

Pedagogical Content Knowledge (PCK) Formation of Pre-Service Kindergarten Teachers in China: A Grounded Theory Approach

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Abstract: The quality of education significantly depends on the professionalism and expertise of teachers. Over the years, the evolving demands of education have underscored the need for teachers to possess a unique blend of content knowledge and pedagogical skills. Pedagogical Content Knowledge (PCK), conceptualized by Shulman, emerges as a pivotal framework that encapsulates the integration of content knowledge (CK) and pedagogical knowledge (PK), reflecting the essential competencies required for effective teaching.

Keywords: Pedagogical Content Knowledge (PCK); Pre-Service Kindergarten Teachers; A Grounded Theory Approach.

1. Introduction

This research aims to explore the development of PCK among preservice early childhood teachers in China. By employing Shulman's framework, this study seeks to understand how these teachers integrate CK and PK to enhance their teaching effectiveness. The research will investigate the components of PCK, including knowledge of content and students, instructional strategies, curriculum, assessment, and classroom management, and how these elements are developed through formal education, professional development, classroom experience, and reflective practice[1] [2].

Given the crucial role of PCK in effective teaching, this study also examines the specific challenges preservice early childhood teachers face in developing PCK. It will provide insights into the current state of teacher education in China and offer recommendations for enhancing the professional preparation of early childhood teachers. By addressing the gap between theoretical knowledge and practical application, this research aims to contribute to the improvement of teacher education programs, ultimately leading to better educational outcomes for young children[3].

The concept of Pedagogical Content Knowledge (PCK) has been extensively explored in recent educational research, highlighting its critical role in effective teaching. PCK represents the unique blend of content and pedagogy that teachers need to transform subject matter into teachable content. Studies across various educational contexts underscore the significance of PCK in enhancing teaching effectiveness, particularly in disciplines such as physical education, where content knowledge, common content knowledge, and specialized content knowledge are foundational for effective instruction.

Continuous curriculum updates are essential to keep pace with technological advancements and societal changes. Educational programs that implement life-based learning approaches have shown positive outcomes, emphasizing the need for dynamic curriculum design that supports the development of PCK. In the realm of physics education, effective lesson planning is critical. Valid assessment methods are necessary to measure the effectiveness of lesson planning

skills developed through teacher training programs.

2. Research Process

The integration of Information and Communication Technology (ICT) into teaching practices has also been linked to teachers' PCK. Research indicates that technological pedagogical content knowledge (TPACK), which integrates technology with pedagogy and content knowledge, influences the use of ICT in education. An innovative organizational climate and teachers' self-efficacy play significant roles in the successful integration of technology, further highlighting the interconnectedness of PCK and TPACK.

Studies have found that gender and teaching experience do not significantly affect teachers' self-efficacy in technology integration and TPACK. Instead, a strong correlation exists between self-efficacy in technology use and overall TPACK competence. This suggests that both male and female teachers, regardless of their experience level, can develop high levels of self-efficacy in using technology if supported appropriately.

In STEM education, structured training courses significantly improve pre-service teachers' ability to balance and integrate STEM disciplines. Developing PCK for integrated STEM education requires considerable time and support, indicating that short-term interventions may be insufficient for fostering deep integration of STEM content and pedagogical practices.

Despite the progress made, several gaps remain in the research on PCK. There is limited understanding of the long-term impact of PCK training on teaching practices and student outcomes. Future studies need to explore how sustained PCK development affects educational effectiveness over time. Additionally, while several instruments have been developed to measure PCK, there is still a need for more reliable and valid assessment tools. Current methods vary in accuracy and applicability, indicating a gap in standardized measurement approaches.

Moreover, the integration of PCK in diverse educational settings, including under-resourced schools and non-traditional learning environments, remains underexplored. More research is needed to understand how PCK can be effectively applied across different contexts. Interdisciplinary applications of PCK, such as its use in research methods

education, also require further investigation to expand its versatility and impact.

Emotions play a crucial role in shaping teachers' professional identity and PCK. Positive emotions enhance teaching effectiveness and classroom climate, while negative emotions can hinder professional development. However, comprehensive studies examining how emotional factors can be systematically integrated into teacher training programs to enhance PCK development are lacking. Addressing these gaps will be crucial for advancing the field and improving the effectiveness of teacher education programs.

