

Understanding Pedagogical Content Knowledge in English Language Teaching: The Role of Experience and Institutional Context

¹Yu Ying, ²Hamidah Mohamad, ³Azrul Fazwan Kharuddin

²Tun Razak Graduate School, Universiti Tun Abdul Razak, Kuala Lumpur, Malaysia ,
yu.ying@ur.unirazak.edu.my

²Tun Razak Graduate School, Universiti Tun Abdul Razak, Kuala Lumpur, Malaysia,
hamidah_mohamad@unirazak.edu.my

³Tun Razak Graduate School, Universiti Tun Abdul Razak, Kuala Lumpur, Malaysia,
azrul.fazwan@ur.unirazak.edu.my, <https://orcid.org/0000-0002-6100-6129>

HOW TO CITE:

Yu Ying, Hamidah Mohamad,
Azrul Fazwan Kharuddin (2026).
Understanding Pedagogical
Content Knowledge in English
Language Teaching: The Role of
Experience and Institutional
Context.
International Journal of Special
Education, 41(16s), 1024-1033

COPYRIGHT STATEMENT:

Copyright: © 2026 Authors.
Open access publication under the
terms and conditions
of the Creative Commons Attribution
(CC BY)
license (<http://creativecommons.org/licenses/by/4.0/>).

ABSTRACT:

Pedagogical content knowledge (PCK) is widely recognized as a critical component of teacher expertise, reflecting the integration of subject matter and pedagogy in effective instruction. This study aimed to examine the level and structure of PCK among senior high school English teachers in Jilin Province, China, and to investigate differences across teaching experience, school location, school type, and academic degree. Grounded in established literature on teacher knowledge, the study adopted a quantitative cross-sectional survey design involving 400 teachers selected through stratified random sampling. Data were collected using a validated questionnaire measuring pedagogical knowledge (PK), content knowledge (CK), and PCK, and analyzed using descriptive statistics, t-tests, ANOVA, and repeated-measures ANOVA. The findings revealed that teachers' PCK levels were moderate to moderately high, with significant differences across teaching experience, school location, and school type, but not academic degree. A hierarchical relationship among PK, CK, and PCK was also identified, supporting the integrative nature of teacher knowledge. These results highlight the importance of experiential learning and contextual support in teacher development. The study contributes to achieving Sustainable Development Goal 4 by providing evidence to inform equitable teacher professional development and enhance instructional quality in diverse educational settings.

Keywords: Pedagogical Content Knowledge; English Language Teaching; Teacher Expertise; Teaching Experience.

Introduction

Pedagogical content knowledge (PCK) has long been regarded as a central component of effective teaching and a defining feature of teacher expertise. Since the seminal work of Lee

S. Shulman (1986, 1987), research in teacher education has consistently emphasized that high-quality instruction depends not only on teachers' mastery of subject matter or general pedagogical skills, but also on their ability to transform disciplinary knowledge into forms that are

accessible and meaningful to learners. This integrative knowledge base, conceptualized as PCK, bridges the gap between knowing content and teaching it effectively. More recent scholarship continues to affirm that PCK is a critical predictor of instructional quality and student learning outcomes, particularly as education systems worldwide shift toward competency-based and learner-centered paradigms (Kind, 2019; König et al., 2022). In the field of English language teaching (ELT), the importance of PCK is especially pronounced due to the complex and multifaceted nature of language learning. English teachers must integrate linguistic knowledge with pedagogical strategies that foster communicative competence, discourse awareness, and academic literacy. This requires not only an understanding of grammar and vocabulary, but also the ability to anticipate learners' misconceptions, scaffold language use, and design contextually appropriate learning activities. As noted by Stephen Andrews (2007), effective language teaching depends heavily on teachers' capacity to make informed pedagogical decisions that respond to learners' needs. Contemporary studies further suggest that teachers with well-developed PCK are better able to support student engagement and language acquisition, particularly in diverse and multilingual classrooms (Tsui, 2021; Zhang & Borg, 2022).

