

Developing Pedagogical Content Knowledge (PCK) in Pre-Service and In-Service Teacher Training

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Abstract:

This study examines the development of Pedagogical Content Knowledge (PCK) in pre-service and in-service teacher training and its impact on teaching effectiveness. Using a qualitative descriptive approach, data were collected through interviews, classroom observations, and document analysis involving teachers and teacher educators. The findings reveal that PCK development significantly enhances teachers' ability to transform subject matter into meaningful and accessible learning experiences. Pre-service teachers benefit from structured practicum and mentoring, while in-service teachers improve their instructional practices through continuous professional development. The study also highlights the importance of reflective practice, collaboration, assessment, and technology integration in strengthening PCK. However, challenges such as limited resources, time constraints, and varying levels of teacher motivation were identified. The study concludes that a comprehensive and sustained approach to teacher education is essential to optimize PCK development and improve the overall quality of teaching and learning.

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Introduction (مقدمة)

Developing Pedagogical Content Knowledge (PCK) has become a fundamental concern in contemporary teacher education, particularly in preparing educators to effectively deliver subject matter to diverse learners. PCK emphasizes the blending of content expertise with pedagogical strategies, enabling teachers to transform knowledge into forms that are accessible and meaningful for students. This concept underscores that effective teaching is not solely about mastering subject content but also about understanding how to present it appropriately. As educational demands continue to evolve, the importance of PCK becomes increasingly evident. Teachers are expected to adapt their instructional approaches to meet varied learning needs. Therefore, PCK is widely recognized as a core component of teacher competence (Shulman, 1986).

In pre-service teacher training, the development of PCK begins with the acquisition of foundational knowledge in both subject matter and pedagogy. Teacher education programs are designed to integrate these two domains through coursework and practical experiences. Prospective teachers are introduced to teaching methods, classroom management, and curriculum design. At the same time, they deepen their understanding of the subjects they will teach. This dual focus helps them begin to develop the ability to transform content into teachable knowledge. Field experiences such as teaching practicums play a crucial role in this process (Grossman, 1990).

The transition from theoretical understanding to practical application is a critical stage in PCK development. Pre-service teachers often face challenges in applying abstract pedagogical concepts in real classroom situations. Teaching practicum experiences provide opportunities to experiment with instructional strategies and receive feedback. Through guided practice, they learn how to adapt content to different student needs. This experiential learning strengthens their ability to connect theory with practice. Consequently, practical experience is essential for building effective PCK (Darling-Hammond, 2017).

In-service teacher training further develops PCK by providing opportunities for continuous professional growth. As teachers encounter new challenges in their classrooms, they must refine their instructional practices. Professional development programs offer training in innovative teaching strategies and subject-specific pedagogy. These programs enable teachers to update their knowledge and improve their teaching effectiveness. Continuous learning ensures that teachers remain responsive to changing educational contexts. Therefore, in-service training is vital for sustaining PCK development (Desimone, 2009).

Reflective practice is another important element in the development of PCK. Teachers are encouraged to reflect on their teaching experiences to identify strengths and areas for improvement. Reflection allows educators to critically evaluate their instructional decisions. This process leads to deeper understanding and more effective teaching strategies. Reflective practice also fosters a habit of continuous learning. As a result, it plays a significant role in enhancing PCK over time (Schön, 1983).

Understanding students' learning processes is a key component of PCK. Teachers must be aware of students' prior knowledge, misconceptions, and learning difficulties. This understanding enables them to design instruction that addresses students' specific needs. By anticipating challenges, teachers can provide appropriate explanations and examples. This learner-centered approach improves the effectiveness of teaching. Therefore, knowledge of learners is an integral part of PCK development (Shulman, 1987).

Collaboration among teachers contributes significantly to the enhancement of PCK. Professional learning communities provide platforms for sharing experiences and best practices. Through collaboration, teachers can learn new strategies and gain insights into effective teaching methods. Peer discussions and joint problem-solving promote innovation in instructional practices. Collaboration also supports continuous professional growth. As a result, it strengthens both individual and collective PCK (Vescio et al., 2008).

