The Correlation between Self-Efficacy Levels and Pedagogical Content Knowledge among Madrasah Ibtidaiyah Teachers

Ifada Novikasari
UIN Prof. K.H. Saifuddin Zuhri Purwokerto, Indonesia
ifa_da@uinsaizu.ac.id

Donny Khoirul Azis*
UIN Prof. K.H. Saifuddin Zuhri Purwokerto, Indonesia
dony@uinsaizu.ac.id

Noor Elebiary
University of Birmingham, United Kingdom
Nae363@aol.com

Abstract
This study examines the relationship between self-efficacy in geometry and Pedagogical Content Knowledge (PCK) among Madrasah Ibtidaiyah teachers in Banyumas Regency. Self-efficacy was assessed in 79 sampled teachers using a multidimensional teaching self-efficacy scale focused on effectiveness and classroom management, while PCK was evaluated through tasks involving the perimeter and area of two-dimensional shapes. The findings reveal a weak correlation between self-efficacy and PCK, indicating limited interdependence. This highlights the need to address gaps in both areas. Within an Islamic context, the study emphasizes the relevance of tazkiyah (self-purification) and ilm (knowledge acquisition) as principles of teacher development. It recommends targeted training aligned with Islamic values to simultaneously enhance self-efficacy and PCK. Such an integrated approach aims to improve teaching skills, foster holistic growth, and create a nurturing learning environment that benefits both teachers and students.

Keywords: pedagogy content knowledge; self-efficacy, madrasah ibtidaiyah teachers

INTRODUCTION

The teaching and nurturing of primary school children form the foundation of knowledge transmission, highlighting the critical role of teachers in effectively delivering instructional material (Tuomainen, 2023). While various factors influence educational outcomes, studies indicate that teachers' pedagogical content knowledge (PCK) and self-efficacy are significant contributors to positive outcomes, particularly in less popular subjects like mathematics (Waswa & Al-Kassab, 2023). Self-efficacy refers to teachers' willingness to assume active roles in classroom instruction and maintain control over students. It has been shown to positively impact teaching quality and student performance (Barni et al., 2019). Teachers with high self-efficacy are more engaged in instructional duties and better equipped to overcome challenges, which is especially important in subjects like mathematics.

However, this effectiveness is closely tied to teachers' ability to teach subject matter effectively (Berry et al., 2016; Novikasari & Dede, 2024). In mathematics education, a key component of PCK involves teaching foundational concepts such as area and perimeter, essential for early mathematical development (Hill et al., 2008; Runnalls & Hong, 2020). In Madrasah Ibtidaiyah, understanding teachers' self-efficacy and PCK levels is crucial for ensuring the quality and effectiveness of teaching, learning, and broader educational processes. This paper aims to analyze the relationship between these variables to improve teacher training and enhance academic achievement at the elementary level.

Beyond mastering PCK, teachers' self-efficacy significantly influences educational outcomes (Emiru & Gedefaw, 2024). Self-efficacy, introduced by Bandura (Lippke, 2020), refers to individuals' belief in their ability to accomplish tasks and achieve goals. This psychological construct profoundly impacts education, with teachers exhibiting high self-efficacy demonstrating confidence, persistence, and innovation in overcoming instructional challenges. Such teachers effectively motivate students, create conducive learning environments, and adapt methodologies to address diverse learner needs.

In mathematics education, particularly topics like area and perimeter, teacher self-efficacy is a critical determinant of instructional effectiveness (Hong et al., 2018; Kurnia et al., 2021; Sturgill et al., 2024). Teaching these concepts requires both deep conceptual understanding and the ability to apply them in real-world contexts. Teachers with strong self-efficacy excel in explaining complex concepts, providing relevant examples, and addressing students' learning challenges (Berg et al., 2024).

In contrast, less confident teachers may hesitate to adopt innovative techniques or embrace challenges, relying instead on familiar methods (Etukudo & Foluke, 2024; Haara et al., 2020). Such hesitancy can hinder their competence in practical lessons and limit their ability to meet diverse learning needs, particularly in mathematics. Understanding teachers' self-efficacy is vital, as it shapes their drive, resilience, and pursuit of professional development. Equally important is PCK, which enables teachers to

effectively convey abstract mathematical ideas, such as the area and perimeter of plane figures, to students.

Self-efficacy, or self-belief, is a psychological concept introduced by Albert Bandura in 1977. Bandura defined it as an individual's belief in their ability to organize and execute actions required to achieve specific outcomes. Self-efficacy plays a critical role in shaping thoughts, emotions, and behaviors. Teacher self-efficacy refers to educators' confidence in their ability to teach effectively and influence student learning. Teachers with high self-efficacy exhibit greater confidence, persistence, and creativity in their teaching methods and are more adept at overcoming instructional challenges (Lippke, 2020).

