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Modelling the Interplay of K-12 Science Teachers’ Pedagogical Practices

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Abstract This study investigates the interplay of various pedagogical strategies—Student-Centered Pedagogy, Hands-On Learning, Scaffolding, Assessment and Feedback, and Professional Development—and their impact on student outcomes in K-12 science education. Grounded in constructivist learning theory and Vygotsky’s Zone of Proximal Development, the research employed Partial Least Squares Structural Equation Modeling to analyze data from 250 K-12 educators. The findings demonstrate that Student-centered pedagogy and Hands-on learning significantly enhanced student engagement and learning when integrated with scaffolding and timely feedback. Scaffolding was found to be crucial in facilitating complex learning while ongoing formative assessment improved students' ability to self-regulate. Professional development emerged as an essential factor, though indirect, in ensuring teachers’ successful implementation of these pedagogical strategies. The study contributes to the growing body of literature advocating for an integrated, student-centered approach in science education. It provides actionable recommendations for educators, curriculum developers, and policymakers to improve teaching practices and foster deeper student learning in science classrooms.

Keywords: *Student-Centered Pedagogy, Hands-On Learning, Scaffolding, Assessment and Feedback, Professional Development, K-12 Science Education, PLS-SEM, Constructivist Learning Theory*

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1. Introduction

The teaching of science in K-12 classrooms plays a pivotal role in shaping students' understanding of complex concepts and equipping them with the skills necessary to apply scientific knowledge in real-world contexts. This study seeks to examine the interplay of various teaching methods and their collective influence on student learning.

Recent educational research emphasizes the importance of shifting from traditional lecture-based methods to student-centered approaches that actively engage learners [1,2,3]. For instance, Michael [4] shows that active learning strategies enhance student engagement and retention of material in science education, while Prince and Felder [5] and Guerrero and Bautista [3] argue that inquiry-based methods foster deeper conceptual understanding. Similarly, Supovitz and Spillane [6] and Ligado, Guray, and Bautista [7] stress that effective science instruction must cultivate critical thinking and problem-solving skills to meet the demands of an evolving technological landscape. Understanding how different teaching strategies can integrate to achieve these outcomes is critical for educators [8].

This study explores five core teaching strategies—Student-Centered Pedagogy (SCP), Hands-On Learning (HOL), Scaffolding (SCAF), Assessment and Feedback (AF), and Professional Development (PROFD)—and their impact on student outcomes. The research aims to evaluate the direct effects of each strategy on student learning and investigate how scaffolding and assessment enhance the effectiveness of student-centered and hands-on learning approaches. Furthermore, it examines the role of ongoing professional development in supporting teachers' implementation of these strategies. By synthesizing these elements, this study aspires to provide a comprehensive framework for improving science education in K-12 classrooms.

The theoretical foundation of this research is grounded in constructivist learning theory, supported by recent evidence that students learn best through active engagement and reflective practices [9]. Moreover, Vygotsky’s concept of the Zone of Proximal Development (ZPD) remains influential, with contemporary research emphasizing the need for guided learning where students are challenged with appropriate support [10].

To assess the relationships among these variables, the study utilizes Partial Least Squares Structural Equation Modeling (PLS-SEM), a method that effectively handles complex models and latent variables, providing a detailed analysis of how various teaching strategies interact to influence learning outcomes [11,12,13].

By providing empirical evidence of the synergistic effects of different teaching strategies, this research aims to contribute meaningfully to the field of education. The study's findings will support the adoption of integrated teaching models, inform the structuring of professional development programs, and offer actionable recommendations for curriculum reform. Additionally, this research could guide policymakers in implementing strategies that foster innovative teaching practices and improve student performance in science. Ultimately, this study seeks to advance the conversation on effective science education and provide valuable insights for educators and educational leaders.

2. Methodology

This study employs a quantitative research design utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM) to investigate the relationships among various teaching strategies and their impact on student learning outcomes. PLS-SEM is chosen for its suitability in handling complex models with latent variables, allowing for an in-depth analysis of direct and indirect effects within the research framework [11,12].

