Pedagogical Knowledge of Internship Students in Teaching Elementary School Science Materials

Trivena(✉), Yohanis Padallingan, and Sarah Maramba

Universitas Kristen Indonesia Toraja, Rantepao, Tana Toraja, South Sulawesi, Indonesia
trivena@ukitoraja.ac.id

Abstract. The purpose of this study was to analyse the Pedagogical Knowledge (PK) of interns in teaching science materials in elementary schools. The study utilized a descriptive research design with a quantitative approach. The population of the study comprised students from the Elementary School Teacher Education program at Universitas Kristen Indonesia Toraja. The survey sample included 72 students who had completed or were currently undertaking an internship as part of the Introduction to Schooling Field II course at an elementary school. The instrument employed in the study was developed based on the research of Akyuz, Desstya, and Mishra, which had undergone validity and reliability testing and was specifically designed for the elementary school level. Data processing was conducted using the Microsoft Excel application, wherein the collected data was analysed to determine the average score per indicator and category. The results indicated that the average total PK of interns teaching science in elementary schools was 7.8. Based on these findings, it can be concluded that the PK of interns teaching science in elementary schools is categorized as "high."

Keywords: Elementary School · Internship Student · Pedagogical Knowledge · Science Materials

1 Introduction

The teacher is one of the keys to students' success in the classroom [1]. Some studies even claim that teachers' learning has a significant impact on student development [2].

To conduct effective and efficient learning, teachers must possess several competencies as outlined in Regulation of the Minister of National Education of the Republic of Indonesia Number 16 of 2017 regarding Academic Qualification Standards and Teacher Competencies [3]. These competencies include pedagogic competence, professional competence, personality competence, and social competence [4].

However, based on initial observations conducted in elementary schools, it was discovered that there are still numerous teachers who lack comprehension and struggle to implement these four competencies in fulfilling their roles and responsibilities as educators. This preliminary finding is further substantiated by several relevant previous

M. Kristiawan et al. (Eds.): OCERI 2023, ASSEHR 775, pp. 676–684, 2024.
https://doi.org/10.2991/978-2-38476-108-1_67

studies that examine the competencies of elementary school teachers, particularly in adapting to the demands of the 21st century [5–8].

One of the competencies that teachers need to possess is pedagogic competence. According to Law No. 14 of 2005, pedagogic competence refers to the ability to manage learning. Furthermore, Minister of Education and Culture Regulation No. 16 of 2007 provides a description of pedagogic competence, which includes the following aspects; 1) Mastering the physical, moral, spiritual, social, cultural, emotional, and intellectual characteristics of students; 2) Proficiency in learning theory and educational principles; 3) Developing a curriculum relevant to the subjects being taught; 4) Organizing educational activities; 5) Utilizing information and communication technology for educational purposes; 6) Facilitating the development of students' potential to help them actualize their various abilities; 7) Effective, empathetic, and polite communication with students; 8) Conducting assessments and evaluations of the learning process and outcomes; 9) Utilizing assessment and evaluation results to enhance the learning experience; 10) Engaging in reflective practices to improve the quality of learning [9].

Pedagogic competence, as referred to in Shulman's theory, is commonly known as Pedagogical Knowledge (PK) [10]. According to Shulman, as cited in Loughran (2016), teaching is a complex process that extends beyond the mere transmission of knowledge. Therefore, teachers must grasp this complexity in order to enhance their effectiveness as educators [11]. This implies that teachers need to integrate pedagogical knowledge with content knowledge or subject matter within the classroom setting. This integration is commonly known as Pedagogical Content Knowledge (PCK) [12].

Previous research conducted on an elementary school teacher's pedagogical practices in teaching science materials revealed that the teacher's Pedagogical Content Knowledge (PCK) category was classified as "Pre-PCK" or in a lower category [13]. This indicates that teachers have not yet fully grasped the approach of integrating pedagogical knowledge and content knowledge in their teaching methods.

Based on the findings of this study, researchers are motivated to further investigate the competence of Pedagogical Content Knowledge (PCK) and its correlation with Technological Pedagogical Content Knowledge (TPACK) among practicing teachers and prospective elementary school teachers in teaching science. This study aims to specifically examine the pedagogical knowledge (PK) of students enrolled in the elementary school teacher education program, particularly those who are undergoing internships in schools. Within the TPACK framework, PK constitutes one of the components or frameworks that will be analysed [14].