Shulman's conceptualization of Pedagogical Content Knowledge (PCK) served as a guiding framework for this qualitative research. It provided a framework for understanding the unique knowledge and skills that teachers needed to effectively teach specific subject matter. According to Shulman, PCK represented the transformation and fusion of content knowledge (CK) and pedagogical knowledge (PK) in the context of teaching and learning.

Content Knowledge (CK) referred to a teacher's deep understanding of the subject matter they taught. It encompassed factual knowledge, concepts, theories, principles, and ways of organizing knowledge within a specific discipline. CK included knowing what to teach, why it was important, and how it connected to other concepts within the discipline. This knowledge was acquired through formal education, ongoing professional development, and personal experiences.

Pedagogical Knowledge (PK) focused on the knowledge and skills related to teaching and learning processes. It included understanding how students learned, different instructional strategies, assessment techniques, classroom management, student engagement, and differentiation. PK involved knowledge of various teaching methods, approaches, and techniques that facilitated effective learning. It also encompassed understanding the developmental characteristics, needs, and diversity of learners.

PCK emerged through the transformation and fusion of CK and PK. It went beyond the individual knowledge domains and combined them in a way that was appropriate for teaching specific content to specific students. PCK involved understanding how to represent and formulate the content in a way that was accessible and meaningful to learners. It included knowledge of common student misconceptions and difficulties in understanding specific concepts, as well as strategies to address these challenges.

Shulman identified several components that contributed to PCK: knowledge of content and students, knowledge of instructional strategies, knowledge of curriculum, knowledge of assessment, and knowledge of classroom management. Knowledge of content and students involved understanding the content being taught, the structure of the subject, and how it related to other topics. It also included knowledge of students' prior knowledge, misconceptions, and learning needs. Knowledge of instructional strategies encompassed the selection and use of appropriate instructional strategies, techniques, and methods to effectively convey the content to students. It included knowing how to design and sequence learning experiences, develop appropriate assessments, and provide timely feedback. Knowledge of curriculum included familiarity with curriculum frameworks, standards, and learning objectives. Teachers with PCK could align their instructional planning and delivery to the intended curriculum goals. Knowledge of assessment involved understanding how

to assess student learning and understanding. It included the use of formative and summative assessment strategies, interpreting assessment results, and using feedback to inform instructional decisions. Knowledge of classroom management encompassed the ability to create and maintain a positive and productive learning environment. It included knowledge of classroom routines, behavior management strategies, and creating a supportive and inclusive classroom culture.

The development of PCK occurred through a combination of formal education, ongoing professional development, classroom experience, and reflective practice. Teachers developed PCK by engaging in activities such as lesson planning, observing and reflecting on their teaching, collaborating with colleagues, and seeking opportunities for professional growth.

In totality, Shulman's conceptualization of PCK highlighted the essential role of integrating content knowledge (CK) and pedagogical knowledge (PK) in effective teaching. PCK represented the unique knowledge and skills that teachers possessed to teach specific subject matter in a meaningful and effective way. It involved understanding the content, knowing how to teach it, and addressing the needs and challenges of students.

The primary focus of this research was to investigate how teachers acquired, developed, and employed Pedagogical Content Knowledge (PCK) to enhance their teaching practices and promote effective student learning outcomes. By conducting in-depth research, this study aimed to contribute to the existing knowledge base on PCK formation and provide valuable insights for preservice kindergarten teachers and professional development programs.

Specifically, the research objectives of this study were narrowed to the following aspects of preservice kindergarten teachers: the development of PCK, the investigation of reflection and metacognition in PCK formation, the exploration of the link between PCK and student learning outcomes, and the proposal of strategies for enhancing PCK formation.

At that time, there was a lack of investigation into the sources of PCK for preservice preschool teachers. The significance of this study lay in understanding the current status of PCK among preservice preschool teachers and providing suggestions to promote their development based on the contribution degree of PCK sources. This study offered basic reference data for further research and considerations.

