Creative Education, 2023, 14, 2301-2312
https://www.scirp.org/journal/ce
ISSN Online: 2151-4771
ISSN Print: 2151-4755

Elaborating Teachers' Pedagogical Content Knowledge from Static and Dynamic Perspectives

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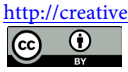
How to cite this paper: Wang, L., & Zhan, F. M. (2023). Elaborating Teachers' Pedagogical Content Knowledge from Static and Dynamic Perspectives. *Creative Education, 14,* 2301-2312.
https://doi.org/10.4236/ce.2023.1411145

Received: October 4, 2023
Accepted: November 25, 2023
Published: November 28, 2023



Abstract

Teacher knowledge constitutes a crucial element of teacher cognition and serves as a fundamental criterion for evaluating the efficacy of teaching quality. As a key component of the teacher knowledge base, pedagogical content knowledge (PCK) serves as a crucial determinant of teachers' practical expertise and professional identity. PCK is a combination of subject knowledge and pedagogical knowledge that significantly influences teachers' instructional practices in the classroom. Its impact extends beyond students' learning process and the quality of teachers' instruction; it also plays a vital role in fostering the professional growth of teachers. In order to improve the language proficiency of second language learners, it is imperative for language teachers to possess a solid understanding of PCK. This literature review provides a critical examination of the concept of PCK from both static and dynamic perspectives. It also elaborates on the components of PCK based on previous research and discusses its inherent nature. This review aims to deepen the understanding of PCK among teachers and teacher educators. In addition, this initiative helps frontline educators effectively implement PCK in their instructional practices, thereby enhancing the overall quality of teaching.

Keywords

Dynamic Perspective, Pedagogical Content Knowledge, Static Perspective, Teacher Knowledge

1. Introduction

To deepen their understanding of the intricate field of education, a growing number of educators are directing their research endeavors toward the study of teacher cognition. The cognitive dimensions of teachers, which include their

knowledge, beliefs, and thoughts, significantly impact and shape their instructional practices within the classroom (Borg, 2003). Stenhouse (as cited in Rudduck, 1995: p. 3) stated that teachers could enact significant changes within educational institutions by understanding the classroom environment. The emergence of teacher cognition as a scholarly field has provided a solid basis for investigating teachers' knowledge and has sparked discussions regarding their pedagogical content knowledge, commonly known as PCK.

2. Definition of Pedagogical Content Knowledge

Shulman (1986) highlighted the significance of PCK as the fundamental basis for teachers' comprehension of the subject matter they instruct. The utilization of specific teaching methods, such as diagrams, explanations, examples, and demonstrations, enables educators to effectively enhance students' comprehension of the content knowledge. Shulman further emphasized that PCK is not merely the combination of content knowledge and pedagogy, but rather a unique amalgamation of the two categories. Since its introduction by Shulman, the concept of PCK has stimulated researchers to engage in endeavors aimed at redefining and refining this concept. In the study conducted by Hashweh (2005), PCK is defined as teachers' proactive acquisition and dissemination of instructional knowledge and expertise. The PCK framework serves as the fundamental basis for teachers to enhance their teaching practices and instructional development in their respective domains. The author highlighted the distinctiveness and specialized knowledge of PCK. Simultaneously, he established associations between PCK and other forms of knowledge or beliefs, positing that such connections can effectively enhance the comprehensive exploration of PCK. Hashweh's definition of PCK has initiated a discussion on the viewpoints of static and dynamic perspectives.

Geddis (1993: p. 675) highlighted the importance of subject-specific teaching skills for effective educators. According to Geddis, a "good teacher" should possess expertise in disciplines such as history, chemistry, or English. While some general teaching skills may apply across subjects, the author emphasizes the significance of specialized knowledge in facilitating effective instruction. The significance of teachers' PCK in facilitating the transfer of knowledge to novice teachers was emphasized. Teachers should also possess an awareness of the necessity to transform their content knowledge into a form that students can comprehend and be prepared to make necessary adjustments to their teaching methods as required. Teaching should not be viewed solely as the acquisition of classroom management skills or teaching knowledge. Instead, it should be approached as an inquiry into the dynamic integration of teaching and subject knowledge. According to Geddis (1993), it is imperative for educators to possess PCK, which comprises three fundamental components. Firstly, it is imperative for educators to possess a profound comprehension of students' misconceptions. Secondly, teachers should possess a high level of proficiency in implementing efficacious strategies to address and correct these misconceptions. Lastly, instruc-

tors should possess the capability to employ a diverse array of representational modalities in order to augment their pedagogical methodologies.

