IRJE |Indonesian Research Journal in Education| |Vol. 9| No. 1|June|Year 2025|

Effectiveness of principals' supervision and the learning performance of high school teachers through digital-based PLC

RITA HASTUTI[1*], PERMANA JOHAR[2], AND TAUFANI[3]

Abstract

Teachers' learning performance can be improved through the principal's supervision by implementing several strategies and supporting tools. One of the strategies in learning supervision can be carried out through digital-based Professional Learning Communication (PLC) activities. The purpose of this study is to analyze the effectiveness of learning supervision in improving teacher learning performance through digital-based PLC activities, using a quantitative method with a multiple-regression research design. The results showed that *the adjusted* R2 (determination coefficient) was 0.934, meaning that the supervision activity of digital-based *PLC* (X_1), and the supervision outcome activity of digital-based PLC (X_2) contributed 93.4%, to the improving the learning performance of high school teachers (Y), while the remaining 6.6% explained by other factors that are not described in this study. The result of F (418.635) > F-table (3.91) and the significance value of P = 0.001 < α 0.05, means that the test model is feasible. In other words, there is a significant simultaneous influence of both variables on the improvement of high school teachers' learning performance (Y).

Keywords

Principal supervision, digital-based PLC, teacher learning performance.

Article History

Received 11 September 2024
Accepted 01 May 2025

How to Cite

Hastuti, R., Johar, P., & Taufani. Effectiveness of principal supervision improved the learning performance of high school teachers through digital-based PLC.*Indonesian Research Journal in Education |IRJE|*, 9(1), 146-163. https://doi.org/10.22437/irje.v9i01.37112

[1] Universitas Pendidikan Indonesia, Indonesia, Corresponding author: ritahastuti@upi.edu
[2, 3] Universitas Pendidikan Indonesia, Indonesia

Introduction

The advancement of digital technology in recent years has resulted in major changes in various aspects of education, including in the development of teacher competence and professionalism through the Professional Learning Community (PLC). Currently, teacher professional development through the Professional Learning Community (PLC) has begun to use digital technology as one of the innovations adopted by schools. The implementation of this digital-based PLC allows teachers to collaborate more effectively, share best practices, and receive constructive feedback, all of which play an important role in improving the quality of learning. In its implementation, digital-based PLC can also be a medium for school principals to provide feedback and supervision to teachers, with the aim of improving learning performance.

Through digital-based PLC activities, school principals can actually maximize their role by providing feedback and supervising learning. External factors that can affect teacher performance are supervision carried out by school principals (Awam et al., 2024). As mentioned by (Torres, 2024), school leaders can conduct supervision, discussions with teachers, and provide them with knowledge and insight through feedback to teachers. The principal's support for PLC activities is very important, because it is directly related to the quality of graduates. As mentioned, the support provided by school principals to teachers through professional learning communities (PLCs) can sustainably maintain and improve the quality of school graduates (Antinluoma et al., 2021).

The support and facilitation of school principals in PLC activities also has an impact on improving teacher learning performance. As explained by (Sowndappan, 2023), that in particular, the constant professional support of the principal in PLC activities will improve the teaching performance of teachers. A digital-based PLC is a program that involves collaboration and participation, so support from the principal must be based on the principle of partnership. In this case, teachers are considered as discussion partners who must be encouraged and supported to improve the quality of learning. As mentioned by (Johannesson, 2022), collaborative programs supported by schools encourage teachers to be more responsible in improving the quality of their learning.

Some approaches and strategies can be applied to improve teacher learning performance, as mentioned by (Ma, et al., 2020), including inviting experts to introduce knowledge or guide practical training face-to-face. However, in the implementation of digital-based PLC, school principals can optimally utilize their role as supervisors to provide guidance and feedback, in order to improve the learning performance of teachers.

Principal supervision plays a key role in directing and supporting the implementation of PLCs, especially those based on digital platforms. The role of the principal in supervising, facilitating, and providing feedback to teachers is very important to ensure that the PLC runs effectively and has a positive impact on the teacher's learning performance. Various studies show that effective supervision of school principals can increase teachers' involvement in PLCs and encourage them to be more proactive in their professional development. As mentioned by (Wetchan, 2023), the strategy of supervision over planning, implementation, reinforcement, evaluation, and feedback (called the PAREF Model), which is applied through

the professional learning community network (PLCN), can effectively improve the quality of teacher learning.

Teachers' learning performance, which includes planning, implementing, and evaluating learning, is greatly influenced by their participation in PLCs. Optimal support and facilitation from principals in PLC activities can help teachers recognize their strengths and weaknesses and develop strategies to improve learning effectiveness. Studies have shown that teachers who are active in digital-based PLCs show significant improvements in their pedagogic skills. This will have an impact on improving the quality of graduates. As mentioned by (Hord, S, 2009), the quality of graduates of educational units is actually related to the quality of teachers' learning performance in the classroom and school. It is stated that the most significant thing to see in the quality of learning quality is seen from the teacher's learning performance.

This study aims to analyze the supervision of school principals on the stages of PLC activities, and the results of digital-based PLC activities, as well as their effectiveness in improving teacher learning performance. By collecting and analyzing data quantitatively, this study explores how school principals utilize digital platforms in PLCs to effectively supervise to improve teachers' learning performance.

Methodology

Research design, site, and participants

This study uses a quantitative method, applying a multiple regression analysis design (Creswell & Creswell, 2018). In this study, there are two independent variables, namely: first, supervision activity of digital-based LPC, which includes sub-variables: supervision planning activity of digital-based PLC, supervision implementation activity of digital-based PLC, and supervision evaluation activity of digital-based PLC; second, supervision outcome activity of digital-based PLC, including sub-variables: quality supervision of teacher learning (jargu), quality supervision of peer learning (jarse), and quality supervision of development professional teacher (karpro). Improving the learning performance of high school teachers is a bound variable in this study.

