International Journal of Technology in Education and Science

www.ijtes.net

Does Digital Pedagogical Training Enhance Teacher Resilience, Teacher Well-Being, and Teacher Performance? A Quasi-Experimental Study

Furtasan Ali Yusuf

Department of Primary Teacher Education, Universitas Bina Bangsa, Indonesia, 0000-0002-9062-6626
Corresponding author: Furtasan Ali Yusuf (fay@binabangsa.ac.id)

Article Info

Article History

Received:
28 February 2026

Revised:
15 April 2026

Accepted:
2 May 2026

Published:
10 May 2026

Keywords

Digital pedagogical training
Teacher resilience
Teacher well-being
Teacher performance

Abstract

Teachers face increasingly strong demands to adapt to digital-based learning, yet empirical evidence regarding the influence of digital pedagogical training on teacher resilience, teacher well-being, and teacher performance remains limited. This study aims to analyze the influence of digital pedagogical training on teacher resilience, teacher well-being, and teacher performance. This study employs a quantitative approach through a quasi-experimental method with a pretest-posttest non-equivalent control group design. The research sample consisted of 60 teachers affiliated with two Teacher Working Groups (Kelompok Kerja Guru/KKG) across two sub-districts in Serang City, Banten Province, selected through purposive sampling and cluster sampling. Data were collected using a five-point Likert scale questionnaire. Instrument quality was established through content validity based on expert judgment, construct validity using Pearson Product Moment correlation, and reliability using Cronbach's Alpha; all final instruments were declared valid and highly reliable. Data analysis was conducted through descriptive statistics, prerequisite tests comprising Kolmogorov–Smirnov normality testing, Levene's Test for homogeneity, and an initial equivalence test using an independent sample t-test, followed by MANCOVA and ANCOVA. The findings indicate that (1) digital pedagogical training has a significant effect on teacher resilience; (2) digital pedagogical training has a significant effect on teacher well-being; and (3) digital pedagogical training has a significant effect on teacher performance. Overall, digital pedagogical training exerts a positive and significant influence, both simultaneously and individually, on teacher resilience, teacher well-being, and teacher performance. The implications of this study suggest that digitally-based teacher professional development should be designed not only to strengthen technological and pedagogical competencies, but also to support teachers' psychological capacity and professional sustainability.

Citation: Yusuf, F. A. (2026). Does digital pedagogical training enhance teacher resilience, teacher well-being, and teacher performance? A quasi-experimental study. *International Journal of Technology in Education and Science (IJTES), 10*(3), 592-614. https://doi.org/10.46328/ijtes.7980

ISSN: 2651-5369 / © International Journal of Technology in Education and Science (IJTES).
This is an open access article under the CC BY-NC-SA license
(http://creativecommons.org/licenses/by-nc-sa/4.0/).

OPEN ACCESS

Introduction

Digital transformation has reshaped the way learning is designed, implemented, and evaluated across various education systems (Puolitaival & Kiroff, 2021; Sun & Peng, 2020). These changes have simultaneously shifted expectations regarding teacher professionalism, from mere mastery of subject matter and conventional pedagogy toward the capacity to integrate technology meaningfully into the learning process (Neufeld & Delcore, 2018; West & Malatji, 2021). Teachers' digital competence is now regarded as an essential component of an effective digital education ecosystem, rather than an ancillary or peripheral skill (OECD, 2018). These changes have opened opportunities for more flexible, interactive, and student-responsive learning. New pressures have likewise emerged, particularly as teachers must continually adapt to evolving tools, platforms, and pedagogical demands. This situation places teachers in a position that requires a level of professional readiness considerably more complex than before (Berkovich & Hassan, 2025; Maryana & Torre, 2021; Sariyatun et al., 2018).

These conditions render digital pedagogical training one of the most relevant strategies for supporting teachers in adapting. Teachers' capacity in digital education cannot be adequately developed through tool mastery alone; it also requires sustained professional development that connects the technological, pedagogical, and classroom practice dimensions (Hidayah et al., 2023; Susiani et al., 2022; Yusuf & Fajari, 2022). The distinction between technically oriented training and pedagogically oriented training becomes significant at this point. Technical training typically stops at how to operate a device or application, whereas pedagogical training emphasizes how technology is used to build interaction, assessment, student engagement, and meaningful digital learning experiences (Astutik & Roesminingsih, 2021; Mustikawati & Qomariah, 2020). It is the latter orientation that more closely aligns with the actual needs of teachers in real classrooms. Digital pedagogical training, therefore, is not merely concerned with digital tools, but also with the quality of teachers' instructional decisions when using technology (Kaya & Öz, 2021; Lin et al., 2021).

The positioning of digital training in the literature has more frequently been discussed as a means of enhancing teacher competence and performance (Maratos et al., 2019). Teacher performance remains an important variable, as the quality of learning is ultimately reflected in teachers' capacity to plan instruction, implement learning, conduct assessment, establish a learning environment, and sustain professionalism consistently (Berikkhanova et al., 2021; Hidayah et al., 2021). Recent meta-analyses on online teacher professional development also indicate that online professional development exerts a positive influence on teacher and classroom outcomes, although the magnitude of this influence is shaped by the quality of program design (Filderman et al., 2022; Zhang et al., 2024; Zhou et al., 2023). Teachers who receive training that is relevant, well-structured, and closely aligned with teaching practice are more likely to demonstrate improved work performance. It is this assumption that justifies positioning teacher performance as one of the primary variables in this study.

Attention to performance alone, however, is insufficient for understanding the full professional consequences of digital transformation. The concept of teacher resilience warrants inclusion in this discussion, as the teaching profession demands the capacity to endure, adapt, and continue functioning professionally in the face of pressure and change (Ahmed et al., 2018; Christensen & Knezek, 2025). Teacher resilience is a dynamic process grounded

in relationships, motivation, emotion, well-being, and contextual resources. The shift toward digital learning can serve as a source of stress when demands change rapidly, but it can equally serve as a source of professional reinforcement when teachers receive appropriate support and learning experiences (Martin & Marsh, 2008; Ramdani et al., 2020). Furthermore, resilience can be developed through deliberately designed professional interventions (Liaqat et al., 2024). Structured digital pedagogical training therefore has the potential to reduce occupational uncertainty, strengthen teachers' sense of capability, and expand their adaptive capacity.

An equally important dimension is teacher well-being. The Teacher Subjective Wellbeing Questionnaire positions teaching efficacy and school connectedness as the core of teachers' subjective well-being (Ertürk, 2021). Digital demands, increased workload, and shifting learning patterns can affect the quality of teachers' professional experience, both psychologically and socially (Ertürk, 2021; Hidayah et al., 2023). Systematic reviews of teacher well-being similarly indicate that social relationships and working conditions play an important role in shaping teacher well-being, while recent findings on technostress demonstrate that technology can become a source of pressure when not offset by adequate support (Carstensen & Klusmann, 2021; García-Lázaro et al., 2022). Appropriate training has the potential to improve this situation by enhancing efficacy, fostering a sense of connectedness, and cultivating more positive work experiences. The relevance of teacher well-being in digital training research cannot therefore be overlooked.

Although scholarship on teachers' digital competence has grown rapidly, prior research has largely focused on digital competence, technological readiness, or teacher performance in isolation. Systematic reviews of the dimensions of teachers' digital competence indicate that this research landscape is broad, yet its examination is frequently fragmented along specific constructs (Maryana & Torre, 2021; Meekaew & Jongnimitsataporn, 2023; Sariyatun et al., 2018). Other studies on teacher professional development in digital pedagogy affirm the importance of integrating technology, pedagogy, and digital self-efficacy (Limon & Dilekçi, 2025; Park et al., 2016; Yoo, 2016), yet relatively few have examined the simultaneous effects of such development on teacher resilience, teacher well-being, and teacher performance. Several studies on online professional development do demonstrate effectiveness in relation to teacher outcomes (Cocca et al., 2018; Ibrahim et al., 2020; Mert & Özgenel, 2020), but none has specifically tested this three-variable configuration within a single analytical model. The use of quasi-experimental designs in the context of primary school teachers or KKG communities also remains relatively limited (Park et al., 2016; Rachmadtullah et al., 2024). It is this gap that affords the present study the opportunity to offer a more integrative empirical contribution.

