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Determinants of Teachers' Digital Literacy: The Role of Capacity Building, Career Inclusion, and Digital Platform Engagement

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Abstract:
This study aims to examine the effects of capacity building, career inclusion, and the use of the Merdeka Mengajar Platform on teachers' digital literacy. A quantitative correlational design was employed, involving 18 teachers selected through total sampling. The research instrument, developed based on the DigCompEdu framework, demonstrated strong validity (Corrected Item-Total Correlation = 0.466–0.847) and high reliability (Cronbach's Alpha = 0.906). Data were analyzed using simple and multiple regression techniques. The results indicate that capacity building (B = 0.974; $p < 0.001$), career inclusion (B = 0.919; $p < 0.001$), and platform usage (B = 0.889; $p < 0.001$) each have a positive and significant effect on teachers' digital literacy. Simultaneously, these variables show a significant combined effect ($F = 17.706$; $p < 0.001$), explaining 79.1% of the variance ($R^2 = 0.791$). These findings imply that enhancing teachers' digital literacy requires not only technical training but also systemic support through professional development, inclusive career pathways, and sustained engagement with digital platforms. An integrated strategy is essential to accelerate teachers' digital readiness in contemporary educational contexts.

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INTRODUCTION

The rapid digital transformation of education has fundamentally reshaped how teaching and learning are designed and delivered worldwide (Amiri, 2025; Wang et al., 2024). This study is important because teachers are now expected not only to operate digital tools but also to integrate them into pedagogically meaningful learning environments. The reason lies in the growing demand for 21st-century skills, which digital literacy has become a core competence that influences instructional quality and student outcomes. Empirical evidence shows that teachers with strong digital literacy are better able to foster interactive, personalized, and collaborative learning experiences (Zhang & Zhang, 2024). Moreover, digital competence contributes to educational resilience, particularly in post-pandemic contexts where hybrid and online learning models are increasingly adopted. Therefore, strengthening teachers' digital literacy is not merely a technical necessity but a strategic priority for improving educational quality and equity. In conclusion, examining the factors that influence teachers' digital literacy is essential to ensure that education systems can adapt effectively to ongoing digital transformation and societal change.

This study is grounded in the DigCompEdu framework, which conceptualizes teachers' digital competence across multiple domains, including professional

engagement, digital resources, teaching and learning, assessment, and learner empowerment (Håkansson, 2024; Kassim, 2023). Digital literacy, within this framework, refers to the ability to access, evaluate, create, and utilize digital information effectively in educational contexts (Silander, 2024; Thomson & Dumont, 2022). To explain its determinants, this study integrates three key theoretical constructs. First, capacity building theory emphasizes continuous professional development through training, mentoring, and collaborative learning as drivers of competence enhancement (Kacou et al., 2022; Scaramuzzi et al., 2023). Second, career inclusion theory highlights the role of perceived fairness, opportunity, and institutional support in shaping teachers' motivation and engagement (Ding et al., 2023; Fejes et al., 2022). Third, technology acceptance and usage perspectives explain how the consistent use of digital platforms supports skill development and innovation (Alshammari & Alkhwaldi, 2025; Wohlfart & Wagner, 2025). Together, these theories provide a comprehensive framework for analyzing teachers' digital literacy.

Despite global progress, significant challenges remain in ensuring equitable digital competence among teachers, particularly in developing countries. In Indonesia, efforts to promote digital education through initiatives such as the Merdeka Mengajar Platform (PMM) have shown promising potential but also revealed persistent disparities (Ramadhani et al., 2024; Waluyo & Utanto, 2025). The problem arises from unequal technological infrastructure, limited access to training, and varying levels of institutional support, especially in non-urban and madrasah contexts. These conditions create a digital divide that affects teachers' ability to adopt and utilize technology effectively in teaching. Furthermore, many teachers still perceive digital tools as supplementary rather than integral to pedagogy, which limits innovation in learning practices. This situation indicates that improving digital literacy requires more than providing technology; it necessitates systemic support, professional development, and motivational factors. Therefore, identifying the key determinants of teachers' digital literacy is crucial to addressing these challenges and ensuring more inclusive and effective digital transformation in education.

