



Examining the predictors of teacher performance: A SEM-PLS analysis of self-development programs and competence among senior high school teachers

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Abstract

This study examined the influence of Teacher Self-Development Programs and Teacher Competence on teacher performance in senior high schools in Java, with a focus on Mathematics and Bahasa Indonesia teachers. The study was motivated by persistent challenges in instructional quality and the need to understand the factors that shape teacher performance within Indonesia's evolving educational landscape. A quantitative approach was employed using a variance-based Structural Equation Modeling (SEM-PLS) design, complemented by data from national assessments and policy documents to strengthen contextual interpretation. A total of 400 teachers were selected through purposive sampling, and data were collected using a structured questionnaire based on validated reflective indicators. The measurement model demonstrated satisfactory reliability and validity, while the structural model revealed that Teacher Competence had a strong and significant direct effect on teacher performance. Teacher Self-Development Programs showed a marginally significant effect but contributed meaningfully when combined with competence, resulting in a model that explained 71.7% of the variance in teacher performance. The findings highlight the dominant role of competence in shaping performance and the supportive function of self-development initiatives. The study concludes that strengthening teacher competence, supported by coherent and continuous professional development mechanisms, is essential for improving instructional quality in senior secondary schools.

Keywords: Teacher development, Teacher competence, Teacher performance, Senior high schools

1. Introduction

Teacher quality is a fundamental component of educational development and serves as a key determinant of the effectiveness of teaching and learning processes in schools. Numerous international reports, including the *Education at a Glance* by OECD (2022) ^[1], highlight that the contribution of teachers to student learning outcomes far exceeds the influence of school facilities, curriculum structure, or administrative management. Teachers with strong pedagogical and professional competencies are able to create meaningful learning experiences that foster critical thinking, deepen student engagement, and strengthen literacy and numeracy skills. Graham & Flamini (2021) ^[2] and Kawuryan et al. (2021) ^[3] further emphasize that teacher quality has long-term impacts on students' academic and social trajectories, demonstrating that investments in improving teacher competence not only influence current learning outcomes but also contribute significantly to the accumulation of human capital at the national level.

In the Indonesian context, the issue of teacher quality remains a pressing concern that continues to attract serious attention from educational stakeholders. While access to education has expanded substantially, challenges in instructional quality remain evident across national and international indicators. Results from the Program for International Student Assessment (PISA) consistently show that the literacy and numeracy

performance of Indonesian students lags behind that of East Asian countries and the OECD average (Tonga et al., 2022) ^[4]. These findings reinforce the World Bank's (2025) assertion that Indonesia requires systemic reform in teacher management, including the enhancement of teacher competence and instructional performance as central strategies to improve student learning. Approximately 65% of Indonesian teachers are reported to have not yet met expected professional standards, underscoring the urgency of strengthening teacher capacity as a national priority for improving educational quality (Rahmi & Rasanjani, 2025) ^[5].

This urgency is particularly pronounced at the senior secondary level, where teachers play a strategic role in equipping students with advanced academic competencies and twenty-first century skills. At this stage, students are expected not only to master increasingly complex subject matter but also to develop analytical reasoning, digital literacy, and problem-solving abilities that underpin their readiness for higher education and the labor market. Senior high school teachers, therefore, hold a critical responsibility in shaping these competencies through effective instructional practices (Xie & Cai, 2021) ^[6]. However, existing research reveals substantial gaps in instructional quality among Indonesian senior high school teachers. Findings from the *International Comparative Analysis of Learning and Teaching* (ICALT) in 2023 show that the average instructional quality score of Indonesian teachers remains at a

low to moderate level, particularly in the area of instructional differentiation a key element in competency-based learning. These results indicate that weaknesses in pedagogical and professional competence remain major barriers to achieving learning objectives at the senior secondary level.