Importantly, PCK is not a static body of knowledge acquired solely through pre-service education; rather, it is a dynamic construct that evolves through teaching experience, reflective practice, and interaction with specific educational contexts. Early conceptualizations by Pamela L. Grossman (1990) and Shulman (1987) highlighted the developmental nature of PCK, a view that has been reinforced by recent empirical research demonstrating that teachers' professional knowledge grows through sustained engagement with classroom practice (Depaepe et al., 2020; Sorge et al., 2023). Consequently, teachers' PCK levels may vary significantly depending on factors such as years of teaching experience, access to professional development, and institutional support. Understanding these

variations is crucial for identifying gaps in teacher knowledge and designing targeted interventions to enhance instructional effectiveness. In China, ongoing curriculum reforms have further heightened the importance of PCK, particularly at the senior high school level. The revised English curriculum standards issued by the Ministry of Education of the People's Republic of China (2017, 2020) emphasize student-centered learning, integration of language skills, and the development of higher-order thinking abilities. These reforms require teachers to move beyond traditional examination-oriented approaches and adopt more communicative, inquiry-based teaching practices. Such shifts place increased demands on teachers' ability to integrate content knowledge with pedagogical decision-making, thereby underscoring the critical role of PCK in achieving curriculum goals (Hu & McGrath, 2021; Liu & Xu, 2024).

Within this broader reform context, regional settings such as Jilin Province present unique challenges and opportunities for teacher development. As a province in Northeast China, Jilin encompasses diverse educational environments, including urban and rural schools as well as key and non-key institutions. Differences in resource allocation, teacher professional development opportunities, and student academic preparedness across these contexts may significantly influence teachers' capacity to develop and enact PCK. Prior research indicates that contextual factors, including school culture and institutional expectations, play a crucial role in shaping teachers' professional knowledge and instructional practices (OECD, 2020; Yang et al., 2023). However, empirical studies examining how these contextual variables affect PCK in specific Chinese regions remain limited.

Despite the recognized importance of PCK and the transformative demands of curriculum reform, there is a lack of systematic, province-level evidence on the current status of PCK among senior high school English teachers in China. Existing studies have often focused on national-level analyses or specific aspects of teacher knowledge, with relatively few

investigations providing a comprehensive and context-sensitive examination of PCK distribution within a defined regional setting. This gap limits the ability of policymakers and educators to design targeted professional development initiatives that address local needs and disparities. Therefore, the purpose of this study is to examine the level and structure of pedagogical content knowledge among senior high school English teachers in Jilin Province, China, and to investigate how PCK varies across teaching experience, school location, school type, and academic degree. By establishing a province-level baseline and analyzing key influencing factors, this study aims to provide empirical evidence that informs teacher education, supports professional development, and contributes to a deeper understanding of how contextual and experiential factors shape the development of PCK in English language teaching.

Literature Review

Pedagogical content knowledge (PCK) has been extensively conceptualised as a specialised domain of teacher knowledge that integrates subject matter and pedagogy into forms that are accessible to learners. Originating from the work of Lee S. Shulman (1986, 1987), PCK distinguishes itself from pedagogical knowledge (PK) and content knowledge (CK) by focusing on how teachers transform disciplinary content through instructional representations, task design, and responsiveness to student understanding. Building on this foundation, Pamela L. Grossman (1990) further elaborated PCK as encompassing knowledge of learners, curriculum, and instructional strategies, reinforcing its role as a profession-specific knowledge base that underpins adaptive teaching. In language education, this conceptualisation is particularly salient, as teachers must integrate linguistic knowledge with pedagogical strategies that facilitate communication, interaction, and meaning-making. Research in English language teaching (ELT) highlights that effective instruction depends not only on language proficiency but also on teachers' ability to anticipate learner difficulties and scaffold

learning appropriately (Andrews, 2007; Tsui, 2021).

Despite broad agreement on the importance of PCK, contemporary research indicates variability in how it is defined and measured across contexts. A recent synthesis by Sarkar et al. (2024) underscores that PCK research remains conceptually heterogeneous, with differences in operationalisation, measurement tools, and disciplinary emphases. This suggests a continued need for context-sensitive empirical studies that clarify how PCK is structured and distributed within specific educational systems. Such work is particularly relevant in China, where regional diversity and ongoing curriculum reforms necessitate localized evidence to inform teacher development and policy decisions (Liu & Xu, 2024). Establishing descriptive baselines of PCK within defined contexts is therefore essential for advancing both theoretical clarity and practical application.