The location of this research is in the Jakarta area, with the research subjects covering 5 (three) high schools, namely: SMA Negeri 3 in South Jakarta, SMA Negeri 8 in South Jakarta, SMAN 24 in Central Jakarta, SMAN 73 in North Jakarta, SMAN 113 in East Jakarta, SMAS Barunawati in West Jakarta and SMAS Pangudi Luhur in South Jakarta. The research subjects as data sources/respondents were 133 people consisting of teachers and school principals.

Data collection and analysis

The data collection technique was carried out using a questionnaire, which was in the form of a questionnaire. The questionnaire has been tested for validity and reliability to ensure the validity of the instrument.

Data analysis was carried out using multiple linear regression to estimate the causal influence between variables that were determined in the causal model. There are two sides of influence analysis, namely: (1) variables of supervision activity of digital-based PLC include sub-variables: supervision planning activity, supervision implementation activity, and

supervision evaluation activity; and (2) the variables of supervision outcome activity of digital-based PLC, including sub-variables: quality supervision of teacher learning (jargu), quality supervision of peer learning (jarse), and quality supervision of development professional teacher (karpro), which are measured by their influence on improving the learning performance of high school teachers.

Regression analysis was carried out using the SPSS program version 23.0 (Ghozali, 2016) between the sub – variables supervision planning activity of digital-based PLC (X1.1), supervision implementation activity of digital-based PLC (X1.2), and supervision evaluation activity of digital-based PLC (X1.3) on improving the learning performance of high school teachers (Y). Regression analysis was also carried out between the sub-variables quality supervision of teacher learning (jargu) (X2.1), quality supervision of peer learning (jarse) (X2.2), quality supervision of development professional teacher (karpro) (X2.3), which was measured by its influence on improving the learning performance of high school teachers.

Results

Multiple regression analyis, this study aims to analyze the effectiveness of principal supervision in improving the learning performance of high school teachers. The analysis was carried out on two variables of principal supervision, namely: first, supervision activities of digital-based PLC, including 3 (three) sub-variables, namely: 1) supervision planning activity of digital-based PLC; 2) supervision implementation activity of digital-based PLC; and 3) supervision evaluation activity of digital-based PLC. The second variable is the supervision outcome activity of digital-based PLC including 3 (three) sub-variables, namely: 1) the quality supervision of teacher learning (jargu); 2) the quality supervision of peer learning (jarse); and 3) the quality supervision of development professional teacher (karpro).

Data quality test, data were collected using questionnaires as research instruments. Each variable indicator of the research was given a choice of closed answers using a four-point Likert scale, from 1 to 4. The collected data is then analyzed through validity and reliability tests to ensure that the questionnaire is suitable for use.

Validity test, an instrument is said to be valid if the r-value is > from the r-table, then the valid statement item has an error rate of Alpha 0.05. The number of respondents is 133, then the r-table (N-2 = 131) is 0.173. The results of the recapitulation of the validity test in this study are presented in Table 1 as follows:

Table 1. *Validity test results variable*

Variables	Sub Variables	Grain	r calculate	r table	Ket
Supervision Activity of digital-based PLC (X_1)	Supervision planning activity of digital-based PLC ($X_{1.1}$)	X.1.1	0.892	0.1703	valid
		X.1.2	0.896	0.1703	valid
		X.1.3	0.947	0.1703	valid
	Supervision Implementation activity of digital-based PLC ($X_{1.2}$)	X 1.4	0.932	0.1703	valid
		X 1.5	0.924	0.1703	valid
		X.1.6	0.957	0.1703	valid

	Supervision Evaluation activity of digital-based PLC ($X_{1.3}$)	X.1.7	0.914	0.1703	valid
		X.1.8	0.935	0.1703	valid
		X.1.9	0.951	0.1703	valid
Supervision Outcome Activity of digital-based PLC (X_2)	Quality Supervision of Teacher Learning (Jargu) ($X_{2.1}$)	X.2.1	0.940	0.1703	valid
		X.2.2	0.915	0.1703	valid
		X.2.3	0.947	0.1703	valid
		X.2.4	0.930	0.1703	valid
	Quality Supervision of peer learning (Jarse) ($X_{2.2}$)	X.2.5	0.960	0.1703	valid
		X.2.6	0.939	0.1703	valid
		X.2.7	0.955	0.1703	valid
	Quality supervision of development professional teacher (Karpro) ($X_{2.3}$)	X.2.8	0.898	0.1703	valid
		X.2.9	0.927	0.1703	valid
		X.2.10	0.938	0.1703	valid
		X.2.11	0.900	0.1703	valid
Improving the learning performance of high school teachers (Y**)**	Jargu Performance	Y.1.1	0.934	0.1703	valid
	Jarse Performance	Y.1.2	0.933	0.1703	valid
	Karpro Performance	Y.1.3	0.948	0.1703	valid

The results of the validity test are in Table 1. The above shows that all sub-variables have the r-value > of the r-table (0.1703). This shows that the statement items in the developed research instrument are declared valid.

Reliability test, the reliability test for this research instrument uses the Alpha Cronbach value, which aims to evaluate the unidimensionality of statement items against the latent variables studied. An instrument is considered reliable if its Alpha Cronbach value is equal to or greater than 0.60. The recapitulation of the results of the instrument reliability test can be seen in Table 2 below.