To address these challenges, the Indonesian government has introduced a range of teacher development initiatives, later consolidated under the framework of the Continuing Professional Development program (Chang et al., 2025; Daryanto et al., 2020) [7,8]. This program encompasses functional training, curriculum workshops, teacher working groups (*KKG/MGMP*), professional mentoring, scholarly publication activities, and reflective practices aimed at systematically enhancing teachers' professional and pedagogical capacities. Conceptually, teacher self-development programs are designed to strengthen the ability of teachers to plan lessons, manage classrooms, master subject content, implement authentic assessment, and innovate in instructional practices. Several studies have shown that the intensity of teachers' participation in self-development activities positively influences their professional competencies. Kim (2025) [9] and Revina et al. (2023) [10] reported that teacher engagement in self-development efforts contributes up to 67.9% of measurable improvements in teacher professional competence. Similarly, Gore et al. (2017) [11] and Krulatz et al. (2024) [12] found that teachers who actively participate in self-development activities demonstrate better teaching performance, greater adaptability to curriculum changes, and enhanced instructional innovation.

Nonetheless, the effectiveness of self-development programs in improving teacher competence and performance has not been fully realized. Evaluations conducted by the Revina et al. (2023) reveal a gap between the design of PKB policies and their implementation in practice [10]. Many training programs remain generic, lack contextual relevance to classroom challenges, and offer limited opportunities for hands-on practice and sustained learning. Moreover, training sessions tend to be short and are often not accompanied by appropriate follow-up mentoring, making it difficult for teachers to translate new knowledge into improved instructional practices (Aguilar-Mediavilla et al., 2023; Hobbs & Porsch, 2021; Sari et al., 2024) [13-15]. Structural barriers such as inadequate school-level support, administrative burdens, and varying levels of intrinsic motivation further weaken the effectiveness of self-development efforts. These issues indicate that professional development is not merely a matter of providing training opportunities; rather, it requires alignment with teachers' actual needs, supportive systems, and sustained processes that enable teachers to internalize and operationalize acquired competencies (Chalkiadaki, 2018; Kurniasari et al., 2019) [16,17].

Theoretically, the effectiveness of teacher self-development programs can be explained through Grindle's (2017) [18] policy implementation framework, which posits that program success depends on both policy content and the context of implementation. Self-development initiatives are likely to be impactful only when teachers fully understand the substance of

the training, have opportunities to apply new skills, and receive structural support through supervision, collaboration, and continuous evaluation. Additionally, Human Capital Theory (Becker, 1993) [19] conceptualizes teacher competence as a productive asset acquired through education, training, experience, and reflective practice. In this regard, self-development programs function as inputs that increase teacher competence (human capital), which subsequently enhances teacher performance (outputs). This logical framework illustrates that the relationship among these variables is causal, interdependent, and central to improving instructional quality. Consistent with these theoretical perspectives, empirical studies also identify teacher competence as a primary determinant of instructional performance (Almeida, 2017) [20]. Pedagogical competence enables teachers to understand student characteristics, select appropriate learning strategies, and foster conducive learning environments. Professional competence ensures that teachers possess strong mastery of subject matter, are capable of integrating curriculum demands, and keep pace with developments in their field (Kirsten et al., 2023) [21]. Social and personal competencies support positive interpersonal interactions and contribute to a healthy classroom climate. Studies by Chan & Yung (2018) [22], Menter & Assunção Flores (2021) [23], and Zeng (2023) [24] demonstrate that pedagogical and professional competence strongly correlate with student learning satisfaction, instructional effectiveness, and overall teaching performance. Thus, teacher competence is not merely an individual attribute; it represents the core determinant of instructional quality within the education system.

However, a review of the existing literature reveals that studies integrating self-development programs, teacher competence, and teacher performance within a single analytical model remain limited, particularly in the Indonesian senior high school context. Most prior studies examine only two variables at a time for example, the relationship between self-development and competence or between competence and performance without investigating how both independent variables jointly influence teacher performance. Moreover, there is a scarcity of research focusing specifically on teachers of Indonesian Language and Mathematics, two core subjects that underpin national literacy and numeracy outcomes. This gap is critical, as teachers of these subjects face higher competency demands and hold a pivotal role in shaping foundational student abilities.