Pedagogical content knowledge (PCK), introduced by Shulman, reflects teachers' ability to integrate subject expertise with effective teaching methods, emphasizing the fusion of deep subject knowledge and instructional skill (Berry et al., 2016). Teachers with strong PCK effectively present material in engaging ways, respond adeptly to student inquiries, and address learning difficulties. This aligns with Islamic principles, which stress combining expertise with wisdom in teaching. Al Ghazali emphasized that teaching should focus not only on content but also on the method of delivery (Alhaib & Kadhem Alsandi, 2022). Moreover, educators embodying Islamic principles of ijtihad (independent reasoning) demonstrate adaptability in addressing educational challenges (Hussain & Cooper-Davies, 2024).

The relationship between self-efficacy and pedagogical content knowledge (PCK) can be analyzed from multiple perspectives. High self-efficacy enhances teachers' motivation for continuous learning and development, improving their competence in mastering subject matter and teaching methods (Barni et al., 2019). Confident educators are more open to diverse teaching approaches and actively engage in professional development opportunities, such as workshops or courses, aligning with the lifelong learning principle emphasized in Islamic education (Lahmar, 2020; Stimpson & Calvert, 2021). A strong belief in one's capabilities also enables teachers to overcome instructional challenges. Educators guided by ijtihad (independent reasoning) are more likely to experiment with varied teaching methods and adapt to students' needs, thereby enriching the learning experience. This reflects the balance of effort and trust in Allah, as emphasized in Qur'anic teachings, particularly Surah Al-Baqarah (2:286).

Studies show a positive correlation between self-efficacy and PCK. For instance, Berg et al. (2024) found that teachers with high self-efficacy possess stronger PCK and create more conducive learning environments. This suggests that confidence in teaching ability enhances pedagogical understanding and skills, leading to improved student outcomes.

In Banyumas Regency's primary education context, stakeholders aim to improve educational quality, and a deeper understanding of self-efficacy and PCK is critical for designing effective interventions. This study focuses on the relationship between Madrasah Ibtidaiyah teachers' self-efficacy and PCK and explores how these factors influence instructional

practices. Holistic teacher training programs addressing both cognitive and affective aspects of teaching are expected to enhance teacher effectiveness and improve learner performance.

Teacher self-efficacy in primary education within Banyumas Regency plays a critical role in improving mathematics education quality. Teachers confident in teaching topics like the area and perimeter of plane figures are more effective in conveying concepts, employing innovative methods, and addressing student learning difficulties. Understanding the relationship between self-efficacy and pedagogical content knowledge (PCK) is essential for designing training programs and professional development initiatives to enhance teacher competence and performance (Honicke et al., 2023; Salas-Rodríguez & Lara, 2023).

This research uniquely focuses on the correlation between self-efficacy and PCK among Madrasah Ibtidaiyah teachers, specifically regarding teaching area and perimeter of plane figures. Unlike broader studies on these variables, this research targets a specific population: teachers at Islamic primary schools in Banyumas Regency. It aims to explore how self-efficacy influences teachers' mastery and instruction of specific mathematical topics. This targeted approach is expected to inform the development of focused training programs addressing instructional gaps, thereby enhancing mathematics teaching and learning in Madrasah Ibtidaiyah.

METHOD

This study employed a quantitative approach, specifically a survey method, to examine how teacher self-efficacy influenced the pedagogical content knowledge (PCK) of Madrasah Ibtidaiyah teachers in Banyumas Regency when teaching geometric concepts such as area and perimeter. The survey method was chosen for its efficiency in reaching a large number of respondents within a short period, providing a broad and representative picture of the target population. The target population included all Madrasah Ibtidaiyah teachers in Banyumas Regency, as they were responsible for teaching mathematics at the elementary level.

A random sampling technique was applied to ensure fair representation, enhancing the external validity of the findings. A total of 79 teachers was determined as the sample size through statistical calculation, ensuring sufficient statistical power to test the hypotheses regarding the relationship between self-efficacy and PCK. This sample size accounted for logistical constraints, such as time and resources, while maintaining the reliability and validity of the results. The sample size also allowed the use of parametric statistical tests, ensuring robust analyses.

