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# Technological Pedagogical and Content Knowledge: Tai Chi teachers in higher education

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# Abstract

The aim of the study was to examine the TPACK levels of Tai Chi teachers in higher education. 218 Tai Chi teachers in higher education institutions in Henan Province, China voluntarily responded to an online questionnaire. SPSS 24.0 software was used for data analysis. The findings showed significant differences in Tai Chi teachers' TPACK levels and its components based on the different demographic variables. The implication of this study is for policymakers to draw up relevant policies that can enhance the weaker areas of TPACK components among Tai Chi teachers.

Keywords: TPACK levels; TPACK sub-component; Tai Chi Teachers; Higher Education

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# **1.0 Introduction**

Tai Chi, which helps maintain physical and psychological well-being, is embodied in conventional Chinese philosophical thinking. As a result, there has been a significant increase in the number of professionals engaged in Tai Chi, and this is also seen in the increased number of courses on Tai Chi offered at university levels. However, due to the varying levels of expertise among Tai Chi practitioners, it is necessary to research their teaching approaches to enhance the teaching and learning of Tai Chi.

In May 2014, the "iCourse" website collaborated with NetEase Cloud Classroom to launch the "Chinese Universities MOOC" platform, which allowed domestic universities to develop and implement MOOCs on this platform. In 2015, the Ministry of Education issued the "Opinions on Strengthening the Construction, Application, and Management of Online Open Courses in Higher Education Institutions," proposing the development of a distinctive Chinese online open course system (Wu, 2015). Various disciplines have immediately developed the Internet+ high-quality course model, and up to now, the application of digital technology in teaching across disciplines has become relatively mature (Lin et al., 2022). As Yi and Yang (2020) highlighted, high-quality MOOCs for Tai Chi courses have been recorded, and the response has been quite positive.

However, whether it is in the context of Internet+ or conventional classroom settings, Tai Chi teaching lacks a fundamental instructional framework to guide its practice. Additionally, the significance of Tai Chi has not been adequately reflected in the improvement and maintenance of Tai Chi instructor qualifications. It is within this context that the problem statement was addressed in this research.

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## 2.0 Literature Review

### 2.1 Technological pedagogical and content knowledge

The Technological Pedagogical Content Knowledge (TPACK) framework was initially created by Mishra and Koehler (2006), partly due to the lack of a structured framework for analyzing and studying teacher knowledge. It was originally conceptualized based on the Pedagogical Content Knowledge (PCK) framework in education domains and later integrated the technological dimension to form the TPCK or TPACK framework, aiming to address the issue of increased technology use in modern classrooms. The TPACK framework is used to analyze teacher knowledge based on three primary factors: technological knowledge, pedagogical knowledge, and content knowledge, providing a holistic view of what teachers know or do not know (Koehler & Mishra, 2009).

The basic concept of TPACK is that "all knowledge is interconnected within a context, and the synergistic intersection of the three types of knowledge (technological, pedagogical, and content) defines teachers' knowledge" (Mishra & Koehler, 2008, p. 16). Figure 1 illustrates the three types of knowledge in TPACK and their collaborative intersections.



Figure1. Technological Pedagogical, and Content Knowledge (TPACK)

Technological, pedagogical, and content knowledge are essential in TPACK. The collaborative intersections of technological, pedagogical, and content knowledge respectively form the pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK), which are also crucial for the effective implementation of TPACK in the classroom.

In TPACK, the elements of content, pedagogy, and technology are not hierarchical; rather, they must coexist and be effectively utilized to facilitate effective teaching. However, the possession of these three elements and their collaborative intersections can vary among teachers due to their diverse learning experiences, and thus, this study also examined the Tai Chi teachers' possession of the three elements and their collaborative intersections.

#### 2.2 Tai Chi teachers in higher education

In China, there has been relatively limited research on university-level Tai Chi teachers. The existing research mainly focuses on the teaching practices of university Tai Chi teachers, such as the application of multimedia in Tai Chi instruction, the employment of the " audiovisual method" in Tai Chi teaching, the use of mobile video recording in Tai Chi instruction, video feedback, the integration of "Internet+" in Tai Chi teaching and classroom settings, as well as the utilization of smart devices, among others.

