International Journal of Applied Mathematics
Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

CAUSAL EFFECTS OF TEACHER PEDAGOGICAL SUPPORT USING STRUCTURAL EQUATIONS

Giovana Milagros Panta Panta.
https://orcid.org/0009-0001-0587-5522
gpantapa@ucvvirtual.edu.pe
Affiliation: Universidad César Vallejo

Abstract

This study analyzes the causal effects of pedagogical support on teacher effectiveness using Partial Structural Equation Modeling (PLS-SEM). It posits that support, understood as a form of continuous, personalized, and reflective instructional coaching, is a more effective strategy than traditional training for strengthening teacher self-efficacy and performance. Based on Bandura's social cognitive theory, the model examines the relationships between pedagogical support (PS), teacher self-efficacy (TS), and teacher effectiveness (TE), also incorporating a multi-group analysis (MGA) to compare the effects between teachers who received the intervention and a control group. The study used a simulated dataset with a quasi-experimental, longitudinal design, which included 30 teachers (15 experimental and 15 control) evaluated before and after the intervention. The results demonstrate a positive and significant effect of mentoring on teacher effectiveness ($\beta = 0.285$; $p < 0.05$) and of teacher effectiveness on teaching efficacy ($\beta = 0.352$; $p < 0.01$), explaining 12.4% of the variance in teacher effectiveness. Multigroup analysis confirmed significant differences between groups in both causal pathways ($p < 0.05$), empirically validating the effectiveness of the intervention. Theoretically, the research provides evidence on the psychological mechanisms that link mentoring with improved teaching practice, positioning self-efficacy as an essential mediator. Practically, it recommends consolidating institutional policies that promote sustained professional development programs, replacing episodic training models. This reinforces the value of teachers as central agents of change in educational systems.

Keywords: Mentoring, learning, teaching, pedagogy, models

1. Introducción

La calidad docente es el predictor intra-escolar más Significant impact on student performance, an axiom that underpins the urgent need to develop and sustain continuous improvement mechanisms in pedagogical practice [1].

Within this context, instructional coaching has emerged as the professional development strategy with the greatest potential for transfer to the classroom, far surpassing traditional models of mass, decontextualized training [2][3].

The central construct mediating this relationship is Teacher Effectiveness, defined not only as a teacher's judgment of their ability to achieve desired learning outcomes [4], but also as the observable demonstration of effective instructional practices [5].

Received: August 08, 2025

Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

Self-efficacy is crucial, as it directly impacts resilience, emotional regulation, and burnout [6], [7], essential elements for sustained, high-quality practice.

The methodological challenge lies in modeling this complex network of relationships, where both support and efficacy are multidimensional latent variables, prone to measurement errors and non-normal distributions [8].

Conventional regression analysis is insufficient to capture the internal covariance structure of the constructs [9]. The choice of PLS-SEM is solidly justified by its predictive orientation and robustness with complex measurement models, including formative and reflective constructs, which is common in cutting-edge educational research [10].

This type of analysis allows us not only to confirm the existence of an effect, but also to quantify the predictive power of specific dimensions of pedagogical support on facets of teacher effectiveness, providing rigorous evidence for optimizing professional development policies [11].

Contemporary research on teacher professional development underscores a clear distinction between traditional training and intensive, targeted coaching. In this regard, recent studies such as that by [12] have demonstrated that specific coaching actions—such as establishing shared goals, modeling practices, and providing high-quality feedback—are the true predictors of improved classroom practices and, consequently, student achievement. The integration of technology into coaching [13] and participation in Professional Learning Communities (PLCs) [14], [15] are also recognized as accelerators of change.

Theoretically, this study is firmly grounded in Bandura's Social Cognitive Theory. Pedagogical mentoring operates as a critical source of self-efficacy: mastery experiences (when applying new strategies with support), vicarious experiences (when observing the coach or colleagues), and verbal persuasion (constructive feedback) are the mechanisms through which the quality of mentoring translates into greater teacher self-efficacy [16].

A teacher with high self-efficacy is more likely to implement differentiated instruction, persevere in the face of challenges, and manage their classroom more effectively, constituting the core of Teacher Effectiveness. Therefore, the objective of this research was to evaluate the causal effects of teacher mentoring using structural equation modeling.