The study sample comprises K-12 educators from multiple schools, selected through a stratified random sampling technique to ensure representation across different educational settings and demographic backgrounds. The final sample includes 250 teachers, providing a robust dataset for analysis. This sample size is deemed adequate for PLS-SEM, which is effective with moderate to large sample sizes [14].

Data were collected using a structured questionnaire designed to measure the key variables of interest: Student-Centered Pedagogy (SCP), Hands-On Learning (HOL), Scaffolding (SCAF), Assessment and Feedback (AF), and Professional Development (PROFD). The questionnaire includes validated scales for each construct, adapted from existing literature to ensure reliability and validity. The survey was administered online, with follow-up reminders sent to maximize response rates.

The questionnaire consists of multiple-choice and Likert-scale items, with responses ranging from strongly disagree (1) to strongly agree (5). The constructs are measured as follows:

Student-Centered Pedagogy (SCP): Assessed using items related to the implementation of student-focused teaching strategies and active learning.

Hands-On Learning (HOL): Evaluated through items on the use of practical, experiential learning activities in the classroom.

Scaffolding (SCAF): Measured by items that capture the extent and effectiveness of support provided to students during learning activities.

Assessment and Feedback (AF): Assessed through items related to the frequency, quality, and impact of formative and summative feedback on student learning.

Professional Development (PROFD): Evaluated based on items reflecting participation in and benefits gained from professional growth opportunities.

The data analysis involved two stages using PLS-SEM. In the first stage, the measurement model is assessed for validity and reliability. This includes evaluating construct validity (convergent and discriminant validity) and internal consistency reliability using Composite Reliability (CR) and Average Variance Extracted (AVE) [11,12]. In the second stage, the structural model is evaluated to test the hypotheses concerning the relationships between the variables. This involves assessing path coefficients, effect sizes (f^2), and the goodness of fit of the model.

The adequacy of the research model is evaluated using several Model Fit and Quality Indices. The Average Path Coefficient (APC), Average R-squared (ARS), and Average Adjusted R-squared (AARS) are considered statistically significant if their p-values are less than .05. The Average Block Variance Inflation Factor (AVIF) and Average Full Collinearity VIF (AFVIF) should ideally be 3.3 or lower, with values up to 5 being acceptable. The Goodness of Fit (GoF) index is categorized as small (≥ 0.1), medium (≥ 0.25), or large (≥ 0.36), with larger values indicating a better model fit. The Standardized Root Mean Square Residual (SRMR) and the Standardized Mean Square Residual (SMAR) should both be less than or equal to .10.

The study adhered to ethical standards by ensuring informed consent from all participants, maintaining confidentiality, and using the data solely for research purposes. Participants are provided with clear information about the study's objectives and their rights, including the option to withdraw at any time without consequence.

3. Results and Discussion

The present study utilized Partial Least Squares Structural Equation Modeling (PLS-SEM) to investigate the relationships among the latent variables under consideration. PLS-SEM was selected as the statistical modeling technique due to its effectiveness in analyzing complex models involving unobserved or latent variables. The PLS-SEM approach follows a two-stage process: the first stage involves assessing the measurement model, ensuring the reliability and validity of the constructs; the second stage evaluates the structural model, examining the relationships between the variables.

This section presents the study's findings, organized into distinct subsections: Model Fit and Quality Indices, and Structural Model Analysis. The latter focuses on testing the direct effects and interrelationships among the key variables—Student-Centered Pedagogy (SCP), Hands-On Learning (HOL), Scaffolding (SCAF), Assessment and Feedback (AF), and Professional Development (PROFD).

Measurement Component

Validity and Reliability of the Latent Variables

To assess the reliability of a construct, one must examine the consistency between the reflective items and their intended measurements [15]. Construct reliability is deemed acceptable when both the composite reliability (CR) and Cronbach's alpha (CA) are at least 0.70 or higher [16].

Convergent validity, in contrast, evaluates whether respondents' interpretations of the items related to each variable are consistent with the intentions of the instrument designer. In Partial Least Squares Structural Equation Modeling (PLS-SEM), convergent validity is typically assessed using two methods. First, item loadings should be a minimum of 0.50 and statistically significant ($p < 0.05$). Item loading represents the correlation between the item and the construct. Second, the average variance extracted (AVE) should be at least 0.50 [17]. AVE reflects the degree to which the construct's variance is greater than the variance due to measurement error [15].