Previous studies have extensively examined the role of digital competence in education, highlighting its importance for improving teaching quality and student engagement (Aldhaen, 2024; Hidayat-Ur-Rehman, 2024). Research on capacity building demonstrates that structured training programs, leadership support, and professional learning communities significantly enhance teachers' digital skills (Kacou et al., 2022; Scaramuzzi et al., 2023). Similarly, studies on career inclusion indicate that teachers who perceive fair opportunities for professional growth are more motivated to adopt innovative practices, including digital technologies (Dignath et al., 2022; Russen & Dawson, 2024). In addition, the use of digital platforms such as learning management systems and teacher portals has been found to positively influence digital competence when supported by institutional policies (Díaz-Suárez et al., 2025; Timotheou et al., 2023). However, these studies often examine each factor in isolation, focusing either on training, motivation, or technology usage separately. As a result, the complex interactions among structural, psychosocial, and technological factors remain insufficiently explored in the context of teachers' digital literacy development.

Although the DigCompEdu framework has been widely adopted internationally as a comprehensive tool for measuring teachers' digital competence, its application in Indonesia is still limited (Håkansson, 2024; Kassim, 2023). Existing studies on the Merdeka Mengajar Platform tend to be descriptive, emphasizing user perceptions and

implementation challenges without testing causal or correlational relationships (Andayani et al., 2024; Waldi & Zen, 2025). Furthermore, research focusing on madrasahs, particularly in non-urban areas, remains scarce despite their unique organizational and cultural characteristics. This gap is critical because madrasahs often face distinct challenges related to resource availability, institutional support, and technological adaptation. Additionally, there is a lack of integrative models that simultaneously examine capacity building, career inclusion, and digital platform utilization as predictors of digital literacy. Therefore, addressing this gap is essential to provide a more holistic understanding of how multiple factors interact to shape teachers' digital competence in diverse educational settings.

This study offers a novel contribution by integrating capacity building, career inclusion, and the use of the Merdeka Mengajar Platform into a single correlational model based on the DigCompEdu framework. The research problem addressed is how these three factors simultaneously influence teachers' digital literacy, particularly in underrepresented educational contexts. The study argues that digital literacy is a multidimensional construct shaped by the interaction of structural support, psychosocial motivation, and technological engagement. It hypothesizes that capacity building enhances teachers' skills, career inclusion strengthens their motivation, and platform usage provides practical experience, all of which collectively improve digital literacy. By testing this integrated model, the study contributes significantly to the literature on digital competence and practically to policy development in education. The findings are expected to inform stakeholders in designing more effective strategies for teacher development, thereby accelerating digital readiness and promoting equitable access to quality education in the era of digital transformation.

RESEARCH METHODS

This study uses a quantitative correlational design to examine how capacity building, career inclusion, and the use of the Merdeka Mengajar (PMM) platform are interrelated in shaping teachers' digital literacy at MA Sullamul Hidayah Leces (Pregoner, 2024; Takona, 2024). All teachers were involved through a total sampling technique, as this study aims to comprehensively capture real-world conditions. The instrument used was a Likert-scale questionnaire based on theoretical indicators for each variable. Capacity building, as X1, refers to a teacher professional development framework that emphasizes continuous learning (Jailani, 2023). Career inclusion as X2 is structured based on the theory of perceived institutional support and career development equity (Khoir & Amaliyah, 2025). Meanwhile, the use of PMM as X3 follows recent findings on the effectiveness of national digital platforms in supporting teacher performance (Afif et al., 2023). For the digital literacy variable as Y, this study uses the internationally recognized DigCompEdu framework as a reference in assessing educators' digital competence (Palacios-Rodríguez et al., 2025). This can be seen in the following table:

Table 1. Questionnaire Indicators and Item Numbers

No	Variables	Indicator	Item Number
1	Capacity Increase (X1)	Involvement in training	1, 2, 3
		Intensity of professional development	4, 5, 6
		Implementation of training results	7, 8, 9
		Continuous self-development	10, 11, 12