The KKG context warrants particular consideration, as KKG communities serve as strategic spaces for teacher professional development at the level of practice. Empirical evidence regarding the effectiveness of digital pedagogical training in settings such as this is needed to ensure that teacher capacity-building programs do not remain confined to normative assumptions. The urgency of this study also lies in the need to understand whether digital training genuinely strengthens both the pedagogical and psychological dimensions of teacher development, and not merely their technical skills. The objectives of this study are therefore: (1) to analyze the influence of digital pedagogical training on teacher resilience; (2) to analyze the influence of digital pedagogical training on teacher well-being; and (3) to analyze the influence of digital pedagogical training on teacher performance.

Method

Research Design

This study employs a quantitative approach through a quasi-experimental design to examine the influence of digital pedagogical training on teacher resilience, teacher well-being, and teacher performance. The design applied is a pretest-posttest non-equivalent control group design, as research subjects were not randomly assigned to groups. Two groups were used: an experimental group and a control group, both of which completed a pretest and a posttest.

The experimental group received treatment in the form of LMS/website-based digital pedagogical training, while the control group received treatment in the form of a guidebook. Pre- and post-treatment measurements were intended to identify changes in each of the three dependent variables across both groups. A comparison of pretest and posttest results between groups was used to evaluate the effectiveness of the intervention administered. The research design is visualized in Table 1.

Table 1. Research Design Visualization

Group	Pretest	Treatment	Posttest
E	O1 (Y1, Y2, Y3)	X1	O2 (Y1, Y2, Y3)
C	O3 (Y1, Y2, Y3)	X2	O4 (Y1, Y2, Y3)

Notes:
E = experimental group.
C = control group.
O1 and O3 = initial measurement (pretest).
O2 and O4 = final measurement (posttest).
X1 = LMS/website-based digital pedagogical training.
X2 = provision of a digital pedagogy guidebook.
Y1 = teacher resilience.
Y2 = teacher well-being.
Y3 = teacher performance.

Research Sample

The research sample consisted of 60 teachers affiliated with two Teacher Working Groups (KKG) across two sub-districts in Serang City, Banten Province. The KKG in Sub-district A was designated as the experimental group, while the KKG in Sub-district B was designated as the control group. Subject selection employed a combination of purposive sampling and cluster sampling to ensure that sample characteristics were appropriate to the requirements of the quasi-experimental design. Purposive sampling was used to select two KKGs sharing common general characteristics, such as school level, teachers' professional duties, the need to strengthen digital pedagogical competence, and readiness to participate in the full sequence of research interventions from start to finish. The selection of these two sub-districts was also based on considerations of locational accessibility,

institutional support from KKG administrators, uniformity of work programs, and implementation conditions that would allow the treatment to be administered in a controlled manner without disrupting teachers' routine activities. The use of two KKGs in separate geographical areas was considered important to reduce the potential for cross-group treatment contamination, particularly the exchange of information regarding intervention materials during the course of the study. Furthermore, cluster sampling was applied because the sample units had formed naturally as KKG groups or clusters, making it more appropriate to draw the sample based on existing groups rather than on an individual basis.

Data Collection Technique and Research Instruments

Research data were collected through a questionnaire technique, as all three research variables, teacher resilience, teacher well-being, and teacher performance, are more appropriately measured through teachers' perceptions, professional experiences, and structured self-assessments. Each instrument was constructed using a five-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, and 5 = strongly agree. This model was selected to allow participants' responses to reflect the intensity of their agreement with each statement with greater sensitivity. The research instruments comprised three questionnaires — one each for teacher resilience, teacher well-being, and teacher performance — with an initial total of 20 items per variable, yielding a combined total of 60 items. A summary of the research instrument indicators is presented below.

Table 2. Summary of Research Instrument Indicators

Variable	Theoretical Basis	Core Dimensions/Indicators	Number of Items
Teacher resilience	Mansfield et al.	(1) understanding of resilience, (2) professional relationships, (3) personal well-being, (4) motivation and commitment, (5) emotional regulation	20
Teacher well-being	Renshaw et al. / TSWQ	(1) teaching efficacy, (2) school connectedness	20
Teacher performance	Stronge	(1) professional knowledge, (2) instructional planning, (3) instructional delivery, (4) learning assessment, (5) learning environment, (6) professionalism	20

Content validity of the instruments was established through expert evaluation to ensure that each item possessed substantive appropriateness, linguistic clarity, and relevance to the research objectives. This process involved four validators: an instrument expert to assess item construction, a content expert to examine the alignment of item content with the conceptual variables, a language expert to evaluate the accuracy, clarity, and readability of the wording, and an educational management expert to review the relevance of the instruments to the professional context of teachers and the field implementation of the research. The experts' evaluations served as the basis for revising items that remained insufficiently precise before the instruments were tested empirically. A summary of the content validity results is presented below.

Table 3. Summary of Instrument Content Validity Results

Aspect Assessed	Validator	Assessment Focus	Assessment Result	Decision
Instrument construct feasibility	Instrument expert	Indicator alignment, appropriateness of item format, measurability of statements, and compatibility with the Likert scale	Very valid	Usable with minor revisions
Content substance feasibility	Content expert	Alignment of item content with the concepts of teacher resilience, teacher well-being, and teacher performance	Very valid	Usable with minor revisions
Linguistic feasibility	Language expert	Clarity of wording, grammatical accuracy, sentence effectiveness, and instrument readability	Valid	Usable with minor revisions
Contextual feasibility	Educational management expert	Alignment of instruments with the context of teachers' duties, the KKG environment, and the implementation of educational research	Very valid	Usable with minor revisions

Construct validity of the instruments was subsequently tested empirically to determine the capacity of each statement item to represent the variable being measured. The instrument validity testing involved 60 teachers who participated in the pilot testing stage of the study. Testing was conducted using Pearson Product Moment correlation between the score of each item and the total score for each respective variable. An item was declared valid if the calculated r value exceeded the r table value at a significance level of 0.05, indicating that the item was suitable for retention in the research instrument. The analysis results indicate that all items across the teacher resilience, teacher well-being, and teacher performance variables yielded correlation coefficients above the critical value, and all items were therefore declared valid. A summary of the item validity test results is presented below.

Table 4. Summary of Instrument Construct Validity Test Results

Variable	Number of Trial Items	Number of Valid Items	Number of Invalid Items	Range of r Values for Valid Items	r Table	Note
Teacher resilience	40	37	3	0.312–0.741	0.254	Instrument valid
Teacher well-being	40	35	5	0.298–0.726	0.254	Instrument valid
Teacher performance	40	28	12	0.287–0.703	0.254	Instrument valid

Based on the validity test results, the teacher resilience variable yielded 37 valid items from an initial pool of 40, the teacher well-being variable yielded 35 valid items from 40, and the teacher performance variable yielded 28 valid items from 40. Although the number of valid items for each variable exceeded the requirements of the research instrument, the researchers selected the 20 best items per variable to ensure that the instrument composition remained proportional, efficient, and representative of all construct indicators. The selection of the

final items was conducted based on several criteria, including the magnitude of the item–total correlation coefficients obtained from the validity testing, the contribution of each item to the reliability coefficient, and the representation of each theoretical indicator within the construct. Items with higher correlation values and stronger contributions to internal consistency were prioritized, while items with relatively lower correlation values or overlapping indicator representations were excluded. This procedure ensured that the final instrument maintained adequate construct representation while remaining efficient and manageable for respondents.

Instrument reliability was subsequently tested to determine the level of internal consistency among statement items for each research variable. Reliability testing was conducted using Cronbach's Alpha coefficient on items that had been declared valid through the construct validity test. Higher alpha values indicate that the instrument items share a more consistent relationship in measuring the same construct. An instrument is declared reliable if the Cronbach's Alpha coefficient exceeds the minimum threshold of 0.70. A summary of the instrument reliability test results is presented below.