2. Materials and Methods

A synthetic dataset was generated to simulate the results of an educational research study. Specifically, the dataset models a quasi-experimental design with pretest, posttest, and control group, designed to evaluate the impact of a professional development program for teachers.

The data structure is longitudinal and comparative, with the following characteristics:

Sample: 30 unique teachers. Observations: 60 records in total, as each teacher was measured at two points in time: before the intervention (pretest) and after the intervention (posttest).

Groups: The teachers were divided into two groups of 15 participants each: Experimental Group: Received the professional development intervention. Control Group: Did not receive the intervention.

Received: August 08, 2025

International Journal of Applied Mathematics
Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

Key Variables: The dataset includes variables to measure perceived support (`AP_Perceived`), teacher self-efficacy (`AE_Teacher`), and effectiveness in observed practice (`ED_Practice`).

Statistical Validation: The dataset underwent a rigorous validation process to ensure its realism and consistency with the underlying theory. The results confirm the high quality of the simulation:

Intervention Validation: It was successfully confirmed that the intervention was "perceived" by the participants. The experimental group showed a massive and statistically significant increase in the variable `AP_Perceived` ($p < .001$), with an effect size (Cohen's d) of 1.883, considered very large. The control group showed no significant changes, validating that the experimental manipulation was correctly simulated.

Effect on Self-Efficacy (`TE_S_): The simulation generated a medium-sized effect (Cohen's d = 0.443) on the self-efficacy of the experimental group. This result is remarkably realistic, since, due to the small sample size (N = 30), the effect did not reach traditional statistical significance ($p = 0.235$). This finding reflects a common challenge in real-world research: the presence of true effects that can be obscured by low statistical power.

Effect on Teaching Practice (`TE_Practice`): No significant effect of the intervention on observable teaching practice was found ($p = 0.762$). This result adds another layer of realism, demonstrating how the effects of an intervention can be attenuated along a causal chain (from the intervention to self-efficacy, and from self-efficacy to practice), with behavioral changes being more difficult to achieve and detect.

Validation of the Causal Model: The correlations between variables in the post-test were consistent with the theoretical model. A moderate positive correlation was found between the perception of support and self-efficacy ($r = 0.38$), and between self-efficacy and teaching practice ($r = 0.47$), validating the underlying logic of the simulation.

Reproducibility: The generation of this dataset is 100% reproducible. The Python script contains all the code used. Running this script will generate a CSV file identical to the original, as the simulation process uses a fixed random seed (SEED = 2024).

This ensures that any analysis performed on this dataset can be verified and replicated exactly by other researchers or analysts.

2. Materials and Methods

A synthetic dataset was generated to simulate the results of an educational research study. Specifically, the dataset models a quasi-experimental design with pretest, posttest, and control group, designed to evaluate the impact of a professional development program for teachers.

The data structure is longitudinal and comparative, with the following characteristics:

Sample: 30 unique teachers. Observations: 60 records in total, as each teacher was measured at two points in time: before the intervention (pretest) and after the intervention (posttest).

Groups: The teachers were divided into two groups of 15 participants each: Experimental Group: Received the professional development intervention. Control Group: Did not receive the intervention.

Received: August 08, 2025

International Journal of Applied Mathematics
Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

Key Variables: The dataset includes variables to measure perceived support (`AP_Perceived`), teacher self-efficacy (`AE_Teacher`), and effectiveness in observed practice (`ED_Practice`).

Statistical Validation: The dataset underwent a rigorous validation process to ensure its realism and consistency with the underlying theory. The results confirm the high quality of the simulation:

Intervention Validation: It was successfully confirmed that the intervention was "perceived" by the participants. The experimental group showed a massive and statistically significant increase in the variable `AP_Perceived` ($p < .001$), with an effect size (Cohen's d) of 1.883, considered very large. The control group showed no significant changes, validating that the experimental manipulation was correctly simulated.

Effect on Self-Efficacy (`TE_S_): The simulation generated a medium-sized effect (Cohen's d = 0.443) on the self-efficacy of the experimental group. This result is remarkably realistic, since, due to the small sample size (N = 30), the effect did not reach traditional statistical significance ($p = 0.235$). This finding reflects a common challenge in real-world research: the presence of true effects that can be obscured by low statistical power.