The study had several key beneficiaries who gained significant advantages from its findings. Preservice kindergarten teachers were primary beneficiaries, as they gained insights into the development of their own pedagogical content knowledge (PCK), helping them to enhance their teaching practices and improve student learning outcomes. Teacher education programs also benefited by utilizing the findings to improve curricula and training programs, ensuring that preservice teachers were better prepared to develop and apply PCK. Additionally, professional development programs gained from the strategies proposed for enhancing PCK formation, allowing them to design more effective training sessions for in-service teachers. Educational researchers found valuable reference data and insights for further research into PCK, especially in the context of preservice and early childhood education. Policymakers in education used the study's findings to inform policies and initiatives aimed at improving teacher quality and student learning outcomes.

Preschool institutions and administrators applied the research outcomes to support and guide teachers in their professional growth and instructional strategies. Indirectly, students in kindergarten benefited from improved teaching practices and better educational experiences as a result of teachers' enhanced PCK. Lastly, parents and guardians gained confidence in the quality of education their children received, knowing that teachers were well-prepared and knowledgeable. These beneficiaries collectively contributed to a broader impact on the educational ecosystem, promoting a more effective and informed approach to teaching and learning in early childhood education.

This study is focused on the exploration of the various dimensions and components that constitute PCK among preservice kindergarten teachers. It aims to gain a comprehensive understanding of how PCK integrates content knowledge (CK) and pedagogical knowledge (PK) to form a unique knowledge base that supports effective teaching. This research aims to identify and examine the contextual factors that influence the formation of PCK in teachers. It intends to explore the impact of formal teacher education, professional development programs, classroom experience, and collaborative learning environments on the development and enhancement of PCK. A crucial objective of this research is to investigate the role of reflective practices and metacognitive processes in the formation of PCK. It plans to explore how teachers reflect on their instructional practices, analyze student learning, and adapt their teaching approaches to enhance their PCK. The researcher seeks to investigate the relationship between teachers' PCK and student learning outcomes and aims to examine how teachers' PCK impacts student engagement, understanding, and achievement in specific subject areas. The methodology for this research will involve employing a grounded theory approach. It intends to conduct qualitative interviews and observations to gain in-depth insights into teachers' experiences and perceptions regarding PCK formation.

Pedagogical Knowledge refers to the understanding and application of teaching principles, strategies, and approaches that support effective instruction and student learning. It encompasses the knowledge and skills that teachers possess to plan, deliver, and assess instructional experiences in ways that engage learners, promote understanding, and facilitate their development. Pedagogical knowledge is acquired through a combination of formal education, teacher training programs, professional development opportunities, classroom experience, and ongoing reflection and growth. It is a dynamic and evolving body of knowledge that empowers teachers to design and deliver effective instruction, create engaging learning experiences, and support the diverse needs of their students.

Content Knowledge refers to a deep and comprehensive understanding of a specific subject matter or discipline. It encompasses the factual knowledge, concepts, principles, theories, and skills associated with a particular field of study. Content knowledge provides the foundation for effective teaching and allows educators to convey accurate and meaningful information to their students. Content knowledge is typically acquired through formal education, specialized training, professional development, and practical experience in a specific field. It provides the necessary expertise for teachers to design and deliver effective instruction, develop appropriate learning materials, provide accurate explanations and demonstrations, and guide students' exploration and

understanding of the subject matter.

Pedagogical Content Knowledge (PCK) is a specialized form of knowledge that represents the integration of pedagogical knowledge (PK) and content knowledge (CK) in the context of teaching and learning. It refers to the unique understanding and expertise that teachers possess in effectively teaching specific subject matter to their students. Developing PCK is a dynamic and ongoing process that occurs through a combination of formal education, practical experience, reflection, collaboration, and ongoing professional development. Teachers with strong PCK have a deep understanding of the subject matter and the instructional practices that are most effective in helping students learn and succeed.

This study employed a qualitative research approach, specifically utilizing grounded theory methodology. Grounded theory was particularly suited for this research objective as it allowed for the exploration and generation of theories based on empirical data, in this case, the experiences and perspectives of teachers. The purpose of this research study was to explore the formation of Pedagogical Content Knowledge (PCK) in teachers using a grounded theory approach. Grounded theory allowed for an in-depth understanding of how PCK develops, the factors that influence its formation, and the processes involved in its acquisition.

The study was conducted among the schools in Hebei Province, China, where the educational system is structured and regulated by the Chinese Ministry of Education. Hebei Province, located in the northern part of China, has a well-established education system that provides comprehensive education from preschool to higher education.