Table 5. Summary of Reliability Test Results

Variable	Number of Trial Items	Number of Reliable Items	Number of Unreliable Items	Cronbach's Alpha	Criterion	Note
Teacher resilience	40	32	8	0.903	> 0.70	Highly reliable
Teacher well-being	40	30	10	0.889	> 0.70	Highly reliable
Teacher performance	40	26	14	0.876	> 0.70	Highly reliable

Based on the reliability test results, the teacher resilience variable yielded 32 reliable items and 8 unreliable items, the teacher well-being variable yielded 30 reliable items and 10 unreliable items, and the teacher performance variable yielded 26 reliable items and 14 unreliable items. From among the reliable items, the 20 best items for each variable were selected to form the final research instrument. The analysis results indicate that Cronbach's Alpha values for all three variables exceeded 0.70, and the final instruments were therefore declared to possess high internal consistency.

Data Analysis Technique

The data analysis technique in this study comprises descriptive analysis and inferential analysis for hypothesis testing, conducted using SPSS. Descriptive analysis was used to describe the distribution of data for the teacher resilience, teacher well-being, and teacher performance variables through the calculation of mean values, standard deviations, minimum scores, maximum scores, and other score variations. These descriptive results were subsequently used to classify each variable's scores into high, moderate, and low categories based on criteria established by the researchers. The hypothesis testing stage was preceded by prerequisite assumption tests comprising a normality test using Kolmogorov–Smirnov, a variance homogeneity test using Levene's Test, and

an initial equivalence test between groups using an independent sample t-test based on pretest scores. These prerequisite tests were conducted to verify the statistical assumptions required for the application of Multivariate Analysis of Covariance (MANCOVA) and Analysis of Covariance (ANCOVA). Specifically, the normality test was used to ensure that the distribution of the data approximated normal distribution, while the homogeneity test was conducted to confirm the equality of variances between the experimental and control groups. In addition, the initial equivalence test based on pretest scores was performed to ensure that both groups had comparable baseline conditions before the treatment was administered. These prerequisite tests were intended to ensure that the data met the statistical assumptions required for further analysis using parametric models.

Primary hypothesis testing was conducted using Multivariate Analysis of Covariance (MANCOVA) to assess the simultaneous effect of the treatment on all three dependent variables after controlling for initial scores as a covariate. MANCOVA was also selected because the three dependent variables were assumed to be intercorrelated, rendering multivariate analysis more appropriate for providing a comprehensive picture of the treatment effect. A subsequent stage employed Analysis of Covariance (ANCOVA) to test the effect of the treatment on each variable, teacher resilience, teacher well-being, and teacher performance, individually.

Results

Descriptive Statistics

The research data were obtained from the pretest and posttest administrations of the teacher resilience, teacher well-being, and teacher performance questionnaires. Descriptive analysis was conducted by calculating the mean, standard deviation, minimum score, and maximum score at both the pretest and posttest stages. A complete summary of the descriptive statistics for each research variable is presented in Table 6.

Table 6. Descriptive Analysis Results for Research Variables

Variable	Group/Stage	Mean	Median	SD	SE	Variance	Min	Max
Teacher resilience	Experimental–Pretest	61.33	61.00	5.78	1.06	33.40	51	72
	Experimental–Posttest	78.87	78.50	5.23	0.96	27.43	69	89
	Control–Pretest	61.27	61.50	5.74	1.05	32.96	49	71
	Control–Posttest	65.97	66.00	4.90	0.89	23.96	56	76
Teacher well-being	Experimental–Pretest	62.53	64.00	5.57	1.02	31.02	54	73
	Experimental–Posttest	79.37	79.50	4.46	0.81	19.90	72	87
	Control–Pretest	61.77	63.00	4.98	0.91	24.81	53	72
	Control–Posttest	66.97	67.00	5.42	0.99	29.41	57	77
Teacher performance	Experimental–Pretest	63.57	62.50	5.96	1.09	35.63	54	74
	Experimental–Posttest	80.40	80.00	4.92	0.90	24.18	70	90
	Control–Pretest	62.63	63.50	4.54	0.83	20.59	54	71
	Control–Posttest	67.83	68.00	4.24	0.77	17.94	61	78

Table 6 indicates that the initial scores of the experimental and control groups on all three research variables were

comparably close, as reflected in the relatively equivalent pretest mean values. Following the administration of the treatment, the experimental group demonstrated a greater increase in mean scores than the control group across all variables. For teacher resilience, the experimental group's mean increased from 61.33 to 78.87, while the control group increased only from 61.27 to 65.97. For teacher well-being, the experimental group's mean rose from 62.53 to 79.37, whereas the control group's mean changed from 61.77 to 66.97. The same pattern is evident for teacher performance, where the experimental group's mean increased from 63.57 to 80.40, while the control group increased from 62.63 to 67.83. Descriptive statistics are not only presented in tabular form but are also visualized to illustrate the pattern of individual score changes in the experimental and control groups. Figure 1, 2, and 4 present the visualization of individual pretest and posttest scores for each research variable.

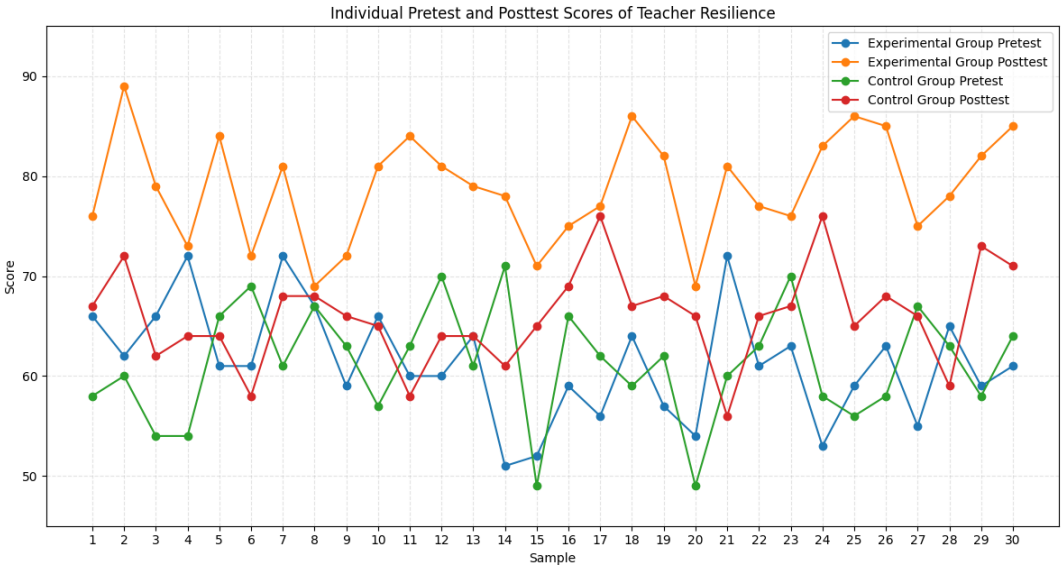

Figure 1. Distribution of Individual Pretest and Posttest Scores on Teacher Resilience in the Experimental and Control Groups

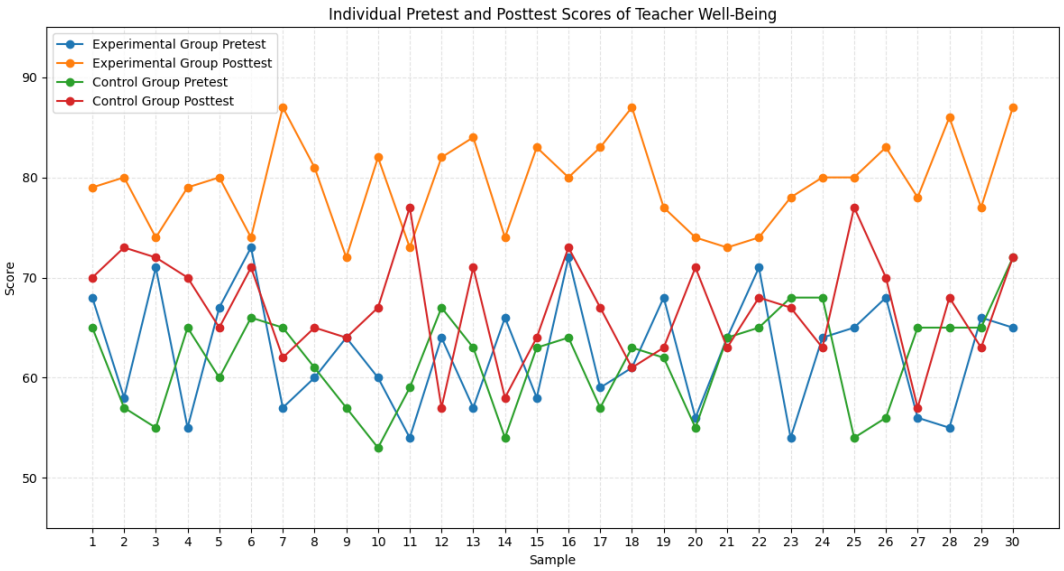

Figure 2. Distribution of Individual Pretest and Posttest Scores on Teacher Well-Being in the Experimental and Control Groups