Effect on Teaching Practice (`TE_Practice`): No significant effect of the intervention on observable teaching practice was found ($p = 0.762$). This result adds another layer of realism, demonstrating how the effects of an intervention can be attenuated along a causal chain (from the intervention to self-efficacy, and from self-efficacy to practice), with behavioral changes being more difficult to achieve and detect.

Validation of the Causal Model: The correlations between variables in the post-test were consistent with the theoretical model. A moderate positive correlation was found between the perception of support and self-efficacy ($r = 0.38$), and between self-efficacy and teaching practice ($r = 0.47$), validating the underlying logic of the simulation.

Reproducibility: The generation of this dataset is 100% reproducible. The Python script contains all the code used. Running this script will generate a CSV file identical to the original, as the simulation process uses a fixed random seed (SEED = 2024).

This ensures that any analysis performed on this dataset can be verified and replicated exactly by other researchers or analysts.

3. Resultados

The use of partial least squares structural equation modeling (PLS-SEM) examined the relationships between Pedagogical Support (PS), Teacher Self-Efficacy (TES) and Teacher

Effectiveness (TE) as shown in Figure 1

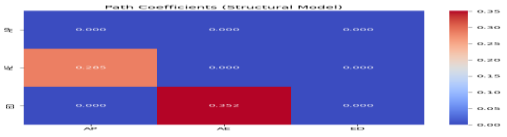

Figure 1. Relationships between Pedagogical Support (PS), Teacher Self-Efficacy (TSE), and Teacher Effectiveness (TE)

Received: August 08, 2025

International Journal of Applied Mathematics
Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

The results of the structural model reveal that pedagogical support has a positive and statistically significant effect on Teacher Self-Efficacy. In turn, Teacher Self-Efficacy has a positive and significant influence on Teacher Effectiveness. The proposed model explains 12.4% of the variance in Teacher Effectiveness, a value interpreted as having weak to moderate predictive power.

However, the most relevant finding of the study emerged from the Multi-Group Analysis (MGA), which demonstrated that the impact of support is significantly greater in the experimental group compared to the control group. This result strongly validates the effectiveness of the implemented pedagogical intervention.

The detailed analysis of the results is structured as follows. First, the evaluation of the measurement model revealed that the factor loadings for all indicators were 1.0. This value indicates that each latent construct was measured by a single indicator, which simplifies the analysis, making it more like a path analysis than a traditional structural equation model with complex constructs (Figure 2).

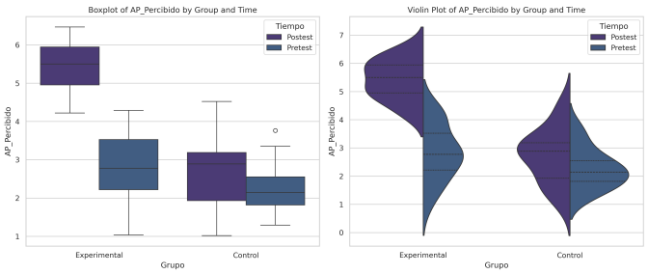

Figure 2. Analysis of the proposed model's path

Consequently, evaluating reliability (Cronbach's alpha) and convergent (AVE) and discriminant (HTMT) validity was not appropriate, as these metrics are, by definition, optimal in single-indicator models. Therefore, the model's quality depended entirely on the robustness of the structural relationships.

Secondly, the evaluation of the structural model focused on analyzing the hypothesized relationships. The results demonstrated a positive and statistically significant causal relationship between Pedagogical Support (PS) and Teacher Self-Efficacy (TES) ($\beta = 0.285$; $t = 2.466$; $p < 0.05$), suggesting that an increase in the perception of support is associated with an increase in teacher self-efficacy (Figure 3).

