education Level | | | | | | | | | | | | | | | |
| Doctoral degree | 3 | 4.04 | | 4.36 | | 4.30 | | 4.34 | | 4.04 | | 4.03 | | 4.30 | |
| Master's Degree | 169 | 3.86 | .292 | 4.30 | .459 | 4.26 | .642 | 4.10 | .448 | 3.92 | .435 | 4.01 | .248 | 4.20 | .372 |
| Bachelor's Degree | 4 | 3.69 | | 4.24 | | 4.17 | | 3.90 | | 3.80 | | 3.98 | | 3.84 | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Academic Title | | | | | | | | | | | | | |
| Professor | 6 | 3.88 | | 4.32 | | 4.10 | | 3.80 | | 3.84 | | 4.29 | | 3.84 | |
| Associate Prof. | 32 | 3.90 | .542 | 4.29 | .040 | 3.98 | .030 | 3.92 | .526 | 3.87 | .582 | 4.20 | .379 | 3.79 | .256 |
| Lecturer | 112 | 4.13 | | 4.15 | | 3.76 | | 3.98 | | 3.79 | | 4.16 | | 3.85 | |
| Teaching Assistant | 26 | 3.79 | | 3.89 | | 3.74 | | 3.58 | | 3.91 | | 3.93 | | 3.66 | |
| Teaching Experience | | | | | | | | | | | | | | | |
| Less than 5 years | 29 | 4.36 | | 3.94 | | 4.21 | | 3.91 | | 4.29 | | 4.09 | | 4.28 | |
| 6–10 years | 122 | 3.82 | .003 | 4.35 | .006 | 4.28 | .285 | 3.78 | .393 | 3.97 | .001 | 4.15 | .098 | 3.68 | .286 |
| 11-15years | 16 | 3.98 | | 4.35 | | 4.34 | | 4.00 | | 4.13 | | 4.01 | | 3.71 | |
| 16 years and above | 9 | 3.72 | | 4.40 | | 4.38 | | 3.77 | | 3.58 | | 4.15 | | 3.58 | |

### 3.4.3 Analysis of Information-Based Teaching Ability by TPACK Dimensions

3.4.3.1 TK Dimension Analysis:

The overall level of Technological Knowledge (TK) is moderately low (M=3.80), ranking second lowest among the seven dimensions of TPACK. Basic technical skills (TK1) scored the highest (M=4.12), indicating the effective promotion of basic technical skills by educational informatization policies. However, the highest standard deviation (SD=1.345) in the technology learning ability dimension (TK2) reflects significant variation in teachers' willingness to engage in technology learning. Additionally, 24.4% of teachers reported difficulties in adapting to new technologies, as shown by the lowest score in the ability to use the latest technology (TK5) with a mean of 3.14.

3.4.3.2 CK Dimension Analysis:

Teachers performed strongly in the Content Knowledge (CK) dimension, particularly in English language knowledge (CK1), language skills (CK2), and cultural knowledge (CK3). However, the ability to think in English (CK4) was a weakness, with a mean of 3.69, indicating that only 15.3% of teachers were able to make the switch to English thinking.

3.4.3.3 PK Dimension Analysis:

In the Pedagogical Knowledge (PK) dimension, teachers showed proficiency, especially in classroom organization (PK5), diverse teaching strategies (PK1), and adjusting teaching pace (PK2), with high mean scores indicating solid pedagogical strategies. However, the ability to adapt teaching styles (PK4) scored the lowest (M=3.61), with 74% of teachers only agreeing to a moderate extent.

3.4.3.4 PCK Dimension Analysis:

In Pedagogical Content Knowledge (PCK), teachers performed well in areas such as selecting teaching methods (PCK1), applying diverse teaching methods (PCK2), and identifying teaching priorities (PCK3), with high mean scores. However, teachers showed a significant lack of ability to anticipate student misunderstandings in specific topics (PCK5, M=3.46), indicating an area for improvement in diagnostic skills for student learning.