Pedagogical Knowledge (PK) for elementary school teachers, particularly in teaching science, needs to be fostered during their university education. Students who aspire to become teachers are expected not only to comprehend pedagogical knowledge but also to effectively apply it in the learning process. Internships provide an invaluable opportunity for students to directly develop and implement pedagogical knowledge with students, specifically when teaching science subjects.

Understanding science or scientific concepts from an early age holds great significance for children's future development [15]. Science is a knowledge domain closely intertwined with students' daily lives. However, there are still numerous teachers who lack understanding in this regard, resulting in their choice of teaching methods or models

for science materials being impacted [16]. Consequently, science lessons in elementary schools often rely heavily on rote memorization by students [17]. Relevant research indicates a significant relationship between the pedagogical competence and science content competence of elementary school teachers [18]. This implies that if a teacher possesses low pedagogical competence, their science content competence tends to be similarly low, and vice versa.

Based on the aforementioned background, the objective of this study was to examine the pedagogical knowledge of prospective elementary school teacher students in the context of science materials, particularly those who have undergone school internships. This research aims to contribute valuable information and research materials for future studies concerning the competence and pedagogical knowledge of elementary school teachers, as well as research in the field of Technological Pedagogical Content Knowledge (TPACK).

2 Methods

This study adopts a descriptive research design with a quantitative approach. According to Arikunto, descriptive research aims to describe variables without intending to prove a hypothesis. On the other hand, research with a quantitative approach involves utilizing numerical data throughout the process, including data collection, interpretation, and presentation of results [19]. The population of this study consists of students from the Indonesian Christian University Toraja's Elementary School Teacher Education program. The survey sample comprises 72 students who have completed or are currently undertaking internships as part of the Introduction to School Field Course II. The instrument utilized is a questionnaire, measured using a Likert scale with options ranging from "1. Strongly disagree" to "4. Strongly agree." The questionnaire is supplemented by an interview guide. The instrument used in this study is based on previous research by Akyuz (2018), Desstya (2018), and Mishra (2019), which have been validated and proven reliable, specifically designed for the elementary school level [14, 20, 21]. The measurement of pedagogical knowledge in teaching science among Elementary School Teacher Education students includes five indicators: understanding science learning methods, strategies, approaches, and models; identifying students' science misconceptions through methods, strategies, approaches, and science learning models employed; understanding thematic learning and preparing thematic science lesson plans; and adapting lesson plans to classroom conditions. Data processing is conducted using the Microsoft Excel application, where the collected data is analyzed to determine the average score per indicator using the following formula:

$$\text{Average Score} = \frac{total\ score}{maximum\ score} \times 10$$

Afterwards, the obtained average scores are categorized into the following intervals:

3 Results and Discussion

Based on the data processing of the questionnaire, the average scores for the Pedagogical Knowledge (PK) interval categories of internship students teaching science in elementary schools are as follows:

Table 1. Category Intervals

Intervals	Category
8,5 - 10	Very High
6,9 - 8,4	High
5,3 - 6,8	Currently
3,7 - 5,2	Low
2 - 3,6	Very Low

Table 2. Average Pedagogical Knowledge (PK) Score of Internship Students in Teaching Science in Elementary Schools

No.	Indicator	Average	Category
1.	Understanding science learning methods, strategies, approaches and models	7,5	High
2.	Identifying students' science misconceptions	7,8	High
3.	Understanding thematic learning	7,3	High
4.	Prepare the lesson plan thematic science	8,3	High
5.	Adjust the lesson plan to class conditions	8,1	High
Total Average		7,8	High

Based on Table 2, it is observed that the overall average score for Pedagogical Knowledge (PK) among elementary school teacher education internship students in science learning is 7.8. These findings indicate a "high" level of PK among the students. The data analysis results for each indicator are presented below:

Table 3 demonstrates that the overall average score for Pedagogical Knowledge (PK) among interns regarding the understanding of science learning methods, strategies, approaches, and models is categorized as "high." Each sub-indicator also falls within the "high" category, except for the first sub-indicator, which attains a "medium" category. This indicates that, on average, there are still students who employ lecture-based methods when teaching science in elementary schools. However, the overall findings suggest that interns possess good knowledge of various learning models applicable to science instruction. The data further reveal that the utilization of learning models such as PjBL, discovery, and inquiry learning is categorized as "high." These outcomes serve as valuable preparation for prospective elementary school teachers, as they recognize the necessity of employing models that foster student-led discovery through inquiry-based learning approaches [22].