Table 2. *Reliability test results*

No	Variables	Cronbac'sh Alpha	R table	Ket
1	Supervision activity of digital-based PLC (X1)	0.968	0.60	Reliable
2	Supervision outcome activity of digital-based PLC (X2)	0.973	0.60	Reliable
3	Improving the learning performance of high school teachers (Y)	0.932	0.60	Reliable

The results of the reliability test in Table 2 show that all research instruments have a Cronbach's Alpha coefficient of more than 0.60. It can be said that all instruments are reliable so that they can be used to conduct research.

Results of the classic assumption test, classical assumption tests that must be met in simple linear regression analysis include the Normality Test, the Multicollenearity Test and the Heterokedasticity Test. The results of the classic assumption test of this study are as follows.

Data normality test, the normality test aims to determine whether the residuals of the regression model used follow the normal distribution or not. In this study, the normality test was carried out by testing the residue using the Kolmogorov-Smirnov test. If the residual

significance probability value is greater than 0.05, then the data is considered normally distributed. Conversely, if the residual significance probability value is less than 0.05, then the data is considered not normally distributed. The results of the normality test in this study can be seen in Table 3 below.

Table 3. *Results of the one-sample kolmogorov-smirnov test*

		Unstandardized Residual
N		133
Normal Parameters[a,b]	Mean	0E-7
	Std. Deviation	.51570331
Most Extreme Differences	Absolute	.326
	Positive	.326
	Negative	-.248
Kolmogorov-Smirnov Z		0.755
Asymp. Sig. (2-tailed)		.060

a. Test distribution is Normal. b. Calculated from data.

Based on the results of the analysis in Table 3, a significance value of 0.060 was obtained which was greater than 0.05. Since the significance value of the Kolmogorov-Smirnov test is more than 0.05, it can be concluded that the regression equation model is normally distributed.

Multicollinearity test, the multicollinearity test aims to identify the correlation between independent variables in a regression model. A good regression model does not show a correlation between independent variables. To detect this correlation, tolerance and variance inflation factor (VIF) values can be checked. If the tolerance value is more than 10% or the VIF is less than 10, then these variables are considered free of multicollinearity. The results of the multicollinearity test in this study can be seen in the following Table 4.

Table 4. *Multicollinearitas test results*

Coefficientsa

Model	Unstandardized Coefficients		Standardized Coefficients	t	Mr.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	BRIGHT
(Constant)	.138	.359		.385	.701		
Supervision activity of digital-based PLC	.046	.035	.130	1.298	.197	.103	9.665
Supervision outcome activity of digital-based PLC	.234	.029	.807	8.069	.000	.103	9.665

a. Dependent Variable: Improving the learning performance of high school teachers

a. Dependent Variable: Improving the learning performance of high school teachers

Based on the results of the analysis in Table 4. Above it can be seen that the tolerance value of the variation supervision activity of digital-based PLC (X1) and the variable of supervision outcome activity of digital-based PLC (X2) is (0.103) > 0.100. Meanwhile, the VIF values of all two variables X1 (9.665) and X2 (9.665) < out of 10, which means that the regression equation model is free of multicollinearity.

Heteroskedasticy test, the heteroscedasticity test aims to determine whether there is a difference in residual variance between one observation and another observation in the regression model, which was tested using the Glejser test. A good regression model does not show symptoms of heteroscedasticity or has a homogeneous variance. If the tested free variable does not show a significant influence or the significance value is more than 0.05 on the absolute residual value, then the regression model is considered to contain no heteroscedasticity symptoms. The results of the heteroscedasticity test are presented in the following Table 5.

Table 5. *Heteroscedasticity test results*

Coefficientsa

Coefficientsa Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Mr.
(Constant)	.511	.291		1.757	.081
Supervision activity of digital-based PLC	.014	.029	.133	.489	.626
Supervision outcome activity of digital-based PLC	-.017	.023	-.197	-.726	.469

a. Dependent Variable: Abs_Res

In Table 5, it can be seen that the significance value of the supervision activity variable of digital-based PLC (X_1) is 0.626, and the supervision outcome activity of digital-based PLC (X_2) is 0.469. The value is greater than 0.05 which means that there is no influence between the independent variables on *absolute residuals*. Thus, the regression model created does not contain any symptoms of heteroscedasticity. Based on the description in Table 3, Table 4 and Table 5 above, it shows that all classical assumption tests have been met, so the results of regression analysis deserve further discussion. After all the classical assumptions are met, then the results of multiple linear regression analysis are presented. The calculation of the multiple linear regression coefficient was carried out by regression analysis through SPSS 27.0 for Windows software.

Results multiple linear regression analysis supervision activity variables of digital-based PLC

Table 6. *Results f multiple linear regression analysis on sub-variables supervision activity of digital-based plc*

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Mr.
		B	Std. Error	Beta		
1	(Constant)	.629	.428		1.468	.145
	Supervision Planning Activity of Digital-based PLC ($X_{1.1}$)	.442	.120	.429	3.672	.000
	Supervision Implementation Activity of Digital-based PLC ($X_{1.2}$)	.125	.102	.124	1.222	.224
	Supervision Evaluation activity of Digital-based PLC ($X_{1.3}$)	.377	.085	.377	4.419	.000

a. Dependent Variable: Improving the learning performance of high school teachers

Based on the results of the multiple linear regression analysis as presented in Table 6, the following regression equation can be made:

$$Y = (0.629 + 0.442\ X_{1.1} + 0.125\ X_{1.2} + 0.377\ X_{1.3})\ X_1$$

In Table 6, it can be seen that of the three sub-variables of supervision activity of digital-based PLC, one variable has a significance value greater than 0.05 (X > 0.05), namely the sub-variable of supervision planning activity of digital-based PLC (X1.2) with a significance of 0.224. This shows that these sub-variables do not have a significant effect on Improving the learning performance of high school teachers (Y). In contrast to the other two sub-variables, the supervision planning activity of digital-based PLC (X1.1) and the supervision evaluation activity of digital-based PLC (X1.3) showed a significance value of 0.000, which means that the regression coefficient in this variable was positive and significant with a significance value of less than 0.05. This shows that the two sub-variables have a positive and significant influence on Improving the learning performance of high school teachers (Y). Based on the regression equation, the following can be explained as follows.