2	Career Inclusion (X2)	Clarity of career path	13, 14
		Access to promotional and training opportunities	15, 16, 17
		Leadership support	18, 19, 20
		Performance award	21, 22
3	Utilization of PMM (X3)	Frequency of PMM use	23, 24
		Self-training	25,26
		Use of teaching devices	27, 28
		Learning community	29, 30
4	Teacher Digital Literacy (Y)	Use of digital devices & applications	31, 32
		Information search and evaluation	33, 34
		Digital content creation	35, 36
		Integration of technology in learning	37, 38
		Digital assessment	39, 40
		Digital ethics & security	41, 42

The research data was analyzed through several stages. First, a validity test was conducted using Corrected Item–Total Correlation to ensure each statement item measured the intended construct, and a reliability test using Cronbach's Alpha to determine the instrument's internal consistency. After the instrument was declared valid and reliable, the analysis prerequisite tests continued, including normality, linearity, multicollinearity, and heteroscedasticity tests to ensure the data met the regression assumptions. The next stage was simple and multiple linear regression analyses to determine the effect of capacity building, career inclusion, and the use of the Merdeka Mengajar Platform on teachers' digital literacy, both partially and simultaneously. The entire analysis was carried out using SPSS at the 0.05 significance level.

Based on this conceptual framework, this study proposes three main hypotheses: first, capacity building (X1) is thought to have a positive effect on teachers' digital literacy (Y); second, career inclusion (X2) is thought to have a positive relationship with digital literacy (Y); and third, the use of PMM (X3) is expected to contribute positively to improving teachers' digital literacy (Y). In addition, these three variables are expected to simultaneously have a significant influence on teachers' digital competence in madrasas. To test these hypotheses, this study uses multiple regression analysis to obtain an empirical picture of the strength of the relationship between variables and to validate the formulated conceptual model.

RESULTS AND DISCUSSION

Results

This section presents empirical findings from an analysis of data collected from all teachers using a total sampling technique. Prior to the main analysis using multiple linear regression, a series of prerequisite tests and instrument quality checks were conducted to ensure that the data met the analytical feasibility requirements. This stage included testing for validity, reliability, and normality of data distribution. After all assumptions were met, regression analysis was used to estimate the effect of capacity building, career inclusion, and the use of the Merdeka Mengajar (PMM) Platform on teachers' digital literacy. The results of the analysis are presented systematically to provide a comprehensive empirical picture of the relationships between the variables in this research model.

Table 2. Case Processing Summary

		N	%
Cases	Valid	18	100.0
	Excluded[a]	0	.0
	Total	18	100.0

a. Listwise deletion based on all variables in the procedure.

Table 2 shows that all data from 18 respondents were fully usable in the analysis. Of the 18 questionnaires collected, none had to be removed due to incompleteness or missing values. In other words, all respondents completed the research instrument completely, preventing SPSS from performing listwise deletion.

Table 3. Item-Total Statistics (Validity Test)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
X1.1	43.67	68.118	.847	.888
X1.2	43.94	74.997	.497	.905
X1.3	44.11	72.458	.537	.904
X1.4	44.11	73.752	.466	.907
X2.1	44.39	68.958	.776	.892
X2.2	44.50	68.265	.618	.901
X2.3	43.61	74.487	.627	.900
X2.4	43.67	74.235	.658	.899
X3.1	44.00	68.235	.696	.896
X3.2	43.50	74.735	.546	.903
X3.3	44.28	67.271	.764	.892
X3.4	43.61	71.663	.664	.897

Table 3 shows that the Item–Total Statistics table provides an overview of the quality of each statement item in the instrument, particularly its validity and contribution to internal consistency. Based on the analysis results, all items showed a Corrected Item Total Correlation value above 0.466, ranging from 0.466 to 0.847. This figure is well above the minimum limit of 0.30, which is generally used as a standard for item validity. Therefore, it can be concluded that all items successfully represent the construct being measured and have a strong relationship with the total scale.