Park and Oliver (2008) put forward a comprehensive concept of PCK based on the research of the past two decades. They believe that PCK is the use of a variety of teaching methods by teachers in the teaching environment in a specific cultural and social context. Strategies, representations, and assessments facilitate students' understanding of specific subject knowledge. This concept emphasizes the influence of situational, cultural, social, and other factors and includes two basic factors proposed by Shulman: knowledge about students and knowledge of teaching strategies. In order to address the inherent discrepancy between teacher knowledge and student learning outcomes, it is beneficial to employ adaptable teacher assessment tools that can effectively demonstrate and measure teaching effectiveness. Additionally, it is important to give due consideration to the concept of teacher evaluation knowledge as defined by Park and Oliver.

In the 2012 PCK Summit, held in Colorado, United States, the participants collectively established a comprehensive definition of PCK. According to the summit's consensus, PCK refers to a specialized knowledge base that encompasses the planning and execution of specific subject matter within a particular classroom context. Additionally, PCK is recognized as a crucial teaching skill. This definition (Gess-Newsome, 2015: p. 31) introduces the concept of "PCK and skills" and emphasizes the prominence of student learning outcomes. PCK is thus regarded as both abstract knowledge and practical skills that can solve real problems in teaching. The incorporation of student learning outcomes emphasizes the importance of evaluating and measuring student learning, while also allowing for a more objective and comprehensive assessment of teacher knowledge. The evaluation of teaching effectiveness should be based on the actual performance and achievements of students, rather than relying solely on teachers' subjective perceptions or impressions. The disparity between teacher knowledge and student learning outcomes partially elucidates why certain teachers, despite possessing a high level of knowledge, may still struggle to attain a high standard of teaching quality.

Within academic discourse, scholars widely agree on the comprehensive nature of PCK. This knowledge encompasses teachers' understanding and utilization of effective instructional strategies, diverse representations, and assessments, all aimed at facilitating students' comprehension of specific subject matter. Additionally, educators are required to effectively navigate and adjust to the contextual, cultural, and social limitations that exist within the educational setting.

3. Static Perspectives on Pedagogical Content Knowledge

Researchers who analyze PCK from a static perspective pay more attention to teachers' teaching experience at a certain stage. For example, Tamir (1988) claimed that subject knowledge includes knowledge about students, curriculum, assessment, and pedagogy. There is a clear line between general pedagogical

knowledge and specific subject knowledge. Scholars in the field of general education possess a comprehensive understanding of pedagogical approaches that are applicable across various disciplines, including the skill of constructing multiple-choice questions. Conversely, individuals with expertise in teaching, either as professionals or those in training, possess specialized knowledge in specific subjects, such as evaluating laboratory skills. Tamir's differentiation between these two concepts holds significance for teacher education, particularly in terms of equipping educators with the necessary skills to effectively organize classroom activities. Grossman (1990) proposed four fundamental pillars of teacher expertise, namely general pedagogical knowledge, subject knowledge, PCK, and knowledge pertaining to the learning environment. For the first time, she incorporated curriculum knowledge into the category of PCK, distinguishing content experts from teachers. In this model, knowledge about the purpose of teaching is listed above the other three items because Grossman believes that these concepts constitute core knowledge and influence the choice of teachers and the design of teaching content and activities. These four dimensions of knowledge are interconnected and mutually influential. Different from previous scholars, Grossman classifies the components of PCK and emphasizes the transformative nature of PCK.

In their study, An et al. (2004) proposed a model for understanding the PCK of mathematics teachers. They argued that pedagogical knowledge is the central component, while subject knowledge and curriculum knowledge play a supportive role in its development. The authors also highlighted the reciprocal relationship between teacher beliefs and PCK. They found that different educational concepts can result in distinct characteristics of PCK and that a deep understanding of PCK can shape teachers' beliefs and ultimately impact the quality of their teaching. An et al. integrate student learning outcomes to test the effectiveness of PCK, a breakthrough that integrates teacher assessment with student learning.