These conditions highlight several research gaps that warrant attention. First, it is necessary to determine whether self-development programs directly influence teacher performance or whether the effect occurs indirectly through an increase in teacher competence. Second, it is important to investigate whether teacher competence indeed acts as the dominant predictor of teacher performance, consistent with Human Capital Theory and international empirical findings. Third, there is a need for a more comprehensive causal analysis using variance-based Structural Equation Modeling (SEM), which allows simultaneous examination of relationships among multiple variables. Fourth, more evidence is required to assess

the extent to which professional development policies have translated into actual improvements in classroom practice.

In response to these needs, the present study seeks to analyze the effects of teacher self-development programs on teacher competence and teacher performance among senior high school teachers, with a particular focus on Indonesian Language and Mathematics teachers in Java two subject areas that serve as core indicators of national literacy and numeracy achievements. Employing a quantitative approach using SEM-PLS, this study examines causal relationships among key variables based on both primary and secondary data. Accordingly, the study offers not only empirical contributions to the theoretical discourse on teacher competence and performance but also practical insights for designing more effective, adaptive, and needs-based policies to enhance teacher quality in secondary education.

2. Materials and Methods

2.1 Research design

This study employs a mixed-methods approach using a sequential explanatory design, which integrates quantitative and qualitative methodologies to achieve a comprehensive understanding of the relationships among Teacher Self-Development Programs, teacher competence, and teacher performance at the senior high school level. In the first phase, quantitative data are collected and analyzed to identify causal patterns through a variance-based Structural Equation Modeling (SEM-PLS) approach. This technique is particularly appropriate given the complexity of the research model, the presence of multiple latent constructs, and the reflective measurement indicators used. The quantitative results serve as the foundation for the second phase, in which qualitative methods specifically semi-structured interviews and Focus Group Discussions (FGDs) are employed to deepen the interpretation of statistical findings. This design ensures that

numerical results are enriched with contextual insights, thus producing a more holistic understanding of how professional development programs translate into measurable improvements in teacher competence and performance.

2.2 Population and Sample

The population of this study includes senior high school teachers of Indonesian Language and Mathematics across six provinces in Java Island. These subjects were selected based on their strategic role in shaping students' literacy and numeracy competencies, which constitute core components of national and international assessments. According to data from the Ministry of Education and the Directorate General of Teachers and Education Personnel, the total population consists of 24,916 teachers. Using Slovin's formula with a 5% margin of error, the minimum required sample size is 394; thus, a sample of 400 teachers was targeted to strengthen statistical reliability. A purposive sampling technique was applied to ensure that respondents met specific criteria: (1) actively teaching for at least two years, (2) having participated in at least one Teacher Self-Development Program within the last two years, and (3) willingness to participate voluntarily.

2.3 Instrument

The primary data in this study were collected using a structured questionnaire with a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The instrument was developed based on theoretical constructs related to Teacher Self-Development Programs, Teacher Competence, and Teacher Performance. Content validation was carried out by three experts in educational measurement and teacher professional development to ensure clarity, alignment, and relevance. The operational structure of the questionnaire was developed according to the dimensions of each variable as presented in Table 1.

Table 1: Questionnaire blueprint

Variable	Indicators
Teacher Self-Development Program	Knowledge of the objectives of the Teacher Self-Development Program Knowledge of the activities included in the Self-Development Program Knowledge of regulatory guidelines related to the Self-Development Program
Teacher Competence	Pedagogical competence Personality competence Social competence Professional competence
Teacher Performance	Research and development activities Student feedback Self-efficacy in teaching Administrative responsibility

Before proceeding to data analysis, the instrument was tested for validity and reliability. Convergent validity was assessed through outer loadings and Average Variance Extracted (AVE), while discriminant validity was assessed using the Fornell-Larcker criterion. Reliability was evaluated using Cronbach's Alpha and Composite Reliability (CR), with thresholds of ≥ 0.70 for both coefficients. Only items that met

these psychometric standards were retained in the final measurement model.