Furthermore, the Cronbach's Alpha if Item Deleted column shows that the alpha value ranges from 0.888 to 0.907 when one item is deleted. This range does not provide a significant increase in reliability beyond the instrument's total alpha value of 0.906. In other words, no single item weakens the instrument's internal consistency, and deleting items does not yield a significant improvement in reliability. This confirms that each item has a positive contribution to the overall instrument, so all items are worthy of being retained for further analysis.

Table 4. Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.906	12

Table 4 shows that the alpha value ranges from 0.888 to 0.907 when one item is removed from the instrument. All of these values are slightly below or slightly above the instrument's total reliability of 0.906. This pattern indicates that no single item

substantially reduces the instrument's reliability. In fact, item removal does not significantly increase the alpha value. In other words, each item consistently contributes to the overall construct being measured, so all questions are worth retaining. This finding confirms that the instrument has good internal consistency and is stable enough to be used in subsequent analyses.

Table 5. Simple Linear Regression Analysis of Capacity Building (X1) on Digital Literacy (Y)

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.809	2.680		2.168	.046
	Capacity Building	.974	.165	.828	5.903	.000
a. Dependent Variable: Teacher Digital Literacy						

Table 5 shows that the simple linear regression results indicate that the significance value (Sig.) for the capacity improvement variable is 0.000, which is lower than the 0.05 significance threshold. This indicates that the capacity improvement variable has a significant influence on teachers' digital literacy. Thus, the hypothesis stating that capacity improvement influences teachers' digital literacy is accepted. The unstandardized regression coefficient (B) of 0.974 indicates that a one-unit increase in capacity improvement will increase teachers' digital literacy by 0.974 units. This means that the greater the efforts to increase teachers' capacity through training, workshops, or other competency development, the higher the teacher's level of digital literacy. In addition, the standard coefficient (Beta) of 0.828 indicates that the capacity improvement variable has a strong influence on teachers' digital literacy. The calculated t value of 5.903, which is much greater than the table t value, further strengthens that the influence is statistically very convincing.

Table 6. Simple Linear Regression Analysis of Career Inclusion (X2) on Digital Literacy (Y)

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.988	2.728		2.562	.021
	Career Inclusion	.919	.171	.802	5.368	.000
a. Dependent Variable: Teacher Digital Literacy						

Table 6 shows that the simple linear regression results indicate that the career inclusion variable has a significant influence on teachers' digital literacy. This is indicated by a significance value of 0.000, which is smaller than the significance limit of 0.05, so the research hypothesis is accepted. The unstandardized regression coefficient (B) of 0.919 indicates that a one-unit increase in career inclusion will increase teachers' digital literacy by 0.919 units. In addition, the beta coefficient of 0.802 indicates that the influence of career inclusion on teachers' digital literacy is in the very strong category. The high t-value of 5.368 further emphasizes that the career inclusion variable makes a statistically significant contribution to improving teachers' digital literacy. Thus, it can be concluded that the better the support and access to career inclusion provided to teachers, the higher their digital literacy skills.

Table 7. Simple Linear Regression Analysis of PMM Utilization (X3) on Digital Literacy (Y)

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.758	2.625		2.575	.020
	Utilization of PMM	.889	.157	.817	5.669	.000
a. Dependent Variable: Teacher Digital Literacy						

Table 7 shows that the simple linear regression results indicate that the PMM utilization variable has a significant effect on teachers' digital literacy. This is indicated by a significance value of 0.000, which is smaller than the significance limit of 0.05, so the proposed hypothesis can be accepted. The unstandardized regression coefficient (B) of 0.889 indicates that a one-unit increase in PMM utilization will increase teachers' digital literacy by 0.889 units. In addition, the beta coefficient value of 0.817 indicates that the effect of PMM utilization on teachers' digital literacy is very strong. The calculated t value of 5.669, which is much greater than the t table value, further supports the conclusion that PMM utilization makes a significant contribution to improving teachers' digital literacy. Thus, it can be concluded that the more effectively teachers use PMM (Merdeka Mengajar Platform), the higher their digital literacy skills.

