

Technological Pedagogical Content Knowledge (TPACK) Proficiency and Identified Gaps Among Wushu Teachers

Yan Ding¹

¹Jose Rizal University, Manila, Philippines

Publication Date: 2026/10/30

Abstract

Despite global advances in digital pedagogy, structured professional development that integrates technology into martial arts instruction remains scarce. Grounded in the Technological Pedagogical Content Knowledge (TPACK) framework, this explanatory sequential mixed-methods study examined the self-described TPACK proficiency of Wushu teachers and the specific proficiency gaps they experience in practice. A researcher-developed questionnaire was administered to a random sample of Wushu teachers, and ten of them were subsequently interviewed. Quantitative findings indicate that teachers are generally proficient across all three TPACK domains (overall $M = 2.98$, $SD = 0.26$), with Content Knowledge ranking highest ($M = 3.01$) and Technological Knowledge lowest ($M = 2.96$). Qualitative findings, however, revealed three concrete gaps: limited use of mobile and wearable technologies, absence of standardized tools for performance assessment, and inadequate understanding of biomechanics and physical conditioning principles. The study concludes that Wushu teachers possess strong mastery of technique and instructional strategy but require targeted development in technology integration, objective assessment, and the science of movement. A four-module ITM-Wushu (Integrated TPACK Training Model for Wushu Teachers) is proposed to address these gaps. Implications for teacher education and suggestions for future research are discussed.

Keywords: *TPACK, Wushu, Martial Arts Education, Technological Literacy, Performance Assessment, Biomechanics, Professional Development.*

I. INTRODUCTION

➤ Background of the Study

In the digital age, the development of teachers' Technological Pedagogical Content Knowledge (TPACK) has evolved from being merely desirable to becoming an essential expectation within the Chinese educational system. The Ministry of Education of the People's Republic of China has highlighted that advancements in education are closely linked to the integration of information and communication technologies. The national framework Educational Modernization of China 2035 promotes the strategic adoption of modern technologies as a means to accelerate educational reform, expecting educators to integrate technological tools into instruction and transform traditional learning approaches.

Wushu, as a traditional Chinese martial art, embodies both a form of physical training and a rich cultural heritage. It is a holistic discipline that engages the entire

body, keeping practitioners active while fostering the development of strength, flexibility, coordination, speed, and balance. As a practice-oriented sport, however, Wushu instruction has historically relied on demonstration, imitation, and repetitive practice — modes that, while effective for skill acquisition, tend to oversimplify learning and can lead students to rely on rote memorization of movements rather than developing a deeper understanding of their underlying principles.

Contemporary research has increasingly emphasized the value of digital technology in modernizing Wushu instruction. Wang (2022) demonstrated that modern information technology enriches Wushu teaching methods and increases student engagement. Multimedia technology can deconstruct intricate Wushu movements, enabling students to learn progressively according to established routines, levels, and rules. Chen (2024) argued for continuous innovation in instructional approaches so that learners develop not only technical proficiency but also an

ding, yan. (2026). Technological Pedagogical Content Knowledge (TPACK) Proficiency and Identified Gaps Among Wushu Teachers. *International Journal of Scientific Research and Modern Technology*, 5(10), 55–60. <https://doi.org/10.38124/ijsrmt.v5i10.1744>

appreciation of traditional cultural values. The “Internet Plus” model, in particular, has been identified as a promising approach for integrating online and offline resources into martial arts education.

Despite these advantages, many Wushu instructors remain underprepared to use digital tools effectively. Existing studies tend to focus on technology adoption or on specific technical interventions, while the professional competence of the teachers who deliver this instruction — and the gaps they experience when trying to integrate technology, pedagogy, and content — has received comparatively little attention.

