# PROFILE OF PEDAGOGICAL CONTENT KNOWLEDGE ABILITIES OF PRE-SERVICE STUDENTS

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## ABSTRACT

This study aims to describe the profile of Pedagogical Content Knowledge (PCK) abilities among in-service Teacher Professional Education (TPE) students at Mahasaraswati University in Denpasar. A descriptive research method utilizing a survey technique was employed, gathering data through an online Knowledge Test Simulation (KTS) available at https://simulasiup.unmas.ac.id/. The sample comprised 148 TPE students across five fields of study: Indonesian, English, Mathematics, History, and Biology. Data analysis was based on UP simulation scores, which assessed five components of PCK: knowledge of teaching strategies, content knowledge, understanding of students, curriculum knowledge, and evaluation knowledge. The results indicated that most students exhibited a moderate level of Pedagogical Content Knowledge (PCK), with an average score of 41.32 out of a possible 80. Scores varied significantly, ranging from a maximum of 80 to a minimum of 0. Approximately half of the students (50%) fell into the moderate category, while 20% achieved a high category and 5% reached a very high level of PCK. Conversely, 15% were classified as low, and 10% as deficient. The analysis revealed that students' primary challenges lie in effectively integrating content knowledge with pedagogical techniques and developing appropriate student assessments. The study concludes that, although some students demonstrate strong mastery of PCK, the majority require additional support in enhancing their teaching strategies and assessment skills.

**Keywords:** pedagogical content knowledge, knowledge test simulation, teacher professional education

## *ABSTRAK*

*Penelitian ini bertujuan untuk menggambarkan profil kemampuan Pedagogical Content Knowledge (PCK) mahasiswa Pendidikan Profesi Guru (PPG) Dalam Jabatan di Universitas Mahasaraswati, Denpasar. Metode penelitian deskriptif dengan teknik survei digunakan dalam penelitian ini, di mana data dikumpulkan melalui Simulasi Ujian Pengetahuan (KTS) secara daring di https://simulasiup.unmas.ac.id/. Sampel terdiri dari 148 mahasiswa PPG dari lima bidang studi: Bahasa Indonesia, Bahasa Inggris, Matematika, Sejarah, dan Biologi. Analisis data didasarkan pada skor simulasi UP yang mencakup lima komponen PCK, yaitu pengetahuan strategi mengajar, pengetahuan konten, pemahaman siswa, pengetahuan kurikulum, dan pengetahuan evaluasi. Hasil penelitian menunjukkan bahwa sebagian besar mahasiswa memiliki tingkat PCK pada kategori sedang, dengan skor rata-rata 41,32 pada skala 0 hingga 80. Skor tertinggi yang dicapai adalah 80, sedangkan skor terendah adalah 0. Sekitar 50% mahasiswa berada pada kategori sedang, 20% pada kategori tinggi, dan 5% pada kategori sangat tinggi, sementara 15% berada pada kategori rendah dan 10% pada kategori sangat rendah. Analisis menunjukkan bahwa kelemahan utama mahasiswa adalah kemampuan untuk mengintegrasikan pengetahuan konten dengan pedagogi secara efektif serta dalam merancang evaluasi yang tepat untuk siswa. Penelitian ini menyimpulkan bahwa meskipun beberapa mahasiswa menunjukkan penguasaan PCK yang baik, mayoritas masih memerlukan penguatan dalam strategi pengajaran dan keterampilan evaluasi.*

***Kata Kunci:*** *pengetahuan konten pedagogis, simulasi tes pengetahuan, pendidikan*

## INTRODUCTION

Teacher Professional Education (TPE) is an initiative by the Indonesian government aimed at enhancing the quality of education. This program equips teachers with the knowledge, skills, and attitudes necessary to become professional and competent educators. According to

Regulation No. 43 of 2015 from the Ministry of Education and Culture, prospective professional teachers must possess four core competencies: pedagogical, professional, personal, and social. Among these, pedagogical competence is a fundamental element that prospective teachers must master (Ifrianti, 2018). For this reason, Bhakti and Maryani (2016) assert that teachers must understand the principles and mechanisms of Pedagogical Content Knowledge (PCK). By grasping PCK, prospective teachers can effectively explain the material and enhance students' comprehension, making it easier for them to understand the content. This, in turn, improves the quality and effectiveness of the learning process in schools.