Table 3. Understanding science learning methods, strategies, approaches and models

No.	Sub-Indicator	Average	Category
1.	Teaching science in class using the lecture method	5,4	Currently
2.	Using various methods, strategies, approaches and models of science learning when teaching in class	8,1	High
3.	Using the PjBL/discovery/inquiry learning model when teaching science in class	7,8	High
4.	Using experimental methods when teaching science in class	7,7	High
Total Average		7,5	High

Table 4. Identifying Students' Science Misconceptions

No.	Sub-Indicator	Average	Category
1.	Using science learning methods, strategies, approaches, and models to identify students' science misconceptions in	7,8	High
2.	class Identifying students' science misconceptions when teaching science in class	7,8	High
3.	Correcting students' science misconceptions when I meet them in class	7,8	High
Total Average		7,8	High

Based on Table 4, the research findings reveal that internship students obtain a score of 7.8 on the indicator of identifying student misconceptions, placing them in the "high" category. These results indicate that students in elementary school teacher education possess the knowledge and ability to identify misconceptions held by students regarding science concepts. Understanding students' misconceptions is crucial as it enables teachers to address and rectify these misconceptions by providing scientifically accurate knowledge [23].

Table 5 above illustrates that students' understanding of thematic learning falls within the "high" category, with an average score of 7.3. It is important for students to grasp the concept of thematic learning as it allows them to integrate science education with other subjects and make informed choices regarding suitable learning models [24].

Based on the indicators presented in Table VI, the study findings indicate that interns' preparation of the Science Learning Implementation Plan in elementary schools falls

Table 5. Understanding Thematic Learning

No.	Sub-Indicator	Average	Category
1.	Understanding thematic learning in elementary school	7,4	High
2.	Understand the thematic learning methods/strategies/approaches/models in elementary school	7,4	High
3.	Understanding student assessment in thematic learning	7,0	High
Total Average		7,3	High

Table 6. Prepare The Lesson Plan Thematic Science

No.	Sub-Indicator	Average	Category
1.	Making lesson plans before teaching in class	8,6	Very High
2.	Making learning designs before teaching in class	8,0	High
Total Average		8,3	High

Table 7. Adjust The Lesson Plan to Class Conditions

No.	Sub-Indicator	Average	Category
1.	Teach in class based on the lesson plans that I have made before	8,2	High
2.	Teach in class according to the conditions in the class	8,2	High
3.	Develop lesson plans based on conditions in class	7,9	High
Total Average		8,1	High

within the "High" category, with an average score of 8.3. This demonstrates that students possess the knowledge and skills required to develop lesson plans and design science learning activities prior to teaching. The pedagogical knowledge of teachers is closely associated with their ability to create effective lesson plans, emphasizing student-cantered learning processes through the application of various science learning models [25].

The data processing results for the final indicator in Table VII demonstrate that interns' knowledge of adjusting lesson plan preparations to match class conditions is categorized as "high," with a score of 8.1. It is essential to contextualize science learning in the classroom, as science and scientific events are closely linked to students' everyday lives [26]. By incorporating contextual elements, students can better comprehend science materials and establish direct connections with the events they encounter in their daily experiences [27].

4 Conclusion

The Pedagogical Knowledge (PK) of interns in elementary science learning falls within the high category, with an average score of 7.8. This indicates that students possess a strong understanding of preparing lesson plans, selecting appropriate learning models for teaching science, and identifying misconceptions related to science knowledge. However, further improvements are still necessary to integrate their pedagogical knowledge with content knowledge, ensuring that science concepts and materials are easily understood by elementary school students.