➤ *Problem Statement*

Despite Wushu’s dual role as both a sport and a cultural heritage, its teaching in many institutions continues to rely on conventional, demonstration-based modes. The rapid development of digital platforms, augmented reality, and hybrid teaching models has created both opportunities and pressures for Wushu educators. A persistent concern in the literature is the need to strengthen teachers’ competence in integrating technology into subject-specific instruction. Yet, to date, no structured, TPACK-grounded training plan exists for Wushu teachers in the country. This study therefore addresses the challenge of how Wushu educators can be supported to integrate technology into their teaching in ways that are pedagogically sound and content-appropriate.

➤ *Purpose of the Study*

This study examines the TPACK proficiency of Wushu teachers and identifies the specific proficiency gaps they experience, with a view to proposing a TPACK-based training plan tailored to martial arts education.

➤ *Research Questions*

The study sought to answer the following questions:

- How do Wushu teachers describe their level of proficiency in terms of technological, pedagogical, and content knowledge?
- What are the identified TPACK proficiency gaps of Wushu teachers?
- What TPACK-based training plan may be recommended for Wushu teachers in martial arts education?

➤ *Significance of the Study*

This study is significant in that it addresses the critical need to modernize Wushu instruction through evidence-based professional development. Its findings are expected to benefit teachers by clarifying their development needs, institutions by informing training design, and the broader field of martial arts education by extending the TPACK framework to a practice-oriented discipline in which it has rarely been applied.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The TPACK framework, introduced by Mishra and Koehler, extends Shulman’s Pedagogical Content Knowledge (PCK) by incorporating technology as a core component of teacher knowledge. It posits that effective technology integration requires the intersection of three primary domains: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK), together with their four interacting components — TPK, TCK, PCK, and the integrative TPACK. Joshi (2023), in a systematic review, confirmed a positive association between TPACK and teachers’ self-efficacy, while Tondeur et al. (2021) provided structural-equation-modeling evidence for the internal coherence of the TPACK construct within teacher education.

In subject-specific contexts, TPACK has been widely used to examine how teachers integrate digital tools into instruction. Fabian et al. (2024) investigated the inherent structure of TPACK from a subject-specific angle using test-based instruments, supporting its applicability beyond general education. In martial arts and physical education, however, the literature remains focused on the technologies themselves — virtual reality (Pu & Yang, 2022; Witte et al., 2025), augmented reality training modules (Ramdhan & Asoka, 2021), and online or “Internet Plus” teaching models (Feng & Huang, 2024; Sun, 2023) — rather than on the professional competence of the teachers delivering them.

Martial arts instruction is inherently practice-oriented and performance-based. Effective assessment therefore requires clear criteria for form, technique, and execution. Yet studies of performance evaluation in martial arts consistently point to subjectivity and the absence of standardized rubrics. Schildkamp (2021) emphasized the importance of data-based decision-making and the use of consistent assessment tools in improving educational practice. Similarly, biomechanical and conditioning principles — balance, coordination, power generation, flexibility, and injury prevention — are increasingly recognized as essential to the science of movement in sport, including Wushu (Li et al., 2024; Ward et al., 2021).

The present study is situated at the intersection of these strands. It applies the TPACK framework to Wushu instruction not as a vehicle for promoting a particular technology, but as an analytical lens for understanding teachers’ perceived competence and the concrete gaps between that competence and the demands of contemporary, technology-enhanced practice.

III. METHOD

➤ *Research Design*

This study adopted an explanatory sequential mixed-methods design. Quantitative data were collected first through a survey questionnaire to establish the overall proficiency profile of Wushu teachers. These results then

informed the development of interview questions, and qualitative data were collected through semi-structured interviews to explain and elaborate upon the quantitative trends.

➤ *Participants and Sampling*

Participants were Wushu teachers selected through random sampling. The survey was administered to the sampled teachers, and ten (10) teachers were purposefully selected from among them for interviews on the basis of their educational background and teaching experience. The findings, conclusions, and recommendations of this paper are applied only to the population of the respondents and should not be generalized beyond it.