The importance of PCK is essential for the development of professional teachers. This knowledge enables educators to effectively integrate pedagogical and content expertise in the teaching and learning process (Wu et al., 2019). Gess-Newsome et al., (2019) reveal that a teacher's PCK significantly influences students' academic performance. However, several challenges persist in achieving these teaching competencies. Observations of both online and offline teaching processes indicate that prospective teachers often struggle to deliver material effectively due to limited experience and knowledge of effective teaching methods and strategies. Additionally, many prospective teachers find it challenging to recognize students' learning difficulties, which hinders their ability to provide appropriate feedback. Finally, they often encounter difficulties in designing learning materials that incorporate teaching strategies relevant to their students' contexts and characteristics.

Various studies have addressed these three issues. The difficulties prospective teachers face in delivering material are attributed to their limited use of information technology (IT). Subudiasih et al., (2023) found that members of the PTE program encountered challenges in adopting technology and lacked technical expertise, including software skills, the selection of assessment tools, and lesson planning. Additionally, Rosnawati et al., (2020) discovered that while teachers demonstrated a correct conceptual understanding of derivatives in their lesson plans, their grasp of the concepts was still partial and lacked comprehensive depth. Meanwhile, Meiliasari, (2018) identified that student issues could be effectively addressed through lesson study, which allowed pre-service teachers to apply their knowledge in planning, conducting research lessons, and engaging in post-lesson discussions. Thus, PCK can be developed through IT skills and lesson study, although prospective teachers' understanding of teaching concepts remains incomplete.

Given the numerous studies and challenges surrounding pre-service teachers' teaching abilities, understanding the PCK profile of PTE students is crucial for enhancing the quality of education. It provides an initial assessment of their pedagogical competence and content mastery before actual classroom teaching, serving as valuable data for evaluating the learning process and curriculum, particularly at Universitas Mahasaraswati Denpasar. Consequently, this study proposes two research questions.

1. What is the level of PCK among pre-service teachers in mathematics, history, Indonesian language, English, and biology across each PCK component?

2. What factors contribute to the gaps in understanding among the different components of PCK?

Based on the two research questions above, this study offers both theoretical and empirical contributions to future research related to teachers' skills in mastering PCK. Theoretically, this research aims to enhance understanding of the factors influencing abilities among pre-service teachers. Practically, it serves as a reference for students regarding the importance of PCK knowledge in teaching practice and as an evaluation tool for universities to improve course quality.

This research synthesizes and summarizes theories related to PCK to provide a foundational understanding of the basic PCK concept. Shulman (2013) introduced the concept of PCK as a unique integration of content and pedagogical knowledge essential for effective teaching. Shulman argued that an in-depth understanding of the subject matter alone is not enough for teachers; they must also possess the skills to convey this material in ways that are accessible and understandable to students. According to Aminah and Wahyuni (2019),the PCK concept positions teachers as professionals who not only master their disciplines but also excel in teaching strategies tailored to students' needs and abilities, thus enabling more meaningful and effective learning. The PCK framework, according to Shulman (2013), is shown in Figure 1.

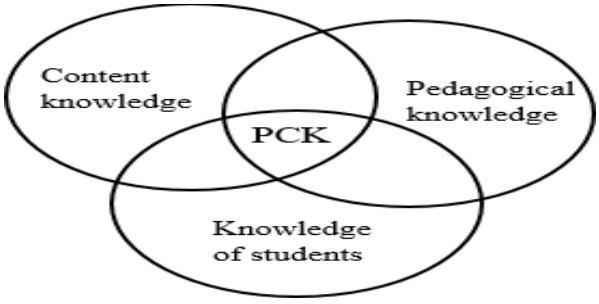


**Figure 1.** Framework of PCK (Shulman, 2013)

Park and Oliver (2008) expanded on Shulman's views by identifying the main components of PCK, including knowledge of teaching strategies, understanding of student characteristics, and curriculum knowledge. Loughran et al., (2012) explained that PCK is a crucial conceptual tool that helps teachers understand their professional role in education. According to Johar and Hanum (2021), teachers with strong PCK can adapt their teaching to various student needs and respond to different learning situations. In Khairi et al., (2022) view PCK is not only a cognitive framework but also an adaptive skill that enables teachers to design and modify instructional materials more effectively to help students achieve a better understanding.

