



Research Article

TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE OF PRIMARY SCHOOL TEACHERS IN SOUTHERN VIETNAM: A LATENT CLASS ANALYSIS

Le Duy Hung

Ho Chi Minh City University of Education, Vietnam

Corresponding author: Le Duy Hung – Email: hungld@hcmue.edu.vn

Received: July 13, 2024; Revised: August 19, 2025; Accepted: September 25, 2025

ABSTRACT

Technological Pedagogical Content Knowledge (TPACK) is a conceptual framework that explores the intersection of subject matter expertise, pedagogical strategies, and technology integration in teaching. This model has garnered significant attention in both academic and practical contexts, offering a comprehensive structure for evaluating and enhancing educators' ability to integrate technology effectively in modern classrooms. Despite its growing international application, the TPACK framework remains under-researched in the Vietnamese context. This study aims to investigate the TPACK of primary school teachers in Southern Vietnam. A cross-sectional survey was conducted with a sample of 208 primary teachers. Employing latent class analysis, the results revealed a three-group classification: Class 1, representing the largest proportion, demonstrated moderate levels of TPACK; Class 2 exhibited low levels of TPACK, indicating an urgent need for targeted training and capacity-building; while Class 3 showed high levels of TPACK, suggesting strong readiness for technology integration in teaching. Demographic analysis further illuminated specific trends and professional development needs among these teacher groups. The findings provide valuable insights for designing differentiated training programs and policies to enhance TPACK in primary education.

Keywords: latent class analysis; primary education; teachers; technological pedagogical content knowledge

1. Introduction

Technological Pedagogical Content Knowledge (TPACK) is a theoretical framework developed by Koehler and Mishra (2009) to support teachers in effectively integrating technology into their teaching. TPACK extends Shulman's (1986) concept of pedagogical content knowledge by adding technology as a crucial component of modern education. This framework posits that teaching with technology requires a sophisticated understanding of

Cite this article as: Le, D. H. (2025). Technological pedagogical content knowledge of primary school teachers in Southern Vietnam: A latent class analysis. *Ho Chi Minh City University of Education Journal of Science*, 22(9), 1653-1661. [https://doi.org/10.54607/hcmue.js.22.9.5110\(2025\)](https://doi.org/10.54607/hcmue.js.22.9.5110(2025))

how content, pedagogy, and technology interact with one another (Koehler & Mishra, 2009). This framework is structured around three core domains of knowledge: content knowledge, pedagogical knowledge, and technological knowledge. Each domain contributes to effective teaching in distinct ways. Content knowledge refers to a teacher's deep understanding of a specific subject area, which is essential for accurately, meaningfully, and comprehensively conveying knowledge to students (Shulman, 1986). Pedagogical knowledge involves understanding various teaching methods, learning theories, and classroom management strategies. Technological knowledge refers to teachers' familiarity with digital tools and educational technologies, which is critical for the integration of technology into instruction.

Beyond these core components, the TPACK framework also emphasizes the dynamic interactions among its constituent domains, which give rise to key intersections essential for flexible and effective teaching. Pedagogical Content Knowledge, the intersection of content and pedagogy, equips teachers with strategies to present subject matter effectively (for example, using problem-based learning to teach mathematics) (Koehler & Mishra, 2009). Technological content knowledge, the combination of content knowledge and technological knowledge, enables teachers to use technology to clarify complex concepts or increase student engagement, such as through simulations that concretize abstract scientific ideas (Voogt et al., 2013). Technological Pedagogical Knowledge merges pedagogy with technology, focusing on how digital tools can support and enhance instructional practices (for instance, through the use of multimedia to make lessons more interactive) (Chai et al., 2013).

At the heart of the TPACK framework lies the synthesis of all three domains: TPACK itself. It emphasizes the necessity not only of understanding what to teach (content) and how to teach it (pedagogy), but also of identifying which technologies can support specific instructional goals (Angeli & Valanides, 2009). In today's educational context, TPACK enables teachers to create flexible and effective learning environments that respond to the diverse needs of students by harmonizing these three domains (Voogt et al., 2013). As digital learning continues to expand globally, TPACK offers a structured approach for supporting teachers in navigating increasingly technology-integrated educational settings (Chai et al., 2013).