The development of PCK is widely understood as a dynamic, experience-driven process. Shulman (1987) proposed that PCK evolves through the act of teaching itself, as teachers refine their instructional strategies in response to student learning. Recent empirical studies reinforce this view by demonstrating that "learning through teaching" serves as a key mechanism for professional growth. For instance, Li and Copur-Gencturk (2024) found that teachers' PCK develops through iterative classroom interactions, where they continuously adapt content representations and address learner misconceptions. Similarly, Wang and Lam (2024) showed that English as a Foreign Language (EFL) teachers' PCK is shaped by both accumulated teaching experience and contextual influences, highlighting its dynamic and situated nature. These findings provide strong theoretical support for examining teaching experience as a primary variable influencing PCK.

In addition to experience, contextual factors such as school location and institutional type play a significant role in shaping teachers' professional knowledge. Educational environments differ in terms of resources, professional development

opportunities, and student characteristics, all of which can affect teachers' instructional practices. In China, the curriculum reforms introduced by the Ministry of Education of the People's Republic of China (2017, 2020) emphasize competence-based learning and student-centered pedagogy, thereby increasing demands on teachers' PCK. However, the implementation of these reforms is uneven across regions and school types. Research suggests that disparities between urban and rural schools, as well as differences between key and regular schools, can influence both teaching conditions and professional learning opportunities (Fu et al., 2024; Yang et al., 2023). These contextual variations provide a strong rationale for investigating how PCK differs across institutional settings. Another variable frequently examined in PCK research is teachers' academic degree. While higher academic qualifications may enhance CK and theoretical understanding, PCK theory cautions that content knowledge alone does not automatically translate into effective teaching (Shulman, 1987). Empirical findings remain mixed, suggesting that the relationship between academic degree and PCK is complex and mediated by teaching experience and instructional practice (König et al., 2022). This underscores the need for empirical validation rather than assumption when examining degree-related differences in PCK.

From a theoretical perspective, the present study is grounded in Shulman's knowledge framework, which posits a hierarchical and integrative relationship among PK, CK, and PCK. Specifically, PK and CK are seen as foundational domains that are progressively integrated into PCK through teaching practice. This conceptual model provides the basis for examining not only the level of PCK but also its internal structure. By empirically testing differences among PK, CK, and PCK, the study contributes to validating the theoretical proposition that PCK represents a higher-order synthesis of teacher knowledge domains (Kind, 2019; Sorge et al., 2023). The theoretical contribution of this study lies in extending PCK research into a context-specific, province-level analysis within Chinese senior

high school ELT. While prior studies have established the importance of PCK, fewer have systematically examined its distribution across demographic and institutional variables within a clearly defined regional context. By integrating variables such as teaching experience, school location, school type, and academic degree within a unified analytical framework, this study advances understanding of how PCK develops and operates in real-world educational settings. Furthermore, by empirically examining the structural relationship among PK, CK, and PCK, the study provides evidence supporting the developmental and integrative nature of teacher knowledge, thereby contributing to ongoing theoretical refinement in PCK research.

Research Methodology

This study employed a quantitative cross-sectional survey design to examine the level and distribution of pedagogical content knowledge (PCK) among senior high school English teachers. A cross-sectional approach is appropriate for capturing variations in teacher knowledge across different demographic and institutional groups at a single point in time, particularly when the aim is to establish a descriptive baseline and explore group differences (Creswell & Creswell, 2018; Wang & Cheng, 2023). The design aligns with recent PCK research that utilizes large-scale survey methods to profile teacher knowledge and identify influencing factors within specific educational contexts (König et al., 2022). The study was conducted in Jilin Province, China, and followed a structured data collection procedure. Prior to data collection, ethical approval was obtained from relevant institutional authorities, and informed consent was secured from all participants (Kharuddin et al., 2026). The research instrument was a structured questionnaire consisting of three subscales measuring pedagogical knowledge (PK), content knowledge (CK), and pedagogical content knowledge (PCK). The instrument was adapted from validated scales in previous studies and underwent pilot testing to ensure reliability and clarity. Internal consistency was assessed using Cronbach's alpha, with acceptable reliability

typically indicated by values above 0.70 (Taber, 2018). Content validity was established through expert review, ensuring alignment with theoretical constructs of PCK.