Data collection relied on a structured questionnaire with two sections. The first section assessed teachers' self-efficacy using a Likert scale, including statements related to teaching mathematics and classroom management competencies (Berg et al., 2024). Key indicators included fostering student participation, managing disruptive behavior, and effectively applying teaching techniques. The second section focused on

PCK, particularly regarding area and perimeter, and measured teachers' knowledge of these concepts, their application in teaching, and the transfer of this knowledge to students (Hill et al., 2008). We validated and ensured the reliability of the questionnaire to accurately and consistently measure the intended variables, achieving a validity score of 0.815 for the questionnaire and 0.772 for the test, with reliability scores of 0.825 and 0.726, respectively. Thus, the questionnaire and test instruments were deemed valid and reliable based on these scores.

Subsequently, the collected data were analyzed using descriptive and inferential statistical techniques to examine the relationship between teacher self-efficacy and pedagogical content knowledge. Statistical software was employed to ensure accuracy and reliability in the analysis. The categorization of questionnaire and test results followed criteria set by Agresti (2018): 1) If the average test value is $\geq x + s$, the group is categorized as high; 2) If the average value is $< x + s$ but $\geq x - s$, the group is categorized as middle; 3)If the average value is $< x - s$, the group is categorized as low.

DISCUSSION

This section analyzes the survey results, presented in tables categorizing teacher self-efficacy levels as high, moderate, or low. These categories are derived from the computation of overall scores from the completed questionnaires. High category: Teachers with strong self-efficacy who believe in their ability to effectively manage classrooms and teach efficiently. Moderate category: Teachers with some confidence in their skills but facing

certain challenges. Low category: Teachers with limited confidence in their teaching and classroom management abilities. The tables aim to illustrate the distribution of self-efficacy levels among the teachers.

Table 1. Teachers' Self-efficacy

Score	Category	Total
X ≥ 14.126	High	9
10.314 ≤ x < 14.126	Medium	59
X < 10.314	Low	11

Based on Table 1, the results reveal variations in teacher self-efficacy levels among respondents. Nine teachers demonstrated high self-efficacy, showing strong confidence in their teaching and classroom management abilities, as supported by indicators such as teaching effectiveness and student involvement (Berg et al., 2024). The majority, comprising 59 teachers, were categorized under moderate self-efficacy, indicating adequate confidence but highlighting the need for targeted professional development to enhance areas such as student engagement and teaching strategies (Sturgill et al., 2024). Meanwhile, 11 teachers fell into the low self-efficacy category, emphasizing the necessity for interventions to build their confidence and effectiveness in teaching and classroom management (Haara et al., 2020).

The findings on teachers' pedagogical content knowledge (PCK) regarding the perimeter and area of plane figures were similarly divided into high, moderate, and low levels, reflecting varied comprehension among teachers. This categorization provides an overall representation of both effective and ineffective understanding of the content.

Teachers categorized at the high level of PCK demonstrate a strong understanding of perimeter and area concepts for various plane figures, enabling effective classroom instruction. This finding aligns with Shulman's concept of PCK, which emphasizes subject mastery and the ability to present it in a teachable form (Sarkar et al., 2024). Teachers in the moderate category possess adequate knowledge but require further training to refine their conceptual understanding and teaching methods. Hill et al. (2008) suggest that such training enhances mathematical comprehension and its application in practical contexts. From an Islamic educational perspective, Al-Ghazali highlights the importance of mastering content and effectively conveying it, viewing teaching as an art that integrates knowledge and wisdom (hikmah) (Quasem, 2013). Teachers in the low category exhibit significant knowledge gaps, necessitating extensive training to improve content understanding and instructional techniques.

Table 2 illustrates the degree of teachers' PCK levels. As noted by Haara et al. (2020), such contextual information can guide targeted interventions, addressing deficiencies to enhance comprehension and instructional strategies. These focused efforts have the potential to elevate the quality of education and improve overall academic performance. Similarly, Memon and Alhashmi (2018) stress the importance of holistic, systematic knowledge enhancement through structured methodologies to create better learning environments.

Table 2. Teachers' Pedagogical Content Knowledge

Score	Category	Total
X ≥ 1.475	High	13
0.155 ≤ x < 1.475	Medium	24
X < 0.155	Low	42

The assessment results of pedagogical content knowledge related to perimeter and area worksheets revealed varying levels among respondents. According to Table 2, only 13 teachers fell within the high PCK category, demonstrating extensive knowledge of the concepts and effectively applying this knowledge in their teaching (Li & Copur-Gencturk, 2024).

Meanwhile, 24 teachers were categorized as moderate, showing satisfactory understanding of area concepts but with notable gaps requiring improvement. These findings highlight the need for expanded professional development programs to enhance teachers' PCK in a contextualized manner (König et al., 2024), emphasizing the necessity of deepening mathematical understanding to ensure effective instruction.