In Vietnam, the TPACK framework has become increasingly important as the Ministry of Education and Training promotes digital transformation initiatives within the national education system. The ministry's emphasis on integrating technology into classrooms aligns with the TPACK model, encouraging teachers to adopt a multidimensional approach to teaching (Ministry of Education and Training, 2017). Given the highly standardized nature of the Vietnamese education system, TPACK enables educators to align digital tools with curriculum standards while simultaneously enhancing student engagement through interactive and technology-supported pedagogical methods.

Moreover, the relevance of the TPACK framework is amplified by the diversity of educational contexts across Vietnam. Teachers in both urban and rural areas face distinct

challenges, particularly regarding access to technology and the extent of training in digital pedagogy (Nguyen Thi Hong Duyen & Quach My Quyen, 2023). In these varied settings, TPACK can serve as a bridge, guiding educators in using technology effectively while maintaining a focus on core instructional content and pedagogical rigor. By adopting this framework, Vietnamese educators are better equipped to deliver meaningful, technology-enhanced lessons that prepare students for an increasingly digital world. Therefore, conducting research and investigation into TPACK among Vietnamese teachers will offer a comprehensive understanding of their needs and challenges in integrating technology into instruction. Such research not only supports teachers in optimizing their use of educational technology but also contributes to the broader goal of building a high-quality and globally responsive education system in Vietnam.

2. Materials and Methods

This study employed a cross-sectional research design. The questionnaire used in this research was developed by Koehler and Mishra (2006) based on the TPACK framework, including three core components: content knowledge, pedagogical knowledge, and technological knowledge. The Content Knowledge section assessed teachers' understanding of subject matter, ensuring accuracy and curricular relevance. The Pedagogical Knowledge section evaluated teachers' capacity to apply instructional strategies and manage classrooms effectively. The Technological Knowledge section measured their ability to use technology in instructional contexts. Additionally, the questionnaire captured intersecting domains of knowledge, including pedagogical content knowledge, technological content knowledge, and technological pedagogical knowledge, in order to assess how teachers integrate technology to enhance instructional effectiveness and address students' learning needs.

This instrument consisted of 28 items, rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores on each subscale indicate a greater level of proficiency in the respective domain of TPACK. The overall TPACK score was calculated by summing the responses to the 28 items, each rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). This yielded a possible total score ranging from 28 to 140, with higher values reflecting stronger TPACK proficiency. For the latent class analysis (LCA), the classification of teachers into distinct subgroups was not based on arbitrary cut-off points but determined by statistical model fit. Specifically, a series of models with increasing numbers of classes were estimated and compared using established fit indices (AIC, BIC, SABIC, entropy, and Lo–Mendell–Rubin likelihood ratio test). The three-class solution was selected as the optimal model because it provided the best balance between statistical adequacy and interpretability while avoiding classes with very small sample sizes. Thus, the thresholds for group membership emerged empirically from the LCA model, rather than being imposed a priori.

A total of 208 teachers participated in the study. Regarding gender, there were 31 male teachers (14.90%) and 177 female teachers (85.10%). In terms of educational attainment, 3 teachers (1.40%) held a vocational or associate degree, 6 teachers (2.90%) held a college diploma, 194 teachers (93.30%) had a bachelor's degree, and 5 teachers (2.40%) held a master's degree.

3. Results

3.1. Latent Class Analysis

Based on Table 1, we selected the three-class model for this study, guided by considerations of model stability and interpretability. Although the four-class model demonstrated strong statistical fit indices, one of its classes contained only three individuals. Retaining a class with such a small sample size could undermine the reliability of group-level analyses, reduce the generalizability of findings, and compromise the model's overall stability. When comparing model fit indices, the three-class model showed notable improvement over the two-class model, with progressively lower AIC, BIC, and SABIC values, suggesting better model fit. While the four-class and five-class models continued to improve these indices marginally, the addition of extremely small latent classes lacked practical interpretive value and might decrease model robustness. Thus, the three-class model was selected as the optimal balance between statistical adequacy and practical interpretability. This decision enhances the model's applicability and strengthens the explanatory power of the study.