Preschool education in Hebei Province is not mandatory but widely available, serving children aged 3 to 6 years. It aims to foster physical, emotional, social, and cognitive development, focusing on providing a nurturing environment and preparing children for primary education.

Primary education spans six years, from Grade 1 to Grade 6, and provides students with a foundation in Chinese language, mathematics, science, social studies, and moral education. Students also receive instruction in physical education, music, and arts. Following primary education, students move on to three years of junior secondary education (Junior High School) and three years of senior secondary education (Senior High School). The secondary-level curriculum is more specialized, including subjects like Chinese language, mathematics, English, physics, chemistry, biology, history, geography, and physical education. At the end of senior high school, students take the National College Entrance Examination (NCEE), commonly known as Gaokao, which determines admission to higher education institutions.

Vocational education and training (VET) programs are also available for students who prefer to acquire technical skills and enter the workforce directly after secondary education. Vocational schools and training centers provide specialized programs in fields such as agriculture, engineering, business, tourism, and healthcare.

Hebei Province is home to several universities and colleges offering a wide range of academic programs. Students who perform well in the Gaokao have the opportunity to pursue undergraduate degrees at these institutions, which offer bachelor's, master's, and doctoral programs in various disciplines, including humanities, sciences, engineering, and medicine.

Overall, the educational system in Hebei Province emphasizes the acquisition of academic knowledge, moral education, and the development of well-rounded individuals. The curriculum places a strong emphasis on core subjects while also providing opportunities for extracurricular activities, sports, and arts to foster holistic development. Guided by national policies and standards, the educational system in Hebei Province aims to provide quality education to its population.

In grounded theory, the sampling technique used was theoretical sampling. Theoretical sampling is a purposeful sampling method that focuses on selecting participants or sources of data based on the emerging concepts and categories that developed during the data analysis process. It aimed to gather data that would provide insights into and further develop the emerging theory. Theoretical sampling involved the following key principles: sampling for maximum variation, sampling to test and refine concepts, sampling for negative cases, and an ongoing iterative process.

The main objective of the study interviews were six kindergarten teachers. After the number of participants reached six, theoretical saturation was achieved, meaning that the influencing factors of PCK in kindergarten teachers could be adequately explained without further increasing the number of respondents. The basic information of the six respondents is shown in the table below. As can be seen from the table, the six respondents were all first-line kindergarten teachers in Hebei and Beijing, with one even achieving the position of deputy principal. These six respondents had rich teaching experience, working for at least 12 years and up to 20 years. They had extensive experience in applying PCK knowledge in kindergarten teaching. Additionally, the respondents were between 35 and 45 years old, indicating they were all middle-aged teachers. Compared to young teachers, they had more teaching experience and strategies, resulting in better teaching outcomes for young children, making them suitable for analyzing influencing factors.

The primary data collection method was semi-structured interviews. These interviews provided an opportunity for teachers to reflect on their experiences and perceptions regarding PCK formation. The interviews were conducted with a purposeful sampling approach, targeting teachers with diverse backgrounds, teaching experiences, and subject expertise. The sample size was determined through theoretical saturation, where data collection continued until no new insights or themes emerged.

In addition to interviews, other data sources included classroom observations, teacher reflections, and artifacts such as lesson plans, instructional materials, and professional development documents. These supplementary data sources provided a more comprehensive understanding of the teachers' experiences and the contextual factors influencing PCK formation.

The data gathering procedure for this study was meticulously structured to ensure comprehensive and reliable data collection. Initially, the study identified the target schools within Hebei Province, China, and obtained the necessary permissions from the school administrations and relevant educational authorities. A detailed plan outlining the purpose and scope of the research was presented to these stakeholders to gain their cooperation and support.

The data collection commenced with the selection of participants, which included teachers, administrators, and students from the identified schools. Participants were chosen

using a stratified sampling method to ensure a representative sample across different school levels and regions within the province. Consent forms were distributed to all participants, explaining the nature of the study, ensuring confidentiality, and seeking their voluntary participation.