- A constant value of 0.629 means that if the variable supervision activity of digital-based PLC (X1) is fixed, the effectiveness of improving the learning performance of high school teachers (Y) will be affected by 6.29% This value shows that even though there is no perception of PLC supervision, there is still a positive assessment of the effectiveness of teacher learning performance (positive significantly).

- The regression coefficient (b1) for supervision planning activity of digital-based PLC (X1.1) of 0.442 shows a significant positive influence. This means that if PLC supervision planning activity is managed and improved, the effectiveness of Improving the learning performance of high school teachers (Y) will increase by 44.2%. This significant positive coefficient shows that the supervision planning activity of digital-based PLC and the effectiveness of supervision implementation activity of digital-based PLC have a comparable relationship (directly proportional). Thus, the increase or decrease in the perception of supervision planning activity of digital-based PLC (X1.1) is directly proportional to the change in the perception of Improving the learning performance of high school teachers (Y).
- The regression coefficient (b2) for the supervision implementation activity of digital-based PLC (X1.2) is 0.125, indicating a significant positive influence. This means that if the supervision implementation activity of digital-based PLC is managed and improved, then the effectiveness of Improving the learning performance of high school teachers (Y) will increase by 12.5%. This positive coefficient shows that the supervision implementation activity of digital-based PLC and the improvement of teacher learning performance have a comparable relationship (directly proportional). Thus, increasing or decreasing the perception of the supervision of the implementation of digital-based PLC (X1.2) will have an impact on Improving the learning performance of high school teachers (Y).
- The regression coefficient (b3) for the supervision evaluation activity of digital-based PLC (X1.3) of 0.377 shows a significant positive influence. This means that if the supervision evaluation activity of digital-based PLC is managed and improved, the effectiveness of Improving the learning performance of high school teachers (Y) will increase by 37.7%. This positive coefficient shows that supervision evaluation activity of digital-based PLC and improvement of teacher learning performance have a comparable relationship (directly proportional). Thus, when there is an increase or decrease in the perception of supervision evaluation of digital-based PLC (X1.3), it will affect the increase in perception of improving the learning performance of high school teachers (Y).

Results of multiple linear regression analysis of supervision outcome activity of digital-based plc

Based on the results of the multiple linear regression analysis as presented in Table 7, the regression equation can be made as follows:

$$Y = (0.208 + 0.369\ X_{2.1} + 0.090\ X_{2.2} + 0.603\ X_{2.3})\ X_2$$

In Table 7, it can be seen that of the three sub-variables of supervision outcome activity of digital-based PLC, one variable has a significance value greater than 0.05 (X > 0.05), namely the sub-variable quality supervision of peer learning (X.2.2) with a significance value of 0.334. This shows that these sub-variables do not have a significant effect on Improving the learning performance of high school teachers (Y). In contrast to the other two sub-variables, namely quality supervision of teacher learning (X2.1) and quality supervision of development professional teacher (X2.3) show significance values of 0.035 and 0.000 which means that the

regression coefficient in this variable is positive and significant with significance value of less than 0.05. This shows that the sub-variables quality supervision of teacher learning (X2.1) and quality supervision of development professional teacher (X.2.3) in the supervision outcome activity of digital-based PLC (X2) have a positive and significant influence on Improving the learning performance of high school teachers (Y).

Table 7. *Results of multiple linear regression analysis on sub variables supervision outcome activity of digital-based plc*

Coefficientsa

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	t	Mr.
		B	**Std. Error**	**Beta**		
1	(Constant)	.208	.310		.670	.504
	Quality Supervision of Teacher Learning (Jargu) (X 2.1)	.369	.039	.091	1.797	.035
	Quality Supervision of peer learning (Jarse) (X 2.2)	.090	.093	.091	.970	.334
	Quality Supervision of development professional teacher (X 2.3)	.603	.067	.786	8.987	.000

Based on the regression equation, the following can be explained:

- A constant value of 0.208 means that if the variable the supervision outcome activity of digital-based PLC (X2) does not change, then improving the learning performance of high school teachers (Y) will be affected by 20.8%. This constant value shows that although there is no perception of the supervision outcome activity of digital-based PLC (X2), there is still a significant positive assessment of Improving the learning performance of high school teachers.
- The regression coefficient (b1) for the sub-variable quality supervision of teacher learning (X2.1) is 0.369, indicating a positive value. This means that if the quality supervision of teacher learning (X2.1) is managed and improved, assuming other variables remain, improving the learning performance of high school teachers (Y) will increase by 36.9%. This positive coefficient shows that there is a comparable relationship between the quality supervision of teacher learning (X2.1) and the improving the learning performance of high school teachers (Y). The quality supervision of teacher learning (X2.1) has a positive regression coefficient, this variable has a significant influence on Improving the learning performance of high school teachers (Y) because the significance value obtained is less than 0.05, which is 0.035.
- The regression coefficient (b2) for the sub-variable quality supervision of peer learning (X2.2) is 0.090, showing a significant positive influence. This means that if the quality supervision of peer learning (X2.2) is managed and improved, assuming other variables remain, the improving learning performance of high school teachers (Y) will increase by

9.0%. This positive coefficient shows that there is a comparable (directly proportional) relationship between the quality supervision of peer learning (X2.2) and the Improving the learning performance of high school teachers (Y). Thus, when there is an increase or decrease in the perception of the quality supervision of peer learning (X2.2), it will affect the perception of improving the learning performance of high school teachers (Y).