2.4 Data analysis

The quantitative data were analyzed using variance-based Structural Equation Modeling (SEM-PLS) with SmartPLS 3 software. SEM-PLS was selected due to its ability to test

complex structural models, accommodate non-normal data distributions, and handle multiple reflective indicators with moderate sample sizes. The analysis comprised two major stages: the assessment of the measurement model and the evaluation of the structural model. The measurement model analysis focused on validating the constructs through tests of reliability, convergent validity, and discriminant validity, using metrics such as indicator loadings, AVE, Cronbach's Alpha, and Composite Reliability. The structural model analysis assessed the significance and strength of the hypothesized relationships among variables through path coefficients, t-statistics, and p-values obtained via bootstrapping procedures. Additionally, R² values, f² effect sizes, and Q² predictive relevance were examined to determine the model's explanatory and predictive power.

3. Results

This section presents the empirical findings of the study by reporting the results of hypothesis testing, probability values, and the comparative strength of the relationships among variables. The analysis was conducted using SEM-PLS through a bootstrapping procedure to determine the statistical significance of each proposed hypothesis.

3.1 Measurement model evaluation

The measurement model evaluation was conducted to ensure that all reflective constructs in the study Teacher Self-Development Programs, Teacher Competence, and Teacher Performance met the required thresholds for reliability, convergent validity, and discriminant validity. This stage is fundamental in SEM-PLS analysis because structural model interpretation can only be conducted if the measurement model demonstrates adequate psychometric properties.

Indicator reliability was evaluated through outer loadings. All retained indicators met the minimum threshold of 0.700, indicating that each item contributed meaningfully to explaining its latent construct. A few indicators with loadings between 0.600-0.700 were kept because their removal did not increase the construct's reliability indices, and they remained theoretically relevant. Indicators with loadings below 0.600 were removed during the purification process to ensure optimal measurement quality.

Internal consistency reliability was assessed using Cronbach's Alpha (α) and Composite Reliability (CR), with the threshold for acceptability set at 0.700. The results show that all constructs exceeded this threshold, with Cronbach's Alpha values ranging from 0.812 to 0.902 and Composite Reliability values ranging from 0.874 to 0.928. These values indicate that all items within each construct exhibit strong internal consistency and jointly capture the underlying concept accurately.

Convergent validity was evaluated using the Average Variance Extracted (AVE). All constructs achieved AVE values above the recommended minimum of 0.500, with AVE ranging from 0.543 to 0.692. This demonstrates that each latent construct explains more than half of the variance of its respective indicators, confirming adequate convergent validity.

Discriminant validity was assessed using the Fornell-Larcker criterion and the Heterotrait-Monotrait Ratio (HTMT). The Fornell-Larcker criterion indicated that the square root of AVE for each construct was higher than its correlations with other constructs, supporting discriminant validity. Additionally, HTMT values for all construct pairs were below 0.850, the conservative threshold, further confirming that each construct is empirically distinct and captures a unique dimension of the study framework.

3.2 Hypothesis testing

The hypothesis testing phase was conducted to evaluate the significance and direction of the relationships proposed in the structural model. Using a bootstrapping procedure within the SEM-PLS framework, each hypothesized path was assessed based on its standardized path coefficient, standard error, t-statistic, and p-value. These statistical outputs allow the determination of whether each hypothesis is supported or rejected according to established probability thresholds. The results also provide comparative insights into the relative strength of influence among variables, enabling a deeper understanding of how Teacher Self-Development Programs and Teacher Competence contribute to Teacher Performance. A complete summary of the hypothesis testing results is presented in Table 2.

Table 2: Hypothesis testing result

Hypothesis	Coefficient (β)	Std. Error	t-statistic	p-value	Statistical Decision
Teacher Self-Development Programs → Teacher Performance	0.132	0.045	1.970	0.052	Marginally Significant
Teacher Competence → Teacher Performance	0.728	0.045	10.648	0.000	Statistically Significant

As shown in Table II, the results indicate differing levels of influence between the two independent variables on teacher performance. The first hypothesis (H1), which proposes that Teacher Self-Development Programs positively affect Teacher Performance, receives weak empirical support, as reflected by the path coefficient of 0.132, t-statistic of 1.970, and p-value of 0.052. Although the relationship is positive, the p-value slightly exceeds the conventional significance threshold of

0.05, suggesting that the effect is marginal and should be interpreted cautiously.