➤ *Instrument*

A researcher-developed questionnaire was used, composed of four parts: (I) teacher profile, (II) Technological Knowledge, (III) Pedagogical Knowledge, and (IV) Content Knowledge. A four-point Likert scale was employed (4 = Very Proficient, 3 = Proficient, 2 = Somewhat Proficient, 1 = Not Proficient). Prior to full implementation, the instrument underwent pilot testing to establish its validity and reliability.

➤ *Data Collection and Analysis*

In the quantitative phase, descriptive statistics — means and standard deviations — were used to describe the proficiency level of teachers across the three TPACK domains. In the qualitative phase, responses to semi-

structured interview questions were analyzed thematically to identify recurring proficiency gaps. The two phases were then integrated in the reporting stage to yield a comprehensive interpretation of the findings.

➤ *Ethical Considerations*

The study complied with ethical research standards. Permission to conduct the study was sought from the relevant institutions, and participants were informed of the purpose of the research. Participation was voluntary and the data were treated confidentially.

IV. RESULTS

The findings are presented in two parts, corresponding to the research questions. The first reports the proficiency level of Wushu teachers across the three TPACK domains; the second reports the proficiency gaps identified through interview.

➤ *Proficiency Level of Wushu Teachers*

Table 1 summarizes the proficiency level of Wushu teachers across the three domains. The overall mean was $M = 2.98$ ($SD = 0.26$), interpreted as Proficient. Among the three domains, Content Knowledge ranked highest ($M = 3.01$), followed by Pedagogical Knowledge ($M = 2.99$) and Technological Knowledge ($M = 2.96$). The minimal differences among the means suggest a relatively balanced development of competencies.

Table 1 Proficiency Level of Wushu Teachers

Domain	Indicators	Mean	SD	Descriptive Interpretation
Technological Knowledge (TK)	10	2.96	0.26	Proficient
Pedagogical Knowledge (PK)	10	2.99	0.25	Proficient
Content Knowledge (CK)	10	3.01	0.25	Proficient
Overall	30	2.98	0.26	Proficient

Note. Scale: 3.26–4.00 = Very Proficient; 2.51–3.25 = Proficient; 1.76–2.50 = Somewhat Proficient; 1.00–1.75 = Not Proficient.

The results indicate that teachers are well grounded in the foundational use of digital platforms and in interactive, practice-based teaching strategies. However, the lowest-rated indicators were consistently those involving mobile applications, wearable technologies, and the use of performance data — pointing to a measurable gap between general technological competence and the use of specialized tools.

➤ *Identified TPACK Proficiency Gaps*

The qualitative phase, based on interviews with ten Wushu teachers, revealed three major proficiency gaps. These are summarized in Table 2 and elaborated below.

Table 2 Identified TPACK Proficiency Gaps

Identified Gap	Key Themes
Use of mobile applications or wearable technologies	Limited technological literacy; insufficient training and confidence; difficulty applying tools within training routines
Assessment of learners' Wushu performance	Absence of standardized assessment tools; subjectivity in performance evaluation; difficulty with multi-criteria assessment
Understanding of physical and biomechanical concepts	Limited knowledge of biomechanics; insufficient understanding of strength and power development; gaps in flexibility and injury prevention; limited grasp of balance, coordination, and power principles

First, participants demonstrated minimal familiarity with mobile applications and wearable technologies for tracking performance, and expressed low confidence in

using them. Second, they lacked structured rubrics and standardized scoring systems, relying instead on personal judgment and observational feedback. Third, participants

showed limited understanding of biomechanics and physical conditioning — including force generation, flexibility development, injury prevention, and the principles of balance, coordination, and power. Across all three gaps, participants emphasized the absence of formal training as a contributing factor.