Research on the use of multimedia in Tai Chi instruction primarily emerged during the initial application of the Internet in physical education teaching. The earliest studies in China that utilized multimedia technology for teaching Tai Chi can be traced back to 2003. Researchers conducted instructional experiments using multimedia and found that it enhances and stimulates students' interests in learning, teaching quality, students' self-learning abilities, and awareness of lifelong physical education. These studies also provided theoretical and practical implications for standardizing, advancing, and modernizing Tai Chi instruction (Jiang, 2003; Xiao & Tian, 2004).

With regards to the research on the "audiovisual method" in Tai Chi instruction, most studies of Tai Chi teaching were based on instructional experiments. Studies found that by viewing demonstrations on movement, the "audiovisual method not only allows students to correct their movements but also facilitates their understanding of technical key points (Li, 2020). Dai and Shen (2021) highlighted

that this method aids in enhancing understanding and mastering technical movements, facilitates physical and mental relaxation, and helps in controlling breathing rhythms. It also helps students overcome fatigue, boredom, and psychological fear while building confidence. In the same vein, Zhang and Li (2020) maintained it helped students relax, alleviate exercise fatigue, prolong exercise duration, and enhance physical endurance. In addition, it attributes to improving the effectiveness of Tai Chi teaching in classrooms.

Research on the "Internet Plus" approach and its integration into Tai Chi instruction have primarily focused on micro-lessons, flipped classrooms, and the incorporation of "Internet Plus" in conventional classrooms. A comparative analysis by Liu (2016) revealed that the MOOC flipped classroom teaching model is suitable for optional martial arts courses in universities, and it can improve students' athletic skills while stimulating their initiative and creativity in learning. As Zhang (2020) stressed, microlesson is a novel form of curriculum that effectively addresses the limitations of conventional Tai Chi instruction, meeting the needs of both teachers and students.

Research on the application of smart devices, such as smart bands and smart sportswear, examined different Tai Chi teaching effectiveness in smart device classrooms and conventional classrooms. Studies have shown that the use of smart devices enhances students' enthusiasm for learning (Zhang & Zhang, 2022), deepen their understanding and memory of the details of Tai Chi movements, and provides a favorable experiential context (Guo & Chen, 2022). In addition, smart devices have been found to accelerate students' learning progress and improve Tai Chi learning outcomes (Li et al., 2022; Pinkl & Cohen, 2022). Zhu et al. (2022) assert that virtual reality in teaching can also reduce errors in movement postures.

### 2.3 Problem statement

The literature shows that there are numerous resources and studies emphasizing the benefits of Tai Chi (Liu, 2010; Yan, 2010). Numerous books teach various forms and techniques of Tai Chi to the public (Hong, 2008), and limited research focused on the teaching of Tai Chi within an instructional framework (Cong & Jin, 2021). However, most of these published books and papers serve as guides on how to practice Tai Chi accurately and explain its concepts. In today's Tai Chi teaching, which is highly influenced by digital technology, there is limited research that analyzed the actual teaching methods of Tai Chi, how Tai Chi teachers teach their students, and the competencies that Tai Chi teachers should possess in the teaching process. As noted by Oh et al. (2018), unlike other physical education courses, there is a lack of established teaching frameworks, particularly a TPACK for Tai Chi instruction in higher education. There appears to be that though scholars have begun researching technology in Tai Chi instruction, there has been no utilization of the TPACK framework for Tai Chi instruction at the tertiary level.

#### 2.4 Aim of study

The aim of this study is to examine the levels of TPACK among Tai Chi teachers in higher education and subsequently enhance their teaching abilities.

#### 2.5 Research questions

The research questions addressed in this paper are:

(i) What are the levels of each component of TPACK?

(ii) Are there significant differences in Tai Chi teachers' TPACK levels based on the different demographic variables (gender, teaching experience, academic specialization, and professional recognition)?

#### 2.6 Research objectives

There are two major objectives:

(i) To determine the levels of Tai Chi teachers' TPACK components.

(ii) To examine if there are significant differences in Tai Chi teachers' TPACK levels based on the different demographic variables (gender, teaching experience, academic specialization, and professional recognition).