Table 1 provides detailed statistics on item loadings, Average Variance Extracted (AVE), and reliability metrics for five key constructs: Student-Centered Pedagogy, Hands-On Learning, Scaffolding, Assessment Feedback, and Professional Development

The values in Table 1 indicate that all five constructs were above the recommended .70 guideline for construct reliability (CR and CA) in terms of their maximum factor loadings. Likewise, convergent validity of the constructs in the structural model were deemed sufficient with item loadings and AVE values recorded were above .50.

Discriminant validity is evident when respondents can clearly distinguish items of one variable from those of other variables within an instrument, particularly in terms of their meaning [16,17]. A practical method to evaluate this involves comparing the square root of the Average Variance Extracted (AVE) of a variable (the diagonal values) with the correlation coefficients (the off-diagonal values) between that variable and others. When the diagonal values consistently surpass the off-diagonal values, it indicates a strong correlation among the items within the variable itself [18]. In this study, it is observed that all diagonal values exceeded the corresponding off-diagonal values, demonstrating that acceptable discriminant validity was upheld across all constructs as shown in Table 2. Tests of convergent validity, discriminant validity, and reliability satisfied the conditions for estimating the structural model.

Table 1. Item Loadings, AVE, and Reliability of the Constructs

Constructs	No. of Items	Factor Loadings	P- value	AVE	CA	CR
1.Student-Centered Pedagogy	10	.801-.860	<.001	.695	.951	.958
2. Hands-On Learning	10	.825-.872	<.001	.723	.957	.963
3. Scaffolding	10	.816-.877	<.001	.718	.956	.962
4. Assessment Feedback	10	.819-.866	<.001	.711	.955	.961
5. Professional Development	10	.835-.882	<.001	.728	.959	.964

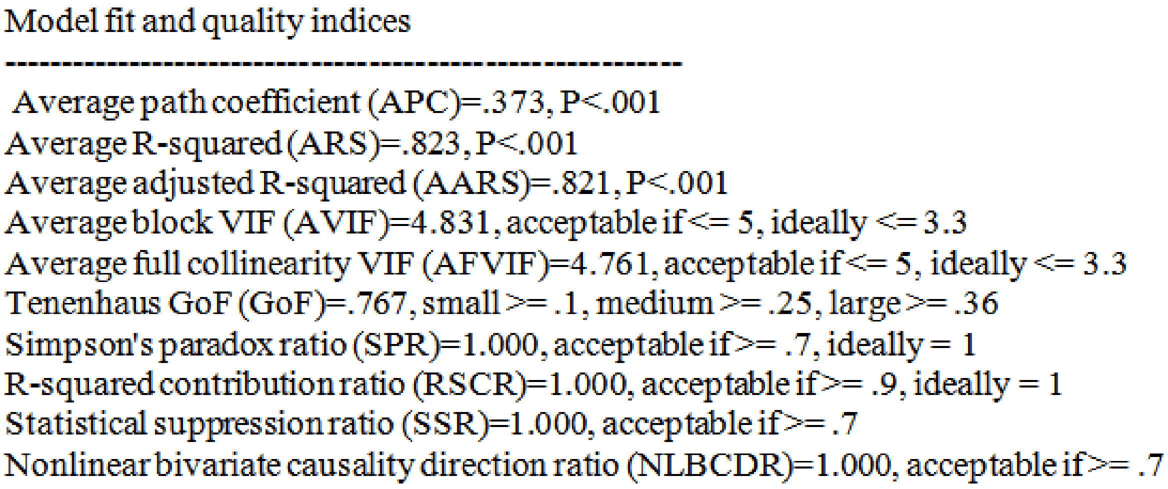
All factor loadings are significant at 0.001 ($p < 0.001$). AVE = average variance extracted; CA = Cronbach’s alpha; CR = composite reliability

Table 2. Correlation coefficients and AVE of the constructs

Constructs	1	2	3	4	5
1.Student-Centered Pedagogy	**(.833)**				
2. Hands-On Learning	0.782	**(0.850)**			
3. Scaffolding	0.761	0.791	**(0.847)**		
4.Assessment Feedback	0.776	0.790	0.771	**(0.843)**	
5.Professional Development	0.765	0.762	0.767	0.796	**(0.853)**

Note. Diagonal values represent the square root of AVE of constructs, while the off-diagonal values are the correlation among the constructs.