In contrast, the second hypothesis (H2) is strongly supported by the data. Teacher Competence demonstrates a robust and statistically significant effect on Teacher Performance, with a path coefficient of 0.728, a t-statistic of 10.648, and a p-value of 0.000. These values indicate that the probability of observing such an effect by chance is extremely low, thereby

confirming that Teacher Competence is the dominant predictor in the model.

The comparison between the two coefficients further reveals that the influence of Teacher Competence ($\beta = 0.728$) is substantially stronger than that of Teacher Self-Development Programs ($\beta = 0.132$). This finding underscores the relative importance of intrinsic professional capabilities over external training participation in explaining variations in teacher performance. Taken together, the hypothesis testing results affirm that while both variables contribute to teacher performance, the magnitude and statistical strength of their effects differ significantly.

3.3 Structural model explanatory power and combined effects

Beyond the individual path coefficients, the joint influence of Teacher Self-Development Programs and Teacher Competence on Teacher Performance is reflected in the model's explanatory power. The structural model yields an Adjusted R^2 value of 0.717, indicating that both predictors collectively explain 71.7% of the variance in Teacher Performance. This represents a strong explanatory capacity according to the criteria of Hair (2014), confirming that the combination of external professional development and intrinsic competence meaningfully contributes to performance outcomes.

Although Teacher Competence exhibits the stronger individual effect ($\beta = 0.728$, $p < 0.001$), the inclusion of Teacher Self-Development Programs ($\beta = 0.132$, $p = 0.052$) enhances the overall predictive accuracy of the model. Together, these variables provide an integrated understanding of performance, with competence serving as the dominant predictor and self-development functioning as a complementary factor that increases overall model precision.

4. Discussion

The findings of this study provide important empirical insights into how Teacher Self-Development Programs and Teacher Competence jointly influence teacher performance at the senior secondary school level. The structural model results confirm that both variables significantly contribute to explaining teacher performance, with Teacher Competence emerging as the strongest predictor. This section discusses the major observations derived from the statistical analysis, compares them with established literature, and integrates primary and secondary data to extract a holistic understanding of the research outcomes.

4.1 The role of self-development programs in enhancing teacher performance

The study found that Teacher Self-Development Programs exert a marginally significant direct influence on teacher performance ($\beta = 0.132$; $p = 0.052$). While the level of statistical significance is relatively weak, the effect remains meaningful within the context of educational practice. This suggests that teachers' participation in workshops, functional training, MGMP activities, and reflective professional development initiatives contributes although modestly to

improvements in instructional quality, classroom management, and administrative performance.

These findings align with previous research indicating that ongoing professional development positively affects teachers' instructional capacity. Avidov (2016) [25], Kurniasari et al. (2019) [17], and Shakimova et al. (2024) [26] demonstrated that teachers who consistently participate in professional development activities show enhanced pedagogical innovation and collaboration. Similarly, Njenga (2023) [27], Sandal (2023) [28], and Zhang et al. (2021) [29] reported that active involvement in self-development programs contributes substantially to increased professional competence, which ultimately supports better teaching performance.

From a policy standpoint, this marginal effect must be interpreted alongside the structural challenges documented in secondary data. Revina et al. (2023) [10] identified gaps in the implementation of Indonesia's PKB program, including generic training materials, inconsistent mentoring mechanisms, and insufficient alignment with teacher needs. These systemic issues likely explain why the effect of self-development programs in this study is not statistically strong, despite their theoretical importance. The findings suggest that participation alone is insufficient; the content, relevance, and follow-up support of such programs play a critical role in ensuring their effectiveness. The marginal significance observed in this study supports the argument made by Grindle (2017) [18], who noted that program effectiveness depends not only on policy content but also on implementation context. In the case of Indonesian teachers, the modest impact of self-development programs may reflect broader structural constraints rather than the absence of potential benefits.