3.4.3.5 TPK Dimension Analysis

In the Technological Pedagogical Knowledge (TPK) dimension, teachers performed relatively well in terms of aligning teaching methods with technology (TPK1, M=4.14) and dynamically adjusting technology use (TPK4, M=4.00). These high scores suggest that teachers are beginning to master the integration of technological tools with teaching strategies. However, the ability to reflect on the role of technology in reshaping pedagogy (TPK3, M=3.95) was only moderate, with 45.8% of teachers acknowledging this capacity. The lowest score was found in the critical reflection on technology (TPK5, M=3.20), with no teachers selecting "strongly agree," indicating that teachers are not yet actively reflecting on the deep impact of technology on teaching outcomes. The low standard deviation (SD=0.911) reveals a high level of convergence in the group, suggesting that most teachers have similar, lower-level reflection capabilities.

3.4.3.6 TCK Dimension Analysis

In the Technological Content Knowledge (TCK) dimension, teachers demonstrated solid performance in utilizing technology to present foreign language content (TCK2, M=4.21) and optimize language knowledge visualization (TCK1, M=4.17). However, they faced challenges in integrating technology with cultural content (TCK4, M=3.98), with 15% of teachers selecting "disagree" or "strongly disagree," indicating a gap in the application of technology to create a real-world language environment or cultural context. Furthermore, the ability to use technology to obtain the latest subject-related materials and teaching content (TCK5) scored the lowest (M=3.39), with only 59.9% of teachers agreeing or strongly agreeing, suggesting that teachers lack awareness and skills to use technology for keeping up with the latest developments in their field.

3.4.3.7 TPACK Dimension Analysis

The overall score for TPACK was the lowest among all seven dimensions. The highest score within this dimension was found in the ability to choose appropriate technology based on subject content and teaching methods (TPACK1, M=3.94). This suggests that teachers have a basic ability to select suitable technological tools for their subject content and teaching methods. This was further supported by TPACK3, which measures the integration of technology, subject content, and teaching methods in the classroom (M=3.83). However, the lowest score was in collaborative problem-solving (TPACK4, M=3.66), indicating that teachers have not yet developed effective mechanisms for knowledge sharing. The lowest reflection ability in integrating technology, content, and pedagogy (TPACK5, M=3.07), with no teachers selecting "strongly agree," shows a lack of systematic reflective capacity regarding the integration of technology, content, and pedagogy. This reflects a critical area for development.

## 4. Factors Influencing the Information-based Teaching Ability of English Teachers in Anhui Higher Vocational Colleges

### 4.1 Direct Impact of TPACK Knowledge Structure

Stepwise regression analysis was used to explore the impact of each dimension of TPACK on the overall TPACK level, with CK, PK, TK, PCK, TPK, and TCK as independent variables. As shown in Table 4, the analysis identifies the predictive variables for TPACK, ranked by their contribution: Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). The regression model is significant ($p < 0.001$), with the combination of independent variables explaining 76.9% of the total variance in TPACK, indicating a strong explanatory power.

The results indicate that TPK has the most significant positive predictive effect on TPACK (B=0.561), which aligns with Lu Xia's studies[10], suggesting that improving TPK significantly enhances the development of TPACK in English teachers at vocational colleges. Furthermore, CK has a negative predictive effect on TPACK, which is consistent with findings from Absari and Xiong[11][12], indicating that some teachers, due to their solid subject knowledge, may resist trying new, technology-supported teaching models, preferring traditional methods instead.