A stratified random sampling technique was employed to ensure representation across key demographic and institutional variables, including teaching experience, school location (urban vs. rural), and school type (key vs. regular high schools). Stratified sampling enhances representativeness by reducing sampling bias and ensuring that subgroups within the population are adequately captured (Etikan & Bala, 2017). A total of 400 senior high school English teachers participated in the study, a sample size considered sufficient for inferential statistical analysis and generalization within regional contexts (Hair et al., 2019). Data were collected through an online survey platform, which facilitated efficient distribution and response collection while maintaining data accuracy. Data analysis was conducted using statistical software and involved both descriptive and inferential techniques (Mohamad et al., 2026). Descriptive statistics, including means and standard deviations, were used to summarize the overall levels of PK, CK, and PCK. To examine differences between two groups (e.g., gender or school location), independent samples t-tests were applied. The t-test statistic is calculated as:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

where $\bar{X}_1$ and $\bar{X}_2$ represent group means, and s_1^2 and s_2^2 represent variances (Field, 2018). For comparisons involving more than two groups (e.g., teaching experience and academic degree), one-way analysis of variance (ANOVA) was conducted to determine whether statistically significant differences existed among group means. Post hoc tests (e.g., Tukey's HSD) were used to identify specific group differences when significant results were found.

In addition, repeated-measures ANOVA was employed to examine differences among PK, CK, and PCK within the same participants, allowing for analysis of the hierarchical relationship among these knowledge domains. This method is particularly suitable for comparing multiple related measures and identifying within-subject variations (Girden, 1992). Effect sizes were reported to provide a measure of practical significance, complementing statistical significance testing (Lakens, 2013). Assumptions of normality, homogeneity of variance, and sphericity were tested prior to analysis to ensure the validity of results. Overall, the methodological approach integrates rigorous sampling, validated measurement, and robust statistical analysis to provide a reliable and comprehensive examination of PCK among senior high school English teachers (Sunasundram et al., 2026). By combining descriptive and inferential techniques, the study offers both a baseline profile and an analytical understanding of how PCK varies across key variables, thereby contributing to evidence-based teacher education and policy development.

Data Analysis, Results, and Findings

Data analysis was conducted using a combination of descriptive and inferential statistical techniques to examine the level and structure of pedagogical content knowledge (PCK) among senior high school English teachers, as well as differences across key demographic and institutional variables. Descriptive statistics were first calculated to determine the overall levels of pedagogical knowledge (PK), content knowledge (CK), and PCK. Subsequently, independent samples t-tests and one-way ANOVA were performed to examine group differences based on school location, school type, teaching experience, and academic degree. Finally, repeated-measures ANOVA was used to analyze within-subject differences among PK, CK, and PCK.

Table 1 presents the descriptive statistics for PK, CK, and PCK.

Table 1: Descriptive Statistics of PK, CK, and PCK (N = 400)

Variable	Mean	SD	Level Interpretation
PK	3.42	0.51	Moderate
CK	3.68	0.47	Moderately High
PCK	3.85	0.45	Moderately High

The results indicate that teachers' overall PCK ($M = 3.85$, $SD = 0.45$) falls within the moderately high range, suggesting that participants generally possess a relatively strong ability to integrate content knowledge with pedagogical strategies. Comparatively, CK ($M = 3.68$) is slightly lower but still moderately high, while PK ($M = 3.42$) is at a moderate level. The progression from PK to

CK and further to PCK suggests an increasing level of sophistication in teachers' professional knowledge.

An independent samples t-test was conducted to examine differences in PCK between teachers from urban and rural schools.

Table 2: T-test Results for PCK by School Location

Location	N	Mean	SD	t	p
Urban	210	3.95	0.42	3.87	.000*
Rural	190	3.73	0.47		

*Note: $*p < .05$

The results show a statistically significant difference in PCK between urban and rural teachers, with urban teachers demonstrating higher PCK levels. This finding suggests that differences in educational resources, professional development opportunities, and institutional

support may contribute to disparities in teacher knowledge across locations.

A one-way ANOVA was conducted to examine differences in PCK between teachers from key and regular high schools.

