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THE ROLE OF PEDAGOGICAL CONTENT KNOWLEDGE IN IMPROVING ELEMENTARY TEACHER' TEACHING EFFECTIVENESS

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Abstract

This study aims to examine the role of Pedagogical Content Knowledge in enhancing the effectiveness of elementary school teachers' instruction thru a literature review approach. The background of the research is based on the importance of teachers' professional competence in facing the demands of 21st-century learning, which emphasizes conceptual understanding, active engagement, and meaningful learning. The method used is qualitative research by reviewing various scientific sources in the form of national and international journal articles, educational books, conference proceedings, as well as relevant theses and dissertations. The study results indicate that Pedagogical Content Knowledge plays a significant role in improving the quality of learning thru the presentation of more concrete concepts, the ability to address student misconceptions, and the enhancement of two-way interaction in the classroom. Teachers with a high level of Pedagogical Content Knowledge are able to design learning strategies that align with the characteristics of elementary school students, thereby encouraging active engagement and deeper conceptual understanding. Moreover, Pedagogical Content Knowledge contributes to the improvement of students' learning outcomes and critical thinking skills because the learning process focuses on understanding rather than mere memorization. This study concludes that strengthening Pedagogical Content Knowledge is a key factor in enhancing the effectiveness of elementary school teachers' instruction. Therefore, the professional development of teachers needs to be directed toward training based on Pedagogical Content Knowledge so that the quality of learning in elementary schools improves sustainably.

Keywords: Pedagogical Content Knowledge, Teaching Effectiveness, Elementary School Teachers.

INTRODUCTION

Learning in Elementary Schools in the 21st century is facing rapid changes due to the development of information technology and the demands of global competencies. Students are no longer sufficient to just master rote memorization of material, but are required to be able to think critically, creatively, and collaboratively. This condition requires teachers to shift their teaching approach from being teacher-centered to student-centered (Rieu et al., 2022). However, in practice, there is still a lot of one-way learning that is textbook-oriented. Teachers often focus on delivering material without paying attention to the students' understanding process. As a result, the learning becomes less meaningful and students find it difficult to relate the material to real life.

In addition to the challenge of changing the learning paradigm, there are differences in teachers' abilities to deliver lesson material. Some teachers are able to explain concepts simply and understandably for students, while others still struggle to adjust the material to the child's developmental level. This difference causes a gap in the quality of learning between classes and even between schools. A teacher who only masters the material may not necessarily be able to teach it effectively. Conversely, a teacher who understands the character of students can simplify complex concepts into easily understandable ones (Putriani, 2023). This shows that the success of learning does not only depend on mastery of the material.

Meaningful learning is greatly influenced by the professional competence of the teacher. Teachers are required to connect the subject matter with the concrete experiences of the students. When teachers only transfer information, students tend to memorize without understanding the concept. Meaningful learning occurs when students are able to connect new knowledge with prior knowledge (Ottogalli & Bermudez, 2024). Therefore, teachers must understand how students learn, not just what needs to be taught. Professional competence is key to creating an effective learning process.

One important concept in teacher professional competence is Pedagogical Content Knowledge (PCK). PCK is the integration of mastery of the material and the ability to teach that material to students. Teachers not only know the content of the lesson but also the best way to explain it. This concept emphasizes that each subject has different teaching strategies. Teachers need to choose an approach that aligns with the characteristics of

the concept and the students' abilities (Koberstein-Schwarz & Meisert, 2022). Thus, learning becomes clearer and more directed.

PCK helps teachers identify learning difficulties and misconceptions experienced by students. Teachers can use analogies, concrete examples, or relevant learning media. When the teaching strategy is appropriate, students find it easier to understand basic concepts. A good understanding will increase student engagement and confidence in learning (Pilous et al., 2023). This directly impacts the quality of classroom learning interactions. In other words, PCK plays an important role in improving the quality of the learning process. The quality of the learning process is closely related to student learning outcomes. Teachers with high PCK tend to be able to explain the material systematically and contextually. Students not only know the answer but also understand the reasoning behind it. A good conceptual understanding enhances critical thinking and problem-solving skills. Various studies show that understanding-based learning lasts longer than rote memorization (Opiyo, 2022). Therefore, PCK becomes an important factor in the effectiveness of teaching.