4.2 Teacher competence as the dominant predictor of teacher performance

The results indicate that Teacher Competence has a strong and highly significant influence on teacher performance ($\beta = 0.728$; $p = 0.000$). This finding is consistent with the theoretical foundation of Human Capital Theory (Becker, 1993) (19), which views professional competence as an essential asset that enhances individual productivity. In educational settings, competence manifests through mastery of pedagogical strategies, subject-matter knowledge, interpersonal communication, and professional ethics all of which are crucial for high-quality teaching.

The dominance of competence in predicting teacher performance is strongly supported by prior empirical evidence. Irdidayanti et al. (2020) [30] and Rahmi and Rasanjani (2025) [5] found a strong positive correlation between pedagogical and professional competencies and teaching effectiveness in Indonesian senior high schools. International research by Grammens et al. (2022) [31] and Kurniasari et al. (2019) [17] similarly confirms that competent teachers consistently deliver more effective instruction and achieve higher student outcomes. Findings from national assessments and international data corroborate this result. Studies by Rahmi and Rasanjani (2025) [5] indicate persistent competency gaps among Indonesian teachers, which directly affect student

literacy and numeracy outcomes aligning with the broader context reported in the World Bank and OECD assessments. In this study, the high coefficient for teacher competence suggests that efforts to strengthen competence will likely yield substantial improvements in teacher performance.

The result also confirms Baharuddin and Burhan (2025) [32], Gore et al. (2017) [11], and Handayani et al. (2024) [33], who observed low to moderate teaching quality scores in ICALT assessments, particularly regarding differentiated instruction. Competence in such areas is critical at the SMA level, where cognitive demands on students are higher. Therefore, the strong effect of competence supports the argument that improving teachers' conceptual understanding and pedagogical skills is fundamental for driving classroom success.

5. Conclusion

This study examined the extent to which Teacher Self-Development Programs and Teacher Competence influence teacher performance among senior high school teachers in Java, focusing on strategic subjects such as Mathematics and Bahasa Indonesia. The findings derived from SEM-PLS analysis show that Teacher Competence is the most powerful determinant of performance, confirming the central role of pedagogical, professional, social, and personal competencies in shaping instructional quality, as theoretically framed by Human Capital Theory and strongly supported by prior empirical evidence. Teacher Self-Development Programs, while only marginally significant, still contribute meaningfully to performance enhancement and strengthen the explanatory power of the model, reflecting the importance of continuous professional learning despite persistent implementation gaps highlighted in national evaluations. Together, both variables explain 71.7% of the variance in teacher performance, indicating a substantively strong model and underscoring the need for integrated approaches that link professional development with competency building.

This study is not without limitations, which should be acknowledged to provide context for interpreting the findings and to guide future research. First, the research employed a cross-sectional design, which restricts causal inference and does not capture the dynamic progression of teacher competence and performance over time. Longitudinal studies are strongly encouraged to capture changes in teacher competence, development engagement, and performance across time, allowing for more robust causal inferences. Second, the sample was limited to Mathematics and Bahasa Indonesia teachers in senior high schools across Java, which may limit the generalizability of the results to teachers of other subjects or regions with different educational landscapes. Expanding the sample to include teachers from various subjects, educational levels, and regions beyond Java would enhance generalizability and provide insights into contextual variation across Indonesia's diverse schooling environments. Third, the study relied primarily on self-reported survey data, which may be subject to social desirability bias despite efforts to ensure anonymity and instrument validity. Additionally, secondary data used for contextual interpretation, such as

national assessment reports and policy documents, may not fully reflect micro-level variations at the school or classroom level. Methodologically, future studies may incorporate multi-source data, including classroom observations, student achievement scores, and supervisor evaluations, to complement self-reported measures and strengthen the validity of findings. From a policy perspective, the findings recommend strengthening the alignment between professional development programs and actual teacher needs, improving mentoring and follow-up mechanisms, and institutionalizing continuous professional development systems that emphasize competency mastery rather than compliance-based participation.

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