The development of PCK in teachers is also influenced by teaching experience and professional training, as highlighted by (Van Driel et al., 1998). They found that teaching experience and opportunities for participation in professional development significantly contribute to enhancing teachers' PCK. Lee and Luft (2008) supported this finding, showing that factors

such as professional training and teaching experience play essential roles in strengthening teachers' PCK, which, in turn, positively impacts teaching quality. Thus, the integration of content knowledge and pedagogy within PCK becomes a crucial foundation for improving educational quality and student achievement. Pedagogical Content (Dhurumraj & Ramaila, 2024).

Based on the theory, this research aims to identify the level of PCK abilities among PPG students in various fields of study and to assess how well these students can solve PCK-related problems across its components. The findings from this study can be utilized for the development of a more relevant curriculum and teaching strategies, as well as providing insights for evaluating the implementation of PPG.

## RESEARCH METHOD

Based on its objectives, this study is classified as descriptive research. The researcher explains and provides an in-depth description of the level of Pedagogical Content Knowledge (PCK) among the PPG students in service, Class of 2023. In terms of data collection techniques, this research falls under the category of survey research. The study is conducted in a natural setting without applying any treatment to the research subjects (Creswell & Creswell, 2003, 2017). The researcher utilized tests and interviews as research instruments. Functionally, this study is classified as evaluative research, as the results will serve as an evaluation tool for the implementation of courses at the LPTK Universitas Mahasaraswati Denpasar. In terms of timing, this type of research is categorized as cross-sectional, as it is conducted at a specific point in time.

The population in this study consists of students from the Teacher Professional Education Program (PPG) in service at Universitas Mahasaraswati Denpasar. The sampling was conducted using a purposive sampling procedure, which involves selecting samples based on specific considerations (Sugiyono, 2012). The consideration used for sample selection was that the students had completed all theoretical courses. The sample comprised 147 PPG students distributed across several fields of study. Specifically, the subjects included 30 students from the Indonesian Language program, 29 students from the English Language program, 30 students from the Biology program, 30 students from the Mathematics program, and 28 students from the History program. Additionally, the consideration for selecting students to be interviewed was that they belonged to the Very Low level of PCK.

The instrument used in this study is a PCK test for prospective mathematics teachers. This test consists of 25 multiple-choice questions designed to assess the knowledge of PPG students in service regarding PCK. The questions are divided into five aspects: knowledge of teaching strategies, knowledge of curriculum and content, understanding of students, knowledge of assessment of learning outcomes, and beliefs or orientations regarding teaching objectives. Additionally, the interview instrument consists of questions prepared by the researcher after analyzing the results of the PCK test.

The interviews conducted with selected students who gained very high (VH), high (H), and low (L) achievement from history, math, Indonesian, English, and Biology study programs were transcribed and

analyzed using thematic analysis. This involves identifying and coding key themes and patterns from the interview responses, particularly focusing on students' perceptions of relevant courses and their suggestions for improving PCK knowledge acquisition. The qualitative data will complement the quantitative findings by providing deeper insights into the challenges and experiences students face in relation to their PCK development.

## FINDINGS AND DISCUSSION

### The level of PCK among pre-service teachers

This study aims to determine the profile of Pedagogical Content Knowledge (PCK) among PPG students in service at Universitas Mahasaraswati Denpasar. The research data was obtained from the results of the Knowledge Examination (UP) simulation conducted online through the website https://simulasiup.unmas.ac.id/. To participate in this simulation, students first logged in to the site using the provided username and password. A total of 148 students participated in the UP simulation, covering five fields of study: Indonesian Language, English Language, Mathematics, History, and Biology. Out of this total, 130 students completed the simulation with a status of "Finished," while 18 students had not taken the exam. The simulation activity was conducted online via a Zoom link in Figure 2.

