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The Impact of Teacher Capacity Building Programs on the Quality of Learning Based on the Sustainable Development Goals

Tamara Agustini¹, Asmaul Husna^{2*}, ^{1,2} Syekh Nurjati State Islamic Cyber University of Cirebon, Indonesia *Corresponding Author: asmaulhusnahusna26@gmail.com

Abstract

Objective: This study aims to determine the effect of a teacher capacity-building program on the quality of learning based on the Sustainable Development Goals (SDGs). The teacher capacity-building program is expected to enhance teachers' pedagogical and professional competencies, as well as their ability to integrate sustainability values into their teaching.

Method: This study employed a quantitative approach using a survey method via a questionnaire. The research instruments consist of two variables, namely the Teacher Capacity Building Program (X) and the Quality of SDG-Based Learning (Y), which are measured using indicators such as training participation, pedagogical competence, knowledge of the SDGs, innovative methods, integration of SDG values, environmental awareness, critical thinking, and student engagement.

Results: The findings indicate that teacher capacity-building programs have a positive impact on the quality of SDG-based learning. Teachers who actively participate in training tend to possess better pedagogical competencies, are able to apply innovative methods, and integrate sustainability values into their teaching. This leads to increased student engagement, improved critical thinking skills, and a greater sense of environmental responsibility.

Conclusion: Teacher capacity-building programs play a crucial role in improving the quality of SDG-based learning. The higher the level of teacher participation and understanding of the training, the more effective the implementation of learning that supports sustainability values in the classroom.

Keywords: *Teacher Capacity Building; SDGs; Quality of Learning; Pedagogical Competencies; Innovative Learning.*

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Introduction

Education is one of the main pillars of a nation's development, particularly in supporting the achievement of the Sustainable Development Goals (SDGs), specifically Goal 4: Quality Education. The SDGs emphasize the importance of inclusive, equitable, and quality education and promote lifelong learning opportunities for all. In this context, the quality of learning is a key factor determining the success of implementing these goals. However, various challenges remain, such as disparities in educational quality, limited resources, and the suboptimal integration of sustainability values into the learning process (Gunawan, 2025).

One strategic effort to improve the quality of learning is through teacher capacity building programs. Capacity building aims to enhance teachers' professional and pedagogical competencies, as well as their understanding of learning innovations and global issues, including the SDGs. Teacher capacity building is crucial because teachers serve as agents of change in transmitting knowledge and values to students. Without adequate capacity, it is difficult for teachers to implement learning that is relevant to the demands of the 21st century and oriented toward sustainable development (Prabawati et al., 2024).

Furthermore, integrating the SDGs into the classroom requires an innovative and contextual approach. Teachers are not only expected to deliver academic content but also to connect learning to global issues such as climate change, social equity, and environmental sustainability. The goal is to develop students who possess critical thinking skills, social awareness, and a concern for the environment. Research shows that SDG-based learning can enhance students' motivation, literacy, and awareness of global issues (Pham Xuan & Håkansson Lindqvist, 2025).

However, the implementation of SDG-based learning in the field still faces various challenges, such as a lack of training for teachers, limited understanding of the SDG concepts, and insufficient institutional support. In addition, existing capacity-building programs are often not integrated in a systematic and sustainable manner. Therefore, more structured efforts are needed to develop teacher training programs that can significantly and sustainably improve the quality of learning (Puspitasari, 2020).

Therefore, this study aims to conduct an in-depth examination of the interaction between teachers' professional capacity and SDG-oriented instructional quality. By gaining a clear understanding of the relationship between these variables, this study seeks to formulate a more measurable direction for the development of educational quality. The expected contributions of this study include strengthening educational policies and updating teaching practices to make them more adaptive and to have a tangible impact on sustainable development (Muala & Nugraheni, 2024).