Model Fit and Quality Indices



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Model fit and quality indices
----------------------------------------------------------
 Average path coefficient (APC)=.373, P<.001
Average R-squared (ARS)=.823, P<.001
Average adjusted R-squared (AARS)=.821, P<.001
Average block VIF (AVIF)=4.831, acceptable if <= 5, ideally <= 3.3
Average full collinearity VIF (AFVIF)=4.761, acceptable if <= 5, ideally <= 3.3
Tenenhaus GoF (GoF)=.767, small >= .1, medium >= .25, large >= .36
Simpson's paradox ratio (SPR)=1.000, acceptable if >= .7, ideally = 1
R-squared contribution ratio (RSCR)=1.000, acceptable if >= .9, ideally = 1
Statistical suppression ratio (SSR)=1.000, acceptable if >= .7
Nonlinear bivariate causality direction ratio (NLBCDR)=1.000, acceptable if >= .7
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Figure 1. Model fit and quality indices

Before presenting the results of the structural model, it is essential to first assess the Model Fit and Quality Indices, as they provide the foundation for evaluating the adequacy of the research model. According to Kock (2020), PLS-SEM parameter estimates can be deemed statistically reliable if certain Model Fit and Quality Indices are satisfied. Specifically, three key indices—Average Path Coefficient (APC), Average R-squared (ARS), and Average Adjusted R-squared (AARS)—must all be statistically significant with p-values below .05. Additionally, the Average Block Variance Inflation Factor (AVIF) and Average Full Collinearity VIF (AFVIF) should ideally be at or below 3.3, though values up to 5 are considered acceptable. The Goodness of Fit (GoF) index further categorizes model adequacy as small (≥ 0.1), medium (≥ 0.25), or large (≥ 0.36), with larger values indicating a better model fit. Furthermore, the Standardized Root Mean Square Residual (SRMR) and the Standardized Mean Square Residual (SMAR) must both be less than or equal to 0.1 to be considered acceptable.

In this study, the Model Fit and Quality Indices, presented in Figure 1, confirm that the research model is robust, as all indices fall within acceptable thresholds. Notably, the model's GoF value lies within the "large" category, indicating an excellent fit between the data and the theoretical model.

Analysis of the data reveals that the research model is adequate since all the model fit and quality indices are at least within the acceptable ranges. In terms of goodness of fit, the GoF of the model is within the large extent range indicative of better model fit.

The research model along with the path coefficients, p-values and R-squared are shown in Figure 2. Discussion about the effects of the variables on the other variables in the model are presented in the next section.

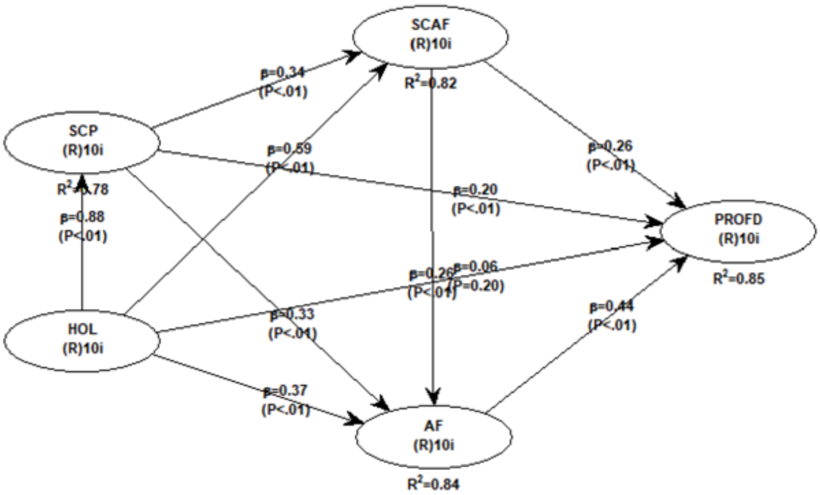

Figure 2. Research model with the path coefficients, p-values, and R-squared Structural Component