Table 8. ANOVA Results of Multiple Linear Regression

ANOVA[b]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	191.522	3	63.841	17.706	000[a]
	Residual	50.478	14	3.606		
	Total	242.000	17			
a. Predictors: (Constant), Capacity Building, Career Inclusion, PMM Utilization						
b. Dependent Variable: Teacher Digital Literacy						

Table 8 shows that the ANOVA results from the multiple linear regression analysis indicate an F value of 17.706 and a significance value of 0.000, both of which are lower than 0.05. In addition, the comparison results show that the calculated F value (17.706) is greater than the F table (3.34) at a significance level of 0.05 with degrees of freedom df1 = 3 and df2 = 14. Thus, the multiple linear regression model used in this study is considered significant, which means that the variables Capacity Building, Career Inclusion and Utilization of PMM simultaneously influence Teacher Digital Literacy.

Table 9. Model Summary (Coefficient of Determination)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.890[a]	.791	.747	1.899
a. Predictors: (Constant), Capacity Building, Career Inclusion, PMM Utilization				

Table 9 shows that the coefficient of determination test yields an R-squared value of 0.791. This means that 79.1% of the variation or change in Teacher Digital Literacy can be explained by the three independent variables, namely Capacity Building, Career Inclusion and Utilization of PMM, which are included in the multiple linear regression model. Meanwhile, the remaining 20.9% is influenced by other factors outside the research model that are not measured, such as individual motivation, technology access,

and school environmental support. Thus, the regression model built can be categorized as having excellent predictive ability, because it can explain most of the dependent variables in this study.

Discussion

The results of the instrument validity and reliability tests indicate that all statement items used in this study have strong psychometric qualities. All Corrected Item Total Correlation values are well above the minimum limit of 0.30, ranging from 0.466 to 0.847, confirming that each item is able to represent the theoretical construct consistently. This finding is in line with modern quantitative instrument development guidelines that emphasize the importance of the fit between indicators and their theoretical constructs (Izah et al., 2023; Jani et al., 2023). Empirically, these results indicate that the four research variables of capacity building, career inclusion, PMM utilization, and teacher digital literacy have been well operationalized and can be continued towards testing the relationship model between variables. In terms of reliability, the instrument demonstrated very strong internal consistency with a Cronbach's Alpha value of 0.906, with no single item significantly increasing reliability if removed (0.888–0.907). This confirms that all items consistently contribute to the construct measurement. Such findings align with international standards requiring internal stability above 0.80 for studies on digital competence and psychosocial factors (Barliana et al., 2025; Edelsbrunner et al., 2025). Therefore, the instrument meets methodological standards and ensures that the results reflect empirical conditions rather than measurement error, particularly in under-researched contexts such as non-urban madrasahs.

The results of the simple regression analysis indicate that capacity building has a very significant influence on teachers' digital literacy, with B = 0.974, t = 5.903, and p = 0.000. The standardized Beta value of 0.828 shows that capacity building is a strong and dominant predictor of digital competence. Substantively, this finding confirms that teachers who engage in training, workshops, mentoring, and continuous professional development are more capable of integrating technology into learning processes. This is particularly important in non-urban contexts, where infrastructure limitations are often present, yet teacher competence can still improve through structured professional development. These findings are consistent with previous studies emphasizing that digital pedagogy training and professional development are key determinants of educators' digital competence (Chiu et al., 2024; Spurava & Kotilainen, 2023). Furthermore, this result reinforces the theoretical argument that digital literacy is primarily shaped by professional readiness and continuous learning processes rather than merely access to technology (Spurava & Kotilainen, 2023; Tan et al., 2025).