The integration of technology into education has introduced new dimensions to PCK development. Teachers are now required to incorporate digital tools into their teaching practices. This has led to the emergence of the Technological Pedagogical Content Knowledge (TPACK) framework. TPACK extends the concept of PCK by including technological knowledge as a key component. Teachers must learn how to use technology effectively to enhance student learning. Thus, technology integration is essential in modern teacher education (Koehler & Mishra, 2009).

Assessment practices also influence the development of PCK. Teachers need to design assessments that accurately measure student understanding and provide meaningful feedback. Assessment data can inform instructional decisions and help teachers adjust their teaching strategies. Effective assessment practices support student learning and improve teaching quality.

They also help teachers identify areas where students need additional support. Therefore, assessment is closely linked to the application of PCK in the classroom (Black & Wiliam, 1998).

Teacher beliefs and attitudes play a significant role in shaping PCK development. Teachers' perceptions of teaching and learning influence how they approach instruction. Positive attitudes toward innovation and professional development encourage continuous improvement. Conversely, resistance to change may hinder the adoption of new teaching strategies. Teacher education programs must address these beliefs to support effective practice. Understanding the role of beliefs is essential for fostering strong PCK (Pajares, 1992).

Despite its importance, developing PCK presents several challenges in both pre-service and in-service contexts. Limited resources, insufficient training opportunities, and lack of institutional support can hinder effective development. In some cases, teacher education programs may not adequately integrate theory and practice. This can result in gaps in teachers' instructional skills. Addressing these challenges requires comprehensive and well-designed training programs. Strong support systems are essential for successful PCK development (Darling-Hammond, 2017).

In conclusion, the development of Pedagogical Content Knowledge is essential for effective teaching in contemporary education. Both pre-service and in-service training play important roles in building and sustaining this competence. The integration of theory, practice, reflection, collaboration, and technology enhances PCK development. Despite existing challenges, well-structured programs can significantly improve teaching quality. This study aims to examine strategies for developing PCK in teacher training and their impact on educational outcomes..

Method (منهج)

This study employs a qualitative research approach with a descriptive design to investigate the development of Pedagogical Content Knowledge (PCK) in both pre-service and in-service teacher training. The qualitative approach is chosen because it allows for an in-depth exploration of teachers' experiences, perceptions, and practices related to PCK development. This method is particularly suitable for examining complex educational processes that involve human interactions and contextual factors. By focusing on participants' perspectives, the study aims to generate rich and meaningful data. The descriptive design enables the researcher to present findings in a detailed and systematic manner. This approach is widely used in educational research to understand instructional practices (Creswell & Poth, 2018).

The research was conducted in teacher education institutions and selected schools that implement both pre-service and in-service training programs. These settings were chosen because they provide a comprehensive context for examining PCK development. Pre-service programs offer insights into initial teacher preparation, while in-service settings reflect ongoing professional development. The combination of these contexts allows for a holistic analysis of PCK development across different stages of teaching careers. Data collection was carried out over a defined period to ensure sufficient engagement with participants. This setting supports the validity of the findings (Yin, 2018).

The participants in this study consisted of pre-service teachers, in-service teachers, and teacher educators. A purposive sampling technique was used to select participants who have direct experience with teacher training programs. Pre-service teachers were selected from final-year cohorts, while in-service teachers were chosen based on their teaching experience and involvement in professional development activities. Teacher educators were included to provide insights into program design and implementation. This diverse group of participants ensured a comprehensive understanding of the research topic. The sampling approach aligns with qualitative research principles (Sugiyono, 2013).

Data collection was conducted using multiple techniques to enhance the credibility and

depth of the study. The primary method was in-depth interviews with participants. These interviews aimed to explore participants' understanding of PCK, their experiences in teacher training, and the challenges they face. A semi-structured interview format was used to allow flexibility in exploring emerging themes. This method enabled the researcher to gather detailed and nuanced information. Interviews were recorded and transcribed for analysis (Kvale & Brinkmann, 2009).

In addition to interviews, classroom observations were conducted to examine how PCK is applied in teaching practices. The researcher observed instructional strategies, teacher-student interactions, and the ways in which content was presented. Observations provided real-time data on how teachers integrate pedagogical and content knowledge. This method allowed the researcher to validate findings from interviews. Observational data were systematically recorded using field notes. This approach ensures a more accurate representation of teaching practices (Spradley, 1980).