Table 3. Parameter estimates of the relationship of the three main variables of the study

Hypotheses	Path	B	p-value	f^2	Results
H_1	SCP→PROFD	.201	<.001	.174	Supported**
H_2	SCP→SCAF	.341	<.001	.294	Supported**
H_3	SCP→AF	.328	<.001	.288	Supported**
H_4	HOL→SCP	.883	<.001	.781	Supported**
H_5	HOL→SCAF	.590	<.001	.527	Supported**
H_6	*HOL →PROFD*	*.055*	*.198*	*.048*	*Not Supported*
H_7	HOL→AF	.366	<.001	.325	Supported**
H_8	SCAF→PROFD	.263	<.001	.229	Supported**
H_9	SCAF→AF	.263	<.001	.229	Supported**
H_{10}	AF→PROFD	.442	<.001	.397	

*Note. f2 is Cohen's effect size: .02=small, .15=moderate, .35=large; β=path coefficient *p < .05, **p < .01*

The parameter estimates in Table 3 detail the relationships between the five main variables of the study. The following details interpretation of the results for each hypothesis tested:

H1: SCP (Student-Centered Pedagogy) → PROFD (Professional Development)

Results: Path coefficient (β) = .201, p-value < .001, f² = .174

Interpretation: The significant path coefficient and moderate effect size indicate that Student-Centered Pedagogy (SCP) positively influences Professional Development (PROFD). This relationship implies that teachers who implement SCP are more likely to engage in continuous learning and professional development activities. Since SCP requires educators to be reflective, adaptive, and responsive to student needs, it naturally encourages ongoing growth. This finding supports the theory that professional development is most effective when it aligns with teachers' instructional practices [19]. The implication for educational practice is that institutions should structure professional development around student-centered approaches, which not only benefit students but also motivate teachers to continually refine their craft. Furthermore, this suggests that professional development programs should be designed to align with the principles of student-centered pedagogy, focusing on reflective practices and adaptive teaching strategies. Such alignment would support teachers in refining their approach and maintaining engagement with contemporary educational practices.

H2: SCP (Student-Centered Pedagogy) → SCAF (Scaffolding)

Results: Path coefficient (β) = .341, p-value < .001, f^2 = .294

Interpretation: The strong positive relationship between SCP and Scaffolding (SCAF) suggests that student-centered approaches benefit significantly from the use of scaffolding techniques. Scaffolding helps bridge the gap between what students already know and what they are learning, allowing teachers to provide the right level of support as students advance through more complex tasks. This supports Vygotsky's Zone of Proximal Development, where scaffolding plays a crucial role in facilitating learning just beyond a student's current ability [20,21]. The implication is that SCP should be paired with scaffolding in classroom practices to maximize student learning, particularly in environments where complex cognitive skills are being developed. Furthermore, this finding implies that curriculum developers and educational leaders should prioritize scaffolding strategies in lesson plans and training programs, ensuring that educators are equipped to provide structured support and gradually release responsibility as students advance.

H3: SCP (Student-Centered Pedagogy) → AF (Assessment and Feedback)

Results: Path coefficient (β) = .328, p-value < .001, f^2 = .288

Interpretation: The significant path coefficient and moderate to large effect size suggest that SCP positively influences Assessment and Feedback (AF). When teachers implement student-centered pedagogy, they are more likely to provide meaningful, timely, and constructive feedback that supports student learning. This finding aligns with formative assessment theory, which posits that active engagement with students allows for more dynamic feedback loops [22]. The implication for educators is that SCP can enhance the effectiveness of assessment by promoting continuous feedback, helping students become more self-regulated learners. Schools should prioritize formative feedback mechanisms within student-centered learning environments to improve student outcomes. Thus, professional development programs should emphasize strategies for integrating ongoing assessments and constructive feedback within student-centered approaches, helping educators to effectively use data to inform instruction and support student progress.