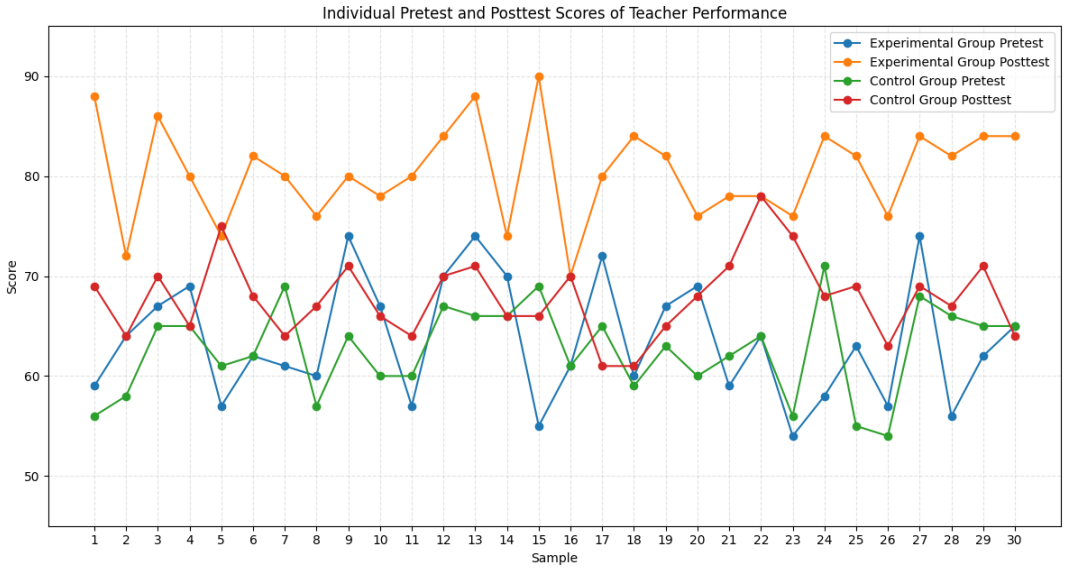

Figure 3. Distribution of Individual Pretest and Posttest Scores on Teacher Performance in the Experimental and Control Groups

Figures 1, 2, and 3 display the distribution of individual pretest and posttest scores for teacher resilience, teacher well-being, and teacher performance in the experimental and control groups. Overall, the pretest scores of both groups appear relatively close across all three variables, indicating that participants' initial conditions were descriptively comparable. Following the treatment, the experimental group demonstrated a more pronounced upward trend in posttest scores than the control group across all research variables. The control group also experienced score changes, though the improvement tended to be smaller and less consistent. These visual findings provide an initial indication that LMS/website-based digital pedagogical training exerts a positive influence on teacher resilience, well-being, and performance, a finding that requires confirmation through inferential statistical testing.

Prerequisite Testing

Normality Test

A normality test was conducted using Kolmogorov–Smirnov to determine whether the data distribution for each research variable satisfied the normality assumption prior to inferential analysis. Data are declared normally distributed if the significance value (Sig.) exceeds 0.05, while a significance value below 0.05 indicates that the data are not normally distributed. A summary of the normality test results is presented in Table 7.

Table 7 indicates that all data for the teacher resilience, teacher well-being, and teacher performance variables — in both the experimental and control groups — yielded Asymp. Sig. (2-tailed) values exceeding 0.05. These results indicate that the pretest and posttest data across all groups are normally distributed. The obtained Kolmogorov–Smirnov Z values likewise show no meaningful distributional deviations in any of the measurement groups. These findings confirm that the normality assumption has been satisfied, and the research data are therefore suitable for further analysis using parametric statistical techniques.

Table 7. Summary of Normality Test Results

Variable	Group	Measurement	Kolmogorov-Smirnov Z	Asymp. Sig. (2-tailed)	Note
Teacher resilience	Experimental Group	Pretest	0.679	0.746	Normal
		Posttest	0.641	0.806	Normal
	Control Group	Pretest	0.706	0.701	Normal
		Posttest	0.663	0.772	Normal
Teacher well-being	Experimental Group	Pretest	0.647	0.797	Normal
		Posttest	0.630	0.823	Normal
	Control Group	Pretest	0.690	0.728	Normal
		Posttest	0.668	0.764	Normal
Teacher performance	Experimental Group	Pretest	0.657	0.781	Normal
		Posttest	0.619	0.838	Normal
	Control Group	Pretest	0.695	0.719	Normal
		Posttest	0.652	0.789	Normal

Homogeneity Test

A homogeneity test was conducted to determine whether the variance of data in the experimental and control groups was equal or homogeneous prior to inferential analysis. Homogeneity testing in this study employed Levene's Test, as it is commonly used to assess the equality of variances between groups in comparative designs. Data are declared homogeneous if the significance value (Sig.) exceeds 0.05, while a significance value below 0.05 indicates that the data are not homogeneous. A summary of the variance homogeneity test results is presented in Table 8.

Table 8. Summary of Homogeneity Test Results

Variable	Measurement	Levene Statistic	df1	df2	Sig.	Note
Teacher resilience	Pretest	0.842	1	58	0.363	Homogeneous
	Posttest	1.126	1	58	0.293	Homogeneous
Teacher well-being	Pretest	0.774	1	58	0.383	Homogeneous
	Posttest	1.018	1	58	0.317	Homogeneous
Teacher performance	Pretest	0.691	1	58	0.409	Homogeneous
	Posttest	0.958	1	58	0.332	Homogeneous

Table 8 indicates that all research variables yielded Levene's Test significance values exceeding 0.05 at both the pretest and posttest stages. These results indicate that the score variances between the experimental and control groups are homogeneous for the teacher resilience, teacher well-being, and teacher performance variables. The absence of significant variance differences between groups confirms that the data satisfy the homogeneity assumption for parametric analysis.

Initial Equivalence Test

An initial equivalence test was conducted to determine whether the experimental and control groups possessed comparable baseline conditions prior to the administration of the treatment. This test employed an independent sample t-test, as the analysis was intended to compare the mean pretest scores of two independent groups. The two groups are declared equivalent if the significance value (Sig. 2-tailed) exceeds 0.05, while a value below 0.05 indicates that the two groups are not equivalent at baseline. A summary of the initial equivalence test results using the independent sample t-test is presented in Table 9.

Table 9. Summary of Independent Sample t-Test Results

Variable	Levene's Test for Equality of Variances F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Note
Teacher resilience	0.842	0.363	0.041	58	0.967	0.067	1.484	Equivalent
Teacher well-being	0.774	0.383	0.536	58	0.594	0.767	1.430	Equivalent
Teacher performance	0.691	0.409	0.661	58	0.511	0.933	1.412	Equivalent

Table 9 indicates that all research variables yielded Sig. (2-tailed) values exceeding 0.05. These results indicate that no significant difference exists between the pretest means of the experimental and control groups for the teacher resilience, teacher well-being, and teacher performance variables. Both groups may therefore be declared to have equivalent baseline conditions prior to the administration of the treatment. This initial equivalence is important as it demonstrates that any changes observed at the posttest stage are not attributable to pre-existing differences between the groups, but are more likely associated with the treatment administered. Based on the results of the normality, homogeneity, and initial equivalence tests, the research data satisfy the conditions required to proceed to hypothesis testing using MANCOVA and ANCOVA.