The largest group, consisting of 42 teachers, was classified as having a low level of PCK, reflecting significant deficits in their understanding and application of these concepts. This outcome underscores the need for targeted feedback and support to address such deficiencies, alongside government efforts to align teacher training programs with these demands to improve student outcomes in mathematics. Finally, survey data on teacher self-efficacy and PCK test results for perimeter and area were analyzed further using a prerequisite normality test. The normality test was conducted to assess whether the data distribution followed a normal distribution, which is a key assumption for many advanced statistical

procedures. This test allowed us to determine whether the survey data on self-efficacy and the pedagogical content knowledge test results were normally distributed. The results of the normality test, including statistical values and significance levels, will be presented in table form to provide a clear overview of the data distribution characteristics used in this study. Presenting the normality test results ensures the validity of the data before further analysis, thereby enhancing the reliability and accuracy of the conclusions drawn from this research.

Table 3. Normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Self-efficacy	0.381	79	0.000	0.681	79	0.000
Ped. Content Know.	0.331	79	0.000	0.742	79	0.000

a. Lilliefors Significance Correction

The normality test results indicate that the survey data on teacher self-efficacy and the pedagogical content knowledge test data on the perimeter and area of plane figures are not normally distributed, as the significance values are less than 0.05. Therefore, a Spearman's rank correlation coefficient test was conducted to analyze the relationship between these two variables. Spearman's test was selected because it is a non-parametric method that does not require the assumption of normal distribution. This test measures the strength and direction of the monotonic relationship between the variables. The results of the Spearman correlation test, including the correlation coefficient and significance values, will be presented in table form to provide a deeper understanding of the association between teacher self-efficacy and pedagogical content knowledge.

Table 4. Correlation between self-efficacy and pedagogical content knowledge

			Self-efficacy	Ped. Content Know.
Spearman's rho	Self-efficacy	Correlation Coefficient	1.000	0.057
		Sig. (2-tailed)	.	0.616
		N	79	79

The Spearman correlation test shows that teacher self-efficacy and pedagogical content knowledge (PCK) have a very weak correlation of 0.057. This value, close to zero, indicates that the two variables have no substantial linear association. In other words, teachers' self-efficacy does not significantly influence their perception and understanding of PCK, particularly in teaching geometric concepts such as circumference and area of flat shapes. This finding supports the argument that teacher self-efficacy may not always directly impact PCK, and in some cases, it may not guarantee the quality of PCK in teaching mathematical content (Jerrim et al., 2023).

Further supporting this conclusion, Jerrim et al. (2023) found that highly contextualized self-efficacy among teachers in various subjects did not correlate well with student achievements or teacher confidence in teaching science and mathematics. This suggests that, while self-efficacy is often considered a prerequisite for effective teaching, it is unlikely to be a reliable predictor of teaching success in these areas. These findings highlight the need to go beyond self-efficacy when developing strategies to improve PCK and teaching efficacy, especially in mathematics and science.

In this study, a figure showing the relationship between teaching experience, teacher self-efficacy, and PCK is useful for understanding these dynamics. The analysis reveals that regardless of teaching experience,

teachers' self-efficacy and PCK levels remain low, which is consistent with studies suggesting that while extended teaching experience can boost self-confidence, it does not necessarily translate into enhanced teaching skills in content areas (Wu & Cai, 2022).

Further data visualization analysis is necessary to explore the relationship, if any, between teaching experience, self-efficacy, and PCK. Such analysis can reveal the non-linear interactions between these variables and provide deeper insights into the factors influencing teaching quality. This step is crucial for informing the design of effective teacher-education programs.

Table 5. Correlation between teaching experience, self-efficacy, and pedagogical content knowledge

			Teaching Exp.	Self-efficacy	Ped. Content Know.
Spearman's rho	Teaching Exp.	Correlation Coefficient	1.000	0.133	0.154
		Sig. (2-tailed)	.	.244	.175
		N	79	79	79

Based on Table 5, the correlations between teaching experience and self-efficacy reveal a low score of 0.133, indicating a minimal linear relationship between years of teaching and teachers' confidence in their instructional abilities. Similarly, the correlation between teaching experience and pedagogical content knowledge shows a modest coefficient of 0.154. This suggests that while there is a slight association, the length of teaching experience alone does not significantly predict the depth of teachers' pedagogical understanding in content areas such as the perimeter and area of plane figures. These findings underscore the complexity of

factors influencing self-efficacy and pedagogical content knowledge among Madrasah Ibtidaiyah teachers.