The primary data collection methods employed were surveys, interviews, and classroom observations. Surveys were administered to teachers and administrators to gather quantitative data on their perceptions and experiences related to pedagogical content knowledge (PCK). These surveys included structured questionnaires with both closed and open-ended questions to capture a broad range of responses. To ensure a high response rate, reminder emails and follow-up visits were conducted.

In-depth interviews were conducted with a subset of teachers and administrators to gain qualitative insights into their PCK development and application. These interviews were semi-structured, allowing for flexibility in probing deeper into specific areas of interest based on initial survey responses. Interview sessions were audio-recorded with the consent of the participants to ensure accuracy in data transcription and analysis.

Classroom observations were carried out to directly assess the implementation of PCK in teaching practices. A standardized observation protocol was used to document various aspects of teaching, including instructional strategies, student engagement, and classroom interactions. Observations were conducted by trained researchers to maintain consistency and objectivity in the data collected. The observation sessions were scheduled at different times to capture a variety of teaching moments and contexts.

Additionally, student performance data were gathered to explore the link between teachers' PCK and student learning outcomes. This data included standardized test scores, classroom assessments, and other relevant academic records. The researchers ensured that all data collected were securely stored and handled in compliance with ethical research standards.

To further enrich the data, focus group discussions were conducted with students to obtain their perspectives on the effectiveness of teaching methods influenced by PCK. These discussions provided additional qualitative data, offering insights into the students' learning experiences and perceptions.

Upon completion of data collection, the data were systematically organized and analyzed using both quantitative and qualitative analysis techniques. Survey data were statistically analyzed to identify patterns and correlations, while interview transcripts, focus group discussions, and observation notes were thematically analyzed to extract key themes and insights.

The data analysis process followed the principles of grounded theory. Initially, the interviews and other collected data were transcribed verbatim to ensure accuracy. This transcription process was critical as it provided a comprehensive and detailed account of the participants' responses, which formed the foundation for subsequent analysis.

Once transcription was completed, the data analysis began with open coding. During this phase, each line of the transcribed text was examined meticulously to identify initial categories and concepts. This open coding process involved labeling segments of data with descriptive codes that captured key ideas and concepts related to PCK formation. These

initial codes were broad and numerous, reflecting the diverse and detailed nature of the data.

As coding progressed, the constant comparative analysis method was employed. This involved continuously comparing new data with existing codes to refine and organize them into broader themes and categories. Through this iterative process, similar codes were grouped together, and redundant or overlapping codes were merged. This refinement helped in distilling the data into more coherent and meaningful themes that accurately captured the essence of PCK formation.

During the constant comparative analysis, patterns and relationships within the data were identified. This process helped in understanding how different aspects of PCK interrelated and influenced each other. It also facilitated the identification of core categories that represented the central themes of the study. These core categories were further explored and elaborated to ensure they were grounded in the data and reflected the participants' experiences accurately.

The final step in the data analysis involved organizing the refined codes and categories into a cohesive framework that encapsulated the key findings of the study. This framework highlighted the main themes and sub-themes related to PCK formation, providing a comprehensive understanding of the process. The grounded theory approach ensured that the analysis was data-driven and reflective of the participants' perspectives, adding rigor and depth to the findings.

To ensure the trustworthiness and rigor of the study, several strategies were employed. Firstly, member checking was used, where participants had the opportunity to review and validate the findings to ensure their accuracy and alignment with their experiences. Peer debriefing was utilized by seeking feedback from colleagues and experts in the field to enhance the validity of the interpretations.

Furthermore, triangulation was employed by utilizing multiple sources of data (interviews, observations, artifacts) to cross-validate the findings and ensure a comprehensive understanding of PCK formation. Reflexivity was maintained by the researchers through regular reflections on their own biases and assumptions, ensuring that they did not unduly influence the interpretation of the data. This reflective practice helped in maintaining objectivity and credibility throughout the research process.

Ethical considerations were thoroughly addressed to ensure the integrity and ethical soundness of the study. Informed consent was obtained from all participants, ensuring that they were fully aware of the study's purpose, procedures, and their right to withdraw at any time without any consequences. Confidentiality and anonymity were maintained by assigning pseudonyms to participants and securely storing all data to prevent unauthorized access.