MANCOVA Test

Multivariate Analysis of Covariance (MANCOVA) was used to examine the simultaneous effect of the treatment on multiple dependent variables after controlling for specified covariates. In this study, MANCOVA was employed to test the simultaneous influence of digital pedagogical training on teacher resilience, teacher well-being, and teacher performance, with initial scores (pretest) controlled as a covariate. The multivariate effect is declared significant if the significance value (Sig.) for multivariate statistics, such as Pillai's Trace, Wilks' Lambda, Hotelling's Trace, or Roy's Largest Root, is less than 0.05. A summary of the MANCOVA test results is presented in Table 10.

Table 10 indicates that the multivariate test results across all criteria, Pillai's Trace, Wilks' Lambda, Hotelling's

Trace, and Roy's Largest Root, yielded significance values of 0.000, which is less than 0.05. These results demonstrate that digital pedagogical training exerts a significant simultaneous effect on teacher resilience, teacher well-being, and teacher performance after initial scores were controlled as a covariate. A Wilks' Lambda value of 0.513 indicates that the multivariate model is capable of meaningfully differentiating the variation across the three dependent variables between the experimental and control groups. The Partial Eta Squared value of 0.487, meanwhile, indicates that the effect of the treatment falls within the strong category with respect to the combined three dependent variables. These findings affirm that LMS/website-based digital pedagogical training does not merely impact a single specific dimension, but exerts a combined influence on teacher resilience, teacher well-being, and teacher performance. Accordingly, further analysis through ANCOVA is required to determine the magnitude of the treatment effect on each variable individually.

Table 10. Multivariate Test

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Note
Pillai's Trace	0.487	16.214	3.000	53.000	0.000	0.487	Significant
Wilks' Lambda	0.513	16.214	3.000	53.000	0.000	0.487	Significant
Hotelling's Trace	0.918	16.214	3.000	53.000	0.000	0.487	Significant
Roy's Largest Root	0.918	16.214	3.000	53.000	0.000	0.487	Significant

ANCOVA Test

Analysis of Covariance (ANCOVA) was used to examine the effect of the treatment on each dependent variable individually after controlling initial scores (pretest) as a covariate. The treatment effect is declared significant if the Sig. value for the group/treatment source of variation is less than 0.05, while a value exceeding 0.05 indicates that the treatment effect is not significant. A summary of the ANCOVA test results is presented in Table 11.

The ANCOVA results indicate that the group/treatment variable exerts a significant effect on teacher resilience, as evidenced by F = 25.223 and Sig. = 0.000. This finding demonstrates that, after controlling for pretest scores, a significant difference in teacher resilience scores exists between the experimental and control groups. A Partial Eta Squared value of 0.318 indicates that the treatment effect on teacher resilience falls within the moderately strong category.

For the teacher well-being variable, the ANCOVA results likewise indicate a significant treatment effect, with F = 30.221 and Sig. = 0.000. These results demonstrate that digital pedagogical training makes a meaningful contribution to the improvement of teacher well-being after the influence of initial scores is controlled. A Partial Eta Squared value of 0.347 indicates that the magnitude of the treatment effect on teacher well-being is strong.
For the teacher performance variable, F = 34.873 and Sig. = 0.000 indicate that the treatment also exerts a significant effect on teacher performance. This result means that, after accounting for initial scores, the experimental group's teacher performance scores differ significantly from those of the control group. A Partial Eta Squared value of 0.380 indicates that the treatment effect on teacher performance is the largest among the three variables.

Table 11. Test of Between-Subjects Effects

Dependent Variable	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Teacher resilience	Corrected Model	2145.376	2	1072.688	18.426	0.000	0.406
	Intercept	1287.544	1	1287.544	22.118	0.000	0.294
	Pretest_Resilience	512.638	1	512.638	8.808	0.004	0.140
	Group	1468.295	1	1468.295	25.223	0.000	0.318
	Error	3319.607	57	58.239			
	Total	317845.000	60				
	Corrected Total	5464.983	59				
Teacher well-being	Corrected Model	2284.119	2	1142.060	20.117	0.000	0.414
	Intercept	1359.271	1	1359.271	23.944	0.000	0.296
	Pretest_WellBeing	438.566	1	438.566	7.724	0.007	0.119
	Group	1715.447	1	1715.447	30.221	0.000	0.347
	Error	3235.481	57	56.763			
	Total	323412.000	60				
	Corrected Total	5519.600	59				
Teacher performance	Corrected Model	2396.882	2	1198.441	22.684	0.000	0.443
	Intercept	1418.903	1	1418.903	26.857	0.000	0.320
	Pretest_Performance	401.227	1	401.227	7.595	0.008	0.118
	Group	1842.774	1	1842.774	34.873	0.000	0.380
	Error	3012.934	57	52.859			
	Total	329265.000	60				
	Corrected Total	5409.816	59				

Discussion

The Influence of Digital Pedagogical Training on Teacher Resilience

The values of F = 25.223, Sig. = 0.000, and partial eta squared = 0.318 position teacher resilience as one of the dimensions that changed substantively following the treatment, after controlling for initial scores. This change is understandable when teacher resilience is conceptualized as a professional capacity that develops through the interaction of personal resources, social relationships, well-being, motivation, and emotional regulation (O'Shea, 2021; Polatlar & Öztabak, 2021). Teacher resilience is a dynamic process that can be learned and strengthened through directed professional learning experiences, rather than a fixed individual trait that is fully formed from the outset (Ahmed et al., 2018; Christensen & Knezek, 2025).

A structured digital learning environment appears to afford teachers the opportunity to reduce pedagogical uncertainty. As digital tools, learning workflows, and teaching strategies become better understood, occupational pressure does not disappear, but becomes more manageable. This point is significant, as the literature on

educational digitalization also reveals a contrasting dimension. Technology can become a source of stress when teachers are required to adapt rapidly without adequate support (Franco et al., 2010). Research on the impact of educational technology on teacher stress indicates that technology use is frequently associated with anxiety and occupational pressure (Fahmi et al., 2022; Karabatak et al., 2018). The findings of this study are therefore more appropriately interpreted as evidence of the success of well-designed digital pedagogical training, rather than the success of technology in isolation.

This perspective renders the findings of the present study conceptually significant. Teacher resilience here appears to develop not through the rhetoric of "teachers must be strong," but through enhanced self-efficacy, clearer strategies, and more manageable professional experiences (Ahmed et al., 2018; Brown, 2022). BRiTE itself was developed to cultivate professional resilience through reflection, support networks, and strategies for managing professional demands (Mansfield, 2020; Xu, 2021). The ANCOVA results in this study point toward the same logic. Digital pedagogical training may thus be read as a form of professional intervention that strengthens teacher resilience at a concrete and measurable level.

The Influence of Digital Pedagogical Training on Teacher Well-Being

The values of F = 30.221, Sig. = 0.000, and partial eta squared = 0.347 indicate that the changes observed in teacher well-being represent more than ordinary fluctuation between groups. The significance of this finding becomes clearer when teacher well-being is examined through the framework of the Teacher Subjective Wellbeing Questionnaire, which positions teaching efficacy and school connectedness as its central axes. Teachers who feel more capable of teaching and more connected to their professional environment generally experience more positive, emotionally stable, and professionally meaningful work lives (Carstensen & Klusmann, 2021; Qi et al., 2025).

The digital training in this study appears to have operated precisely on these two axes. Mastery of digital tools and learning strategies has the potential to enhance teachers' sense of capability in managing their classrooms, designing activities, and resolving instructional challenges. Simultaneously, the LMS/website-based training format typically facilitates interaction, feedback, and a stronger sense of professional connectedness (Basilotta-Gómez-Pablos et al., 2022; Sáez-Delgado et al., 2025). Teachers' digital competence also affirms that relevant professional development can broaden teachers' readiness to navigate pedagogical changes in digital environments. When such readiness grows, feelings of pressure tend to diminish and professional well-being is more likely to improve (Ertürk, 2021; Şan et al., 2025).

The relationship between technology and teacher well-being, however, does not invariably move in a positive direction. Several studies indicate that digitalization can extend working hours, increase administrative demands, and trigger technostress *(Balaban & Tınmaz Kazancı, 2024; Kumalasari & Akmal, 2021)*. The positive findings of the present study are notable precisely because they run counter to these concerns. This trajectory suggests that training design plays a pivotal role. When technology is positioned as a tool that facilitates pedagogical work rather than as an additional burden, teacher well-being tends to strengthen rather than weaken (Ansley et al., 2021;

Eriksson et al., 2018; Ye et al., 2023).