Further analysis of individual respondent data revealed an intriguing anomaly: one teacher with 27 years of experience exhibited high levels of self-efficacy but scored low on pedagogical content knowledge. This case highlights that self-efficacy does not always correlate with pedagogical content knowledge. While the teacher may feel highly confident and effective in classroom management and teaching strategies due to their extensive experience, their response regarding the relationship between the perimeter of a room floor and the number of tiles needed revealed some inaccuracies in their understanding. Specifically, they incorrectly assumed that a smaller perimeter required fewer tiles because of its smaller area. This result emphasizes the importance of strengthening teachers' understanding of technical concepts like perimeter and area in mathematics education, even for those with extensive teaching experience.

These findings align with Jerrim et al.'s (2023) study, which found no significant correlation between self-efficacy and pedagogical content knowledge among teachers. Their research suggested that high self-efficacy does not necessarily translate to high competence in specific pedagogical content areas. The study emphasizes that while self-efficacy is crucial for teachers' confidence and persistence, it does not always reflect their technical understanding or pedagogical skills. This highlights the need for continuous professional development to enhance specific content

knowledge, ensuring teachers can confidently and accurately teach complex concepts.

A unique finding emerged from the case of a teacher identified as SUM, who has 16 years of teaching experience and achieved the highest score on the pedagogical content knowledge test. Despite this, SUM's self-efficacy data indicate a strong belief in the effective management of mathematics learning, yet the teacher acknowledged the challenges posed by rigid topics. This suggests that students predominantly rely on the memorization of formulas for the perimeter and area of plane figures, limiting creative instructional approaches in this area. SUM's exemplary performance in pedagogical content knowledge underscores the importance of experience and a deep understanding of teaching complex mathematical concepts effectively.

Furthermore, SUM's perspective on mathematics as a rigid subject requiring rote memorization, despite their high pedagogical content knowledge, raises intriguing questions. It indicates a possible discrepancy between theoretical knowledge and practical application in teaching, which may stem from institutional constraints or traditional teaching methodologies. These insights highlight the ongoing challenges in fostering innovative and engaging teaching practices, even among educators with strong subject expertise. Addressing these challenges requires continuous professional development and support to empower teachers to adapt their instructional methods creatively while ensuring thorough conceptual understanding among students.

This finding is consistent with the research of Barni et al. (2019), who noted that the teaching context and classroom environment often influence teacher self-efficacy. Despite having high self-efficacy, teachers may face barriers in translating their confidence into effective teaching practices due to systemic and contextual factors. Similarly, Haara et al. (2020) observed that even experienced teachers might struggle to innovate their teaching methods if they are entrenched in traditional educational frameworks. These studies reinforce the idea that while self-efficacy is crucial, it must be complemented by supportive environments and ongoing professional development to enable teachers to apply their knowledge effectively.

Another aspect that teachers should consider is that with many years of teaching experience, they may encounter various teaching challenges, which contributes to their high self-efficacy. However, without regular updates in knowledge, especially on new concepts or teaching methods, teachers may become stagnant in their pedagogical content knowledge. This result emphasizes the need for teachers to continue improving their education and taking appropriate courses, irrespective of their years in teaching. Studies suggest that a successful teacher's professional development in Islamic education should integrate both Islamic principles and contemporary teaching styles to equip educators to fully share knowledge (Mardhiah et al., 2023). This case also highlights the need to adopt a new approach to professional development that focuses on building both self-efficacy and general pedagogical skills. Simultaneously, regular

updates in specific content knowledge should be maintained, ensuring that teachers stay aligned with current trends in education. Therefore, even if teachers possess high levels of self-efficacy, they still need solid content knowledge to fully unlock their teaching potential.

CONCLUSION

This study's findings indicate an almost nonexistent relationship between teacher self-efficacy and their pedagogical content knowledge in teaching perimeter and area of geometric figures, with a Spearman correlation coefficient of 0.057. The result addresses all the research objectives by exploring these two variables, concluding that while self-efficacy is necessary, it is insufficient for an adequate understanding of pedagogical content knowledge. Additionally, the study reveals that raw teaching experience does not automatically translate into high levels of pedagogical content knowledge. This observation underscores the critical need for continuous professional development to enhance pedagogical content knowledge. In Islamic education, continuous professional development is particularly important as it aligns with the principle of lifelong learning emphasized in Islamic teachings. Ultimately, these findings contribute to the existing literature by shedding light on the relationship between teacher self-efficacy and pedagogical content knowledge, emphasizing the importance of each construct in the educational context.

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