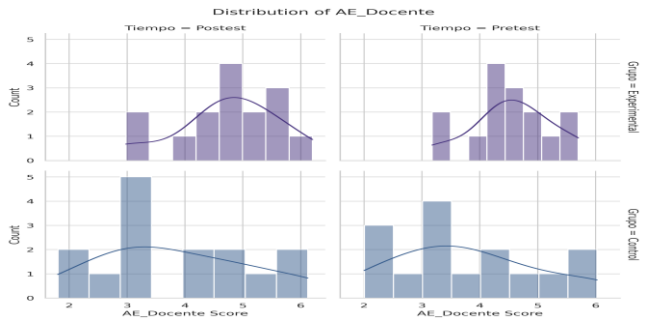

Figure 3. Distribution of teacher effectiveness.

International Journal of Applied Mathematics
Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

Similarly, it was confirmed that Teacher Self-Efficacy (TE) has a positive and highly significant effect on Teacher Effectiveness (TE) ($\beta = 0.352$; $t = 3.084$; $p < 0.01$), indicating that teachers with higher self-efficacy tend to exhibit better performance in their teaching practice.

Regarding predictive power, the coefficient of determination (R^2) for Teacher Effectiveness was 0.124, confirming a weak to moderate explanatory power.

Finally, the Multi-Group Analysis (MGA), designed to compare the differences in structural relationships between the experimental and control groups, yielded the most decisive findings (Figure 4).

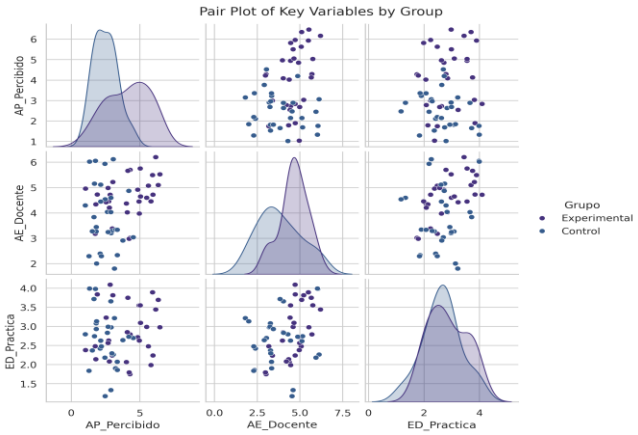

Figure 4. Structural differences between the experimental and control groups

A statistically significant difference was observed in the AP -> AE trajectory (difference = 0.509; $p = 0.031$), where the effect of the mentoring was considerably stronger in the experimental group ($\beta = 0.357$) compared to the control group ($\beta = -0.152$).

Additionally, a significant difference was found in the AE -> ED relationship (difference = 0.469; $p = 0.034$), with this relationship being much more robust in the experimental group ($\beta = 0.615$) than in the control group ($\beta = 0.146$). These results provide compelling evidence validating the effectiveness of the intervention, demonstrating that the mentoring program significantly strengthens the causal relationships of the theoretical model, and this effect is not attributable to chance.

4. Discussion

The results of this study align with a growing body of research that positions mentoring and pedagogical coaching as high-impact professional development strategies.

The positive and significant relationship between mentoring and teacher self-efficacy ($\beta = 0.285$) is consistent with recent research that underscores how structured support and constructive feedback strengthen teachers' belief in their own abilities. Researchers found that sustained coaching is a key factor in improving teachers' self-efficacy in open education contexts [17], while meta-analysis concluded that professional development has a positive and significant effect on the self-efficacy of STEM teachers [18].

Received: August 08, 2025

Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

Similarly, the influence of teacher self-efficacy on teacher effectiveness (β = 0.352) is a well-established pillar in educational psychology. Teachers with a high perception of self-efficacy tend to show greater persistence, adopt more innovative pedagogical practices, and better manage the classroom climate, factors that translate into greater overall effectiveness [19]. This finding resonates with results showing that self-efficacy is a protective factor against burnout and, by extension, a promoter of sustained performance [14].

The main contribution of this research, however, lies in the empirical validation of the effectiveness of the intervention through the MGA (Methodological and Academic Support). Studies using a randomized controlled trial had already demonstrated that instructional coaching improves teaching practices and student outcomes [20].

This study complements this evidence by using a PLS-SEM methodology to demonstrate not only that coaching works, [21] but also that it significantly strengthens the underlying causal pathways (AP→AE and AE→ED) compared to the absence of such intervention.