- The regression coefficient (b3) for the quality supervision development professional teacher (X2.3) is 0.603, indicating a positive influence. This means that if the quality supervision of development professional teachers is managed and improved, the improving the learning performance of high school teachers (Y) will increase by 60.3%. This positive coefficient shows a comparable relationship between the quality supervision of development professional teachers (X2.3) and the improving the learning performance of high school teachers (Y). Although quality supervision of development professional teachers (X2.3) has a positive regression coefficient value, this sub-variable can not significantly affect improving the learning performance of high school teachers (Y), where the significance value obtained is greater than 0.05 which is 0.603.

Determination coefficient test results (R2), the determination coefficient (R2) is used to determine and measure the ability of the test model to explain the variation of independent variables. Use the adjusted R2 value to evaluate which regression test model is best, because, unlike R2, the adjusted R2 value can go up or down if a single independent variable is added to the regression test model.

Table 8. *Results of the determination coefficient test (r2)*

Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.968a	.937	.934	.363

a. Predictors: (constant), quality supervision of development professional teacher (karpro), supervision implementation activity of digital-based PLC, quality supervision of teacher learning (jargu), supervision evaluation activity of digital-based plc, quality supervision of peer learning (jarse), supervision planning activity of digital-based PLC.

The test results in Table 8 show that the adjusted R^2 value (determination coefficient) is as high as 0.934. This means that 93.4% of the variation in teacher learning performance (Y) was significantly influenced by the variables supervision activity of digital-based PLC (X1) and supervision outcome activity of digital-based PLC activities (X2). The remaining 6.6% was explained by other factors not covered in the study.

Simultaneous test results (Test F), the simultaneous test, or F-test, aims to determine whether all independent sub-variables in the variable supervision activity of digital-based PLC (X1) and the variable supervision outcome activity of digital-based PLC (X2) are overall effective in predicting the effectiveness of supervision for improving the learning performance

of high school teachers (Y). The results of the analysis of the F-test in this study can be found in Table 9 below.

Table 9. *Results of test analysis F*

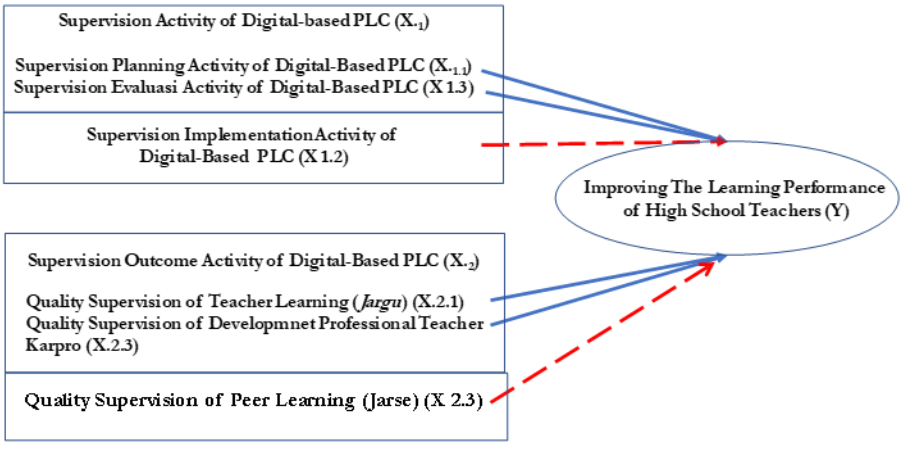
ANOVA

Model		Sum of Squares	df	Mean Square	F	Mr.
1	Regression	226.098	2	113.049	418.635	.001b
	Residual	35.105	130	.270		
	Total	261.203	132			

a. Dependent Variable: Improving the learning performance of high school teachers
b. Predictors: (Constant), Supervision activity of digital PLC; Supervision outcome activity of digital-based PLC.

The results of the F test showed a calculated F-value of 418.635 which was greater than the F-table of 3.91, and a significance value of P-value of 0.001 which was smaller than $\alpha = 0.05$, indicating that the test model in this study was valid. This means that all independent sub-variables of supervision activity of digital-based PLC (X1) and variable supervision outcome activity of digital-based PLC (X2) can simultaneously predict or explain the 'effectiveness' in Improving the learning performance of high school teachers (Y). In other words, there is a significant influence of the variable supervision activity of digital-based PLC (X1) and variable supervision outcome activity of digital-based PLC (X2) on improving the learning performance of high school teachers (Y). This indicates that the test model can effectively project the influence of independent variables on the bound variables because the goodness of fit results is very good with a significance value of P-value 0.001. The factors that directly support the effectiveness of the principal's supervision on improving teacher learning performance through digital-based PLC activities are described as follows.

Figure 1. *The effectiveness of the principal's supervision on improving teacher learning performance through digital-based PLC activities*



Discussion

The results of the study show that the supervision of the principal over the stages of activities, and the results of digital-based PLC activities can significantly improve teacher learning performance. As a responsibility of school leadership, the principal can optimize his role as a learning supervisor through PLC activities based on digital platforms. The supervision carried out by the principal in order to improve the learning performance of high school teachers through digital-based PLC activities includes two things, namely: supervision of the stages of PLC activities, and supervision of the results of PLC activities.