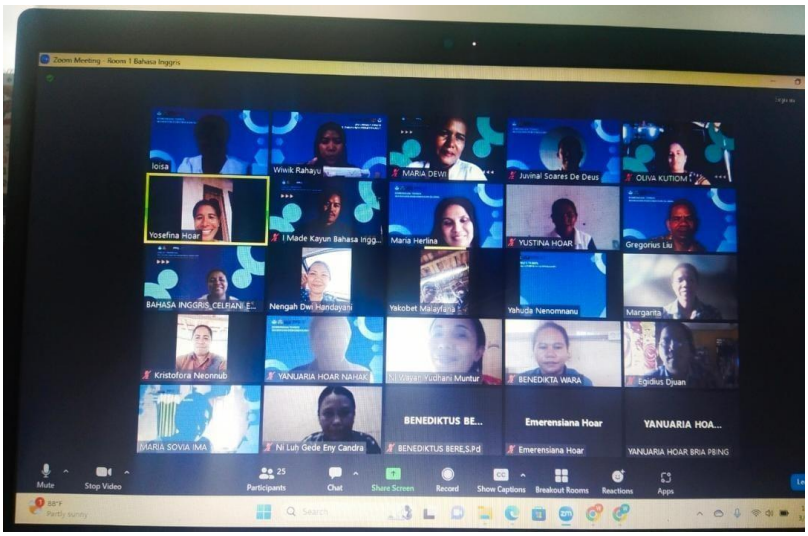


**Figure 2.** Online teaching simulation in a Zoom meeting

From the test, the simulation results reveal a range of student scores from 0 to 80, with an average score of 41.32. Specifically, the highest score achieved was 80, while the lowest score was 0, assigned to students who had not participated in the simulation. The median score was 48, meaning half of the students scored below 48 and the other half above. The distribution of scores indicates that the majority of students' PCK abilities are within the 32 to 56 range, suggesting a moderate level of proficiency for most. Further analysis shows that 25% of students scored below 32, 50% scored below 48, and 75% scored below 56. The score distribution chart highlights that most students are clustered in the mid-range,

with fewer students scoring at the higher or lower extremes. This distribution suggests a bell-curve-like pattern, where the central group exhibits moderate proficiency in PCK, and only a few students display either advanced or low levels of competency, indicating both strengths and areas for improvement within the cohort. The graph defining the proficiency in PCK is presented in Figure 3.

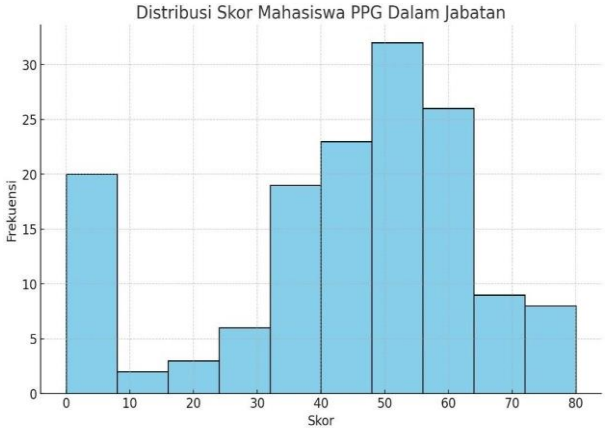


**Figure 3.** Students' Score distribution

The analysis based on simulation participation status reveals that out of the total sample, 130 students have completed the simulation, while 18 students have not yet participated. This high participation rate indicates that a substantial portion of the sample actively engaged in the UP simulation, providing a reliable basis for evaluating the PCK proficiency profile of the group. Since 87.8% of students (130 out of 148) took part, the findings offer a representative overview of the overall PCK capability among the sample population.