Documentation analysis was also used as a complementary data collection method. Relevant documents such as lesson plans, teaching materials, curriculum guidelines, and training modules were examined. These documents provided insights into how PCK is conceptualized and implemented in teacher education programs. They also helped to identify the alignment between theoretical frameworks and actual practices. Document analysis strengthens the credibility of the study by providing additional sources of evidence. This method is widely used in qualitative research (Bowen, 2009).

The data analysis process followed a thematic analysis approach. The researcher began by organizing and coding the collected data to identify patterns and themes related to PCK development. Codes were grouped into categories that reflect key aspects of teacher knowledge and instructional practices. The analysis involved interpreting relationships between themes and drawing meaningful conclusions. This systematic process ensures that the findings are grounded in the data. Thematic analysis is an effective method for analyzing qualitative data (Braun & Clarke, 2006).

To ensure the trustworthiness of the study, several validation strategies were employed. Triangulation was used by comparing data from interviews, observations, and documentation. Member checking was conducted by sharing findings with participants to confirm their accuracy. Prolonged engagement in the research setting helped the researcher gain a deeper understanding of the context. These strategies enhance the credibility and reliability of the findings. Ensuring trustworthiness is essential in qualitative research (Denzin, 2012).

Ethical considerations were carefully addressed throughout the research process. Participants were informed about the purpose of the study and their consent was obtained before data collection. Confidentiality and anonymity were maintained by using pseudonyms and secure data storage. Participants were given the right to withdraw from the study at any time. The researcher ensured that all procedures adhered to ethical research standards. This approach protects the rights and well-being of participants (Orb et al., 2001).

In conclusion, the methodological framework of this study is designed to provide a comprehensive understanding of PCK development in teacher training. By employing a qualitative approach and multiple data collection techniques, the study captures the complexity of teaching practices. The systematic analysis and validation procedures ensure the reliability of the findings. This method allows for a detailed exploration of how PCK is developed and applied. Ultimately, it contributes to improving teacher education programs.

Result (نتائج)

The findings of this study reveal that the development of Pedagogical Content Knowledge (PCK) in pre-service and in-service teacher training significantly enhances teachers' instructional effectiveness. Participants demonstrated an increased ability to transform subject matter into understandable and engaging learning experiences. Pre-service teachers showed progress in integrating theoretical knowledge with classroom practice, particularly during teaching practicum sessions. They became more confident in delivering lessons and adapting content to students' levels of understanding. Similarly, in-service teachers reported improvements in their teaching strategies after participating in professional development programs. Overall, PCK development contributed to more effective and student-centered instruction.

The study also found that pre-service teachers initially faced challenges in applying pedagogical theories to real classroom situations. Many participants struggled with classroom management and adapting instructional methods to diverse student needs. However, through guided practice and mentoring, they gradually developed the ability to present content more effectively. Teaching practicum experiences played a crucial role in this development. These experiences allowed them to experiment with different teaching strategies and receive constructive feedback. As a result, their PCK improved significantly over time.

In-service teachers demonstrated a more advanced level of PCK, particularly in adapting content to different learning contexts. Their experience enabled them to anticipate student misconceptions and address them effectively. Professional development programs further enhanced their ability to use varied instructional strategies. Teachers reported that workshops and collaborative learning activities helped them refine their teaching practices. They also became more reflective in their approach to teaching. This continuous learning process strengthened their pedagogical competence.

Another important finding is the role of reflective practice in PCK development. Both pre-service and in-service teachers reported that reflection helped them evaluate their teaching and identify areas for improvement. Reflective activities such as lesson reviews and peer discussions encouraged critical thinking. Teachers became more aware of their instructional decisions and their impact on student learning. This awareness led to more effective teaching strategies. Reflection emerged as a key factor in continuous professional growth.

Collaboration among teachers was also found to significantly contribute to PCK development. Participants who engaged in professional learning communities benefited from sharing experiences and best practices. Collaborative discussions provided opportunities to explore new teaching approaches. Teachers gained insights into how to present complex concepts more effectively. This exchange of ideas fostered innovation and creativity in teaching. As a result, collaboration enhanced both individual and collective PCK.