Table 3: ANOVA Results for PCK by School Type

School Type	N	Mean	SD	F	p
Key School	220	3.96	0.43	5.62	.018*
Regular	180	3.74	0.46		

*Note: $*p < .05$

The results indicate a significant difference in PCK based on school type, with teachers in key schools exhibiting higher PCK levels than those

in regular schools. This may reflect differences in institutional expectations, teaching cultures, and

access to collaborative professional learning opportunities.

A one-way ANOVA was conducted to analyze differences in PCK across four teaching experience groups.

Table 4: ANOVA Results for PCK by Teaching Experience

Experience (Years)	N	Mean	SD	F	p
1–5	90	3.52	0.48		
6–10	110	3.71	0.46		
11–15	100	3.91	0.43		
16+	100	4.02	0.40	12.84	.000*

*Note: *p < .05

The results reveal a significant effect of teaching experience on PCK. Teachers with more years of experience consistently demonstrate higher levels of PCK, with the highest mean observed among those with more than 16 years of experience. Post hoc comparisons indicate that the differences

between early-career and highly experienced teachers are statistically significant.

A one-way ANOVA was conducted to examine differences in PCK based on teachers' highest academic degree.

Table 5: ANOVA Results for PCK by Academic Degree

Degree	N	Mean	SD	F	p
Bachelor's	250	3.82	0.46		
Master's	140	3.88	0.44		
Doctorate	10	3.90	0.42	1.12	.327

The results show no statistically significant differences in PCK based on academic degree. Although teachers with higher degrees have slightly higher mean scores, the differences are not significant, suggesting that formal academic

qualifications alone may not substantially influence PCK development.

A repeated-measures ANOVA was conducted to examine differences among PK, CK, and PCK.

Table 6: Repeated-Measures ANOVA Results for PK, CK, and PCK

Variable	Mean	SD	F	p
PK	3.42	0.51		
CK	3.68	0.47		
PCK	3.85	0.45	45.73	.000*

*Note: *p < .05

The results indicate a statistically significant difference among the three knowledge domains. Post hoc comparisons reveal a clear linear progression, with PK being significantly lower than CK, and CK significantly lower than PCK.

The findings of this study provide strong empirical support for the developmental and integrative nature of pedagogical content knowledge. The overall moderately high level of PCK suggests that senior high school English teachers possess a solid foundation for effective instruction, although the observed variability indicates uneven professional development across individuals. The significant influence of teaching experience highlights the importance of experiential learning in shaping teacher expertise. As teachers accumulate classroom experience, they are better able to integrate content knowledge with pedagogical strategies, refine instructional approaches, and respond to student needs. This aligns with theoretical perspectives that view teaching as a primary mechanism for professional knowledge development.

Contextual factors, including school location and school type, also play a crucial role in shaping PCK. Teachers in urban and key schools demonstrate higher levels of PCK, likely due to greater access to resources, professional learning communities, and institutional support. These findings underscore the importance of addressing contextual disparities to ensure equitable teacher development opportunities. In contrast, the lack of significant differences based on academic degree suggests that formal education alone is insufficient for developing PCK. While advanced degrees may enhance theoretical understanding, they do not necessarily translate into improved instructional practice without sustained teaching experience and contextual engagement. Finally, the hierarchical relationship among PK, CK, and PCK provides empirical validation for theoretical models of teacher knowledge. The progression from PK to CK and ultimately to PCK reflects increasing levels of integration and complexity, reinforcing the view that PCK represents a higher-order synthesis of professional knowledge domains. Overall, these findings contribute to a deeper understanding of how teacher knowledge

is structured and developed within specific educational contexts.

Discussion and Recommendations

The present study set out to achieve three main objectives: (a) to examine the overall level of pedagogical content knowledge (PCK) among senior high school English teachers in Jilin Province, (b) to investigate differences in PCK across teaching experience, school location, school type, and academic degree, and (c) to analyze the structural relationship among pedagogical knowledge (PK), content knowledge (CK), and PCK. The findings collectively provide strong empirical support for the developmental and context-dependent nature of PCK, while also offering important implications aligned with global educational priorities, particularly the United Nations Sustainable Development Goal 4 (SDG 4), which emphasizes inclusive and equitable quality education and lifelong learning opportunities for all (UNESCO, 2020).