Principal supervision and teacher learning performance, the active role of the principal through supervision activity of digital-based PLC and supervision outcome activity of digital-based PLC results significantly contributed to improving the learning performance of high school teachers, which includes learning planning, implementation, and evaluation of learning outcomes. This result is in line with the explanation (Shdaifat, 2020), that school principals and academic supervisors have an important meaning and a positive attitude towards the role of teachers in the professional learning community (PLC) in schools. The commitment and support of the principal in PLC activities is the key in building teacher togetherness. It was explained by (Tai et al., 2023), that the development of learning community (PLC) professionals in schools has a significant relationship with the commitment and support of the principal, collegial understanding and trust, external support systems, structural support and shared norms. On the other hand (Lokman Mohd. Tahir & Mohammed Borhandden Musah, 2020), explained that primary school teachers are satisfied with the implementation of PLC in their schools, as it is effective professional development, and creates a culture of teamwork and improves the learning process of teachers.

Supervision of school principals through digital-based PLC activities will give an impetus to teacher job satisfaction. As mentioned by (Zhang et al., 2023), that the feedback and supervision of the principal fosters self-efficacy and job satisfaction in teachers in carrying out their duties. The principal in this context, acts as a supervisor and digital vasilitor who integrates technology in daily supervision practices. Therefore, according to (Bryant et al., 2020), the necessary infrastructure is to facilitate teacher empowerment and team building by (a) mediating learning initiatives, (b) designing structures for curriculum enforcement, and (c) creating opportunities for professional dialogue.

The importance of the principal's supervision in PLC activities, because in fact teachers also need reinforcement in terms of knowledge of learning materials and pedagogical knowledge. This is explained by (Kellner & Attorps, 2020), that the supervision of the principal is important because knowledge of the subject matter and pedagogical content is an aspect needed by teachers in compiling the planning, implementation, and results of PLC activities. Another fact is explained by (Harvey & Nilsson, 2022), that in general teachers are proficient in planning and executing PLCs, but evaluating and analyzing the results that have been done and then using them for new planning is more difficult. The effectiveness of principal supervision in providing constructive feedback and support will help increase teacher participation and learning performance.

Principal supervision is basically part of the principal's leadership facilitation of digital-based PLC activities carried out by teachers, and will have an impact not only on students, but

also on teachers and the principal itself. As explained by (Lee & Ip, 2021), learning supervision will help students in achieving higher levels of competence, encourage and build effective leadership and management for teachers, and improve the instructional leadership of school principals. School principals as learning leaders need to provide encouragement and facilitation through various ways in order to obtain maximum learning quality. This is in line with the explanation (Bendtsen et al., 2022), that by understanding the various best ways to facilitate the development of professional communities (PLCs), it will have a positive impact on the quality of teacher learning. The facilitation of school principals in PLC activities through learning supervision will have a positive impact on teacher performance. Continuous supervision allows for the identification of areas for improvement and adjustment of digital-based PLC strategies, ultimately contributing to the improvement of learning quality, professional development, and teacher learning performance.

Conceptually, the teacher's learning performance is actually an appearance that shows the ability to carry out tasks and functions within the scope of learning. Aspects of teacher learning performance, referring to the Regulation of the Minister of State Apparatus Empowerment and Bureaucratic Reform No. 16 of 2009, a subject teacher must have the ability to: (1) develop a learning curriculum in an educational unit; (2) compiling a learning syllabus; (3) prepare a learning implementation plan; (4) carrying out learning activities; compile measuring tools/questions according to subjects; (6) assessing and evaluating the learning process and outcomes in the subjects they teach; (7) analyze the results of learning assessments; (8) carry out learning/improvement and enrichment by utilizing the results of assessment and evaluation; (9) to be a supervisor of assessment and evaluation of learning processes and outcomes at the school and national levels; (10) guiding novice teachers in induction programs; (11) guiding students in extracurricular activities in the learning process; (12) carry out self-development; (12) carrying out scientific publications; and (13) making innovative works. In this context, learning performance is interpreted as performance related to the teacher's professional duties in managing and improving the quality of learning.

Based on the reference above, actually teacher learning performance is related to three main areas, namely: learning planning, learning implementation, and evaluation of learning outcomes. The three main areas of teacher learning performance can be significantly improved through the supervision of school principals in digital platform-based PLC activities. This result is in line with the explanation (Boateng & Nyamekye, 2022), that PLC activities supported by digital platforms are important activities and can improve teachers' learning performance.

The importance of learning performance is mentioned by (Zgenel, 2019), because it will contribute to the quality of graduates. It is stated that teacher learning performance is one of the important aspects in the educational process in schools which has a large contribution to the quality of graduates of education units. Therefore, the supervision of school principals also has an important contribution to improving the quality of graduates. Through supervising the stages of planning, implementation, evaluation, and implementation based on digital platforms, PLC has been proven to provide reinforcement in professional development and teacher learning performance. This is in line with the explanation (Prenger et al., 2021), that PLC is a means of learning for teachers, helping them collaborate, share best practices, and improve the overall quality of education.

Platform digital dalam professional learning community, the current development of digital technology has provided space for the birth of various innovations in the managerial and administrative aspects of the world of education. One of them is the use of digital platforms in teacher professional development activities through the Professional Learning Community (PLC), and currently it has become an important part as one of the innovations adopted by schools. Professional Learning Community (PLC) as a shared learning space/community for teachers in the context of competency development, especially in pedagogic and professional aspects, currently requires the support of a digital platform that can expand collaboration between teachers' peers. With the use of digital platforms in PLCs, it allows for wider, flexible collaboration without geographical limitations, opens up opportunities for the exchange of good practices and allows teachers to continue to update their knowledge and skills with the latest information.