#### 2.7 Significance of the study

With the advancement of technology, various disciplines have extensively incorporated teaching technologies, including in the field of education. Therefore, the findings of this research will contribute to revealing the integration of Technological Pedagogical Content Knowledge (TPACK) among higher education Tai Chi teachers. This study aims to explore the TPACK level of higher education Tai Chi teachers and ultimately enhance their teaching capabilities.

#### 3.0 Methodology

This study employed a survey research design and utilized an adapted version of the TPACK-21 questionnaire developed by Teemu Valtonen et al. in 2017. The survey was conducted among 227 Tai Chi teachers from 56 higher education institutions in Henan Province. The collected data were analyzed using statistical tests such as mean, standard deviation, independent samples t-test, and one-way analysis of variance (ANOVA) using SPSS 24.0 software.

#### 4.0 Findings

The findings of this study are presented in answer to the research questions.

#### 4.1 Levels of TPACK components among Tai Chi teachers Table 1 presents the TPACK levels of Tai Chi teachers. The overall mean TPACK level is 3.52(SD=0.918).

Table 1. Descriptive statistics of TPACK components among Tai Chi teachers								
Item	PK	ΤK	CK	PCK	TPK	TCK	TPACK	
Mean	3.67	3.55	3.38	3.54	3.46	3.52	3.52	
Std. Deviation	1.097	.889	1.143	1.039	.917	.918	.918	

As seen in the table, the mean scores for each knowledge component range from the lowest mean score of 3.38 (CK) to the highest mean score of 3.67 (PK), with a standard deviating average of 1.0 for all components.

4.2 Independent samples t-test for TPACK levels among Tai Chi teachers of different genders Table 2 shows the TPACK level among Tai Chi teachers by gender.

Table 2. Descriptive statistics of TPACK level by gender									
	Gender	Ν	Mean	Std. Deviation	t	Sig.			
TPACK	Male	152	3.66	.920	3.254	0.001			
	Female	75	3.25	.861					

The mean TPACK levels for male teachers is M=3.66 (SD=0.920), compared to female teachers (M= 3.25; SD=0.861). The independent samples t-test result reveals a significant difference (t=3.254, p=0.001) between the male and female TPACK levels.

# 4.3 One-Way ANOVA of TPACK levels among Tai Chi teachers with different teaching experience

As seen in Table 3, the teachers' years of experience varied, with a majority (93) of the teachers with less than 5 years of experience. The number of teachers with 6-10 years and more than 20 years of experience approximates, i.e., 43-44 teachers, and similarly for teachers with less than 25 years and 16-20 years' experience, i.e., 23-24 teachers.

Table 3. Results of the analysis of differences in TPACK levels based on teaching experience.

					<u> </u>
Ν	Mean	Std. Deviation	F	Sig.	Multiple Comparison
93	2.72	.473			
44	4.07	.580			1<2, 1<3,1<4,
24	4.49	.559	102 481	.000	1<5 2<3 2<4
23	4.63	.553			2 > 5 3 > 5 4 > 5
43	3.56	.654			2 0, 3 2 0, 4 2 0
	N 93 44 24 23 43	N Mean   93 2.72   44 4.07   24 4.49   23 4.63   43 3.56	N Mean Std. Deviation   93 2.72 .473   44 4.07 .580   24 4.49 .559   23 4.63 .553   43 3.56 .654	N Mean Std. Deviation F   93 2.72 .473 .473   44 4.07 .580 .559 102.481   23 4.63 .553 .553 .433 3.56 .654	N Mean Std. Deviation F Sig.   93 2.72 .473 .44 4.07 .580   24 4.49 .559 102.481 .000   23 4.63 .553 .533   43 3.56 .654 .654

Teachers with 16-20 teaching years of experience recorded the highest TPACK levels (M = 4.63, SD = 0.553), followed by teachers with teaching experience of 11-15 years (M = 4.49, SD = 0.559) and 6-10 years (M = 4.07, SD = 0.580). Teachers with more than 20 years (M = 3.56, SD = 0.654) and less than 5 years (M = 2.72, SD = 0.473) of teaching experience recorded lower mean scores. It is interesting that teachers with less than 5 years of teaching experience fell in the lowest TPACK levels.