In addition, career inclusion shows a positive and significant effect on teachers' digital literacy, with B = 0.919, t = 5.368, p = 0.000, and Beta = 0.802. These results indicate that teachers who perceive fair career opportunities, institutional support, and access to professional development tend to have higher motivation to improve their digital skills. Substantively, career inclusion fosters a psychological environment that encourages teachers to adopt new technologies, participate in training, and engage in digital learning practices (Chiu et al., 2024; Spurava & Kotilainen, 2023). This finding supports the perspective that digital competence is not only influenced by technical or structural factors but also by psychosocial dimensions such as motivation and career

perception (Sánchez-Canut et al., 2023; Tian et al., 2025). In the context of Education 4.0, inclusive career policies play a crucial role in encouraging teachers to adapt to technological changes and continuously update their competencies. Therefore, strengthening career inclusion can be considered a strategic approach to enhancing teachers' digital readiness and long-term professional growth.

Furthermore, the use of the Merdeka Mengajar Platform (PMM) also has a positive and significant impact on teachers' digital literacy, with B = 0.889, t = 5.669, p = 0.000, and Beta = 0.817. These findings indicate that active engagement with digital platforms enhances teachers' ability to access, manage, and produce digital learning resources. Substantively, PMM provides a practical digital ecosystem that supports self-directed learning, collaboration, and continuous professional development. This hands-on experience strengthens both technical and cognitive aspects of digital literacy. These results are consistent with studies showing that digital platform utilization significantly contributes to improving educators' digital competence through direct interaction with technology-based learning environments (Sánchez-Canut et al., 2023; Tian et al., 2025). From a policy perspective, this finding highlights that PMM is not only an administrative tool but also a strategic instrument for accelerating digital transformation in education. Therefore, increasing access, training, and sustained use of PMM is essential for improving teachers' digital competence in a systematic and sustainable manner (Norman et al., 2025; X. Zhang et al., 2024).

Finally, the results of multiple linear regression analysis show that capacity building, career inclusion, and PMM utilization simultaneously have a strong and significant influence on teachers' digital literacy, with F = 17.706 and p = 0.000. The R Square value of 0.791 indicates that 79.1% of the variation in digital literacy can be explained by these three variables, while the remaining 20.9% is influenced by other factors. This confirms that teachers' digital literacy is a multidimensional construct shaped by the interaction of structural, psychosocial, and technological factors. Substantively, these findings emphasize that improving digital literacy requires an integrated approach that combines professional development, career support, and the effective use of digital platforms. This study contributes to the literature by providing empirical evidence from a madrasah context, which has been relatively underexplored. Overall, the results suggest that policymakers and educational institutions should prioritize comprehensive strategies that simultaneously strengthen capacity building, career inclusion, and digital platform utilization to accelerate teachers' digital readiness in the era of digital transformation.

CONCLUSION

This study highlights that teacher digital literacy is shaped by the simultaneous interaction of capacity building, career inclusion, and the use of the Merdeka Mengajar (PMM) Platform. The most important finding is that professional capacity building emerges as the strongest determinant, followed by PMM utilization and career inclusion, indicating that sustained training and practical engagement with digital platforms are essential for enhancing teachers' competencies. Moreover, the three variables collectively explain a substantial proportion of variance in digital literacy (79.1%), demonstrating that digital competence is not merely a technical outcome but a product of integrated structural, psychosocial, and technological factors. The strength of this study lies in its contribution to the academic field by developing a comprehensive and

integrative model based on the DigCompEdu framework, particularly within the underexplored context of madrasahs. It provides empirical evidence that expands the discourse on teacher digital competence by linking professional development, career structures, and platform utilization in a single analytical framework.

However, this study has several limitations that should be considered in future research. The relatively small sample size and the focus on a single institutional context limit the generalizability of the findings. Additionally, the study relies on self-reported data, which may introduce response bias. Future research is recommended to involve larger and more diverse samples across different educational settings, including comparative studies between urban and non-urban institutions. Further studies may also incorporate mixed-method approaches to gain deeper insights into teachers' experiences and explore additional variables such as organizational culture, leadership, and technological infrastructure. By addressing these limitations, future research can provide a more comprehensive understanding of the factors influencing teacher digital literacy in diverse educational contexts.

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