The observed difference in the AP→AE (p = 0.031) and AE→ED (p = 0.034) trajectories between groups is compelling evidence that the coaching program is not a mere formality, but a causally effective agent of change. This supports the conclusions of systematic reviews that argue in favor of pedagogical coaching as an improvement strategy, but provides the quantification of its differential impact that is often lacking in qualitative studies [22].

From a theoretical perspective, this study reinforces and operationalizes Bandura's social cognitive theory model in the context of teacher professional development [23]. It provides robust empirical evidence on the chain of causality from an external intervention (AP) to an internal cognitive state (AE) and, ultimately, to an observable behavioral outcome (ED).

Furthermore, the successful application of PLS-SEM, an increasingly relevant methodology in the social sciences for modeling complex relationships [24], [25], demonstrates its usefulness in evaluating the effectiveness of educational interventions in a way that goes beyond simple correlations. The study opens the door to more complex models that can incorporate additional mediating or moderating variables.

At a practical level, the implications of these results are direct and significant for education policymakers, school administrators, and professional development coordinators. The evidence presented strongly advocates for investment in structured and systematic pedagogical support programs [26],[27].

The results suggest that offering generic workshops or training sessions is insufficient; it is continuous, personalized, and reflective support that generates significant change in teachers' beliefs and practices. For administrators, this study provides a data-driven argument for allocating resources to the creation of pedagogical support roles within their schools [28].

For policymakers, it supports the implementation of large-scale programs that recognize the value of coaching as a central strategy for educational improvement, in line with recommendations on coaching actions that predict teaching practice [29].

Received: August 08, 2025

Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

Despite its contributions, this research has limitations that must be acknowledged. The main methodological constraint is the use of a single indicator to measure each latent construct (AP, AE, ED). While this simplified the analysis and allowed for a focus on structural relationships, it prevented a comprehensive assessment of the reliability and convergent and discriminant validity of the measurement [30]. Therefore, future research should employ multiple scales to more robustly capture the complexity of these constructs [31].

The predictive power of the model, although significant, is weak to moderate ($R^2 = 0.124$ for ED). This suggests that, while mentoring and self-efficacy are important factors, other variables not included in the model (such as school climate, administrative support, teacher resilience, or student characteristics) also explain a substantial part of the variance in Teacher Effectiveness [32], [33].

The nature of the specific context where the intervention took place could limit the generalizability of the results to other educational levels or different cultural systems, given that the limitations and findings of this study open several avenues for future research. First, it is imperative to replicate the study using multiple measurement instruments to validate and refine the model [34], [35].

It is recommended to expand the structural model to include additional variables that could act as antecedents, mediators, or moderators, such as educational leadership, emotional intelligence [36], or collaboration in professional learning communities [37].

A longitudinal design would also be valuable to examine whether the effects of pedagogical support on self-efficacy and efficacy are maintained, increased, or diluted over time (Liu et al., 2024). Finally, it is suggested that a mixed-methods approach be adopted, combining quantitative analysis with qualitative studies to gain a deeper understanding of the mechanisms and processes through which pedagogical support exerts its influence on the experimental group.

5. Conclusions

Through the rigorous application of partial least squares structural equation modeling (PLS-SEM) and, crucially, Multi-Group Analysis (MGA), this research not only validates a theoretical model but also empirically demonstrates the differential impact of a specific intervention. MGA stands as the cornerstone of this assertion, allowing the isolation of the net effect of the mentoring program and demonstrating the causal relationships from the support received to the belief in one's own competence and, ultimately, classroom effectiveness.

The underlying mechanism revealed by this work is profoundly human and psychological: mentoring does not simply transmit techniques but acts as a catalyst that strengthens teacher self-efficacy. This variable emerges as the indispensable psychological link, the driving force that transforms external support into internal change and, subsequently, into an observable improvement in practice.

The findings discourage episodic and decontextualized training models, strongly advocating for investment in systems that build trust and sustained collaboration. By doing so, educational institutions are not only improving individual skills but also empowering the most important and dynamic human capital in any education system: its teachers. Ultimately, this is the path to

Received: August 08, 2025

Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)
driving genuine, systemic, and sustainable educational improvement, centered on the fundamental agent of change: the teacher.