**Table 3. Analysis of the Impact of TPACK Dimensions on TPACK Level**

| Model | Unstandardized Coefficient | | Standardized coefficient | T | P | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|
| | B | Standard Error | Beta | | | Tolerances | VIF |
| Constant | .170 | .073 | | | .160 | | |
| TK | .117 | .047 | .127 | 2.341 | .006 | .317 | 2.713 |
| CK | -.40 | .030 | -.092 | 2.317 | .022 | .413 | 2.319 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PK | .059 | .046 | .043 | 1.176 | .379 | .231 | 4.715 |
| TCK | .172 | .058 | .165 | 3.691 | .001 | .219 | 4.163 |
| TPK | .561 | .063 | .573 | 9.738 | .000 | .216 | 4.911 |
| PCK | .125 | .064 | .124 | 1.793 | .071 | .163 | 6.103 |

a.Implicit Variable：TPACK

### 4.2 Indirect Moderating Effect of Internal and External Contextual Factors

Multiple linear regression analysis was conducted to examine the predictive efficacy of internal and external factors on English teachers' TPACK level. As shown in Table 5, self-efficacy had the most significant impact on TPACK, indicating that teachers' confidence in their ability to integrate technology positively influences TPACK. While school policy and teacher attitudes also had a positive effect, their impact was smaller. This can be attributed to the fact that school policies, as macro-guidelines, are not tailored to the individual needs of teachers, and are thus less responsive to the diverse needs of teachers across different disciplines and teaching experience levels. Teachers' attitudes toward TPACK, while positive, face practical barriers that hinder their application, such as unmet teaching expectations or a lack of support for technology integration.

**Table 4. Predictive Efficacy of Contextual Factors on English Teachers' TPACK Level**

| Model | Unstandardized Coefficient | | Standardized Coefficient | T | P | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|
| | B | Standard Error | Beta | | | Tolerances | VIF |
| Constant | 1.721 | 0.027 | | 13.724 | 0.000 | | |
| Teacher Attitude towards information-based teaching ability | 0.031 | 0.017 | 0.052 | 2.164 | 0.023 | 0.510 | 1.873 |
| Teacher Self-Efficacy | 0.272 | 0.017 | 0.752 | 13.982 | 0.000 | 0.475 | 1.923 |
| Teacher Participation in Training | 0.141 | 0.017 | 0.535 | 9.531 | 0.000 | 0.451 | 1.511 |
| School Policy and Environment | 0.119 | 0.073 | 0.219 | 9.126 | 0.000 | 0.634 | 1.932 |

## 5. Research Conclusions and Pathways for Improvement

### 5.1 Research Conclusions

In summary, the TPACK level of English teachers in Anhui's higher vocational colleges exhibits a "solid foundation but weak integration" characteristic. Teachers demonstrate strong expertise in subject content (CK) and pedagogical knowledge (PK), with a solid knowledge base and teaching methodology framework. However, they lack exploration in the diversity and flexibility of teaching styles. While there is some alignment between technology tools and teaching objectives, the deeper role of technology in reshaping teaching paradigms has not been fully realized. Additionally, teachers, particularly those with 16 or more years of teaching experience, face challenges in adopting new technologies. The lack of reflection on the integration of technology, content, and pedagogy is a critical area for development. TPK, the enhancement of which has a significant positive effect on TPACK development, along with self-efficacy, emerges as a key influencing factor.

### 5.2 Pathways for Improving the Information-Based Teaching Ability of English Teachers in Higher Vocational Colleges

#### 5.2.1 Strengthening TPACK Development Effectively

Research findings indicate that TPK exerts the most significant impact on the development of TPACK, underscoring the pivotal role of strengthening TPK competence in improving vocational college English teachers' TPACK levels. TPK requires teachers to integrate technological knowledge (TK) with pedagogical knowledge (PK) based on instructional objectives and learner characteristics, optimizing technological tools and aligning them with students' interests and preferences to enhance technological adaptability.

These findings offer important implications for vocational college English teachers. First, teachers should develop a deep understanding of learner characteristics and leverage data-driven learning analytics (TK) to accurately assess students' learning status and needs (PK). This enables them to adjust the adaptability of technological applications (TK) and ensure that technology effectively meets student needs (PK). Second, at the curriculum design level, teachers should map technological tools to language skill training objectives from multiple dimensions, guided by subject-specific pedagogical theories (PK). By collecting and analyzing teaching data (TK), teachers can refine the timing and intensity of technology integration to achieve synergy between technology and pedagogy (PK).