The development of digital platform-based PLCs is basically a consequence of technological developments in education and learning, which are accelerating after the COVID-19 pandemic. The importance of digital platforms in PLC activities is explained by (Botha, 2022), that the implementation of PLCs that use digital platforms prioritizes elements of collaboration between peers. The facilities and infrastructure that support these interactions and collaborations in online learning are provided by digital platforms with various equipment according to the purpose of the interaction to be achieved. The platform is used in the learning process that is carried out online or online. Likewise, it is also mentioned (Liljekvist et al., 2021), that the development of social media and digital platforms can be used by teachers as a medium for self-development through their professional learning communities with a focus on knowledge. In accordance with its characteristics, the digital platform can also be used in Professional Learning Community activities as a means of joint learning activities and encouraging the improvement of teacher learning performance.

However, the use of digital platforms in the implementation of PLCs is not always successful, meaning that it still experiences several obstacles both in planning, implementation and evaluation. As mentioned by (Bragg et al., 2021), the obstacles faced in digital platform-based PLCs are how to plan activities, implement, and evaluate the results of activities. However, these obstacles can actually be overcome through PLC activities collaboratively. As explained (Botha, 2022), collaborative learning is intentional and applied in learning supports teachers to be responsible in practicing collaboratively with fellow teachers. This is also in accordance with the explanation (Ni et al., 2023), that the purpose of PLC activities is so that teachers do not work alone and build communication to foster collaboration and improve the quality of the learning process. In this regard, it is also explained by (Denee, 2024), that through learning communities, teachers can build confidence, focus on learning, opportunities for collaboration, and reflective learning. Through a digital platform-based PLC, teachers have wider opportunities and reach in increasing collaboration between teachers. According to (Alwafi et al., 2020), teachers can increase collaboration among teachers in digital-based PLCs to interact and develop their professionalism.

It was further explained by (Colognesi et al., 2020), that through the application of digital PLC, it will be easier to obtain the support of fellow teachers in their learning community, so that a climate of knowledge exchange can be created that continues to grow. From the same point of view it is also mentioned by (Karlberg & Bezzina, 2022), that teachers who are

members of digital PLCs are faster to collaborate and engage in efforts to ensure that knowledge exchange and self-development continue to be sustainable. In general, the use of digital platforms in PLC activities has high benefits for teachers, students and schools. For teachers, there will be an improvement in learning performance, for students there will be quality of learning processes and outcomes, and for schools, there will be a learning climate that supports the achievement of student competencies optimally.

Conclusion

Based on the results of data analysis, it can be concluded that the variable supervision activity of digital-based PLC (X1), and the variable supervision outcome activity of digital-based PLC activity (X2) contributed 93.4%, to the Improving the learning performance of high school teachers (Y), while the rest is 6.6%explained by other factors that are not described in this study, which is proven by the magnitude of adjusted R2 (adjusted determination coefficient) is 0.934.

Based on data analysis, it can also be concluded that there is a significant simultaneous influence of the variable supervision activity of digital-based PLC (X1) and the variable supervision outcome activity of digital-based PLC (X2) on the improving the learning performance of high school teachers (Y), which is evidenced from the results of the F-test obtained indigo F-value (418.635) > F-table (3.91) and the significance value of P-value 0.001 which is smaller than $\alpha = 0.05$, This means that the test model used in this study is feasible.

References

Alwafi, E. M., Downey, C., & Kinchin, G. (2020). Promoting pre-service teachers' engagement in an online professional learning community. *Journal of Professional Capital and Community*, 5(2), 129–146. https://doi.org/10.1108/JPCC-10-2019-0027

Antinluoma, M., Ilomäki, L., & Toom, A. (2021). Practices of Professional Learning Communities. *Frontiers in Education, 6*(April), 1–14. https://doi.org/10.3389/feduc.2021.617613

Awam, R., Rifma, Hadiyanto, & Sabandi, A. (2024). The Contribution of Principal' s Academic Supervision and Pedagogical Competence to Teacher Performance. Indonesian *Research Journal in Education, 7(*2), 529–544. https://doi.org/https://doi.org/10.22437/irje.v7i2.31476

Bendtsen, M., Forsman, L., Björklund, M., Bendtsen, M., & Forsman, L. (2022). Exploring empowering practices for teachers' sustainable continuing professional development continuing professional development. *Educational Research, 64*(1), 60–76. https://doi.org/10.1080/00131881.2021.2000338

Boateng, S., & Nyamekye, M. (2022). Learning Sciences with Technology: The Use of Padlet Pedagogical Tool to Improve High School Learners' Attainment in Integrated Sciences. *International Journal of Learning, Teaching and Educational Research, 21*(5), 239–262. https://doi.org/doi.org/10.26803/ijlter.21.5.13

Botha, C. (2022). Purposeful Collaboration through Professional Learning Communities: Teacher E ducators' Challenges. *International Journal of Learning, Teaching and Educational Research, 21*(6), 210–225. https://doi.org//10.26803/ijlter.21.6.13

Bragg, L. A., Walsh, C., & Heyeres, M. (2021). Successful design and delivery of online professional development for teachers: A systematic review of the literature. *Computers & Education, 166*(January), 104158. https://doi.org/10.1016/j.compedu.2021.104158

Bryant, D. A., Lun, W. Y., & Adames, A. (2020). How middle leaders support in-service teachers' on-site professional learning. *International Journal of Educational Research, 100*(December 2019). https://doi.org/10.1016/j.ijer.2019.101530

Colognesi, S., Nieuwenhoven, C. Van, & Beausaert, S. (2020). Supporting newly-qualified teachers' professional development and perseverance in secondary education: On the role of informal learning. *European Journal of Teacher Education, 43*(2), 258–276. https://doi.org/10.1080/02619768.2019.1681963

Creswell & Creswell. (2018). *Research design qualitative, quantitative, and mixed methods approaches*. (Fifth Edit). Sage Publications, Inc.