The Influence of Digital Pedagogical Training on Teacher Performance

The values of F = 34.873, Sig. = 0.000, and partial eta squared = 0.380 reveal that the strongest effect emerged in teacher performance. This result is understandable given that teacher performance encompasses professional knowledge, instructional planning, instructional delivery, assessment, learning environment, and professionalism (Afandi et al., 2021). These components represent the domains most directly engaged by digital pedagogical training, making performance changes more readily observable compared to variables that are more psychological in nature (Bustami et al., 2022; Suryanto & Sunarto, 2022).

LMS/website-based training provides teachers with more than new information. Teachers gain practical tools, models of practice, and approaches to organizing learning that can be applied immediately. The impact is highly likely to be felt in the quality of instructional planning, the fluency of content delivery, the variety of learning strategies, and the precision of assessment (Afandi et al., 2023; Mustikawati & Qomariah, 2020). Teacher performance is the outcome of integrated professional practice (Anwar et al., 2020). From this perspective, the findings of this study demonstrate that the digital intervention succeeded in engaging the core of teachers' work, rather than merely adding knowledge that remains at the level of discourse.

A more critical perspective nonetheless warrants consideration. Teacher performance does not invariably improve as a result of digital training, as many programs fail to produce meaningful change when their content is too general, lacks contextual relevance, or is disconnected from teaching routines (Adegbola, 2019; Hakim, 2015). The OECD emphasizes that the development of teachers' digital competence requires systemic support and sustained professional development (OECD, 2018). The strong results of this study are therefore more appropriately interpreted as evidence that training which is relevant, well-structured, and closely aligned with classroom practice is capable of driving teacher performance improvement more effectively.

The Influence of Digital Pedagogical Training on Teacher Resilience, Teacher Well-Being, and Teacher Performance

The multivariate test demonstrates a significant effect on the combined three variables, as reflected in Wilks' Lambda = 0.513, F = 16.214, Sig. = 0.000, and partial eta squared = 0.487. This significance is important not only statistically but also conceptually. Resilience, well-being, and teacher performance rarely move in isolation. Changes in one dimension of the teaching profession frequently resonate across others. This interconnection renders the MANCOVA results more meaningful than the mere sum of three individual ANCOVA outcomes. Teachers who feel more competent in managing digital learning tend to experience a greater sense of control over their work (Maryana & Torre, 2021). This sense of control can strengthen resilience when facing pressure, while simultaneously improving the quality of everyday work experiences (Meekaew & Jongnimitsataporn, 2023). This pathway explains why a single training program can exert an impact across three variables simultaneously. The literature on technology-related stress provides a useful contrast. When digital transformation arrives without

adequate support, what emerges is anxiety and burnout rather than professional growth (Moltudal et al., 2019; Örtegren, 2022). This study demonstrates the opposite trajectory: the strengthening of professional capacity when learning support is available.

The implications for teacher professional development are clear. Pedagogically designed digital programs can function not merely as vehicles for technical skill enhancement, but also as interventions that sustain teachers' professional health more comprehensively (Pamela Ansayam & Tan, 2021; Şimşek & Yazıcı, 2021). This direction is consistent with the view that teachers' digital competence needs to be developed through a systematic and sustained approach (Hidayah et al., 2021; Reinsfield, 2018). The multivariate findings of this study therefore affirm one important point: relevant digital pedagogical training does not stop at improving teaching performance, but simultaneously strengthens teacher resilience and well-being within a single, interconnected process of change.

Despite the meaningful findings produced by this study, several limitations should be acknowledged. First, the sample size was limited to 60 teachers drawn from two Teacher Working Groups (KKG) within a single city. Although the quasi-experimental design strengthens the internal validity of the study, the relatively limited geographical scope may restrict the generalizability of the findings to broader educational contexts. Second, the research employed self-report questionnaires to measure teacher resilience, teacher well-being, and teacher performance. While this approach allows for capturing teachers' perceptions and professional experiences, self-reported data may be influenced by subjective bias. Third, the intervention was implemented within a relatively short period of time, which may not fully capture the long-term effects of digital pedagogical training on teachers' professional development. Future research may therefore consider larger and more diverse samples, incorporate observational or mixed-method approaches, and examine longer-term training impacts to obtain a more comprehensive understanding of digital pedagogical training in educational settings.

Conclusion

This study yields three principal conclusions: (1) digital pedagogical training has a significant effect on teacher resilience, indicating that LMS/website-based digital pedagogical training is capable of strengthening teachers' adaptive capacity in the face of demands and changes in learning practice; (2) digital pedagogical training has a significant effect on teacher well-being, meaning that the enhancement of digital pedagogical competence is associated with the strengthening of teaching efficacy and more positive professional experiences among teachers; and (3) digital pedagogical training has a significant effect on teacher performance, demonstrating that structured, relevant, and contextually grounded training supports improvement in the quality of teachers' professional task execution. Overall, the findings affirm that digital pedagogical training exerts a positive influence exerts a positive influence, both simultaneously and individually, on teacher resilience, teacher well-being, and teacher performance. The implications of this study indicate that teacher professional development in the digital era should be directed not only toward technological mastery, but also toward the integrated strengthening of teachers' psychological and pedagogical capacities.

Recommendations

Recommendations for future research are directed toward expanding the sample size, geographical scope, and diversity of teacher characteristics to enhance the generalizability of findings. Future research should also incorporate mixed methods or observational data to enrich understanding of changes in teacher resilience, well-being, and performance following digital training. Subsequent studies may further examine the duration, design, and intensity of training that prove most effective, so that the influence of digital pedagogical training on various aspects of teachers' professional lives can be understood more thoroughly.

Statements and Declarations

Acknowledgments/Notes: Not applicable.

Supplementary Materials: Not applicable.

Author Contributions: All authors contributed equally. All authors have read and agreed to the published version of the manuscript.

Funding: Not applicable.

Data Availability: Not applicable.

Ethics Approval: The study was approved by the Ethics Committee of the Universitas Bina Bangsa. All methods were performed in accordance with the study protocol and ethical guidelines and regulations.

Informed Consent: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: Not applicable.

References

Adegbola, F., F. (2019). Teacher Pedagogical Characteristics as Determinants of Students' performance in Basic Science in South West Nigeria. *International Education & Research Journal*, *5*(3), 28–30. https://doi.org/10.5897/ERR2019.3761

Afandi, M., Wahyuningsih, S., & Mayasari, L. I. (2021). Does elementary school teacher's performance matter? *Cakrawala Pendidikan*, *40*(1), 242–252.

Afandi, M., Wahyuningsih, S., Yustiana, S., Kusumadewi, R. F., & Rachmadtullah, R. (2023). Correlation of Work Discipline and Pedagogical Competence to Teaching Performance in Elementary Teacher. *International Journal of Instruction*, *16*(4), 189–208. https://doi.org/10.29333/iji.2023.16412a

Ahmed, U., Umrani, W. A., Qureshi, M. A., & Samad, A. (2018). Examining the links between teachers support,

academic efficacy, academic resilience, and student engagement in Bahrain. *International Journal of Advanced and Applied Sciences*, *5*(9), 39–46. https://doi.org/10.21833/ijaas.2018.09.008

Ansley, B. M., Houchins, D. E., Varjas, K., Roach, A., Patterson, D. S., & Hendrick, R. (2021). The impact of an online stress intervention on burnout and teacher efficacy. *Teaching and Teacher Education*, *98*. https://doi.org/10.1016/j.tate.2020.103251

Anwar, Q., Khan, Z., Hafeez, A., Hassan, K., & Khan, M. (2020). Impact of organizational climate on job performance of public university teachers in Khyber Pakhtunkhwa Pakistan. *Ilkogretim - Elementary Education Online*, *19*(4), 3850–3855. https://doi.org/10.17051/ilkonline.2020.04.764792

Astutik, K. F., & Roesminingsih, E. (2021). The Improvement of Teachers' Professional Competency Through Hots-Based Training. *JPI (Jurnal Pendidikan Indonesia)*, *10*(1), 145–151. https://doi.org/10.23887/jpi-undiksha.v10i1.22407