Table 1. Model Fit Indices for Latent Class Solutions

Indices	Values			
Classes	2	3	4	5
LogLik	-3075.1808	-2883.5671	-2650.6898	-2586.0991
AIC	6194.3616	5827.1341	5377.3797	5264.1981
BIC	6267.7875	5927.2603	5504.2061	5417.7249
SABIC	6198.0808	5832.2057	5383.8037	5271.9746
Entropy	0.9594	0.96546	0.98381	0.9746
p-value	0.0099	0.0099	0.0099	0.0099

As shown in Figure 1 and Table 2, the latent class analysis identified three distinct groups. Class 3 scored the highest across most variables, indicating strong proficiency in pedagogical technology integration. This group's superior performance may be attributed to more intensive training or richer teaching experience, enabling the accumulation of both knowledge and skill in technology-enhanced pedagogy. Class 2 demonstrated the lowest scores, particularly in variables related to digital competence and instructional methods. This suggests that individuals in this group may struggle to integrate technology effectively in their teaching, potentially due to limited training opportunities or lack of exposure to modern educational technologies. Class 1 occupied an intermediate position, with relatively balanced scores across variables. This group may have participated in professional development or

training programs but have yet to achieve high proficiency in TPACK-related competencies. Notably, across all classes, technological knowledge scores were generally lower compared to content and pedagogical domains. This trend suggests that a lack of technological fluency may constrain the effective application of TPACK, underscoring the need for targeted interventions that strengthen digital competencies in parallel with pedagogical and content mastery.

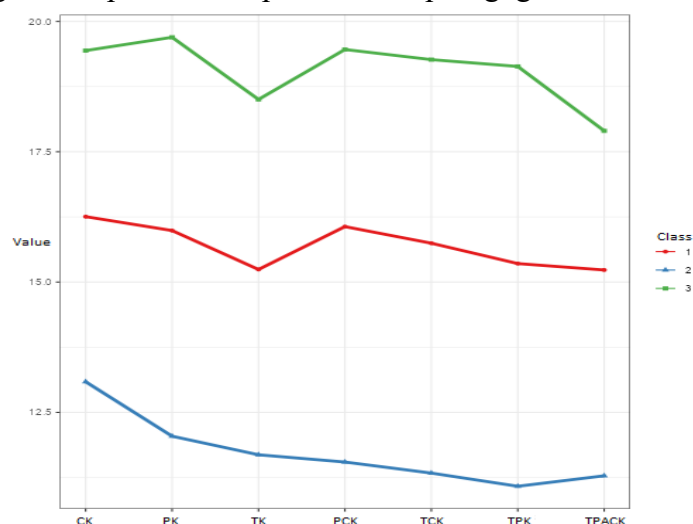


Figure 1. Teacher Class Distribution Based on Latent Class Analysis

Note: CK = Content Knowledge. PK = Pedagogical Knowledge. TK = Technology Knowledge. PCK = Pedagogical Content Knowledge. TCK = Technological Content Knowledge. TPK = Technological Pedagogical Knowledge. TPACK = Technological Pedagogical Content Knowledge.

The predominance of Class 1, with over 150 individuals, indicates that the majority of participants in the sample fall into this category. This finding suggests that moderate levels of TPACK are prevalent in the current educational context. This could be attributed to professional development programs that may lack sufficient depth or fail to effectively engage participants with higher technological pedagogical proficiency. The number of individuals in Class 2 and Class 3 is significantly lower compared to Class 1. This distribution may reflect uneven levels of TPACK within the teaching population, with relatively few teachers exhibiting either high or low levels of integrated knowledge. Notably, Class 2, characterized by low levels of TPACK, represents a small subset of educators who may require more targeted support and intensive training to enhance their pedagogical and technological competencies (see also Figure 2).

Table 2. Descriptive Statistics of TPACK Scores by Latent Class

Classes	N	Mean	SD	SE	p-value
1	154	106.10	5.08	0.41	< .001
2	33	79.30	14.66	2.55	
3	21	129.00	5.89	1.29	

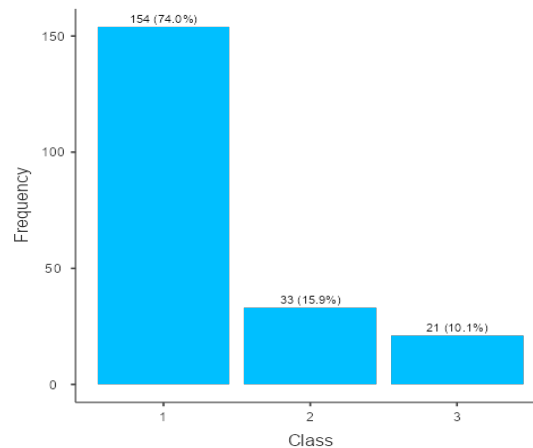


Figure 2. Proportion of Teachers in Each Latent Class

3.2. Characteristics of the Latent Classes

Table 3 presents the descriptive statistics of demographic and professional characteristics across the three latent classes. The data reveal notable trends related to teachers' educational background, professional development engagement, teaching experience, and salary level. The average educational levels across the three classes are relatively similar: 2.96 for Class 1, 2.97 for Class 2, and 3.00 for Class 3. These results indicate a moderate and comparable academic background among teachers in all classes. Although Class 3 holds a slightly higher mean, the marginal difference may reflect a slightly stronger academic foundation, potentially facilitating a better capacity to engage with educational technologies.