As seen in the table, significant differences in TPACK levels among Tai Chi teachers with different teaching experiences, i.e. (F= 102.481, p = 0.000).

## 4.4 Analysis of variance of TPACK level among Tai Chi teachers with different academic specializations

As seen in Table 4, the largest proportion of Tai Chi teachers is 132 teachers with a martial arts major, followed by 82 teachers with sports major but non-martial arts major and only 13 non-sports major teachers. It is not surprising that Tai Chi teachers specializing in Martial Arts recorded the highest TPACK level (M=3.72, SD=0.893), followed by those specializing in Physical Education but not in Martial Arts (M=3.30, SD=0.863), and the lowest level is observed among Tai Chi teachers with non-Physical Education specializations (M=2.92, SD=0.976).

#### Table 4. Analysis of variance of TPACK level among different academic specializations

	Option	Ν	Mean	Std. Deviation	F	Sig.	Multiple Comparison
	Martial arts major	132	3.72	.893			
TPACK	Sports majors but non-martial arts Majors	82	3.30	.863	9.038	.000	1>2, 1>3
	Non-sports majors	13	2.92	.976			

We can see in Table 4 that there is a significant difference in TPACK level among Tai Chi teachers with different academic specializations (F = 9.038, p = 0.000).

4.5 TPACK level among Tai Chi teachers with Different Professional Recognitions

The number of teachers with different professional recognition, which refers to the services provided at different levels, i.e. at the university, province, or national levels varied considerably. The largest proportion of *Tai Chi* teachers services at the university level, i.e. 194 teachers, followed by service at the province (19) and only 4 teachers at the national level.

Table 5. Analysis of TPACK level among different professional recognitions								
	Option	Ν	Mean	Std. Deviation	F	Sig.	Multiple Comparison	
TPACK	At university	194	3.46	.909	4.306	.015	1<2	
	At province level	29	3.98	.876				
	At national level	4	3.38	.924				
		4 1 44 1		1 44 1 1	0	A / 11 / 11		

Note: In the table, 1 represents At university, 2 represents At province level, 3 represents At the national level

We can see in the table 5, that Tai Chi teachers with professional recognition at the province level recorded the highest TPACK level (M=3.98, SD=0.876), followed by Tai Chi teachers serving at the universities (M=3.46, SD=0.909), and the lowest level is among Tai Chi teachers at the National Team (M=3.38, SD=0.924). Significant differences in TPACK levels is found among the Tai Chi teachers with different professional recognitions (F= 4.306, p = 0.015).

# 5.0 Discussion

According to interpretations provided by Nummally (1978) and Chaos et al. (2016), mean score levels can be categorized into five ranges: i) very low (1.00-1.80); ii) low (1.81-2.60); iii) moderate (2.61-3.40); iv) high (3.41-4.20); v) 4.21-5.00. It is evident that Tai Chi teachers have relatively high levels of PK, TK, PCK, TPK, TCK, and TPACK, indicating that they possess a good command of these knowledge components (Atakan, 2019), except for CK level, which is within the moderate range. This suggests that university Tai Chi teachers are generally able to flexibly apply the TPACK framework in their teaching practices.

A further examination of the *Tai Chi* teachers' TPACK levels showed that significant differences existed between male and female Tai Chi teachers, with males recording higher TPACK levels than females. This could be probable as females' mastery and integration of TPACK into *Tai Chi* teaching is not as competent as males' (Fapohunda, 2023). In addition, female teachers may face challenges integrating technology into their teaching practices, leading to relatively lower TPACK levels than their male counterparts. Therefore, in the training process for teachers, it is essential to focus on enhancing the competency of female teachers in TPACK.