Balaban, F., & Tınmaz Kazancı, A. (2024). An Examination of How Toxic Leadership Behaviours of School Principals Relate to Teachers' Perceived Stress. *International Journal of Contemporary Educational Research*, *11*(1), 86–99. https://doi.org/10.52380/ijcer.2024.11.1.538

Basilotta-Gómez-Pablos, V., Matarranz, M., Casado-Aranda, L. A., & Otto, A. (2022). Teachers' digital competencies in higher education: a systematic literature review. In *International Journal of Educational Technology in Higher Education* (Vol. 19, Number 1). https://doi.org/10.1186/s41239-021-00312-8

Berikkhanova, G., Ospanova, B., Yermenova, B., Zharmukhametova, R., Sultanova, N., & Urazbaeva, A. (2021). the Effectiveness of the Training Model of the Future Teacher in Conditions of Inclusive Education. *International Journal of Education and Practice*, *9*(4), 670–686. https://doi.org/10.18488/journal.61.2021.94.670.686

Berkovich, I., & Hassan, T. (2025). Principals' digital transformational leadership, teachers' commitment, and school effectiveness. *Education Inquiry*, *16*(2), 177–194. https://doi.org/10.1080/20004508.2023.2173705

Brown, R. (2022). Teacher Self-Efficacy, Dispositional Optimism, Resiliency, and Behavior Management in High School Classrooms in Puerto Rico. *Revista Puertorriquena de Psicologia*, *32*(1), 18–32. https://doi.org/10.3102/1435099

Bustami, M. R., Azainil, A., & Komariah, L. (2022). Teacher Satisfaction, Self-Efficacy Affect on Teacher Performance: An Evidence from A Vocational School of Pharmaceutical Study Program East Borneo, Indonesia. *EduLine: Journal of Education*, *2*(3), 291–296. https://doi.org/10.35877/454RI.eduline1159

Carstensen, B., & Klusmann, U. (2021). Assertiveness and adaptation: Prospective teachers' social competence development and its significance for occupational well-being. *British Journal of Educational Psychology*, *91*(1), 500–526. https://doi.org/10.1111/bjep.12377

Christensen, R., & Knezek, G. (2025). Impact of Teaching Simulations on Resilience, Empathy and Culturally Responsive Teaching Self-Efficacy in Career Technology Teacher Preparation Students. *International Journal of Technology in Education*, *8*(1), 104–122. https://doi.org/10.46328/ijte.996

Cocca, M., Cocca, A., Martinez, E. A., & Bulnes, M. G. R. (2018). Correlation between Self-Efficacy Perception and Teaching Performances: The Case of Mexican Preschool and Primary School Teachers. *Arab World English Journal*, *9*(1), 56–70. https://doi.org/10.24093/awej/vol9no1.4

Eriksson, T., Germundsjö, L., Åström, E., & Rönnlund, M. (2018). Mindful self-compassion training reduces

stress and burnout symptoms among practicing psychologists: A randomized controlled trial of a brief web-based intervention. *Frontiers in Psychology*, *9*(Nov), 1–10. https://doi.org/10.3389/fpsyg.2018.02340

Ertürk, R. (2021). Analysis of the Relationship between School Administrators' Supportive Behaviors and Teachers' Job Satisfaction and Subjective Well-Being. *International Journal of Contemporary Educational Research*, *8*(4), 184–195. https://doi.org/10.33200/ijcer.956667

Fahmi, P., Sudjono, Parwoto, Supriyatno, Saluy, A. B., Safitri, E., Effiyaldi, Rivaldo, Y., & Endri, E. (2022). Work Stress Mediates Motivation and Discipline on Teacher Performance: Evidence Work from Home Policy. *Journal of Educational and Social Research*, *12*(3), 80–89. https://doi.org/10.36941/jesr-2022-0068

Filderman, M. J., Toste, J. R., Didion, L., & Peng, P. (2022). Data Literacy Training for K–12 Teachers: A Meta-Analysis of the Effects on Teacher Outcomes. In *Remedial and Special Education* (Vol. 43, Number 5). https://doi.org/10.1177/07419325211054208

Franco, C., Mañas, I., Cangas, A. J., Moreno, E., Gallego, J., Gold, E., Smith, A., Hopper, I., Herne, D., Tansey, G., Hulland, C., Flook, L., Goldberg, S. B., Pinger, L., Bonus, K., & Davidson, R. J. (2010). Mindfulness-based stress reduction (MBSR) for primary school teachers. *Journal of Child and Family Studies*, *19*(2), 184–189.

García-Lázaro, I., Colás-Bravo, M. P., & Conde-Jiménez, J. (2022). The Impact of Perceived Self-Efficacy and Satisfaction on Preservice Teachers' Well-Being during the Practicum Experience. *Sustainability (Switzerland)*, *14*(16), 1–17. https://doi.org/10.3390/su141610185

Hakim, A. (2015). Contribution of Competence Teacher (Pedagogical, Personality, Professional Competence and Social) On the Performance of Learning. *The International Journal of Engineering and Science*, *4*(2), 1–12. www.theijes.com

Hidayah, R., Prihatin, T., & Utanto, Y. (2021). Development of Training on Writing Digital Textbooks Based in On in Service Learning for Teacher. *Innovative Journal of Curriculum and Educational Technology*, *10*(2), 74–89.

Hidayah, R., Wangid, M. N., Wuryandani, W., & Salimi, M. (2023). The Influence of Teacher Efficacy on Education Quality: A Meta-Analysis. *International Journal of Educational Methodology*, *9*(2), 435–450. https://doi.org/10.12973/ijem.9.2.435

Ibrahim, I., Fitria, H., & Puspita, Y. (2020). The Effect of Work Discipline and Teacher's Motivation on Teacher's Performance. *Journal of Social Work and Science Education*, *1*(2), 140–145. https://doi.org/10.52690/jswse.v1i2.41

Karabatak, S., Alanoğlui, M., & Şengür, D. (2018). the Effect of Teachers ' Organizational Citizenship Behaviors and Stress Levels on School Effectiveness. *European Journal of Education Studies*, *5*(4), 67–82. https://doi.org/10.5281/zenodo.1464115

Kaya, G., & Öz, S. (2021). Investigation of the Effect of Teacher Training Programs on Reflective Thinking: ALACT Model. *International Journal of Progressive Education*, *17*(2), 275–291. https://doi.org/10.29329/ijpe.2021.332.17

Kumalasari, D., & Akmal, S. Z. (2021). Less Stress, More Satisfied in Online Learning During the COVID-19 Pandemic: The Moderating Role of Academic Resilience. *Psychological Research on Urban Society*,

4(1). https://doi.org/10.7454/proust.v4i1.115

Liaqat, F., Islam, M., Azim, M. U., & Lodhi, A. S. (2024). Investigating academic resilience in learning English: an ecological context of undergraduate students. *Frontiers in Psychology*, *15*(1467544), 1–10. https://doi.org/10.3389/fpsyg.2024.1467544

Limon, İ., & Dilekçi, Ü. (2025). The Relationship between Instructional Leadership and Collective Teacher Efficacy: Teachers' Professional Learning Activities as Mediator. *Journal of Educational Leadership and Policy Studies (JELPS*, *9*(1), 1–19. https://orcid.org/0000-0002-5830-7561,

Lin, Y. S., Chen, S. Y., Tsai, C. W., & Lai, Y. H. (2021). Exploring Computational Thinking Skills Training Through Augmented Reality and AIoT Learning. *Frontiers in Psychology*, *12*(640115), 1–9. https://doi.org/10.3389/fpsyg.2021.640115

Mansfield, C. F. (2020). Cultivating Teacher Resilience: International Approaches, Applications and Impact. In *Cultivating Teacher Resilience: International Approaches, Applications and Impact*. https://doi.org/10.1007/978-981-15-5963-1

Maratos, F. A., Montague, J., Ashra, H., Welford, M., Wood, W., Barnes, C., Sheffield, D., & Gilbert, P. (2019). Evaluation of a Compassionate Mind Training Intervention with School Teachers and Support Staff. *Mindfulness*, *10*(11), 2245–2258. https://doi.org/10.1007/s12671-019-01185-9

Martin, A. J., & Marsh, H. W. (2008). Academic buoyancy: Towards an understanding of students' everyday academic resilience. *Journal of School Psychology*, *46*(1), 53–83. https://doi.org/10.1016/j.jsp.2007.01.002