The level of participation in professional development activities shows some variation: Class 3 reports the highest mean score (3.62), followed by Class 1 (3.44) and Class 2 (3.33). This suggests that teachers in Class 3 are more actively engaged in ongoing training, possibly enhancing their ability to integrate technology effectively in teaching. The relatively lower engagement in Class 2 might indicate limited exposure to professional development opportunities or less institutional support for training.

Mean scores for teaching experience are 4.42 in Class 1, 4.00 in Class 2, and 4.52 in Class 3. Teachers in Class 3 are the most experienced overall, which may explain their more developed TPACK. In contrast, the lower score in Class 2 implies limited teaching experience, which might constrain the development and application of TPACK in classroom settings.

Table 3. Descriptive Statistics of Demographic Characteristics by Latent Class

Class	Educational Attainment	Professional Development	Teaching Experience	Salary
1	2.96	3.44	4.42	2.73
2	2.97	3.33	4.00	2.55
3	3.00	3.62	4.52	2.48

The salary levels across the three classes reflect a noteworthy pattern. All classes report moderate average salary levels, with no significant disparities among them. Notably, Class 3, despite demonstrating the highest levels of TPACK, does not receive the highest salary, nor is it the lowest. This observation underscores a critical issue in the professional environment: there is currently limited financial recognition for teachers with advanced technological competencies. Therefore, it is essential that educational policymakers consider enhancing working conditions and financial incentives. Improving salary structures serves as a catalyst for broader systemic improvement in teaching quality and digital transformation in education.

4. Conclusion

The analysis revealed significant differences in the levels of TPACK across the three latent classes of teachers. Class 2, which exhibited lower TPACK scores, may be struggling to effectively integrate technology into their teaching practices. This highlights a clear need for targeted and intensive training support. Professional development programs should prioritize the enhancement of both basic and advanced technological competencies, including the effective use of contemporary digital tools and educational software. In addition, practice-based workshops that allow teachers to apply new skills and exchange experiences with colleagues can foster deeper engagement and learning. Designing training modules that address the specific needs of each latent class can optimize training outcomes and enhance teachers' ability to apply TPACK in the classroom.

Class 3 demonstrated a high level of participation in professional development activities, reflecting not only strong individual motivation but also a high level of awareness regarding the importance of continuous professional growth. To encourage broader participation across all classes, educational institutions could organize more appealing seminars, colloquia, and extracurricular training sessions. Furthermore, offering formal recognition such as certifications, professional development credits, or even enhanced incentives for active participants may stimulate a more dynamic professional learning culture. Such measures would not only improve teachers' skills but also contribute to the development of a collaborative and supportive teaching environment.

Analyzing the demographic characteristics of the teachers provides not only a clearer picture of training needs but also valuable insights for educational policy-making. Educational administrators should consider developing differentiated professional development programs that are aligned with the profiles of each teacher class. This may include increased investment in technological infrastructure, greater access to learning resources, and expanded opportunities to attend advanced training sessions or workshops. At the same time, appropriate incentive policies must be implemented to ensure that teachers feel both recognized and motivated, which in turn can contribute to improving teaching quality and promoting long-term professional development.

In summary, the findings of this study revealed significant differences in TPACK among the three classes of teachers: Class 1 was the most dominant group in terms of sample size and demonstrated higher overall scores than Class 2; Class 2 showed an urgent need for targeted training to enhance their skills; whereas Class 3 exhibited superior technological integration capabilities, with the highest scores across measured indicators. Furthermore, the analysis of demographic characteristics helped clarify specific needs and trends in professional development. Differences in educational qualifications, levels of participation in professional development programs, and teaching experience across the classes not only indicated key challenges but also presented opportunities for improving teaching quality through tailored training initiatives. Educational institutions and administrators should focus on designing appropriate training courses, encouraging active teacher participation in professional development activities, and implementing fair incentive policies to strengthen teachers' motivation and engagement.