Denee, R. (2024). The network professional learning community approach: an effective model for individual and group learning effective model for individual and group learning. *Teacher Development, 28*(3), 330–346. https://doi.org/10.1080/13664530.2024.2307588

Ghozali, I. (2016). Aplikasi analisis multivariete dengan program IBM SPSS 23.

Harvey, F., & Nilsson, P. (2022). Contradictions and their manifestations in professional learning communities in mathematics. *Journal of Mathematics Teacher Education, 25*(6), 697–723. https://doi.org/10.1007/s10857-021-09513-4

Hord, S. (2009). Professional learning communities: Educators work together toward a shared purpose - improved student learning. Journal of Staff Development, 30(1), 40–43.

Johannesson, P. (2022). Development of professional learning communities through action research: understanding professional learning in practice. *Educational Action Research, 30*(3), 411–426. https://doi.org/10.1080/09650792.2020.1854100

Karlberg, M., & Bezzina, C. (2022). Professional Development in Education The professional development needs of beginning and experienced teachers in four municipalities in Sweden. *Professional Development in Education, 48*(4), 624–641.

Kellner, E., & Attorps, I. (2020). The school – university intersection as a professional learning arena: evaluation of a two- year action research project. *Teacher Development, 24*(3), 366–383. https://doi.org/10.1080/13664530.2020.1773522

Lee, D. H. L., & Ip, N. K. K. (2021). The influence of professional learning communities on informal teacher leadership in a Chinese hierarchical school context. *Educational Management Administration & Leadership, 51*(2), 324–344.

Liljekvist, Y. E., Randahl, A., Bommel, J. Van, Olin-scheller, C., & Liljekvist, Y. E. (2021). Facebook for Professional Development: Pedagogical Content Knowledge in the Centre of Teachers' Online Communities Facebook for Professional Development: Pedagogical Content Knowledge in the Centre of Teachers' Online Communities. *Scandinavian Journal of Educational Research, 65*(5), 723–735.

Lokman Mohd. Tahir, & Mohammed Borhandden Musah. (2020). Implementing professional learning community in rural Malaysian primary schools: exploring teacher feedback Implementing professional learning community in rural Malaysian primary schools: exploring teacher feedback Lokman Mohd. Tahir Mohammed Borhandd. International *Journal of Management in Education, 14*(September), 422–451.

Ma, N., Du, L., Zhang, Y., Cui, Z., & Ma, R. (2020). The effect of interaction between knowledge map and collaborative learning strategies on teachers' learning performance and self-efficacy of group learning. *Interactive Learning Environments, 0*(0), 1–15.

Ni, L., Bausch, G., & Benjamin, R. (2023). Computer science teacher professional development and professional learning communities: a review of the research literature. Computer Science Education, 33(1), 29–60.

Prenger, R., Poortman, C. L., & Handelzalts, A. (2021). Professional learning networks: From teacher learning to school improvement? *In Journal of Educational Change (Vol. 22,* Issue 1). Springer Netherlands. https://doi.org/10.1007/s10833-020-09383-2

Shdaifat, S. A. K. (2020). The future role of vocational education teachers in the professional learning communities in public schools from the perspective of principals and academic supervisors in Jordan. *International Journal of Higher Education, 9*(5), 322–337.

Sowndappan, K. (2023). Practice Level in the Implementation of Professional Learning Communities in Improving the Quality of Teaching among Mathematics Teachers. *Journal of Language and Linguistics in Society, 32*, 1–8. https://doi.org/10.55529/jlls.32.1.8

Tai, M. K., Omar, A. K., & Tai, M. K. (2023). Relationship between professional learning community and teacher attitudes toward change Relationship between professional learning community and teacher attitudes toward change Abdull Kareem Omar. *International Journal of Management in Education, 17*(1), 1–18. https://doi.org/10.1504/IJMIE.2023.10051048

Torres, M. V. (2024). Teachers' Views on the Conduct of Class Observation: The Philippine DepEd Setting. *International Journal of Instruction, 17*(3), 453–474.

Wetchan, T. (2023). The Development of a Supervision Model for Educational Institution Quality Development Using Professional Learning Community Networks (PLCNs) in Thailand. *Journal of Higher Education Theory and Practice, 23*(8), 65–77.

Wolde, B. D. (2021). The Role of Continuous Professional Development in Improving Secondary School Teachers' Teaching and Learning Competencies to Deliver Quality Education in Ethiopia: A Case of Secondary School Education in Ethiopia: A Case of Secondary School. *The Qualitative Report, 26*(5), 1345–1363.

Zgenel, M. Ö. (2019). The role of teacher performance in school effectiveness. International *Journal of Education Technology and Scientific Researches, 4*(10), 417–434. https://doi.org/https://doi.org/10.35826/ijetsar.42

Zhang, J., Yin, H., & Wang, T. (2023). Exploring the effects of professional learning communities on teacher's self-efficacy and job satisfaction in Shanghai, China. *Educational Studies, 49*(1), 17–34. https://doi.org/10.1080/03055698.2020.1834357

Biographical Notes

RITA HASTUTI was a graduate student at the Universitas Pendidikan Indonesia, Indonesia, Corresponding author: ritahastuti@upi.edu

PERMANA JOHAR is working at the Universitas Pendidikan Indonesia, Indonesia.

TAUFANI is working at the Universitas Pendidikan Indonesia, Indonesia.