V. DISCUSSION

The quantitative findings reveal that Wushu teachers demonstrate an overall proficient level of competence across TK, PK, and CK. This aligns with studies emphasizing the growing importance of digital competence among educators in the post-pandemic era. The relatively high ratings for interactive and practice-based teaching strategies are consistent with the work of Trust and Whalen (2021), who emphasized that effective teaching requires more than mere tool familiarity. Teachers in this study are clearly capable of applying general digital tools and of adapting instruction to diverse learners.

The qualitative findings, however, qualify this overall picture. They reveal specific gaps—in the use of mobile and wearable technologies, in the development of standardized performance assessment tools, and in the understanding of biomechanics and physical conditioning principles—that are masked by the broadly positive quantitative profile. This distinction between perceived proficiency and actual instructional challenges is theoretically important: a teacher may rate herself as “proficient” in technology while remaining unable to apply specialized tools in a practice-oriented discipline such as Wushu. The finding echoes Tondeur et al. (2021), who noted that teachers are generally more proficient in basic ICT use than in the pedagogical integration of technology.

The gap in assessment is particularly consequential. In a performance-based discipline, the absence of clear criteria undermines both the fairness of evaluation and the quality of feedback that learners receive. Participants’ reliance on observational judgment corroborates Schildkamp’s (2021) observation that data-based, standardized approaches to assessment remain underdeveloped in many educational settings. Similarly, the limited understanding of biomechanics and conditioning principles points to a need for professional development that connects movement science to the teaching of Wushu techniques—a connection emphasized by Li et al. (2024) and Ward et al. (2021).

Taken together, the findings imply that Wushu teachers possess strong mastery of Wushu techniques and instructional strategies but require further enhancement in applying technological tools, conducting objective assessments, and explaining scientific movement principles in practice. Professional development, therefore, should be targeted rather than general, and should be grounded in the actual intersection of technology, pedagogy, and content that the TPACK framework describes.

VI. A TPACK-BASED TRAINING PLAN FOR WUSHU TEACHERS

On the basis of the findings, this study proposes the ITM-Wushu (Integrated TPACK Training Model for Wushu Teachers). The model is grounded in the TPACK framework and aims to enhance teachers’ Technological, Pedagogical, and Content Knowledge through structured professional development. Its overall goal is to integrate digital technologies, assessment literacy, and the science of movement into Wushu instruction.

➤ *Specific Training Objectives*

At the end of the training, Wushu teachers will be able to:

- Use mobile applications and wearable technologies for tracking Wushu performance;
- Develop standardized rubrics for assessing Wushu skills;
- Apply biomechanics principles in teaching Wushu movements;
- Integrate technology into performance assessment;
- Design technology-enhanced Wushu lessons; and
- Interpret performance data to improve learner outcomes.

➤ *Core Training Modules*

The training plan consists of four modules, each addressing one of the gaps identified in the study: (1) Mobile and Wearable Technologies for Performance Tracking; (2) Standardized Assessment and Rubric Design; (3) Biomechanics and Physical Conditioning for Wushu; and (4) Integrating Technology into Lesson Design and Delivery. The modules are designed to be delivered through a combination of workshops, demonstrations, hands-on training, microteaching, collaborative learning, and coaching and mentoring.

➤ *Monitoring and Evaluation*

The effectiveness of the training plan should be evaluated through pre- and post-training assessments of teachers’ TPACK competence, classroom observation, and analysis of lesson artifacts. Monitoring will focus on teachers’ confidence and actual use of the tools and practices introduced in each module.

VII. CONCLUSION

This study set out to examine the TPACK proficiency of Wushu teachers and to identify the gaps that limit their integration of technology, pedagogy, and content. The findings show that teachers are generally proficient across all three domains, yet face concrete challenges in using mobile and wearable technologies, in assessing performance objectively, and in applying biomechanical and conditioning principles. These findings support the need for a TPACK-based professional development model tailored to martial arts education. The proposed ITM-Wushu model offers a structured response to these needs and may serve as a foundation for future, intervention-

based research that evaluates its impact on teaching practice and learner outcomes.