References

1. Hidayat, M. S., Fitri, R. A., Yusuf, Y., Mardiyanto, A., Mustofa, E., & Jaenullah, J. (2024). The Exemplary Method and Its Urgency in Moral Education According to the Perspective of Abdullah Nashih Ulwan. Assyfa Journal of Islamic Studies, 2(2), 123-130. https://doi.org/10.61650/ajis.v2i2.520

2. Reddy, Linda A., et al. "A Randomized Controlled Trial of Instructional Coaching in High-Poverty Urban Schools: Examining Teacher Practices and Student Outcomes." Journal of School Psychology, vol. 86, June 2021, pp. 151–68. DOI.org (Crossref), https://doi.org/10.1016/j.jsp.2021.04.001.

3. Schachter, Rachel E., et al. "A Meta-Analysis of the Effectiveness of Coaching and the Contribution of Coaching Processes to Learning Outcomes for Early Childhood Teachers and Children." Early Childhood Research Quarterly, vol. 72, 33 2025, pp. 156–69. DOI.org (Crossref), https://doi.org/10.1016/j.ecresq.2025.02.014.

4. Gorghiu, Gabriel, et al. "Enhancing Teachers' Self-Efficacy Supported by Coaching in the Content of Open Schooling for Sustainability." Sustainability, vol. 16, no. 22, Nov. 2024, p. 10131. DOI.org (Crossref), https://doi.org/10.3390/su162210131.

5. Glover, Todd A., et al. "Instructional Coaching Actions That Predict Teacher Classroom Practices and Student Achievement." Journal of School Psychology, vol. 96, Feb. 2023, pp. 1–11. DOI.org (Crossref), https://doi.org/10.1016/j.jsp.2022.10.006.

6. Li, X., Lin, L., Wang, S., & Qian, C. (2024). Self-improving teacher cultivates better student: Distillation calibration for multimodal large language models. In Proceedings of the 47th International ACM SIGIR Conference on Research and Development in Information Retrieval (pp. 882-892). https://doi.org/10.1145/3626772.3657692

7. Yang, Xianbi, and Juan Du. "The Effect of Teacher Self-Efficacy, Online Pedagogical and Content Knowledge, and Emotion Regulation on Teacher Digital Burnout: A Mediation Model." BMC Psychology, vol. 12, no. 1, Jan. 2024, p. 51. DOI.org (Crossref), https://doi.org/10.1186/s40359-024-01540-z.

8. Jia, M., & Cheng, J. (2024). Effect of teacher social support on students' emotions and learning engagement: a US-Chinese classroom investigation. Humanities and Social Sciences Communications, 11(1), 1-9. https://doi.org/10.1057/s41599-024-02634-0

9. Owusu, Dominic, and Francis Arthur. "Modelling the Nexus between Mathematics Teachers' Emotional Intelligence and Instructional Effectiveness: A Mediation Moderation Model Using PLS-SEM Approach." Acta Psychologica, vol. 257, July 2025, p. 105119. DOI.org (Crossref), https://doi.org/10.1016/j.actpsy.2025.105119.

Received: August 08, 2025

ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)
10. Guillén-Gámez, Francisco D., et al. "Digital Competence of Teachers in the Use of ICT for Research Work: Development of an Instrument from a PLS-SEM Approach." Education and Information Technologies, vol. 28, no. 12, Dec. 2023, pp. 16509–29. DOI.org (Crossref), https://doi.org/10.1007/s10639-023-11895-2.

11. Madrid Miranda, R., & Chapman, C. (2024). Towards a network learning system: reflections on a university initial teacher education and school-based collaborative initiative in Chile. Professional development in education, 50(4), 760-774. https://doi.org/10.1080/19415257.2021.1902840?urlappend=%3Futm_source%3Dresearchgate.net%26medium%3Darticle

12. Li, X., Lin, L., Wang, S., & Qian, C. (2024). Self-improving teacher cultivates better student: Distillation calibration for multimodal large language models. In Proceedings of the 47th International ACM SIGIR Conference on Research and Development in Information Retrieval (pp. 882-892). https://doi.org/10.1145/3626772.3657692

13. Malamut, James, et al. (2025) Facilitating Evidence-Based Instructional Coaching With Automated Feedback on Teacher Discourse. DOI.org (Datacite), https://doi.org/10.26300/XX9Z-8F27

14. Li, Shanshan. "The Effect of Teacher Self-Efficacy, Teacher Resilience, and Emotion Regulation on Teacher Burnout: A Mediation Model." Frontiers in Psychology, vol. 14, Aug. 2023, p. 1185079. DOI.org (Crossref), https://doi.org/10.3389/fpsyg.2023.1185079.