Davidowitz and Rollnick (2011) revised the model of PCK to emphasize the importance of teachers' beliefs. Since PCK has a certain reticence, it is necessary to explore its performance in teaching practice through observation. They also raised a consideration: since articulating PCK is not an easy task, prompts should be used to encode classroom observations that facilitate the elaboration of knowledge that teachers may not otherwise be aware of. Their model emphasizes the importance of teacher knowledge representation. However, the connection of the various components of PCK is not specified.

Although the above models can promote teachers' understanding of the connotation of PCK, they do not reflect the nature of a specific subject. Magnusson et al. (1999) proposed a framework for teaching knowledge in science disciplines based on the research of Tamir and Grossman. The author believes that PCK includes five factors: the orientation of teaching science subjects, knowledge of the scientific syllabus, knowledge of students' understanding, knowledge of teaching strategies, and knowledge of scientific understanding. In this particular model,

the prioritization of teaching science is emphasized over the other four factors. While this notion bears resemblance to the concept of teaching objectives in Grossman's framework, Magnusson et al. opt to employ the term "positioning" as a comprehensive concept for instructing a particular subject. Teacher knowledge and beliefs function as conceptual frameworks to assist teachers in formulating teaching strategies, including daily instructional objectives, the selection of student materials, the utilization of textbooks and supplementary resources, and the evaluation of student progress. This framework serves as a valuable resource for investigating the PCK within a particular subject domain.

The model proposed by Magnusson refined each knowledge classification, expounding the close relationship between PCK and subject knowledge. The framework incorporates another key component, assessment knowledge, which provides a detailed account of the PCK of science teachers. However, the framework does not address the relationship between these subsidiary components. Moreover, it does not show the impact of science teachers' subject orientation on PCK, nor does it explain whether teachers with different orientations have the same quality of PCK.

Kuhn (2016) introduced a pedagogical knowledge framework encompassing both content and cognitive structures. The model encompasses the content of the knowledge being taught, the various types of knowledge, and the cognitive structure associated with the corresponding cognitive process. This theoretical model emphasizes the cognitive structure of PCK: declarative knowledge and strategic knowledge. Declarative knowledge is intricately connected to the cognitive processes of memory and comprehension. Case knowledge empowers educators to analyze and utilize declarative knowledge of general concepts to address challenges encountered in classroom instruction. In the context of teaching the Monroe process of persuasive speech, strategic knowledge plays a crucial role in enabling teachers to evaluate and gauge various forms of declarative or case knowledge, commonly referred to as "practical wisdom". For instance, when teachers observe that a significant number of students tend to focus solely on the initial step of "attracting attention" while neglecting the subsequent steps, they can employ illustrative examples or interactive activities to capture students' interest in the other steps.

This theoretical framework offers a novel approach to analyzing PCK. The cognitive level of teachers' knowledge is crucial in their ability to adopt, revise, and adapt various teaching strategies in dynamic and ever-changing classroom environments. However, several challenges arise when attempting to observe teachers at the cognitive level within educational environments.

4. Dynamic Perspectives on Pedagogical Content Knowledge

The perspective of static analysis places emphasis on the importance of enabling teachers to acquire predetermined teaching skills and develop a fixed body of professional knowledge (Kind & Chan, 2019). Nevertheless, due to teachers' di-

verse backgrounds and teaching environments, the dynamic perspective can explain the different approaches adopted by various educators. Relevant studies primarily center on the examination of the constructivist learning theory, encompassing both theoretical and empirical viewpoints.

Cochran et al. (1993) argued that the term "knowledge" is too static and does not conform to the constructivist view because the development of PCK is continuous and evolving. They came up with the concept of "PCK construction" to demonstrate an integrated understanding of pedagogy, subject knowledge, students, and environmental factors.

In contrast to Shulman's model, Cochran et al. (1993) placed greater emphasis on student characteristics and the learning environment. Knowledge about students encompasses factors such as abilities, learning strategies, age, language proficiency, attitudes, motivation, and comprehension of previously acquired concepts. On the other hand, knowledge about the environment pertains to teachers' understanding of societal, political, cultural, and natural aspects that influence the teaching process.

From a constructivist perspective, knowledge about students and the environment plays a crucial role in learning, as it is ultimately the students who determine what they learn, rather than being solely dictated by teachers. Cochran et al. pointed out that the construction of subject teaching is not a simple superposition of these four factors but a comprehensive integration. Although these four circles represent the symmetrical development of teachers' cognition, their contributions are not the same at the beginning of a teacher's career, and the development is also uneven. These four circles will progressively enlarge as educators enhance their pedagogical expertise and capacity for self-reflection. With the continuous increase in these four types of knowledge, teachers' PCK will also increase simultaneously. Cochran et al. explained the concept of PCK from the perspective of constructivism, highlighting the dynamic nature of PCK and promoting teachers' professional development. Therefore, this model has implications for teacher education and teacher development.