Research Methodology

Research Design

This study employs an explanatory survey design using a quantitative approach as its primary methodological framework. The selection of a causal-associative method as the research design is intended to empirically test the cause-and-effect relationship and measure the extent to which the teacher capacity-building program (Variable X) contributes to the quality of learning oriented toward the Sustainable Development Goals (SDGs) (Variable Y). Through this approach, the study does not merely describe phenomena but seeks to provide a structural explanation of the mechanisms of instructional quality transformation triggered by

professional capacity-building interventions(Lelatobur & Waruwu, 2024). The use of this quantitative paradigm allows researchers to generalize the results through rigorous statistical testing, so that the significance of the influence between variables can be proven objectively and measurably in the context of sustainable education.

Population and Sample

The target population in this study comprises all educators at the relevant institutions who have been integrated into a capacity-building program based on the Sustainable Development Goals (SDGs). Sampling was conducted using purposive sampling to ensure that the data collected accurately reflected subjects with competencies and direct experience relevant to the research variables. A total of 42 respondents voluntarily participated in this study, with participant profiles identified based on gender, age range, and years of service (length of teaching experience) to ensure a diversity of perspectives in evaluating the effectiveness of capacity building on instructional quality in the field.

Research Instruments

Primary data collection was conducted using a closed-ended electronic questionnaire (Google Forms) to ensure efficient and accurate data collection. The measurement scale used was a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The use of this scale aimed to precisely capture the gradations of respondents' perceptions and provide space for respondents to clearly express their attitudinal tendencies toward each statement provided. The research variables were constructed into two main dimensions:

- 1) Exogenous Variable (X): Teacher Capacity-Building Program. Measured through eight capacity-building indicators covering: (a) active participation in professional training and workshops (X1, X8), (b) strengthening pedagogical competencies in designing learning scenarios (X2, X3), (c) depth of understanding of SDG concepts and targets (X4, X5), and (d) ability to adopt innovative instructional methods in the classroom (X6, X7).
- 2) Endogenous Variable (Y): SDG-Based Learning Quality. Measured through eight instructional quality indicators, including: (a) the effectiveness of integrating sustainability issues into instructional materials, (b) the ability to stimulate students' critical thinking regarding global issues, (c) the use of active learning methods oriented toward real-world solutions, and (d) success in fostering an environmentally conscious character and a sense of social responsibility in students (Y1–Y8).

Data Analysis Techniques

Data analysis was conducted using variance-based Structural Equation Modeling (SEM) or Partial Least Squares (PLS) methods with the assistance of SmartPLS version 4 software. SmartPLS 4 was selected due to its superior estimation algorithms (which are more robust) and a more precise modeling interface compared to previous versions.

The analysis procedure was carried out in two main stages:

- 1) Outer Model Evaluation (Measurement Model): This stage aims to verify the quality of the instruments through validity and reliability tests. Validity is assessed through Convergent Validity (with the criteria that the Factor Loadings > 0.70 and the Average Variance Extracted/AVE > 0.50) as well as Discriminant Validity. Meanwhile, internal

consistency is measured using Cronbach's Alpha and Composite Reliability with a threshold of > 0.70 .

- 2) Inner Model Evaluation (Structural Model): This stage is conducted to empirically test the research hypotheses. The evaluation is carried out by examining the significance of relationships between variables through T-statistic values (> 1.96) and P-values (< 0.05) generated from a bootstrapping process with 5,000 subsamples. Additionally, the model's predictive power is assessed using the coefficient of determination (R^2) to determine the extent of the exogenous variables contribution to the endogenous variables.

Results

Demographic Profile of Respondents

Respondent characteristics were mapped across 42 educators to understand the professional context underlying their capacity-building behaviors and SDG-based learning quality. This demographic analysis includes teaching experience (years of service) to provide a comprehensive picture of the respondents' level of pedagogical maturity. Through this mapping, the study can identify how teachers' professional backgrounds influence their acceptance of the educational innovations presented.

The dynamics of professional experience and the availability of time for teachers' professional development are dominated by groups of educators with early and mid-career tenure. As presented in Table 1, the majority of respondents have 1–5 years of service (52.4%), followed by teachers with less than 1 year of service (45.2%). Meanwhile, educators with more senior teaching experience specifically those with 6–10 years of service—account for a much lower proportion, at just 2.4%.