References

1. D. Blazar and M. A. Kraft, "Teacher and Teaching Effects on Students' Attitudes and Behaviors," *Educational Evaluation and Policy Analysis*, vol. 39, no. 1, pp. 146–170, Mar. 2017, doi: https://doi.org/10.3102/0162373716670260.
2. P. S. Smith and R. K. Esch, "Identifying and measuring factors related to student learning: The promise and pitfalls of teacher instructional logs," *Paper presented at the annual meeting of the American Educational Research Association, Vancouver, British Columbia, Canada*, 2021. .
3. A. Habibullah, "Teacher Pedagogic Competence," *Edukasi*, vol. 10, no. 3, p. 294376, Dec. 2012, doi: https://doi.org/10.32729/EDUKASI.V10I3.169.
4. M. Ramli, "The Role of Teacher Pedagogic Competence in Thematic Learning in Elementary Schools," *Peran Kompetensi Pedagogik Guru dalam Pembelajaran Tematik di Sekolah Dasar*, vol. 1, no. 5, pp. 984–988, May 2016, Accessed: Oct. 26, 2022. [Online]. Available: http://journal.um.ac.id/index.php/jptpp/article/view/6336.
5. M. Faisal, H. Hotimah, N. Nurhaedah, N. AP, and K. Khaerunnisa, "Increasing the Competence of Elementary School Teachers in Developing Digital Teaching Materials in Gowa Regency," *Publikasi Pendidikan: Jurnal Pemikiran, Penelitian, dan Pengabdian kepada Masyarakat Bidang Pendidikan*, vol. 10, no. 3, pp. 266–270, 2020, Accessed: Oct. 27, 2022. [Online]. Available: https://ojs.unm.ac.id/pubpend/article/view/16187.
6. I. G. D. Gunawan, Pranata, I. M. Pramarta, I. K. Mertayasa, I. M. Pustikayasa, and I. P. Widyanto, "Improving the Competence Quality of Elementary School Teachers in Welcoming the Era of Society 5.0," *Prosiding Webinar Nasional IAHN-TP Palangka Raya 2020*, pp. 15–30, 2020, Accessed: Oct. 27, 2022. [Online]. Available: https://prosiding.iahntp.ac.id/index.php/seminar-nasional/article/view/34.
7. B. Setiawan, P. Pramulia, D. Kusmaharti, T. Juniarso, and S. Wardani, "Improving Elementary School Teacher Competence in Developing Online Learning Media at SDN Margorejo I Surabaya City, East Java Province," *Manggali*, vol. 1, no. 1, p. 46, 2021, doi: https://doi.org/10.31331/manggali.v1i1.1547.
8. D. Sutisna and A. Widodo, "The Role of Elementary School Teacher Competence in Increasing the Effectiveness of Online Learning," *Jurnal Bahana Manajemen Pendidikan*, vol. 9, no. 2, pp. 58–64, 2020, Accessed: Oct. 27, 2022. [Online]. Available: http://ejournal.unp.ac.id/index.php/bahana/article/view/110927.
9. K. Murkatik, E. Harapan, and D. Wardiah, "The Influence of Professional and Pedagogic Competence on Teacher's Performance," *Journal of Social Work and Science Education*, vol. 1, no. 1, pp. 58–69, 2020, doi: https://doi.org/10.52690/jswse.v1i1.10.
10. L. E. E. S. Shulman, "Those Who Understand: Knowledge Growth in Teaching," *Educational Researcher*, vol. 15, no. 2, pp. 4–14, 1986.