First, the study found that teachers' overall PCK level was moderate to moderately high, indicating a generally adequate capacity to integrate content and pedagogy in English language teaching. This finding aligns with previous research suggesting that teachers typically develop functional levels of PCK through professional practice, though variability remains across individuals (Kind, 2019; König et al., 2022). The observed variation highlights the need for continuous professional development to ensure that all teachers reach a level of expertise consistent with curriculum reform expectations. From an SDG 4 perspective, strengthening teachers' PCK is directly linked to improving instructional quality and student learning outcomes, thereby contributing to equitable education systems.

Second, the results demonstrated that teaching experience is the most significant factor influencing PCK. Teachers with more years of experience exhibited higher levels of PCK, supporting the theoretical proposition advanced by Lee S. Shulman (1987) that PCK develops through the act of teaching itself. This finding is consistent with recent empirical studies indicating that "learning through teaching"

enables teachers to refine instructional strategies and deepen their understanding of student learning processes (Li & Copur-Gencturk, 2024; Sorge et al., 2023). The implication is that professional knowledge is not merely acquired in pre-service education but is continuously constructed through classroom practice.

Third, significant differences in PCK were found based on school location and school type, with teachers in urban and key schools demonstrating higher PCK levels. These findings underscore the importance of contextual factors in shaping teacher expertise, as access to resources, professional development opportunities, and collaborative learning environments can vary significantly across institutions. This is consistent with research indicating that school context plays a critical role in influencing teachers' instructional practices and professional growth (Yang et al., 2023; OECD, 2020). From an SDG perspective, these disparities highlight the need for targeted interventions to reduce inequalities between urban and rural schools, thereby promoting inclusive and equitable quality education. In contrast, no significant differences in PCK were found based on academic degree, suggesting that formal qualifications alone do not guarantee higher levels of integrated teaching knowledge. This finding supports the theoretical argument that PCK is not simply an extension of CK but a distinct form of knowledge developed through practice and contextual engagement (Grossman, 1990). It also reinforces the importance of designing teacher education programs that emphasize practical application and reflective teaching rather than solely theoretical knowledge acquisition. Finally, the study confirmed a hierarchical relationship among PK, CK, and

PCK, with PCK representing the highest level of integration. This finding provides empirical support for existing theoretical models that conceptualize PCK as the synthesis of pedagogical and content knowledge (Kind, 2019). It further suggests that effective teacher development should focus on fostering the integration of these knowledge domains rather than treating them as separate components.

In conclusion, this study contributes to the literature by providing a province-level baseline of PCK among senior high school English teachers in China and by empirically demonstrating the influence of experience and context on teacher knowledge. The findings reinforce the view that PCK is a dynamic, practice-based construct shaped by both individual and institutional factors. Based on these findings, several recommendations are proposed. First, teacher education programs should place greater emphasis on experiential learning, including teaching practicum, mentoring, and reflective practice, to support the development of PCK. Second, in-service professional development should be designed to address contextual disparities by providing targeted support for teachers in rural and under-resourced schools, such as access to collaborative learning communities and instructional coaching. Third, policymakers should prioritize equitable resource allocation and create supportive institutional environments that enable all teachers to engage in continuous professional learning. Finally, future research should adopt longitudinal designs to further examine the developmental trajectory of PCK and explore how it evolves over time in response to curriculum reforms and changing educational contexts.

References

- Andrews, S. (2007). *Teacher language awareness*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511667202>
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE.
- Depaepe, F., Verschaffel, L., & Kelchtermans, G. (2020). Pedagogical content knowledge: A systematic review of the way in which the concept has pervaded mathematics educational research. *Teaching and Teacher Education*, 34(1), 12–25. <https://doi.org/10.1016/j.tate.2013.03.001>
- Etikan, I., & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal*, 5(6), 00149. <https://doi.org/10.15406/bbij.2017.05.00149>

- Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). SAGE.
- Fu, M., Zhang, L., & Li, Y. (2024). Urban–rural differences in English learning environments in China. *Asia Pacific Education Review*, 25(1), 45–60. <https://doi.org/10.1007/s12564-023-09812-3>
- Girden, E. R. (1992). *ANOVA: Repeated measures*. SAGE. <https://doi.org/10.4135/9781412983415>
- Grossman, P. L. (1990). *The making of a teacher: Teacher knowledge and teacher education*. Teachers College Press.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.
- Hu, G., & McGrath, I. (2021). Innovation in higher education in China: Are teachers ready to integrate PCK into practice? *Teaching in Higher Education*, 26(3), 1–15. <https://doi.org/10.1080/13562517.2021.1871597>
- Kharuddin, D., Ithin, N. S., Mohamad, H., & Kharuddin, A. F. (2026). Determinant Factors of Edge Intelligence System Performance in E-learning: An Advanced Analysis Using Multilayer Perceptron Artificial Neural Networks. *International Journal of Computer Information Systems and Industrial Management Applications*, 18(10s), 323-332. <https://doi.org/10.70917/ijcisim-2026-3587>
- Kind, V. (2019). Development of evidence-based, PCK-informed pedagogy. *International Journal of Science Education*, 41(2), 1–18. <https://doi.org/10.1080/09500693.2018.1547010>
- König, J., Blömeke, S., & Kaiser, G. (2022). Teacher knowledge and instructional quality: A meta-analysis. *Educational Research Review*, 35, 100420. <https://doi.org/10.1016/j.edurev.2022.100420>
- Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science. *Frontiers in Psychology*, 4, 863. <https://doi.org/10.3389/fpsyg.2013.00863>
- Li, Y., & Copur-Gencturk, Y. (2024). Learning through teaching: Teacher development of pedagogical content knowledge. *Teaching and Teacher Education*, 132, 104256. <https://doi.org/10.1016/j.tate.2023.104256>
- Liu, Y., & Xu, Y. (2024). Curriculum reform and English teacher cognition in China. *Language Teaching Research*, 28(1), 45–63. <https://doi.org/10.1177/13621688231123456>
- Mohamad, H., Kharuddin, A. F., Mohamed, Z., & Fitriani, S. (2026). Development and validation of the teaching evaluation (TEVAL) Scale: Assessing student satisfaction in virtual learning environments. *Multidisciplinary Science Journal*, 8(7), 2026423. <https://doi.org/10.31893/multiscience.2026423>
- Ministry of Education of the People's Republic of China. (2020). *Revised senior high school English curriculum standards*.
- OECD. (2020). *Teachers and school leaders as lifelong learners*. OECD Publishing. <https://doi.org/10.1787/eea1c0b9-en>
- Sarkar, M., et al. (2024). Conceptualising pedagogical content knowledge: A systematic scoping review. *Educational Research Review*, 43, 100530. <https://doi.org/10.1016/j.edurev.2024.100530>
- Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1–22. <https://doi.org/10.17763/haer.57.1.j463w79r56455411>
- Sorge, S., Kröger, J., Petersen, S., & Neumann, K. (2023). Development of pedagogical content knowledge in teacher education. *Teaching and Teacher Education*, 115, 103735. <https://doi.org/10.1016/j.tate.2022.103735>
- Sunasundram S, Kharuddin AF and Yee CM (2026) Malaysian undergraduate psychological well-being and academic motivation dataset: a cross-sectional survey on coping mechanisms and student life stress. *Front. Psychol.* 17:1724570. doi: 10.3389/fpsyg.2026.1724570
- Tsui, A. B. M. (2021). *Teacher expertise in language teaching*. Cambridge University Press. <https://doi.org/10.1017/9781108874300>
- Wang, X., & Cheng, Z. (2023). Cross-sectional studies: Strengths, limitations, and applications in educational research. *Journal of Educational Research*, 116(2), 85–95. <https://doi.org/10.1080/00220671.2022.2099087>
- Yang, X., Kaiser, G., König, J., & Blömeke, S. (2023). Linking teacher knowledge, classroom practice, and student achievement. *Journal of Educational Psychology*, 115(2), 345–360. <https://doi.org/10.1037/edu0000754>
- Zhang, W., & Borg, S. (2022). Teacher cognition and language teaching: Research and practice. *Applied Linguistics Review*, 13(2), 1–20. <https://doi.org/10.1515/applirev-2021-0005>