The students who completed the simulation contributed valid data on various aspects of PCK, covering areas such as lesson planning, content delivery, and pedagogical strategies. With the majority having taken the simulation, the resulting score distribution and competency levels reflect the general proficiency trends and skill gaps within the group. This participation rate strengthens the validity of the conclusions, allowing the results to serve as a benchmark for understanding both the existing strengths and potential areas for improvement in the PCK abilities of PPG students.

In this study, student scores were categorized into five levels to assess their Pedagogical Content Knowledge (PCK) abilities: Very High, High, Moderate, Low, and Very Low. The Very High category includes scores above 60, representing students who achieved 75% and above. The High category encompasses scores between 48 and 60, reflecting a performance level of 60-75%. Students in the Moderate category scored between 32 and 48, corresponding to 40-60%. The Low category includes those with scores ranging from 24 to 32, which represent 25-40% of mastery. Finally, the Very Low category is assigned to students who scored below 24, indicating performance below 25%. This categorization provides a structured view of the distribution of students' PCK abilities in the study.

Based on this classification, the distribution of students' PCK abilities revealed that only a small proportion (5%) achieved Very High PCK competency, with scores over 60. A larger portion, 20% of students, fell into the High category, scoring between 48 and 60. The majority, 50%, were classified as Moderate, with scores ranging from 32 to 48, indicating that half of the students demonstrated average proficiency. Meanwhile, 15% of the students scored between 24 and 32, placing them in the Low category. Finally, 10% of students scored below 24, falling into the Very Low category. The percentage of students' PCK abilities can be presented in Figure 4.

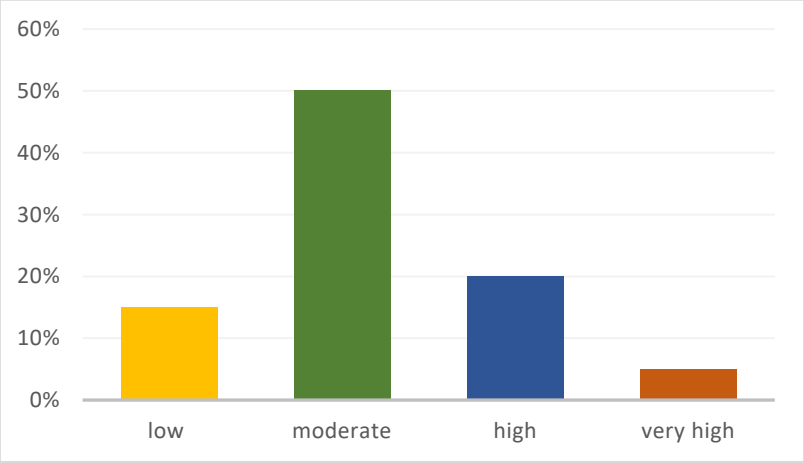


**Figure 4.** The Percentage of Students' PCK Abilities

The findings suggest that most students demonstrate a moderate level of PCK ability, with the average score falling within this range. This implies that, while students possess a foundational understanding of PCK, it remains at a mid-level overall. Only a small fraction of the students displayed Very High PCK abilities, while some were categorized as Very Low. These results indicate that while students have a basic grasp of PCK, there is room for improvement, especially in areas such as instructional strategies and assessment. The data suggest the need for enhanced training and targeted support to help students elevate their PCK competencies to higher levels.

**Factors contribute to the gaps of PCK**

The interview results show several responses that represent the implementation of PCK in the classroom by pre-service teachers. The teachers interviewed are representatives from each program. These teachers were gathered for the interview based on their test results, categorized as very high, high, and low. Below are the interview results categorized by theme.

Strengthening the Integration of Content and Pedagogy

Math education study program VH: *"I believe that the PPG curriculum needs to place greater emphasis on the integration of content material and pedagogical strategies"*. By conducting exercises focused on applying content knowledge in relevant and contextual learning,

students will be greatly assisted in strengthening their Pedagogical Content Knowledge (PCK)."