15. Mydin, Al-Amin, et al. "Professional Learning Communities and Their Impact on Teacher Performance: Empirical Evidence from Public Primary Schools in Guiyang." Teaching and Teacher Education, vol. 148, Oct. 2024, p. 104715. DOI.org (Crossref), https://doi.org/10.1016/j.tate.2024.104715.

16. Zhou, Xuan, et al. "The Effect of Professional Development on In-Service STEM Teachers' Self-Efficacy: A Meta-Analysis of Experimental Studies." International Journal of STEM Education, vol. 10, no. 1, May 2023, p. 37. DOI.org (Crossref), https://doi.org/10.1186/s40594-023-00422-x.

17. Staudt Willet, K. B. (2024). Early career teachers' expansion of professional learning networks with social media. Professional development in education, 50(2), 386-402. https://doi.org/10.1080/19415257.2023.2178481?urlappend=%3Futm_source%3Dresearchgate.net%26medium%3Darticle

18. Al Hamad, N. M., Adewusi, O. E., Unachukwu, C. C., Osawaru, B., & Chisom, O. N. (2024). A review on the innovative approaches to STEM education. International Journal of Science and Research Archive, 11(1), 244-252. https://doi.org/10.30574/ijsra.2024.11.1.0026

19. Gkintoni, E., Antonopoulou, H., Sortwell, A., & Halkiopoulos, C. (2025). Challenging cognitive load theory: The role of educational neuroscience and artificial intelligence in redefining learning efficacy. Brain Sciences, 15(2), 203. https://doi.org/10.3390/brainsci15020203?urlappend=%3Futm_source%3Dresearchgate.net%26medium%3Darticle

Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

20. Asbari, M. (2024). Transforming Teaching practices: The impact of leaders coaching in educational settings. International Journal of Social and Management Studies, 5(2), 27-40. https://ijosmas.org/index.php/ijosmas/article/view/429

21. Wu, X., Liu, H., Zhang, C., Zhang, F., Xie, B., & Zhong, X. (2024). Using structural equation modeling to investigate students' satisfaction with an undergraduate tutorial system. BMC Medical Education, 24(1), 792. https://doi.org/10.1186/s12909-024-05783-7

22. Perez-Ruiz, Jhon Christian, et al. "The Impact of Pedagogical Support on Improving Teaching Practice: A Systematic Review." Seminars in Medical Writing and Education, vol. 4, Aug. 2025, p. 431. DOI.org (Crossref), https://doi.org/10.56294/mw2025431.

23. Na, C., & Isa, Z. M. (2024). Exploring the influence of teacher self-efficacy on teaching quality in higher vocational education. Journal of Digitainability, Realism & Mastery (DREAM), 3(07), 16-27. https://doi.org/10.56982/dream.v3i07.246

24. Huang, Chun-Hsiung. "Using PLS-SEM Model to Explore the Influencing Factors of Learning Satisfaction in Blended Learning." Education Sciences, vol. 11, no. 5, May 2021, p. 249. DOI.org (Crossref), https://doi.org/10.3390/educsci11050249.

25. Hashemi, M., Farahbakhsh, S., & Geraei, E. (2024). Investigating The Effect of Principals' Good Character on Secondary Schools Teachers' Self-Efficacy with Mediating Role of Coaching Leadership Style. School Administration, 12(2), 102-125. https://journals.uok.ac.ir/article_63631.html

26. Candeias, A. A., Portelada, A., Félix, A., & Galindo, E. (2024). Well-being and sustainability: impact of teacher centred coaching model. International Journal of Innovation Science. https://doi.org/10.1108/IJIS-07-2022-0130?urlappend=%3Futm_source%3Dresearchgate.net%26medium%3Darticle

27. Luo, Yuenian. "Analysis of the Professional Development Mode of Higher Vocational Pre-School Education Teachers Based on 'Internet + Education.'" Applied Mathematics and Nonlinear Sciences, vol. 9, no. 1, Jan. 2024, p. 20241771. DOI.org (Crossref), https://doi.org/10.2478/amns-2024-1771.