Additionally, the study received approval from the relevant institutional review board (IRB) or ethics committee, ensuring compliance with ethical standards in research involving human subjects. Participants were treated with respect and their dignity was upheld throughout the research process. Any potential risks were minimized, and participants were assured that their involvement would not lead to any harm or negative consequences.

The researchers also ensured transparency by clearly communicating the aims and scope of the research to the participants. Ethical guidelines were strictly followed during data collection, analysis, and reporting to maintain the highest standards of research integrity. Regular debriefing sessions

were conducted to address any concerns raised by the participants and to provide them with a platform to express their thoughts and feedback on the study.

The following are brief descriptions of the informants:

JA is a 35-year-old female kindergarten teacher with a decade of experience in early childhood education. Her passion lies in integrating play-based learning into the curriculum, believing that play is crucial for children's development.

BB, a 29-year-old male primary school teacher, has a background in special education. He is committed to creating inclusive teaching strategies to support diverse learners, ensuring that every child has the opportunity to succeed.

At 42 years old, CC is a seasoned female secondary school science teacher with 15 years of experience. She utilizes inquiry-based learning methods to enhance student engagement and foster a deeper understanding of scientific concepts.

DD is a 30-year-old male mathematics teacher at a secondary school. Known for his innovative use of technology in the classroom, he strives to improve his students' mathematical understanding through interactive and digital tools.

With a degree in child psychology, EE is a 38-year-old female preschool teacher. She advocates for social-emotional learning, emphasizing the importance of emotional and social development in early childhood.

FF, a 33-year-old male history teacher at a high school, is passionate about making history relevant and engaging. He employs storytelling and project-based learning to bring historical events to life for his students.

GG is a 28-year-old female English teacher at a middle school. Her focus is on integrating literature and digital literacy into her teaching practices, helping students develop a love for reading and writing in a digital age.

At 45 years old, HH is a male geography teacher with two decades of teaching experience. He brings geographical concepts to life through field trips and hands-on activities, fostering a deep appreciation for the world among his students.

II is a 27-year-old female art teacher at an elementary school. She is passionate about fostering creativity and self-expression through various art mediums, encouraging her students to explore their artistic talents.

JJ, a 36-year-old male physical education teacher, promotes healthy lifestyle choices and integrates modern fitness technology into his PE classes. He believes in the importance of physical activity for overall well-being.

KK is a 31-year-old female music teacher at a middle school. She uses a blend of traditional and contemporary music education methods to engage her students, helping them appreciate the world of music.

At 40 years old, LL is a male chemistry teacher at a high school, known for his practical approach to teaching. He uses experiments and real-world applications to help students grasp complex chemical concepts.

MM, a 34-year-old female preschool teacher, has expertise in early childhood literacy. She emphasizes the importance of reading and storytelling in her teaching, fostering a love of books in her young students.

NN is a 29-year-old male IT teacher at a secondary school. He focuses on teaching coding and computational thinking, preparing his students for the demands of the digital age.

A 39-year-old female social studies teacher, OO is passionate about teaching critical thinking and civic

engagement. She uses interactive lessons to help students understand and participate in their communities.

PP is a 32-year-old male physics teacher with a background in engineering. He integrates real-world applications and technology into his lessons, making physics accessible and exciting for his students.

At 26 years old, QQ is a female kindergarten teacher who emphasizes play and exploration in her teaching. She believes that fostering a love of learning in young children is key to their future success.

RR is a 41-year-old male biology teacher at a high school, known for his hands-on approach. He uses outdoor activities to teach biological concepts, helping students connect with the natural world.

SS is a 37-year-old female English as a Second Language (ESL) teacher. She focuses on immersive and interactive methods to facilitate language acquisition, ensuring her students can communicate effectively.

A 28-year-old male drama teacher at a middle school, TT is passionate about using theater and performance to build students' confidence and creativity. He believes that drama can be a powerful tool for personal development.

UU is a 35-year-old female mathematics teacher who advocates for using technology and innovative teaching strategies. She aims to make math accessible and enjoyable for all her students.

At 30 years old, VV is a male environmental science teacher who emphasizes sustainability and environmental stewardship. He uses project-based learning to inspire his students to care for the planet.

WW is a 43-year-old female librarian who integrates digital literacy and research skills into the school curriculum. She supports student learning by providing resources and guidance on effective research practices.