Routine Use of UP Simulation

History education study program H: "*One of my concerns is that the UP simulation, can be used routinely as part of the student evaluation process".* By conducting simulations regularly, students can continuously evaluate and improve their PCK skills."

Improvement of Teaching and Evaluation Strategies Mastery

Indonesian education study program L: *"I see the need for additional training related to teaching strategies that can be adapted to various student learning styles*". Furthermore, appropriate and relevant evaluation is also very important. Therefore, workshops or specialized training focused on both aspects should be considered."

More Intensive Supervision During PPL

English education study program H: *"In my opinion, more intensive supervision is needed while students undergo".* Field Experience Practice (PPL). Direct feedback on the application of PCK is very important. This can be done by supervising lecturers or mentor teachers to ensure that students can optimally develop their PCK skills.

Development of Reflection and Self-Evaluation

Biology education study program VH: "*I encourage students to engage in deeper reflection on their teaching practices, particularly in integrating PCK."* Regular reflection through journals or group discussions will help students identify areas that need improvement."

Emphasis on HOTS and TPaCK Learning

Math H: *"I think the PPG curriculum should encourage students to develop learning materials based on higher-order thinking Skills (HOTS) and Technological Pedagogical Content Knowledge (TPaCK)"*. This is highly relevant to the needs of modern education."

The interviews revealed several important insights regarding the enhancement of the PPG curriculum and the development of pre-service teachers. A strong emphasis on integrating content knowledge with pedagogical strategies emerged as a critical need, as it would significantly aid students in strengthening their PCK. This is in line with Chai et al., (2013) that here are still many potential gaps that the TPACK framework could be employed to facilitate deeper change in education. Therefore, the routine use of UP simulations was recommended to facilitate continuous evaluation and improvement of PCK skills. Park and Oliver (2008) indicated that PCK developed through both real-time and reflective practices within instructional settings, with teacher efficacy and student influences, particularly misconceptions, playing key roles. Additionally, certain aspects of PCK were unique to individual teachers' approaches. Furthermore, encouraging deeper reflection on teaching practices and incorporating Higher Order Thinking Skills (HOTS) and Technological Pedagogical Content Knowledge (TPaCK) into the curriculum are vital steps to meet the contemporary educational demands. The results of this study provide a foundation for several

important developments. Firstly, there is a clear need to enhance the PPG program by strengthening both pedagogical and content aspects for students, particularly through more in-depth exercises and simulations related to Pedagogical Content Knowledge (PCK). Secondly, the PPG curriculum should be adapted to address common challenges faced by students, with a greater focus on teaching strategies and learning assessment. Lastly, this evaluation aims to help students gain a better understanding of their strengths and weaknesses in terms of PCK, thereby fostering their continuous professional development as prospective teachers. By implementing these implications, we can ensure a more effective preparation of future educators to meet the demands of modern teaching.

## CONCLUSION

In conclusion, this study highlights two main findings. First, the majority of students display a moderate level of Pedagogical Content Knowledge (PCK), indicating a foundational but incomplete mastery of PCK concepts, with only a small portion of students reaching a very high level of proficiency. Second, there is significant variability in PCK skills across students, particularly in instructional strategies and assessment methods, pointing to areas that require targeted support. However the findings do not cover a generality due to longitudinal data to track PCK development over time, which could provide further insights into the effectiveness of current training methods. Additionally, the study relies primarily on student self-reports and limited observation, which may not fully capture the nuances of PCK application in classroom settings.

The study has several practical implications. It suggests that the PPG program would benefit from an increased emphasis on integrating content knowledge with pedagogical strategies, as well as implementing routine UP simulations to support continuous development. Providing additional training focused on adaptable teaching strategies and relevant assessments, as well as more intensive supervision during Field Experience Practice (PPL), would also be valuable in supporting student growth. To address these areas, it is recommended that the program incorporate reflection activities, emphasize Higher Order Thinking Skills (HOTS) and Technological Pedagogical Content Knowledge (TPaCK), and foster regular feedback sessions. By adopting these suggestions, the program can better equip future educators with the robust PCK skills needed to excel in diverse and evolving educational environments.

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