The dominance of teachers in this early career stage reflects a respondent profile characterized by high adaptability to curriculum transformations and capacity-building programs oriented toward SDG targets within the relevant institutions. This group tends to be more flexible in adopting new teaching methods compared to senior educators. A complete breakdown of the frequency distribution and percentages based on respondents' teaching experience is presented in Table 1 below:

Table 1. Respondents' Teaching Experience

Category	Frequency (n)
<1 Year	19
1 - 5 Years	22
6 - 10 Years	1
>10 Years	0

Source: Processed Primary Data (2026)

The data presented in Table 1 above provide a solid foundation regarding the characteristics of the respondents in this study. The high proportion of educators in the early stages of their careers indicates that the study sample has significant potential for adaptability to reforms in the education system. This condition offers an advantage in the data collection process, as respondents tend to be more open and honest in expressing their perceptions regarding the research variables being measured.

After gaining a deep understanding of the respondents' demographic profiles, the next step is to test the research instrument. This is necessary to ensure that all items completed by the respondents possess a high level of accuracy and consistency. Therefore, the following section will present the results of the measurement model evaluation (outer model), which includes validity and reliability tests of the instrument prior to further hypothesis testing.

Evaluation of the Measurement Model (Outer Model)

The evaluation of the measurement model—technically known as the outer model—is a fundamental step in Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis, serving as an initial verification to ensure that the questionnaire instruments meet strict validity and reliability standards. This stage is crucial because the accuracy of hypothesis testing results in subsequent stages heavily depends on the quality of the statement items in accurately representing each research construct. The focus of the analysis in this section is directed toward a specific in-depth examination of statistical data without involving path diagram visualization, with the aim of enabling a more comprehensive and detailed examination of discussions regarding item validity and variable reliability.

In determining the suitability of indicators, this study refers to the latest guidelines from Hair Jr. et al., (2021), which stipulate that an ideal indicator should have an outer loading value above 0.708 to ensure that the construct explains more than 50% of the variance of that indicator. However, in the context of social science research, indicators with factor loadings between 0.50 and 0.70 remain justifiable for inclusion, provided their contribution to the Average Variance Extracted (AVE) remains positive and does not compromise the overall stability of the model. The decision to retain indicators within this range was made to preserve the completeness of information and the originality of the dimensions of the variables under study, ensuring that the phenomenon being investigated is captured in its entirety without compromising content validity.

Based on the results of data analysis using SmartPLS 4 software, it was found that all indicators constituting this research model met the required thresholds and were deemed valid. Although there were variations in values among these indicators, each item was found to make a significant contribution to the formation of its respective latent construct. This indicates that respondents had consistent perceptions regarding the administered instrument, thereby minimizing the risk of measurement bias. This consistency provides a strong foundation for the structural model, where the details of the outer loading values indicating the strength of the relationship between the indicators and their constructs are explicitly presented in Table 2 below:

Table 2. Results of the Convergent Validity Test (Outer Loadings)

Variable		Indicator Code	Outer Loading	Description
Program building X	Capacity	X1	0.726	Valid
		X2	0.516	Valid
		X3	0.580	Valid
		X4	0.639	Valid
		X5	0.539	Valid
		X6	0.543	Valid
		X7	0.525	Valid
		X8	0.710	Valid
Quality of Education Y	SDG	Y1	0.614	Valid
		Y2	0.563	Valid
		Y3	0.625	Valid
		Y4	0.591	Valid
		Y5	0.793	Valid
		Y6	0.777	Valid
		Y7	0.659	Valid
		Y8	0.796	Valid

Source: Processed Primary Data (2026)

Based on the results in Table 2, all indicators were deemed valid because they had outer loadings above 0.50. Since this validity criterion was met, all instruments are suitable for use in the structural equation modeling phase to examine the relationships among the variables. These results provide a strong basis for concluding that each indicator possesses adequate internal consistency in measuring its respective research construct.