REFERENCES

- [1]. Bishop, P., & Herron, R. (2015). Use and misuse of the Likert item responses and other ordinal measures. *International Journal of Exercise Science*, 8(3). <https://pmc.ncbi.nlm.nih.gov/articles/>
- [2]. Chen, W. (2024). Research on the reform of Wushu teaching mode in colleges and universities under the background of “internet plus.” Scineer Publishing, 2(3). <https://pdfs.semanticscholar.org/>
- [3]. Creswell, J. W. (n.d.). Choosing a mixed methods design. https://us.sagepub.com/sites/default/files/upm-binaries/35066_Chapter3.pdf
- [4]. Darling-Hammond, L., et al. (2021). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, 24(2), 97–140.
- [5]. Fabian, A., et al. (2024). Unraveling TPACK: Investigating the inherent structure of TPACK from a subject-specific angle using test-based instruments. *Computers & Education*, 217. <https://doi.org/10.1016/j.compedu.2024.104735>
- [6]. Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development*, 68, 2449–2472. <https://doi.org/10.1007/s11423-020-09767-4>
- [7]. Fang, F., & Baohong, X. (2024). An experimental study of SAQ training on the agility and quality of young Wushu students. *Studies in Sports Science and Physical Education*, 2(2), 15–23.
- [8]. Feng, Z., & Huang, F. (2024). The application and effectiveness of Wushu teaching by integrating online teaching models. In *Proceedings of the 2024 4th International Conference on Artificial Intelligence*.
- [9]. Ghazi, M., Abdeen, D. I., & Altaie, M. K. (2024). Enhancing karate skill performance through virtual visuals and artificial intelligence techniques. *Scientific Journal of Sport and Performance*.
- [10]. Ibrahim, N., & Muslim, S. (2020). Development of hyperlinks media to learn basic Wushu techniques. *Journal of Computational and Theoretical Nanoscience*, 17(2–3). <https://www.ingentaconnect.com/>
- [11]. Jianing, X., Thee-Asana, S., & Hongsaenyatham, P. (2024). Guidelines to promote Wushu teaching for university students in Henan province, the People’s Republic of China. *International Journal of Sociology*.
- [12]. Joshi, S. (2023). TPACK and teachers’ self-efficacy: A systematic review. *Canadian Journal of Learning and Technology*, 49(2). <https://cjlt.ca/index.php/cjlt/article/view/28280/20743>
- [13]. König, J., et al. (2021). Adapting to online teaching during COVID-19: Teacher education and teacher competence effects. *European Journal of Teacher Education*, 44(4), 608–622.
- [14]. Li, Z. (2024). New trends in modern technology and traditional martial arts teaching. *Curriculum and Teaching Methodology*. <https://doi.org/10.23977/curtm.2024.070601>
- [15]. Li, L., Geok, S., Li, H., Talib, O., Sun, H., & Lam, S. (2024). A comprehensive study on physical fitness of Wushu routine athletes based on video-driven core strength training mechanisms in wireless networks. *International Journal of Sports Science*.
- [16]. Liang, Q., Maharkan, P., & Hongsaenyatham, P. (2024). Future trends of Wushu and education process for sport university China. *International Journal of Sociologies and Anthropologies Science Reviews*, 4.
- [17]. Ma, W. (2023). Technological training tools in teaching physical education among martial arts athletes. *International Journal of Social Science and Human Research*, 6(3). <https://ijsshr.in/>
- [18]. Pu, Y., & Yang, Y. (2022). Application of virtual reality technology in martial arts situational teaching. <https://doi.org/10.1155/2022/6497310>
- [19]. Ramdhan, S., & Asoka, E. (2021). Development of augmented reality based Wushu training module to improve basic movement ability. *Jurnal Sisfotek Global*, 11(2), 97–101.
- [20]. Rusmono, R., Jarudin, J., & Khuzaimah, P. (2020). Development of digital instruction as a guide in Wushu training. *Universal Journal of Educational Research*, 8(3A). <https://www.researchgate.net/>
- [21]. Schildkamp, K. (2021). Data-based decision-making for school improvement: Research insights and gaps. *Educational Research Review*, 33, 100384.
- [22]. Song, Q., & Wang, Z. (2025). An empirical study on teaching innovation of traditional Wushu culture from the perspective of 6G network. *International Journal of e-Collaboration (IJeC)*, 21(1).
- [23]. Stanford University. (n.d.). Technology integration framework. <https://teachingcommons.stanford.edu/teaching-guides/foundations-course-design/theory-practice/technology-integration-framework>
- [24]. Sun, Y. (2023). Research on multiple strategies of martial art teaching in colleges and universities under the background of “internet+.” *International Journal of Science and Engineering Applications*.
- [25]. Tondeur, J., et al. (2021). A comprehensive investigation of TPACK within teacher education: Evidence from structural equation modeling. *Computers & Education*, 157, 103941.
- [26]. Trust, T., & Whalen, J. (2021). Emergency remote teaching and teacher competence. *Journal of Technology and Teacher Education*, 29(2), 189–199.
- [27]. Trust, T., & Whalen, J. (2021). Should teachers be trained in emergency remote teaching? Lessons learned from the COVID-19 pandemic. *Journal of Technology and Teacher Education*, 29(2), 189–199. <https://doi.org/10.1177/002248712111023045>