H4: HOL (Hands-On Learning) → SCP (Student-Centered Pedagogy)

Results: Path coefficient (β) = .883, p-value < .001, f^2 = .781

Interpretation: The very strong relationship between Hands-On Learning (HOL) and SCP suggests that hands-on activities are integral to fostering a student-centered learning environment. This supports Dewey's experiential learning theory, which posits that students learn best when they actively participate in the learning process [21]. The large effect size indicates that hands-on activities significantly drive SCP, providing the experiential foundation for students to take ownership of their learning. The implication is that educators should integrate hands-on learning into student-centered pedagogies to enhance student engagement and autonomy. Schools should consider investing in resources and training that encourage hands-on approaches across various subject areas. By fostering an environment where experiential learning is central, schools can enhance student engagement and deepen understanding.

H5: HOL (Hands-On Learning) → SCAF (Scaffolding)

Results: Path coefficient (β) = .590, p-value < .001, f^2 = .527

Interpretation: The strong positive relationship between HOL and SCAF suggests that hands-on learning is more effective when paired with scaffolding. Scaffolding provides the structured support students need to succeed in hands-on tasks, particularly when the activities require problem-solving and higher-order thinking skills. This finding is consistent with constructivist approaches to education, where hands-on learning is seen as a way for students to construct their knowledge through guided practice [23]. The implication is that educators should scaffold hands-on learning activities to gradually release responsibility to students as they gain confidence and competence. Curriculum designers should create materials that include scaffolded steps to ensure all students can engage meaningfully in hands-on tasks. This indicates a need for educational resources and professional development that emphasize how to scaffold hands-on activities, ensuring that students receive appropriate support while engaging in active learning.

H6: HOL (Hands-On Learning) → PROFD (Professional Development)

Results: Path coefficient (β) = .055, p-value = .198, f^2 = .048

Interpretation: The insignificant relationship between HOL and PROFD suggests that while hands-on learning may benefit students directly, it does not necessarily translate into teacher professional development. This result indicates that teachers may not automatically grow professionally simply by implementing hands-on activities. The implication is that hands-on learning alone is insufficient to foster teacher growth unless it is coupled with reflective practice, collaboration, or structured professional development initiatives. Schools should consider incorporating professional development programs that focus on integrating hands-on learning into broader pedagogical strategies, ensuring that teachers develop deeper insights into their instructional methods. This highlights the need for professional development programs that go beyond introducing hands-on techniques and focus on reflective practice and integration of these methods into broader pedagogical frameworks. Educators should be supported in understanding how to continuously refine their practice through professional growth opportunities.

H7: HOL (Hands-On Learning) → AF (Assessment and Feedback)

Results: Path coefficient (β) = .366, p-value < .001, f² = .325

Interpretation: The significant positive relationship between HOL and AF highlights that hands-on learning promotes more effective assessment and feedback. In active learning environments, teachers can observe students more closely, providing timely feedback that helps them adjust and improve their performance [3,7,24]. The implication is that assessment in hands-on learning contexts can be more formative, focusing on continuous improvement rather than summative evaluation [24,25,26]. Educators should leverage this connection by integrating frequent feedback mechanisms into hands-on tasks, ensuring that students receive the guidance they need to progress. Thus, educational policies should support the alignment of assessment strategies with hands-on learning, ensuring that feedback practices are embedded in the learning process.

H8: SCAF (Scaffolding) → PROFD (Professional Development)

Results: Path coefficient (β) = .263, p-value < .001, f² = .229

Interpretation: The significant positive relationship between SCAF and PROFD suggests that scaffolding not only benefits students but also contributes to teacher professional development. Teachers who implement scaffolding are more likely to engage in reflective practices and seek ongoing professional development to refine their scaffolding techniques [27,28]. The implication is that scaffolding serves as a vehicle for professional growth, encouraging teachers to develop strategies that support student learning in a structured, developmental way. Professional development programs should focus on deepening teachers' understanding of scaffolding techniques, which can enhance their overall instructional effectiveness. Thus, professional development should include training on scaffolding techniques and provide opportunities for teachers to reflect on and improve their use of scaffolding in practice.