This study has several limitations. First, its cross-sectional design only provides a snapshot of teachers' TPACK at one point in time, limiting causal interpretation. Second, unbalanced gender distribution may reduce the generalizability of the findings. Third, the use of self-reported questionnaires may be subject to bias, as teachers could overestimate their competencies. Finally, contextual factors such as school infrastructure and institutional support were not fully explored, which may also influence teachers' ability to apply TPACK in practice.

❖ **Conflict of Interest:** Author has no conflict of interest to declare.

REFERENCES

- Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge. *Computers & Education*, 52(1), 154-168. <https://doi.org/10.1016/j.compedu.2008.07.006>
- Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society*, 16(2), 31-51.
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60-70.
- Ministry of Education and Training. (2017). Thông tư số 21/2017/TT-BGDĐT ngày 06/9/2017 quy định ứng dụng công nghệ thông tin trong hoạt động bồi dưỡng, tập huấn qua mạng internet cho giáo viên, nhân viên và cán bộ quản lý giáo dục [Circular No. 21/2017/TT-MOET dated

September 6, 2017 on the regulation of applying information technology in online training for teachers, staff and educational managers].

Nguyen, T. H. D., & Quach, M. Q. (2023). Năng lực chuyển đổi số của giáo viên trong hoạt động dạy học và giáo dục học sinh tiểu học [Digital competence of teachers in teaching and educating primary school students]. *Journal of Educational Equipment: Education Management*, 1(296).

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, 15(2), 4-14. <https://doi.org/10.3102/0013189X015002004>

Voogt, J., Fisser, P., Roblin, N. P., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge—A review of the literature. *Journal of Computer Assisted Learning*, 29(2), 109-121. <https://doi.org/10.1111/j.1365-2729.2012.00487.x>

KIẾN THỨC NỘI DUNG SỰ PHẠM CÔNG NGHỆ CỦA GIÁO VIÊN TIỂU HỌC Ở MIỀN NAM VIỆT NAM: MỘT NGHIÊN CỨU PHÂN TÍCH LỚP TIỀM ẨN

Lê Duy Hùng

Trường Đại học Sư phạm Thành phố Hồ Chí Minh, Việt Nam

Tác giả liên hệ: Lê Duy Hùng – Email: hungld@hcmue.edu.vn

Ngày nhận bài: 13-7-2025; Ngày nhận bài sửa: 19-8-2025; Ngày duyệt đăng: 25-9-2025

TÓM TẮT

Kiến thức nội dung sự phạm công nghệ (TPACK) là một khung lý thuyết nghiên cứu về việc kết hợp kiến thức chuyên môn, phương pháp dạy học và công nghệ trong việc dạy học của giáo viên. Khung lý thuyết này gây được nhiều sự chú ý trong nghiên cứu và thực tiễn bởi nó cung cấp một khuôn khổ tương đối toàn diện để nhằm đánh giá và phát triển khả năng ứng dụng công nghệ trong thời đại hiện nay; tuy nhiên, mô hình này chưa được nghiên cứu tại Việt Nam. Nghiên cứu này nhằm mục đích điều tra TPACK của giáo viên tiểu học, một nghiên cứu cắt ngang được thực hiện trên 208 giáo viên tiểu học. Kết quả nghiên cứu dựa trên phép phân tích lớp tiềm ẩn cho thấy có thể phân chia giáo viên ra thành 3 nhóm: nhóm 1 với TPACK ở mức trung bình chiếm ưu thế với số lượng lớn nhất; nhóm 2 với TPACK ở mức thấp thể hiện nhu cầu cấp thiết về đào tạo để cải thiện kỹ năng; trong khi nhóm 3 với TPACK đạt mức cao nhất. Việc phân tích đặc điểm nhân khẩu học của giáo viên đã làm rõ những nhu cầu và xu hướng cụ thể trong việc đào tạo và phát triển chuyên môn ở các nhóm này. Kết quả của nghiên cứu cung cấp những hiểu biết giá trị trong việc thiết kế các chính sách và chương trình đào tạo chuyên biệt nhằm nâng cao TPACK ở giáo viên tiểu học.

Từ khóa: phân tích lớp tiềm ẩn; tiểu học; giáo viên; kiến thức nội dung sự phạm công nghệ