Variable Reliability Test

After confirming the validity of the indicators through outer loading, the next step is to evaluate the internal consistency (reliability) of each research variable. Reliability evaluation in PLS-SEM is based on two main parameters: Cronbach's Alpha and Composite Reliability. The summary of the reliability test results is presented in Table 3 below:

Table 3. Results of the Variable Reliability Test

Variable	Cronbach's Alpha	Composite Reliability (rho_c)	Description
Program Capacity building (X)	0.747	0.817	Reliable
Quality of SDG Education (Y)	0.842	0.873	Reliable

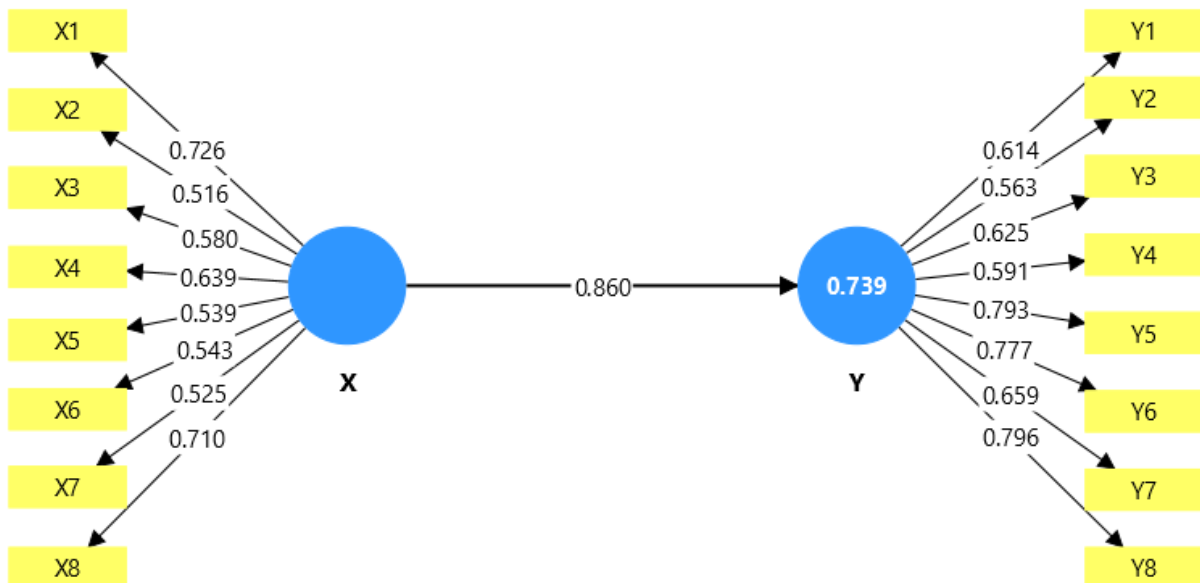
Source: Processed Primary Data (2026)

Based on the results in Table 3, it can be concluded that:

- 1) Consistency Evaluation: Based on the Cronbach's Alpha and Composite Reliability parameters, the Capacity Building Program variable (X) was found to be reliable, with values of 0.747 and 0.817, respectively. The SDGs Learning Quality variable (Y) achieved higher scores (Alpha = 0.842; CR = 0.873), indicating a very satisfactory level of reliability.
- 2) Finalization of the Measurement Model: Overall, each construct has passed the specified reliability threshold. Success at this stage of the measurement model evaluation (outer model) provides scientific justification for the research to move on to the hypothesis testing stage through structural model evaluation (inner model).

Evaluation of the Structural Model (Inner Model)

The evaluation of the structural model aims to predict the relationships between latent variables by testing the coefficient of determination (R-Square) and path coefficients. The results of the model estimation using the PLS algorithm demonstrate the strength of the relationships between constructs, as visualized in Figure 1:

Figure 1. Structural Model Estimation Results (PLS Algorithm)

Source: Processed Primary Data (2026)

Based on Figure 1, the direction of the relationships between variables and the model's explanatory power can be clearly identified. A detailed description of the estimation results is presented as follows:

Model Explanatory Power (R-Square)

The R-Square (R^2) value for the dependent variable is 0.739. Statistically, this means the research model explains 73.9% of the variance in the SDG-based Learning Quality variable. This figure falls into the Strong category, indicating that the independent variables play a highly significant role in shaping the dependent variable. Meanwhile, the remaining 26.1% is influenced by other factors outside this research model.