11. J. Loughran and M. L. Hamilton, "International handbook of teacher education," *International Handbook of Teacher Education: Volume 1*, pp. 1–582, 2016, doi: https://doi.org/10.1007/978-981-10-0366-0.
12. J. H. Van Driel and A. Berry, "Teacher Professional Development Focusing on Pedagogical Content Knowledge," *Educational Researcher*, vol. 41, no. 1, pp. 26–28, 2012, doi: https://doi.org/10.3102/0013189X11431010.
13. T. Trivena and H. Hakpantria, "PCK (Pedagogical Content Knowledge) Early Elementary School Teachers in Teaching the Concept of Heat: A Case Study," *Elementary Journal*, vol. 3, no. 1, pp. 1–13, 2020, Accessed: Oct. 24, 2022. [Online]. Available: http://ukitoraja.ac.id/journals/index.php/ej/article/view/877.
14. D. Akyuz, "Measuring technological pedagogical content knowledge (TPACK) through performance assessment," *Computers and Education*, vol. 125, no. May 2017, pp. 212–225, 2018, doi: https://doi.org/10.1016/j.compedu.2018.06.012.
15. W. Harlen and A. Qualter, *The Teaching of Science in Primary School*, Fourth. London: David Fulton Publisher, 2004.
16. T. Trivena and W. Sopandi, "Mastery of Science Concepts for Prospective Elementary School Teachers on the Topic of Water Pollution," in *Prosiding Seminar Nasional II FKIP UKI Toraja*, 2020, pp. 201–207, Accessed: Oct. 24, 2022. [Online]. Available: https://www.researchgate.net/publication/361330189.
17. T. Trivena, A. Widodo, W. Sopandi, T. Budiarti, and Y. Gumala, "Fifth-grade elementary school perception of STEM," in *International Conference on Mathematics and Science Education of Universitas Pendidikan Indonesia*, 2018, pp. 475–480, Accessed: Oct. 27, 2022. [Online]. Available: https://scholar.google.com/scholar?cluster=11043926665494992314&hl=en&oi=scholarr.
18. A. Asrial, S. Zakariyya, D. A. Kurniawan, and R. Septiasari, "Relationship between Pedagogic Competence and Science Competence in Elementary School Teacher Education Students," *PEDAGOGIA: Jurnal Pendidikan*, vol. 8, no. 2, p. 149, 2019, doi: 0.21070/pedagogia.v8i2.1872.
19. S. Arikunto, *Research Procedures A Practice Approach.* Bandung: PT Rineka Cipta, 2013.
20. A. Desstya, "The Reliability of Technologycal Pedagogical Content Knowledge (TPACK) Instrument Reliability for Elementary School Teachers Science Subject Content," *AL-ASASIYYA: Journal Of Basic Education*, vol. 3, no. 1, pp. 126–139, Nov. 2018, doi: https://doi.org/10.24269/AJBE.V3I1.1338.
21. P. Mishra, "Considering Contextual Knowledge: The TPACK Diagram Gets an Upgrade," *Journal of Digital Learning in Teacher Education*, vol. 35, no. 2, pp. 76–78, 2019, doi: https://doi.org/10.1080/21532974.2019.1588611.
22. N. Latifah, U. Fauzia, and J. B. Kelana, "Natural Science Problem Solving in Elementary School Students Using the Project Based Learning (PjBL) Model," *Jurnal Ilmiah Sekolah Dasar*, vol. 4, no. 4, pp. 596–603, 2020, Accessed: Nov. 05, 2022. [Online]. Available: https://ejournal.undiksha.ac.id/index.php/JISD/article/view/28377.
23. V. Trivena, A. R. Ningsih, and A. Jupri, "Misconception on addition and subtraction of fraction at primary school students in fifth-grade," in *Journal of Physics: Conference Series*, 2017, vol. 895, no. 1, p. 012139, Accessed: Oct. 24, 2022. [Online]. Available: https://iopscience.iop.org/article/https://doi.org/10.1088/1742-6596/895/1/012139/meta.
24. I. G. D. J. Pratama, N. Dantes, and K. Yudiana, "Thematic Learning Plan With A Nature Of Science Learning Model In The Fourth Grade Of Elementary School," *International Journal of Elementary Education*, vol. 4, no. 4, pp. 447–453, 2020, Accessed: Nov. 05, 2022. [Online]. Available: https://ejournal.undiksha.ac.id/index.php/IJEE/article/view/27208.
25. F. Indriani, "Teacher Pedagogic Competence in Managing Science Learning in SD and MI," *Fenomena*, vol. 7, no. 1, p. 17, 2015, doi: https://doi.org/10.21093/fj.v7i1.267.

26. W. W. Cobern, "Contextual Constructivism: The Impact of Culture on the Learning and Teaching of Science," in *The Practice of Constructivism in Science Education*, Routledge, 2020, pp. 67–86.
27. P. Y. A. Dewi and K. H. Primayana, "Effect of Learning Module with Setting Contextual Teaching and Learning to Increase the Understanding of Concepts," *International Journal of Education and Learning*, vol. 1, no. 1, pp. 19–26, 2019, doi: https://doi.org/10.31763/ijele.v1i1.26.