The integration of technology was identified as an important factor in enhancing PCK. Teachers who used digital tools were able to present content in more interactive and engaging ways. Technology facilitated the visualization of abstract concepts, making them easier for students to understand. Pre-service teachers, in particular, showed enthusiasm for incorporating technology into their lessons. In-service teachers also recognized the benefits of digital tools in improving student engagement. The use of technology contributed to the development of Technological Pedagogical Content Knowledge (TPACK).

Assessment practices were found to play a significant role in supporting PCK development. Teachers who used formative assessment strategies were better able to monitor student understanding. Feedback from assessments helped teachers adjust their instructional approaches. This process enabled them to address learning gaps more effectively. Both pre-service and in-service teachers reported that assessment data informed their teaching decisions. As a result, assessment practices enhanced the application of PCK in the classroom.

The study also highlights the importance of understanding student characteristics in PCK development. Teachers who considered students' prior knowledge and learning needs were more effective in delivering instruction. They were able to design lessons that addressed common misconceptions. This learner-centered approach improved student engagement and comprehension. Teachers emphasized the need to adapt their teaching strategies based on student diversity. Understanding learners was therefore a critical component of effective PCK.

Despite these positive findings, several challenges were identified in the development of PCK. Pre-service teachers often lacked sufficient classroom experience, which limited their ability to apply theoretical knowledge. In-service teachers faced time constraints and heavy workloads that hindered participation in professional development programs. Limited access to resources and training opportunities also affected PCK development. These challenges highlight the need for better support systems in teacher education. Addressing these issues is essential for improving teacher competence.

The role of mentoring was found to be crucial in supporting PCK development. Experienced teachers provided guidance and feedback to less experienced teachers. Mentoring helped bridge the gap between theory and practice. Pre-service teachers, in particular, benefited from observing experienced teachers in action. They gained practical insights into effective teaching strategies. Mentoring also fostered confidence and professional growth. This support system played a vital role in enhancing PCK.

Furthermore, the findings indicate that teacher beliefs and attitudes influence the development of PCK. Teachers who were open to innovation and continuous learning showed greater improvement in their teaching practices. Positive attitudes toward professional development encouraged active participation in training programs. Conversely, resistance to change limited the effectiveness of PCK development. Teacher motivation was therefore identified as an important factor in professional growth. Supporting positive attitudes is essential for successful teacher education.

In conclusion, the results demonstrate that the development of PCK in both pre-service and in-service teacher training significantly improves teaching effectiveness. It enhances teachers' ability to deliver content, engage students, and adapt to diverse learning needs. The integration of reflection, collaboration, technology, and assessment further strengthens PCK. Despite existing challenges, the overall impact of PCK development is highly positive. These findings highlight the importance of continuous professional development in improving educational quality.

Discussion (مناقشة)

The findings of this study confirm that the development of Pedagogical Content Knowledge (PCK) is essential in enhancing the quality of teaching in both pre-service and in-service teacher education. Teachers who possess strong PCK are better able to transform subject matter into forms that are understandable and engaging for students. This demonstrates that effective teaching requires more than content mastery; it also demands the ability to present knowledge in ways that align with students' cognitive levels. The results reinforce the theoretical foundation that PCK is a core element of teacher competence and must be continuously developed throughout the teaching career (Shulman, 1987).

The challenges faced by pre-service teachers in applying theoretical knowledge to classroom practice highlight the importance of experiential learning. Many novice teachers struggle to implement pedagogical strategies effectively due to limited teaching experience. This gap between theory and practice suggests that teacher education programs need to provide more structured and guided practicum opportunities. Through direct classroom engagement, pre-

service teachers can gradually develop the skills necessary to adapt content to diverse learning contexts. This supports the argument that practical experience is indispensable in PCK development (Darling-Hammond, 2017).

In contrast, in-service teachers demonstrate more advanced levels of PCK due to their teaching experience and exposure to real classroom situations. Their ability to anticipate student misconceptions and adjust instructional approaches reflects a deeper understanding of both content and pedagogy. However, continuous professional development remains necessary to keep their knowledge up to date. Educational changes, including curriculum reforms and technological advancements, require teachers to continuously refine their teaching strategies. This underscores the importance of lifelong learning in the teaching profession (Desimone, 2009).