Hypothesis Testing

To test the hypothesis, a significance test was conducted by comparing the path coefficients and P-values through a bootstrapping process. A summary of the test results is presented in Table 4:

Table 4. Results of the Hypothesis Test on Direct Effects

Path of Influence	Path Coefficient	T-Statistics	P-Values	Description
Program Capacity building (X) → Quality of SDG Education (Y)	0.860	27.117	<0.001	Accepted

Note: Significant at the $\alpha = 0.05$ level. Source: Processed Primary Data (2026)

The results of the hypothesis testing provide very strong empirical evidence regarding the relationship between variables in this study. The Teacher Capacity Building Program was found to have a significant positive impact on SDG-based learning quality, with a path coefficient of 0.860. This figure indicates that any enhancement in teacher capacity will be followed by a tangible improvement in learning quality.

The significance of this relationship is further confirmed by a T-statistic value of 27.117, which significantly exceeds the critical threshold of 1.96. The reliability of these results is reinforced by a P-value of 0.000, indicating that the risk of error in drawing conclusions is below the 0.1% level. These statistical indicators demonstrate that the research model possesses a very high level of precision.

Given that all test parameters have met the required academic criteria, the final conclusion is that the research hypothesis is accepted. Thus, the Teacher Capacity Building Program plays a crucial and significantly influential role in determining the success of SDG-based learning quality improvement within the school environment.

Discussion

Teacher Capacity-Building Programs as a Key Determinant of Learning Quality

The findings of this study indicate that teacher capacity building is a key determinant in improving the quality of SDG-based learning. The results of the hypothesis testing convincingly demonstrate a highly significant positive effect with a path coefficient of 0.860 and a T-statistic value reaches 27.117 ($P < 0.001$). Empirically, these figures confirm that every strategic intervention to strengthen teacher capacity has a linear and strong impact on the effectiveness of the instructional process in the classroom (Singh, 2025). This proves that competency building is not merely a supplementary factor but an absolute prerequisite for educational success in the era of disruption.

The Relevance of Competency Development within the SDG 4 Framework

The significance of this impact aligns with the demands of global educational transformation, which emphasize that teachers' pedagogical competencies are the primary driving force in achieving SDG 4 targets. Competent teachers' capabilities enable the adoption of innovative teaching methods that are more inclusive and relevant to contemporary challenges (Whitelock et al., 2024). These findings reinforce the argument that capacity-building focused on developing digital skills and active methodologies is far more effective than training that is purely administrative in nature (J. Nagabhooshanam, 2022). This demonstrates that teachers are not merely content deliverers but the primary facilitators of educational success in the era of disruption.

On the other hand, the high statistical significance in this study lends legitimacy to the concept of Continuous Professional Development (CPD). Teachers actively engaged in continuous capacity development demonstrate higher adaptability to curriculum changes and the integration of technology into learning (Aspandi & Muttaqin, 2025). Investing in teacher capacity not only enhances individual technical skills but also strengthens a school's social capital in building a resilient learning ecosystem (Jumawan & Fabiania, 2025). Without structured capacity-building, the effectiveness of the new curriculum struggles to achieve optimal results due to the gap between policy and practical implementation.

Furthermore, a path coefficient of 0.860 indicates that the quality of learning is highly dependent on the consistency and intensity of teacher development programs. Capacity building should not be viewed as a ceremonial activity but rather as a fundamental need for educational institutions to ensure the relevance of learning outcomes to national and global quality standards (Agustin & Nugraheni, 2024). Teachers with access to appropriate competency development were found to be better able to create positive classroom interactions, which in turn enhance student participation and overall learning outcomes.

As a policy implication, these research findings underscore that improving SDG-based education quality cannot be separated from comprehensive efforts to enhance teacher competencies. Strengthening aspects of methodology, digital literacy, and understanding of sustainable values is key to closing the gap in educational quality disparities. Thus, strengthening teacher capacity must be viewed as a long-term strategic investment by school management and the government to ensure competitive and sustainable learning outcomes in the future.