- [28]. Wang, M., Wang, Q., & Salleh, M. (2025). Innovative measures for university Wushu training program: Stimulating students' knowledge, interest, and personal values. *International Theory and Practice in Human Movement Sciences*.
- [29]. Wang, Q. (2024). Improving the pedagogical process of Wushu course in selected universities in Anhui province, China. *Journal of Education and Educational Research*, 9(1). <https://drpress.org/>
- [30]. Ward, P., et al. (2021). Effects of content knowledge on teaching in physical education. *Journal of Teaching in Physical Education*, 40(2), 1–10.
- [31]. Witte, K., Burger, D., & Pastel, S. (2025). Sports training in virtual reality with a focus on visual perception: A systematic review. *Frontiers in Sports and Active Living*. <https://www.frontiersin.org/>
- [32]. Xu, M., Li, H., & Zhu, Y. (2022). The teaching mode of martial arts in colleges and universities based on artificial intelligence assistance. <https://doi.org/10.1155/2022/6162784>
- [33]. Yanan, W., Salleh, M., Hussain, Y., & Jiamei, L. (2025). A study on the cognitive level of TPACK and the differences in demographic variables among university martial arts teachers. *American Research Journal of Education*.
- [34]. Yanan, W., Hussain, Y., Salleh, M., & Jiamei, L. (2025). Improving martial arts teachers' TPACK in universities through training: A quantitative study. *International Journal of Academic Research in Progressive Education and Development*.
- [35]. Zhang, J. (2021). Research on the application and development of multimedia teaching in college Wushu course based on internet technology. *Journal of Physics: Conference Series*.
- [36]. Zhao, C., Li, B., & Guo, K. (2023). Adaptive enhancement design of non-significant regions of a Wushu action 3D image based on the symmetric difference algorithm. *Mathematical Biosciences and Engineering*.
- [37]. Zhao, Q., Xu, Y., Liu, Y., & Chang, J. (2021). Experimental study on action learning of different visual teaching methods in Wushu. *SHS Web of Conferences*, 123. <https://www.shs-conferences.org/>
- [38]. Zhou, Y., Hou, J., Liu, Q., Chao, X., Wang, N., Chen, Y., Guan, J., Zhang, Q., & Diwu, Y. (2021). VR/AR technology in human anatomy teaching and operation training. *Journal of Healthcare Engineering*, 13.