H9: SCAF (Scaffolding) → AF (Assessment and Feedback)

Results: Path coefficient (β) = .263, p-value < .001, f² = .229

Interpretation: The positive and significant relationship between SCAF and AF underscores the role of scaffolding in improving assessment and feedback processes. Scaffolding enables teachers to break down complex tasks, allowing for more targeted feedback at various stages of student progress [29]. The implication is that scaffolding can enhance formative assessment practices by providing students with the right level of support and feedback at the right time. Educators should consider using scaffolding not just as a learning tool but as an integral part of their assessment practices to improve student outcomes [1,2,3]. Thus, teachers who use scaffolding are better positioned to provide targeted feedback, which supports incremental student progress. Curriculum and assessment design should incorporate scaffolding strategies, and professional development should focus on how to deliver feedback within a scaffolded learning framework.

H10: AF (Assessment and Feedback) → PROFD (Professional Development)

Results: Path coefficient (β) = .442, p-value < .001, f² = .397

Interpretation: The strong positive relationship between AF and PROFD suggests that effective assessment and feedback practices are closely linked to professional development. Teachers who use formative feedback not only improve student outcomes but also engage in reflective practices that contribute to their professional growth [20]. The implication is that professional development programs should include training on effective feedback strategies, as these can serve as powerful tools for both student and teacher improvement. Schools should prioritize assessment-focused professional development, encouraging teachers to use feedback as a means of fostering continuous learning and growth [7,8]. Thus, underscoring the importance of incorporating assessment and feedback training into professional development programs, help educators to refine their practices and engage in continuous improvement.

The foregoing highlights the interconnected nature of teaching strategies and their implications for curriculum development, professional training, and educational policy. By aligning professional development with student-centered, hands-on, and scaffolded teaching practices, and ensuring that assessment and feedback are integrated effectively, educational institutions can foster an environment that supports both student learning and teacher growth.

4. Conclusions and Recommendations

The results of this study provide substantial evidence supporting the synergistic effects of integrating Student-Centered Pedagogy (SCP), Hands-On Learning (HOL), Scaffolding (SCAF), Assessment and Feedback (AF), and Professional Development (PROFD) in enhancing science education within K-12 classrooms. The findings indicate that SCP and HOL are foundational to fostering a more engaging and effective learning environment, with HOL, in particular, serving as a critical driver of experiential and active learning. These strategies, when used in conjunction with scaffolding, enable students to progressively master more complex concepts by providing structured support, aligning with Vygotsky's Zone of Proximal Development.

It also highlights the essential role of assessment and feedback in promoting continuous improvement in student outcomes. Teachers who implement SCP and HOL alongside frequent and constructive feedback facilitate a learning environment where students are better able to self-regulate and adapt their learning strategies. The significance of formative assessment, coupled with scaffolded learning, underscores the need for teachers to provide ongoing, meaningful feedback that is closely aligned with the learning objectives.

The role of Professional Development (PROFD) in this pedagogical framework is crucial, albeit more nuanced. While the direct impact of HOL on PROFD was found to be minimal, the data suggest that scaffolding and feedback mechanisms significantly contribute to teachers' professional growth, particularly when reflective practices are incorporated. This finding reinforces the argument that effective professional development must be closely aligned with active learning and assessment practices, fostering continuous instructional improvement.

This study emphasizes the necessity of a comprehensive and integrated approach to science education, in which pedagogical tactics are not used in isolation but rather complement one another. The data suggest that SCP, HOL, SCAF, AF, and PROFD collectively form a robust framework that enhances both student engagement and learning outcomes. These results align with existing research advocating for experiential, student-centered, and scaffolded approaches to education. Future research should focus on further refining this framework, particularly exploring how these strategies can be adapted to different educational contexts and subject areas. Educational policymakers and curriculum developers are encouraged to prioritize professional development programs that align with these pedagogical practices, thereby supporting educators in their efforts to deliver high-quality, student-centered science instruction.

Limitations of the Study

Although this study meets the sample size requirements outlined by Gefen et al. [14], it may be limited by its geographical scope, as it focuses solely on a single schools division in the Philippines. Consequently, this narrow representation may not fully capture the broader context or provide a comprehensive view of K-12 science education across the entire country.

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