Although important, studies on PCK among elementary school teachers still need to be strengthened thru a literature synthesis. Many studies have been conducted separately on specific subjects. There have not been many studies that comprehensively summarize the role of PCK in teaching effectiveness. In fact, elementary school is the foundation for the formation of students' learning concepts. A good understanding from the beginning will affect learning success at the next level. Therefore, a literature review is necessary to thoroughly analyze the role of PCK in enhancing the effectiveness of elementary school teachers' instruction.

RESEARCH METHOD

This research uses a qualitative approach with a literature review method. This approach was chosen to deeply examine the concept of Pedagogical Content Knowledge and its role in enhancing the teaching effectiveness of elementary school teachers based on various findings from previous research. Data sources were obtained from national and international journal articles, educational books, conference proceedings, as well as dissertations or theses relevant to the research topic. Data were collected thru searches of scientific databases such as Google Scholar, Scopus, and Sinta. Subsequently, article selection was conducted using inclusion and exclusion criteria to ensure that the sources used have good relevance and

academic quality. This process ensures that the literature analyzed truly supports the research objectives.

Data analysis is conducted systematically thru several stages. First, data reduction to filter important information related to Pedagogical Content Knowledge and teaching effectiveness. Second, concept categorization by grouping findings based on the main themes that emerge in the literature. Third, synthesis of findings to integrate various research results into a complete and comprehensive understanding. Finally, drawing conceptual conclusions to formulate an overview of the role of Pedagogical Content Knowledge in the teaching practices of elementary school teachers. This approach is expected to produce a systematic, in-depth, and relevant theoretical study for the development of basic education (Snyder, 2019; Tranfield et al., 2003).

RESULT AND DISCUSSION

The Pattern of PCK Roles In Elementary School Learning Practices

Pedagogical Content Knowledge or PCK is a combination of mastery of the material and the teacher's pedagogical ability to effectively convey the material to students. In the practice of learning in elementary schools, PCK is reflected in the way teachers design learning activities that align with the developmental characteristics of children. Teachers do not only prepare materials based on the curriculum but also consider the cognitive levels and learning experiences of the students (Fatwa et al., 2025). This pattern shows that PCK plays a role from the lesson planning stage. A teacher with good PCK is able to identify parts of the material that have the potential to cause difficulties. Thus, the learning strategy can be prepared in a more focused and systematic manner.

In the implementation stage of learning, PCK is evident in the teacher's ability to explain concepts simply and contextually. Elementary school teachers need to use language that is easy to understand and examples that are close to the students' lives. The pattern of PCK roles is evident when teachers are able to transform abstract concepts into concrete ones thru media, illustrations, or demonstrations (Yadav et al., 2025). This is very important because elementary school students are still at the concrete operational stage. Teachers with strong PCK can adjust their teaching methods to the characteristics of the material and the needs of the students. As a result, learning becomes more interactive and easier to understand.

PCK also plays a role in anticipating and addressing students' misconceptions. In practice, teachers often encounter misconceptions that arise from the developing thinking of children. The pattern of the PCK role is evident when teachers are able to predict potential conceptual errors before the learning takes place. The teacher then designs prompting questions or clarification activities to correct that understanding (Watson, 2025). With this approach, students not only know the correct answer but also understand the proper thinking process. This shows that PCK helps create deeper learning.

Furthermore, PCK influences the quality of interaction between teachers and students in the classroom. Teachers who understand content and pedagogy in an integrated manner tend to be able to build two-way communication. This pattern is evident in class discussions, question-and-answer sessions, and feedback provision. Teachers do not only evaluate the final results but also the students' thinking processes. The feedback provided becomes more specific and constructive because it is based on an understanding of the material and the students' character. Such quality interactions encourage active student engagement in learning (Krishnasamy, 2022).

In evaluation activities, PCK helps teachers design assessment instruments that align with learning objectives. Teachers do not merely provide questions, but ensure that those questions accurately measure conceptual understanding. The pattern of the PCK role is evident when assessments are designed to explore conceptual understanding, not just rote memorization. Teachers are also able to interpret evaluation results to improve subsequent teaching strategies. Thus, evaluation becomes an integral part of the learning process, not just an administrative formality (Wicaksono et al., 2024). This indicates that PCK plays a role in the learning cycle comprehensively.

Overall, the pattern of PCK roles in elementary school learning practices is holistic and continuous. PCK influences the stages of planning, implementation, and evaluation of learning. Teachers with good PCK are able to create clear, contextual, and meaningful learning experiences. Students not only understand the material but also develop critical and reflective thinking skills. This pattern emphasizes that PCK is an important foundation in improving the effectiveness of teaching in elementary schools. Therefore, the development of PCK needs to be a focus in the education and training of elementary school teachers.