Moreover, teachers should actively involve students in the selection and evaluation of technological tools (TPK) to enhance the adaptability of digital resources and improve students' digital literacy (TK). Throughout this process, teachers must cultivate a critical awareness, balancing the use of technology to enhance classroom interaction while remaining vigilant against potential cognitive overload caused by excessive technological intervention.

#### 5.2.2 Enhancing Teachers' Self-Efficacy

Findings from this study reveal that self-efficacy is a core factor influencing teachers' TPACK levels, serving as a significant predictor of the effectiveness of classroom technology integration. It plays a crucial role in advancing digitalized teaching proficiency[13]. First, teachers need to cultivate intrinsic motivation for learning by independently acquiring and applying digital educational resources, thereby stimulating enthusiasm for technology integration and instructional innovation. Second, they should proactively incorporate technology integration strategies into various teaching components, such as language skill development and cultural awareness cultivation, to foster the coordinated development of TPACK theoretical knowledge and practical competence. Finally, teachers should establish clear and challenging professional development goals and action plans. Through continuous learning and reflective practice, they can develop a virtuous cycle of "practice-reflection-improvement," ultimately enhancing their TPACK self-efficacy.

#### 5.2.3 Optimizing the Teacher Training System

The development of teachers' TPACK is a long-term, practice-driven, and dynamic process[14]. It requires a systematic reconstruction of the training framework across four key dimensions: design, content, implementation, and evaluation. This approach ensures the delivery of high-value, practical insights into technology integration.

Training design should be guided by the TPACK framework, emphasizing the organic integration of content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). A "learning by design" approach can be employed to encourage teachers to integrate technology, pedagogy, and subject knowledge within authentic instructional design cases, thereby deepening their understanding of these interconnections and enhancing their application skills. Training content must maintain a balanced adaptation between technology and pedagogy. It should be tailored to the characteristics of participating teachers to ensure an optimal configuration of technological and pedagogical components. For instance, for experienced teachers, foundational technology training may be minimized, while TCK and TPK can be reinforced through MOOCs and other advanced learning methods. Training implementation should be instruction-oriented, ensuring that technology selection and application align closely with teaching needs. Training should introduce user-friendly and pedagogically valuable technological tools, supplemented with teaching case analyses to help teachers understand how to effectively integrate technology into their actual classroom practices. A combination of expert lectures, case observations, and shared learning spaces can provide a solid foundation for mastering TK. Training evaluation should adopt a teaching-oriented outcome assessment approach with a structured post-training follow-up mechanism. Practice-based evaluation methods, such as micro-lesson design, can be used to comprehensively assess teachers' technological proficiency and instructional application effectiveness, ensuring the practical value of training outcomes.

## 6. Study Limitations and Future Research

This study has certain limitations that should be acknowledged. Firstly, the sample is regionally concentrated, which may limit the generalizability of the findings to broader contexts. Secondly, the institutions involved in the study are relatively homogeneous in terms of their characteristics, potentially restricting the applicability of the results to diverse educational settings. Lastly, the study relies primarily on quantitative survey methods, which, while valuable for capturing trends and correlations, may not fully capture the nuances of participants' experiences and perspectives.

To address these limitations, future research should expand the scope of the study by including a more diverse sample from different regions and institutions. This would enhance the generalizability of the findings and provide a more comprehensive understanding of the topic. Additionally, incorporating qualitative methods, such as classroom observations and interviews, could offer deeper insights into the dynamic process of technology integration, complementing the quantitative findings with rich, contextualized data. Exploring longitudinal approaches could further reveal how technology integration evolves over time, providing valuable implications for educators and policymakers.

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