XX is a 27-year-old male kindergarten teacher who focuses on fostering social skills and emotional development. He uses collaborative play activities to help children build relationships and understand their emotions.

Finally, YY is a 39-year-old female special education teacher dedicated to creating inclusive classrooms. She supports the diverse needs of all students, ensuring that everyone has the opportunity to learn and grow.

This study has delved into the intricate interplay of factors contributing to the development and application of Pedagogical Content Knowledge (PCK) among pre-service teachers. By examining intrinsic motivators, social connectors, and institutional catalysts, the research underscores the multifaceted nature of effective teaching. The concept of Holistic Pedagogical Mastery emerged as a core category, encapsulating the synergy between personal passion, supportive social networks, and enabling institutional environments.

Intrinsic motivators, such as a deep-seated passion for teaching and a commitment to student success, were found to be fundamental drivers for teachers to deepen their content knowledge and continuously refine their pedagogical strategies. These motivators align closely with Shulman's (1986) conceptualization of PCK, emphasizing the transformation of knowledge into teachable forms. Teachers who are intrinsically motivated are more likely to engage in reflective practices and seek ongoing professional development, thereby enhancing their PCK.

Social connectors, including mentorship, collegial support, and peer interactions, play a crucial role in the development

of PCK. The study found that these social interactions facilitate knowledge sharing, feedback, and collective problem-solving, enriching pedagogical approaches and fostering a culture of continuous improvement and mutual support.

Institutional catalysts provide the necessary resources, professional development opportunities, and leadership support that enable teachers to stay updated with educational advancements and integrate new pedagogical techniques. A supportive institutional environment is critical for sustaining effective teaching practices, as access to training programs, technological tools, and a conducive leadership climate helps teachers enhance their PCK.

The findings of this study highlight the transformative impact of well-developed PCK on student learning outcomes. When teachers effectively integrate content knowledge with pedagogical strategies, they create engaging and meaningful learning experiences, leading to improved student understanding and achievement. This reflects the core purpose of PCK: making subject matter comprehensible and relevant to students.

3. Conclusion

In conclusion, the study emphasizes the importance of a holistic approach to teacher education that integrates personal passion, social support, and institutional resources. By fostering an environment where these elements are harmonized, educational institutions can significantly enhance the development and application of PCK among pre-service teachers, ultimately leading to better student learning outcomes. This comprehensive understanding of Holistic Pedagogical Mastery provides valuable insights for teacher education programs and professional development initiatives, highlighting the need for a balanced and integrated approach to fostering effective teaching practices.

Based on the grounded theory formed in this study, it is recommended that teacher education programs and educational institutions adopt a holistic approach to developing Pedagogical Content Knowledge (PCK) among pre-service teachers. This approach, termed Holistic Pedagogical Mastery, integrates intrinsic motivators, social connectors, and institutional catalysts to create a supportive and enriching environment for teacher development. The following recommendations are made to enhance the effectiveness of teacher education and professional development programs:

Foster Intrinsic Motivation:

Cultivate Passion for Teaching: Teacher education programs should include modules that inspire and sustain a passion for teaching. This can be achieved through reflective practices, storytelling from experienced educators, and opportunities for pre-service teachers to connect with their motivations for choosing the teaching profession.

Promote Student-Centered Learning: Emphasize the importance of student success as a core motivator. Provide training on creating engaging, inclusive, and student-centered learning environments that can drive teachers' intrinsic motivation to continuously improve their PCK[4].

Enhance Social Connectivity:

Mentorship Programs: Establish mentorship programs where experienced teachers can guide and support pre-service teachers. Mentors can provide valuable feedback, share best practices, and help mentees navigate challenges in the classroom.

Collaborative Learning Communities: Encourage the formation of professional learning communities within schools. These communities can facilitate peer interactions, collaborative problem-solving, and shared reflections, which are crucial for developing and refining PCK[5].

Strengthen Institutional Support:

Provide Access to Resources: Ensure that teachers have access to the latest educational resources, technological tools, and professional development opportunities. This includes workshops, seminars, and online courses focused on enhancing PCK.

Leadership Support: Educational leaders should create a supportive climate that values and promotes continuous professional growth. This includes recognizing and rewarding innovative teaching practices and providing time and resources for teachers to engage in professional development.

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