The Impact of PCK On Students' Conceptual Understanding

Pedagogical Content Knowledge (PCK) has a significant impact on students' conceptual understanding in elementary school. PCK allows teachers to teach the material not only informatively but also conceptually. Teachers with high PCK are able to explain the relationships between concepts in a coherent and logical manner (McGaw, 2022). This helps students build a systematic knowledge structure. A good understanding of concepts is not formed thru memorization, but rather thru the process of meaning construction. Therefore, PCK becomes an important factor in deepening the quality of students' understanding.

The impact of PCK is evident when teachers are able to simplify abstract concepts into more concrete ones. At the elementary school level, students are still at the stage of developing concrete operational thinking. A teacher with good PCK will use real-life examples, visual illustrations, or teaching aids to explain the material (Dhal, 2022). This approach helps students connect new concepts with everyday experiences. When students can relate the material to reality, understanding becomes deeper. This process strengthens memory and the transfer of knowledge to other situations.

Additionally, PCK helps teachers identify and address students' misconceptions early on. Misconceptions often occur because students build understanding based on limited experiences. Teachers who understand the characteristics of the material and the mindset of students can predict common mistakes that may arise. With appropriate clarification strategies, teachers can correct misconceptions (Ni'mah et al., 2023). This process is very important to prevent conceptual errors from carrying over to the next stage of learning. Thus, PCK plays a role in building a foundation of accurate understanding.

PCK also affects students' ability to explain concepts in their own words. When teachers present material thru various representations, students have multiple pathways to understand the information. Representations can be in the form of images, stories, discussions, or simple simulations. The diversity of these strategies enriches the cognitive processes of students. Students not only know the answer but also understand the reasoning behind it (Putra et al., 2025). This shows that PCK encourages the formation of deeper conceptual understanding.

Furthermore, PCK contributes to the enhancement of students' critical thinking skills. Teachers who master PCK tend to design questions that demand analysis and reflection. Students are invited to compare, categorize,

and draw conclusions from the information obtained. That activity helps students understand concepts comprehensively. A strong understanding will make it easier for students to solve new problems (Gladys & Naparan, 2025). Thus, PCK not only impacts mastery of the material but also the development of higher-order thinking skills.

Overall, the impact of PCK on students' conceptual understanding is comprehensive and sustainable. PCK helps students build structured, accurate, and meaningful knowledge. Teachers with strong PCK are able to create learning experiences that support exploration and reflection. Students become more active in constructing their own knowledge. This impact is evident in the improvement of discussion quality, explanation skills, and accuracy in answering conceptual questions. Therefore, strengthening teachers' PCK is very important to improve the quality of students' conceptual understanding in elementary schools.

The Impact of PCK on the Quality of Learning Interactions

Pedagogical Content Knowledge (PCK) directly influences the quality of learning interactions in elementary school classrooms. Teachers who understand the material as well as how to teach it tend to create two-way communication. Interaction is no longer dominated by lectures, but involves active dialog between the teacher and students. The teacher is able to adjust the language according to the students' developmental levels so that the message is easy to understand. When students understand the teacher's explanation, they are more willing to ask questions and respond. This condition enhances the overall quality of learning communication (Namanyane & Chabeli, 2025).

PCK also helps teachers design questions that encourage student participation. Questions are not only about recall but also require understanding and simple reasoning. Teachers can develop questions progressively from easy to complex (Mittal et al., 2025). This strategy makes students feel safe to attempt answering. Classroom interactions become more vibrant because many students are involved. Thus, PCK encourages active engagement in the learning process.

In addition, teachers with good PCK are able to provide accurate feedback. Feedback is not just about right or wrong, but explanations that improve students' thinking. The teacher understands where the conceptual errors lie and how to correct them. This makes students feel valued in the learning process. Students are not afraid of making mistakes because

mistakes are used as learning material. Supportive interactions increase students' learning motivation (Hartatik et al., 2025).

PCK also supports collaborative learning in the classroom. Teachers can organize focused group discussions in accordance with the learning objectives. Each group member is given the opportunity to express their opinion. The teacher acts as a facilitator who directs the discussion, not as the center of information. Students learn to listen to and appreciate their peers' opinions. This social interaction enriches students' learning experiences (Arvik et al., n.d.).