According to Hashweh (2005), the meaning of PCK has been continuously expanding, leading to the loss of its most prominent feature, which is the subject's particularity. He posits that PCK does not fall under the category of a subsidiary component of subject knowledge, nor does it constitute comprehensive, all-encompassing knowledge. The author presents a pentagonal model. In this specific model, the primary emphasis is placed on the teacher's construction of teaching, while the surrounding seven types of knowledge exhibit similarities to the knowledge structure proposed by Shulman. Nevertheless, Hashweh (2005) emphasized that integrating these seven types of knowledge is evident in teachers' pedagogical practices, as they are focused on diverse subject matters. For instance, the PCK of science teachers encompasses various topics such as photosynthesis, the respiratory system, as well as the structure and function of organisms. Hashweh (2005) claimed that a close integration exists between instructors'

teaching construction and their reflection and belief systems. The author argues that teachers' beliefs significantly impact their PCK and further suggests that certain beliefs hold greater importance than others in the development of PCK. Teachers' reflections during teaching planning, interaction, and post-activation stages can effectively showcase their PCK. Additionally, he emphasized that forecasting the development of teachers' PCK will serve as a key focus for future research advancements.

The emergence of technological pedagogical content knowledge (TPACK) in the academic field integrated technology into teachers' knowledge and highlighted its constructivist nature (Bagheri, 2020). It is characterized by its inherent instability. There is a consensus that TPACK undergoes continuous formation and development during transformations (Angeli & Valanides, 2013) and can be examined within micro-, meso-, and macro-level contexts (Porras-Hernández & Salinas-Amescua, 2013).

5. Studies of the PCK Components in the General Education Field

The following table presents a comprehensive overview of the various components of PCK that have been suggested by scholars in the field of general education (see **Table 1**).

6. Results and Discussions

Through an analysis of pertinent static and dynamic elaborations on PCK, the subsequent section provides a synthesis of the interpretations of PCK presented by different scholars in the domain of general education.

As seen from the above table, although there are different components in the PCK model for different subjects, PCK has become a widely accepted concept. Cochran et al. (1993) and Hashweh (2005) demonstrated the fluidity of this concept when viewed through a constructivist lens. Although researchers who study the composition of PCK from a static perspective do not include a dynamic perspective in their models, they all agree that PCK is constantly changing. Due to the different backgrounds of teachers' learning experiences, the development paths of their PCK must also be different, so the dynamic perspective is more worthy of attention.

Based on the aforementioned table, three distinct themes can be discerned. Firstly, a comprehensive literature review on PCK in general education offers a comprehensive overview of the current understanding of PCK. Researchers concur that PCK encompasses the expertise and skill of educators in effectively connecting theoretical knowledge with practical application. The concept of PCK exhibits variations in accordance with the principles of social constructivism, as well as cognitive and psychological factors. Additionally, various components intermingle with one another. Second, the fundamental constituents of PCK, as suggested by Shulman, encompass an understanding of students and

Table 1. Studies of the PCK components in the general education field.

Studies by different researchers	Knowledge of									
	aims	curriculum	students	Instructional strategies	Subject matter	context	medium of instruction	resources	evaluation	orientations/ beliefs
Shulman (1986)			√	√						
Tamir (1988)		√	√	√					√	
Grossman (1990)	√	√	√	√						
Marks (1990)			√	√	√		√			
Magnusson, Krajcik, & Borko (1999)		√	√	√					√	√
An, Kulm, & Wu (2004)		√	√	√	√					
Cochran, DeRuiter & King (1993)			√	√	√	√				
Hashweh (2005)	√	√	√	√	√	√		√		
Henze, Van Driel, & Verloop (2008)		√	√	√					√	
Nilsson (2008)				√	√	√				
Rollnick, Bennett, Rhemtula, Dharsey & Ndlovu (2008)			√	√	√	√				
Jang, Guan, & Hsieh (2009)			√	√	√	√				
Chow (2010)	√	√	√	√	√					
Davidowitz & Rollnick (2011)		√	√	√	√	√				√
Zou (2014)		√	√	√	√					
Kind & Chan (2019)		√	√	√	√			√	√	