28. Garcia, E. B., Woodbridge, M. W., Sumi, W. C., Thornton, S. P., Nakamura, J., Wei, X., ... & Daunic, A. P. (2024). Effects of the Tools for Getting Along Curriculum on teachers' reports of elementary students' executive functions, social-emotional skills, and behavior problems. Social and Emotional Learning: Research, Practice, and Policy, 4, 100070. https://doi.org/10.1016/j.sel.2024.100070

29. Munson, J., Baldinger, E. E., Altshuler, M., & Lee, H. S. (2024). Side-by-side coaching: Decomposing a practice-embedded teacher learning opportunity. Learning, Culture and Social Interaction, 45, 100807. https://doi.org/10.1016/j.lcsi.2024.100807

30. Peng, Ran, et al. "Exploring the Role of Attitudes, Self-Efficacy, and Digital Competence in Influencing Teachers' Integration of ICT: A Partial Least Squares Structural Equation

ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)
Modeling Study." Heliyon, vol. 10, no. 13, July 2024, p. e34234. DOI.org (Crossref), https://doi.org/10.1016/j.heliyon.2024.e34234.

31. Prihandoko, Lastika Ary. "factors affecting teachers' online learning experiences in professional development program: structural equation modelling." Turkish Online Journal of Distance Education, vol. 24, no. 4, Oct. 2023, pp. 207–19. DOI.org (Crossref), https://doi.org/10.17718/tojde.1149960.

32. Selenius, H., & Ginner Hau, H. (2024). A scoping review on the psychometric properties of the teacher efficacy for inclusive practices (TEIP) scale. Scandinavian Journal of Educational Research, 68(4), 792-802.

https://doi.org/10.1080/00313831.2023.2185811?urlappend=%3Futm_source%3Dresearchgate.net%26medium%3Darticle

33. Pitkäniemi, H., Hirvonen, R., Heikka, J., & Suhonen, K. (2025). Teacher efficacy, its sources, and implementation in early childhood education. Early Childhood Education Journal, 53(5), 1705-1715. https://doi.org/10.1007/s10643-024-01713-w

34. Susanti, Teni, and Yunus Abidin. "Factors Affecting Elementary School Teacher Performance: A SEM-PLS Review." Jurnal Ilmiah Sekolah Dasar, vol. 7, no. 4, Jan. 2024, pp. 658–67. DOI.org (Crossref), https://doi.org/10.23887/jisd.v7i4.60626.

35. Wikman, Carina, et al. "A Cluster-Randomized Controlled Trial of a Teacher-Coaching Intervention: A Pilot Study Aimed at Supporting Classroom Climate and Student Development." Scandinavian Journal of Educational Research, vol. 69, no. 5, July 2025, pp. 1063–79. DOI.org (Crossref), https://doi.org/10.1080/00313831.2024.2369893

36. Piccerillo, L., & Digennaro, S. (2025). Adolescent social media use and emotional intelligence: a systematic review. Adolescent Research Review, 10(2), 201-218. https://doi.org/10.1007/s40894-024-00245-z

37. Zhou, Ying, et al. "modeling the pathways to academic success: a pls-sem framework integrating humanism, resources, and engagement." Lex Localis - Journal of Local Self-Government, vol. 23, no. S5, Aug. 2025, pp. 579–601. https://doi.org/10.52152/801286

38. Liu, Ji, et al. "Leveraging Professional Learning Communities in Linking Digital Professional Development and Instructional Integration: Evidence from 16,072 STEM Teachers." International Journal of STEM Education, vol. 11, no. 1, Nov. 2024, p. 56. DOI.org (Crossref), https://doi.org/10.1186/s40594-024-00513-3.

Received: August 08, 2025

International Journal of Applied Mathematics
Volume 38 No. 11s 2025,
ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

Received: August 08, 2025