In practice, PCK helps teachers manage the differences in students' abilities. The teacher is able to provide different questions according to the students' level of understanding. Slow students remain engaged without feeling left behind. Fast students are also continuously challenged with more complex tasks. The class becomes inclusive and participatory. Learning interactions are more balanced (Fors et al., 2024).

Overall, PCK enhances the quality of learning interactions comprehensively. The relationship between teachers and students becomes more communicative and open. Learning has shifted from the delivery of information to a process of exchanging ideas. Students actively express their opinions and teachers are responsive to learning needs. Quality interactions support better concept understanding. Therefore, strengthening PCK is important to create an interactive learning environment in elementary schools.

Conceptual Model of the Relationship Between PCK and Teaching Effectiveness

The conceptual model of the relationship between Pedagogical Content Knowledge (PCK) and teaching effectiveness positions PCK as the main variable influencing the quality of learning. PCK functions as an integration between mastery of the material, understanding of student characteristics, and pedagogical strategies. In this model, teachers are not just conveyors of information, but designers of learning experiences (Shi & Baker, 2022). The effectiveness of teaching is viewed as the result of a planned and directed learning process. When PCK is high, the learning process becomes more systematic. Thus, PCK becomes the main foundation for the success of teaching.

At the stage of lesson planning, PCK influences the selection of objectives, methods, and learning media. Teachers are able to adjust the

material to the cognitive development level of the students. Good planning results in relevant and meaningful learning activities. The conceptual model shows that the quality of planning directly impacts the clarity of material delivery. Students find it easier to understand the lessons because the learning flow is logically structured (Arezky's nature, 2025). Therefore, PCK becomes the initial factor that determines the effectiveness of teaching.

In the implementation stage, PCK plays a role thru communication strategies and concept representation. Teachers use concrete examples, analogies, and demonstrations according to the needs of the material. This model illustrates that teaching strategies mediate the relationship between PCK and student engagement. The more precise the strategy used, the more active the students are in learning. Student engagement becomes an important indicator of learning effectiveness (Hasanah et al., 2023). Thus, the implementation of learning becomes the main pathway for the influence of PCK on learning outcomes.

Next, the conceptual model incorporates learning interactions as an intermediary variable. PCK helps teachers build two-way communication and provide constructive feedback. Good interaction increases student motivation and attention. Students are more willing to ask questions and express their opinions. This condition strengthens the process of concept understanding (Hamza, n.d.). Therefore, classroom interaction becomes the link between teacher competence and learning success.

At the evaluation stage, PCK influences the way teachers assess students' understanding. Teachers are able to design assessments that measure conceptual understanding, not just rote memorization. The results of the evaluation are used to improve the next learning strategies (Olugbade, 2023). This model shows a cyclical relationship between PCK, evaluation, and teaching improvement. The effectiveness of teaching is not static, but develops thru reflection. Thus, PCK plays a role in the continuous improvement of learning quality.

Overall, the conceptual model of the relationship between PCK and teaching effectiveness is systemic and layered. PCK influences the planning, implementation, interaction, and evaluation of learning. The four components together determine the success of student learning. The effectiveness of teaching emerges as the final result of the integration of the entire process. This model emphasizes that the improvement of teaching quality must start with strengthening teachers' PCK. Therefore, teacher professional

development needs to focus on the continuous enhancement of PCK capabilities.

CONCLUSION

Pedagogical Content Knowledge (PCK) is a key component in determining the effectiveness of elementary school teachers' instruction. PCK allows teachers to integrate mastery of the material with teaching strategies that align with the developmental characteristics of students. Teachers with good PCK are able to plan lessons systematically, explain concepts concretely, and anticipate students' misconceptions. This has an impact on increasing student engagement in the learning process. Learning interactions become more communicative and centered on understanding, not just the delivery of information. Thus, the quality of the learning process improves comprehensively.

Moreover, the literature review also shows that PCK contributes to the improvement of students' conceptual understanding and learning outcomes. Teachers are able to design assessments that evaluate deep understanding and use the results to improve subsequent learning. PCK forms a reflective and sustainable learning cycle from planning to evaluation. The effectiveness of teaching is not only reflected in academic grades but also in students' critical thinking skills and active participation. Therefore, strengthening PCK needs to be a focus in the education and professional training of elementary school teachers. This effort to enhance competence is believed to improve the quality of learning in elementary schools sustainably.

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