familiarity with teaching strategies, which serve as the central elements of PCK. Thirdly, PCK is a multifaceted concept that exhibits variations in its conceptual definition. For instance, most frameworks consider curriculum knowledge a fundamental element, and it is worth noting that curriculum knowledge can have various interpretations. In accordance with the framework proposed by Magnusson et al., curriculum knowledge encompasses the explicit objectives outlined in the curriculum. In the framework proposed by Grossman, it is important to note that curriculum knowledge does not encompass instructional objectives, as they are listed as separate entities. Given the inherent interconnection between subject knowledge and PCK, there also exists a certain level of controversy surrounding the integration of subject knowledge within the framework of PCK.

In relation to the understanding of assessment knowledge for student learn-

ing, only a limited number of scholars, namely Tamir (1988), Magnusson et al. (1999), Henze et al. (2008), and Kind & Chan (2019) explicitly addressed this aspect. The limited number of references indicates that the investigation of assessment knowledge is predominantly concentrated within specific science disciplines. At the same time, the teaching environment has gained increased attention in recent years, as evidenced by the growing frequency with which the educational context is mentioned as a significant factor.

In addition to the discussion surrounding the essence of PCK, precisely its dynamic or static nature, a scholarly dispute exists regarding whether PCK is canonical, personalized, or a fusion of both. The canonical perspective is that PCK is universally applicable, possesses a standardized or predictable nature, and can be acquired by educators from diverse backgrounds through formal educational programs. On the other hand, PCK is recognized as a personalized form of knowledge that is practical and experiential in nature, specifically tailored to the personal expertise of teachers (Van Driel et al., 2002). In contrast to the more general nature of PCK, a growing body of research supports the notion that it is highly individualized (Tsui, 2003; Hashweh, 2005). This is due to the fact that the utilization of teaching strategies and skills is highly contingent upon the specific teaching environment and the unique circumstances of each teaching event.

Researchers have proposed different PCK frameworks similar to those proposed by Shulman. However, it should be noted that these models also possess certain operational deficiencies. The act of teaching encompasses a multitude of intricate and varied tasks, and it is important to recognize that Shulman's model cannot serve as a universal solution for all challenges. Focusing solely on the different components of PCK can lead to changing teaching from a job of wisdom and decision-making to a skill with little choice and independence. Furthermore, Kuhn proposed a model of PCK from the cognitive point of view. Many frameworks lack attention to teacher noncognitive factors, such as self-efficacy and self-confidence. These factors are necessary in the process of learning to teach; for example, teachers need to be restorative, reflective, and able to respond to teaching feedback to establish high-quality teaching (Ma & Cavanagh, 2018; Burak, 2019).

In addition, there is still a lack of discussion on how to develop PCK, leading people to misunderstand that the development path of teachers' expertise is difficult to define. In the aforementioned models, there is a lack of emphasis on student learning outcomes, suggesting that teachers simply need to possess a set of teaching strategies to achieve positive learning outcomes. Furthermore, these models do not guide how to acquire more effective teaching strategies, nor do they offer criteria for evaluating the quality of student learning. The main issue with PCK in this subject is that it tends to treat knowledge as mere information, without considering how it is acquired through behavior (Settlage, 2013). Unless teachers apply their knowledge in the classroom, it will have a limited impact on

students. Additionally, various factors, such as students' personality traits, preferences, abilities, motivation, curriculum, and environment, influence the quality of both teaching and learning. Even the most appropriate teaching strategies, combined with a thorough understanding of students' learning difficulties, will yield little results if these factors are not taken into account.

7. Conclusion

This literature review presents a systematic examination of studies focusing on the components of PCK across diverse disciplines, considering both static and dynamic perspectives. The review findings suggest that PCK exhibits a dynamic nature rather than a static one. In addition, previous research has shown that PCK is inherently personalized rather than being regarded as canonical knowledge, as the application of pedagogical skills and expertise is predominantly shaped by occurrences and contextual elements within diverse educational settings. To ensure quality instruction, it is crucial to consider the educational context and the non-cognitive attributes of teachers, such as their beliefs, efficacy, orientations, and agency. This research initiative supports educators in effectively understanding and integrating PCK into their instructional methods, ultimately improving the overall standard of teaching.

Author Contributions

Both authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

This study was conducted in accordance with the Academic Integrity Code of North China University of Technology.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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