Maryana, W., & Torre, A. I. A. Dela. (2021). The Role of Teachers in Digital-Based Thematic Learning at Elementary School. *Elementary Education Journal*, *1*(1), 40–54. https://doi.org/10.53088/eej.v1i1.172

Meekaew, N., & Jongnimitsataporn, P. (2023). How capable are they of Becoming a Digital Teacher? Correlation Analysis of Individual Characteristics, Digital Self-efficacy, and Digital Citizenship among Pre-service Teachers in Northeast Thailand. *Higher Education Studies*, *13*(2), 63–73. https://doi.org/10.5539/hes.v13n2p63

Mert, P., & Özgenel, M. (2020). A Relational Research on Paternalist Leadership Behaviors Perceived by Teachers and Teachers' Performance. *Educational Policy Analysis and Strategic Research*, *15*(2), 41–60. https://doi.org/10.29329/epasr.2020.251.3

Moltudal, S., Krumsvik, R., Jones, L., Eikeland, O. J., & Johnson, B. (2019). The Relationship Between Teachers' Perceived Classroom Management Abilities and Their Professional Digital Competence. *Designs for Learning*, *11*(1), 80–98. https://doi.org/10.16993/dfl.128

Mustikawati, E., & Qomariah, N. (2020). The Effect of Education , Training and Competency on Teacher Performance. *International Journal of Business and Management Invention (IJBMI)*, *9*(10), 14–20. https://doi.org/10.35629/8028-0910031420

Neufeld, P. G., & Delcore, H. D. (2018). Situatedness and variations in student adoption of technology practices: Towards a critical techno-pedagogy. *Journal of Information Technology Education: Research*, *17*, 1–38. https://doi.org/10.28945/3934

OECD. (2018). The Future of Education and Skills: Education 2030. *OECD Education Working Papers*.

Örtegren, A. (2022). Digital Citizenship and Professional Digital Competence — Swedish Subject Teacher Education in a Postdigital Era. *Postdigital Science and Education*, *4*(2), 467–493.

https://doi.org/10.1007/s42438-022-00291-7

O'Shea, C. (2021). How Relationships Impact Teacher Job Satisfaction. *International Journal of Modern Education Studies*, *5*(2), 280–298. https://doi.org/10.51383/ijonmes.2021.114

Pamela Ansayam, M. G., & Tan, D. a. (2021). Investigating The Utilization Of Digital Instructional Materials And Digital Tools For Online Learning In Teacher Education Courses. *International Journal of Scientific & Technology Research*, *10*(09), 125–137. www.ijstr.org

Park, J.-O., Kwak, H., & Kim, K.-S. (2016). The Relationship among Teacher-Efficacy, Teacher Evaluation and Teacher Professional Development Motivation for Elementary School Teachers. *Korean Association For Learner-Centered Curriculum and Instruction*, *16*(11), 879–900. https://doi.org/10.22251/jlcci.2016.16.11.879

Polatlar, D. Y., & Öztabak, M. Ü. (2021). The Analysis of the Relation Between Preschool Teachers' Decision Making and Attachment Styles. *International Education Studies*, *14*(9), 1–15. https://doi.org/10.5539/ies.v14n9p1

Puolitaival, T., & Kiroff, L. (2021). Digital technologies in construction management education: A digital natives' perspective. *Proceeding of the Conference CIB W78 2021*, 650–658.

Qi, W., Zhang, Y., & Arshad, M. Z. (2025). Sustainable education in action: Principal leadership, teacher wellbeing, and altruism in the sports context. *Acta Psychologica*, *254*. https://doi.org/10.1016/j.actpsy.2025.104846

Rachmadtullah, R., Mareyke Jessy Tanod, M. J. T., Rasmitadila., R., Irawan, N., McNeilly, A., & Suharni, S. (2024). Elementary School Teachers' Perspectives on Utilizing Artificial Intelligence for Developing Learning Media. *Journal of Integrated Elementary Education*, *4*(1), 71–82. https://doi.org/10.21580/jieed.v4i1.21994

Ramdani, R., Hanurawan, F., Ramli, M., Lasan, B. B., & Afdal, A. (2020). Development and Validation of Indonesian Academic Resilience Scale Using Rasch Models. *International Journal of Instruction*, *14*(1). https://doi.org/10.29333/IJI.2021.1417A

Reinsfield, E. (2018). Secondary technology teachers' perceptions and practice: Digital technology and a future-focused curriculum in New Zealand. *Waikato Journal of Education*, *23*(2), 432–450. https://doi.org/10.15663/wje.v23i2.655

Sáez-Delgado, F., Coronado-Sánchez, P., Mella-Norambuena, J., López-Angulo, Y., Brieba-Fuenzalida, J., Contreras-Saavedra, C., & Lozano-Peña, G. (2025). Use of Digital Technologies to Support Socioemotional Teacher Training: A Systematic Review. *Education Sciences*, *15*(10). https://doi.org/10.3390/educsci15101377

Şan, İ., Karadeniz, D., Orhan Karsak, H. G., & Kara, A. (2025). Digital Dilemma in Teacher Training: Digital Well-Being and Internet Addiction. *International Journal of Technology in Education*, *8*(2). https://doi.org/10.46328/ijte.1053

Sariyatun, Joebagio, H., & Akhyar, M. (2018). Teachers' perception on digital teaching material development in social science education. *Journal of Turkish Science Education*, *15*(Special Issue), 13–21. https://doi.org/10.12973/tused.10252a

Şimşek, M., & Yazıcı, N. (2021). Examining the digital learning material preparation competencies of preservice mathematics teachers. *Participatory Educational Research*, *8*(3), 323–343.

https://doi.org/10.17275/per.21.68.8.3

Sun, S. Y., & Peng, L. H. (2020). Study of the virtual reality education and digitalization in China. *Journal of Physics: Conference Series*, *1456*(1), 1–8. https://doi.org/10.1088/1742-6596/1456/1/012042

Suryanto, J., & Sunarto. (2022). The Effect of Self-Efficacy and Teacher Commitment to Teacher Performance Moderated Academic Supervision. *Attractive : Innovative Education Journal*, *4*(1), 1–12.

Susiani, T. S., Salimi, M., Hidayah, R., Fauziah, M., & Astuti, D. (2022). Utilization of Free Platforms in Online Learning. *Proceedings of the 5th International Conference on Learning Innovation and Quality Education, ICLIQE '21*. https://doi.org/10.1145/3516875.3516997

West, J., & Malatji, M. J. (2021). Technology Integration in Higher Education: The use of Website Design Pedagogy to Promote Quality Teaching and Learning. *The Electronic Journal of E-Learning*, *19*(6), 629–641. www.ejel.org

Xu, R. (2021). Book Review: Cultivating Teacher Resilience: International Approaches, Applications, and Impact. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.706751

Ye, Q., Huang, Y., Ge, X., & Song, X. (2023). Validation of online mindfulness-enhanced course for stress reduction in teachers. *Frontiers in Psychiatry*, *14*(1), 200-219. https://doi.org/10.3389/fpsyt.2023.1086142

Yoo, J. H. (2016). The effect of professional development on teacher efficacy and teachers' self-analysis of their efficacy change. *Journal of Teacher Education for Sustainability*, *18*(1), 84–94. https://doi.org/10.1515/jtes-2016-0007

Yusuf, F. A., & Fajari, L. E. W. (2022). Key Success Factors of Various Quality Assessment Institutions and Quality of Higher Education Services: A Meta-Analysis Study. *Eurasian Journal of Educational Research*, *2022*(98), 184–202. https://doi.org/10.14689/ejer.2022.98.012

Zhang, Y., Zhou, S., Wu, X., & Cheung, A. C. K. (2024). The effect of teacher training programs on pre-service and in-service teachers' global competence: A meta-analysis. *Educational Research Review*, *45*(6), 150-167. https://doi.org/10.1016/j.edurev.2024.100627

Zhou, X., Shu, L., Xu, Z., & Padrón, Y. (2023). The effect of professional development on in-service STEM teachers' self-efficacy: a meta-analysis of experimental studies. *International Journal of STEM Education*, *10*(1), 189-209. https://doi.org/10.1186/s40594-023-00422-x