Comparison with Previous Research

Divergences and Unique Contributions of This Study

In contrast to the study by Yangambi (2023) which stated that school physical facilities are the most influential variable on learning comfort, the findings of this study demonstrate that teacher competence has a higher coefficient of determination (0.860). This indicates a paradigm shift in which the quality of instructional interactions is now valued more highly than the mere availability of facilities and infrastructure. In line with this, Yin Ru Shi (2025) emphasizes that the effectiveness of capacity-building programs depends heavily on teachers' mental readiness and adaptability to technology—a finding that reinforces the results of the significance test in this study.

Furthermore, while Dahl (2025) views teacher development as an individual process, this study offers a new perspective by directly linking it to the framework of achieving the SDGs. These results align with the research by Rahmi & Rassanjani (2025), who found that strengthening teachers' competencies in Indonesia has a positive correlation with schools' readiness to meet global education standards. Thus, this study not only confirms existing theories but also provides new empirical evidence regarding the importance of integrating sustainability values into every teacher professional development program.

Novelty of the Research and Critique of Technocentrism in Education

The novelty of this research lies in demonstrating that the quality of SDG-based learning does not stem from regulatory formalities, but rather from the intensity of capacity building, which has a very high coefficient of determination (0.860). Until now, educational discourse has often been trapped in the assumption that curriculum changes will automatically improve quality. Although Jannah (2023), argues that periodic curriculum updates can raise national standards, this study demonstrates that without strengthening teachers' capacity, curriculum changes amount to nothing more than a replacement of administrative documents that fail to address the root of classroom practices. This aligns with the findings of Dewi & Kuswandono (2025) regarding the phenomenon of "curriculum fatigue," where educational effectiveness declines because teachers are forced to adapt to new regulations without being equipped with adequate methodological competencies.

Similar criticism is directed at school management styles that are overly top-down and bureaucratic. Although instructional management is often considered the key to school effectiveness (Puruwita et al., 2022), the results of this study offer a different perspective: even strict management will not impact the quality of learning if it is not accompanied by teacher autonomy and competence. In line with this, Matos Pedro et al., (2020) emphasize that a school's adaptability to global challenges is determined more by teachers' intellectual capital than by organizational structure or administrative bureaucracy alone.

This study proposes the counterargument that the quality of learning is not the result of policy pressure, but rather the result of sustained investment in competencies. These findings fill a significant gap in the literature by demonstrating that teacher capacity development is a far more stable predictor ($T\text{-stats} = 27.117$) than any managerial variable. Thus, this study affirms that competent teachers are the primary driving force of education, while curriculum and management are merely supporting instruments.

The Educational Landscape and Teacher Resilience in Cirebon

The findings of this study indicate that in Cirebon, the quality of SDG-based education is highly dependent on the professional resilience of teachers. In a local culture that views teachers as role models, strengthening competencies has proven to be far more decisive than the mere availability of physical facilities (Sutisna MN & Haizam Mohd Saudi, 2018). Every improvement in teacher expertise creates a ripple effect that significantly boosts student motivation to learn (Nurdiansyah et al., 2025).

With a T-statistic value of 27.117, educational policy must shift from an administrative focus to intellectual empowerment. Teacher training needs to be designed according to real-world needs in the field, particularly regarding digital literacy and active methodologies (Rahmi & Rasanjani, 2025). This step is crucial for closing the quality gap in education at the grassroots level (Mustafa et al., 2024) and strengthening the role of practitioner communities such as MGMP (Maula & Noviyanti, 2024).

Ultimately, the success of this system depends on the synergy between supportive school policies and teachers' commitment to continuous professional growth. School administrators must act as facilitators who create space for innovation without the constraints of rigid bureaucracy. Prioritizing capacity building as a key investment will foster a learning ecosystem in Cirebon that is not only academically strong but also relevant to global challenges.

Accelerating Quality through Integrated Capacity Building

In practice, a school's effectiveness is no longer measured by its physical grandeur. Given the dominant influence of capacity building (0.860), policies must shift toward competency development that is more cost-effective and has a direct impact on instructional quality (Sutisna MN & Haizam Mohd Saudi, 2018). Operationally, schools need to strengthen the ecosystem of self-directed learning by revitalizing MGMPs transforming them from mere administrative bodies into hubs for creativity and peer coaching (Maula & Noviyanti, 2024).