Secondly, among the five teaching experience groups, except the 11-15 and 16-20-year teaching experience groups, the rest teaching experience groups all showed significant differences in TPACK levels. The TPACK levels of Tai Chi teachers with less than 5 years and more than 20 years of teaching experience are relatively lower than other experience groups. This is mainly attributed to the fact that teachers with less than 5 years of experience lack teaching experience, although they have systematically studied professional knowledge and teaching theories of Tai Chi during their academic years. As Wu (2021) stated, they are in the stage of exploring teaching methods and integrating new information technology knowledge, which may lead to suboptimal classroom outcomes. On the other hand, Tai Chi teachers with over 20 years of teaching experience may have lower TPACK levels due to the fact that during their early years of teaching, information technology was not prevalent, so there were limited resources and opportunities to incorporate technology into Tai Chi instruction. This results in their limited understanding of technology. In addition, Tai Chi teachers with over 20 years of teaching experience, were approximately 50 year sold. Their age may lead to a lack of interest in adopting emerging technologies. Therefore, the overall TPACK levels were relatively low for this group. This is similar to Wu's (2021) and Cong and Jin's (2021)'s studies.

Thirdly, significant differences were observed between Tai Chi teachers with an academic background in martial arts and those with an academic background in sports, as well as those with a non-sports academic background. However, there is no significant difference between Tai Chi teachers with a sports background and those with a non-sports background. This can be mainly attributed to the fact that Tai Chi teachers with martial arts backgrounds have received systematic training and education during their university years. Moreover, many of them have been practicing Tai Chi since childhood, which provided them with a relatively richer knowledge of Tai Chi. On the other hand, Tai Chi teachers with a sports background and those with a non-sports background have limited understanding and knowledge of Tai Chi, resulting in relatively lower TPACK levels. The finding is consistent with studies by Wu (2021) and Zhang and Ouyang (2023).

Significant differences in TPACK levels were also observed between different levels of professional recognitions, specifically between national-level recognition and provincial-level recognition. Tai Chi teachers with high recognitions in the national team exhibited relatively lower TPACK levels. This can be attributed to the fact that the national team placed a higher emphasis on Tai Chi athletic performance, while the requirements for Tai Chi-related literacy were relatively less strict. As a result, Tai Chi teachers with a background in the national team tended to have lower TPACK levels (Wu, 2021).

## 5.1 Implications

This study aimed to examine the TPACK levels and its components and investigated whether there were significant differences in TPACK among Tai Chi teachers with different backgrounds. The survey results revealed that the TPACK levels of Tai Chi teachers with different backgrounds were moderate to high This might be influenced by the three-year pandemic period during which teachers relied heavily on online teaching. Usually, teaching experience and professional recognition levels are considered as factors predicting teachers' instructional abilities. However, the investigation found that Tai Chi teachers with teaching experience of over 20 years and those recognized at the national level had relatively lower TPACK levels. This suggests that in future research, when assuming causal relationships, not only previous experiences but also the historical context should be taken into account. The findings of this study

provide insights for further researchers to develop tailored training programs for Tai Chi teachers with different backgrounds to enhance their overall TPACK levels.

#### 5.2 Limitations

The limitations of this study are as follows: Firstly, the samples were limited to Tai Chi teachers from universities in Henan province, China, which may not fully represent the TPACK levels of teachers from other regions. Secondly, the participation of only 227 Tai Chi teachers in this study could limit the results observed among different groups.

#### 6.0 Conclusion & Recommendations

In conclusion, this study investigated the TPACK levels and differences among Tai Chi teachers with different backgrounds (gender, teaching experience, academic specialization, and professional recognition), providing an overview of understanding to test and interpret the current situation of different level in teaching Tai Chi among teachers in Henan of China. Future research, however, could employ mixed methods to gain deeper insights into the strategies and challenges the teachers of Tai Chi have to face when using the TPACK framework for teaching ,by which this could lead to a more scientific and effective utilization of the TPACK framework in Tai Chi instruction based on this study. In addition, future studies could also examine in greater detail of differences among the components of TPACK for Tai Chi teachers with various backgrounds, such as examining and investigate the effect of TK based on the different genders of teachers in imparting Tai Chi. Thus, the consequence of which could be identifying more specific factors that influence their TPACK levels in the way of imparting Tai Chi by teachers in Henan of China.

#### Acknowledgment

Thank you to the 227 Tai Chi teachers from 56 universities in Henan Province, China.

### Paper Contribution to Related Field of Study

This study will contribute to the research on the TPACK framework in the field of Tai Chi teaching and learning. By analyzing the variations in TPACK levels among Tai Chi teachers in higher education institutions with different backgrounds, it provides insights for researchers interested in the study of Tai Chi teaching.

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