Reflective practice emerges as a significant factor in strengthening PCK. Teachers who engage in reflection are more likely to evaluate their instructional effectiveness and make necessary improvements. Reflection encourages teachers to analyze their teaching experiences critically and identify strategies that work best for their students. This process fosters self-awareness and professional growth. As a result, reflective practice contributes to the continuous improvement of teaching quality. It also promotes a deeper understanding of the relationship between teaching methods and student outcomes (Schön, 1983).

Collaboration among teachers is another important aspect that enhances PCK development. Professional learning communities provide a platform for sharing experiences and discussing instructional challenges. Through collaboration, teachers gain new insights and learn alternative approaches to teaching complex concepts. This exchange of knowledge fosters innovation and improves instructional practices. Collaborative environments also support mutual learning and professional support. Therefore, collaboration plays a vital role in strengthening both individual and collective teacher competence (Vescio et al., 2008).

The integration of technology into teaching practices further expands the concept of PCK. The emergence of Technological Pedagogical Content Knowledge (TPACK) highlights the need for teachers to integrate digital tools effectively into their instruction. Technology enables teachers to present abstract concepts in more visual and interactive ways, enhancing student understanding. However, successful integration requires both technical skills and pedagogical knowledge. Teachers must be trained to use technology meaningfully rather than merely as a supplementary tool. This finding aligns with contemporary perspectives on digital learning (Koehler & Mishra, 2009).

Assessment practices also contribute significantly to the development of PCK. Teachers who use formative assessment strategies can better understand students' learning progress and adjust their teaching accordingly. Feedback from assessments provides valuable information about students' strengths and weaknesses. This allows teachers to design more effective instructional strategies. Assessment, therefore, is not only a tool for measuring learning but also a means of improving teaching. It plays a crucial role in linking teaching practices with student outcomes (Black & Wiliam, 1998).

Another important finding is the role of understanding student characteristics in effective teaching. Teachers who consider students' prior knowledge, learning styles, and potential misconceptions are more successful in delivering instruction. This learner-centered approach ensures that teaching is responsive to students' needs. It also enhances student engagement and comprehension. Understanding learners is a fundamental component of PCK. Without this knowledge, teaching may fail to address students' actual learning challenges (Shulman, 1986).

Despite the positive impact of PCK development, several challenges remain. Limited time, heavy workloads, and lack of institutional support can hinder teachers' participation in professional development programs. Additionally, not all teachers are equally motivated to

engage in continuous learning. These challenges indicate the need for supportive policies and resources to facilitate teacher development. Educational institutions must create an environment that encourages professional growth. Addressing these barriers is essential for maximizing the benefits of PCK development (Guskey, 2002).

The discussion highlights that PCK development is a multifaceted process that requires continuous effort and support. It involves the integration of content knowledge, pedagogical skills, reflection, collaboration, and technology. Both pre-service and in-service teacher training play crucial roles in this process. While challenges exist, the benefits of strong PCK are evident in improved teaching effectiveness and student learning outcomes. Therefore, a comprehensive and sustained approach to teacher education is necessary to ensure long-term success in educational practice.

Conclusion (خاتمة)

This study concludes that the development of Pedagogical Content Knowledge (PCK) is a fundamental component in enhancing teaching effectiveness across both pre-service and in-service teacher training. Teachers who possess well-developed PCK are better equipped to transform complex subject matter into meaningful and accessible learning experiences for students. The integration of theory and practice, supported by reflective activities and practical teaching experiences, plays a crucial role in strengthening this competence. Furthermore, elements such as collaboration, assessment, and technology integration contribute significantly to the continuous growth of teachers' pedagogical capabilities.

However, the study also highlights that the development of PCK is not without challenges. Factors such as limited time, insufficient resources, and varying levels of teacher motivation can hinder professional growth. Therefore, sustained institutional support, effective professional development programs, and a strong commitment to lifelong learning are essential. By addressing these challenges and promoting a comprehensive approach to teacher education, PCK development can be optimized, ultimately leading to improved teaching quality and better student learning outcomes.

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