For local governments, these findings serve as a basis for redirecting procurement budgets toward personalized teacher development (Mustafa et al., 2024). School supervisors must act as growth facilitators to foster professionalism in the communal region of Cirebon (Nurdiansyah et al., 2025). Through a solid community of practitioners, capacity building will spread more rapidly across all levels of education.

Finally, for educators, dedication to professional development is statistically proven ($T=27.117$) to be the primary determinant of instructional success (Rahmi & Rasanjani, 2025). Synergy between supportive policies and teachers' commitment to growth will create a resilient and sustainable educational ecosystem in Cirebon.

Conclusion

Based on the results of the data analysis and discussion, this study draws the following key conclusions:

- 1) **Strong Correlation Between Capacity Building and the SDGs:** The study's findings confirm that strengthening teachers' capacity is a crucial determinant in improving the quality of SDG-based learning. A path coefficient value of 0.860 indicates a very strong positive relationship, where the effectiveness of sustainable learning is directly proportional to the intensity of teachers' professional development at the school.
- 2) **Dominance of Teacher Competency Factors:** This study demonstrates that instructional quality is not solely determined by physical aspects such as school facilities but is predominantly influenced by teachers' competency readiness. Teachers possessing digital literacy and adaptive pedagogical skills are proven to be more capable of integrating SDG values into interactive and contextual learning processes.
- 3) **Model Contribution (R^2):** The capacity-building variable contributes 73.9% to the variation in SDG-based learning quality. This significant percentage underscores that systematic teacher development programs are a strategic investment capable of explaining the majority of the success in implementing sustainable education at the study site.
- 4) **Implications and Local Resilience:** In the context of education in Cirebon, teachers' professional resilience serves as the primary foundation for addressing global challenges. This implies that empowering teachers through learning communities (such as MGMPs) and flexible institutional support is more effective in improving educational quality than purely administrative approaches.

Recommendations

Based on the research findings regarding the impact of teacher capacity-building programs on the quality of SDG-based learning, the following practical and academic recommendations are proposed:

- 1) **For School Administrations and Educational Institutions:** Given that capacity-building programs have proven to be a key determinant in improving the quality of learning with a path coefficient of 0.860, schools are strongly advised to prioritize budget allocation for continuous professional development rather than focusing solely on physical facilities. Practically, schools need to revitalize the role of Subject Teachers' Working Groups (MGMP) as platforms for peer coaching and creativity to accelerate the integration of sustainability values into the curriculum. Additionally, school leaders must act as facilitators by providing a flexible institutional environment, thereby granting teachers pedagogical autonomy to innovate without the constraints of rigid bureaucracy.
- 2) **For Local Governments and Policy Makers:** The findings of this study should serve as a foundation for local governments, particularly in the Cirebon region, to shift educational policies from an administrative focus toward intellectual empowerment.

The Education Office is recommended to redirect resources toward personalized teacher training programs that align with real-world needs in the field, particularly regarding digital literacy and active learning methodologies. By strengthening teachers' intellectual capital, the government can more effectively bridge the quality gap in education at the grassroots level to ensure learning outcomes align with global sustainable development goals.

- 3) For Future Researchers: Although this study demonstrates a very strong relationship among the variables, the R-Square value of 0.739 indicates that 26.1% of the variance in SDG-based learning quality remains unexplained by this model. Therefore, future researchers are advised to: (a) include additional external variables such as students' intrinsic motivation, teachers' professional resilience, or the availability of digital infrastructure, and (b) expand the scope of the research by involving more diverse geographic demographics or using comparative longitudinal studies to verify whether these professional development patterns remain consistent across different educational contexts.

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Student ID/Staff ID : 2381090068

Affiliation : Syekh Nurjati State Islamic Cyber University of Cirebon

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Student ID/Staff ID : 2381090079

Affiliation : Syekh Nurjati State Islamic Cyber University of Cirebon

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