



Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on Science Teaching Effectiveness among Pre-service Teachers in Niger State, Nigeria

MUSA, Asmau¹

asmaumusa1100@gmail.com

ABDULLAHI, Mohammed²

abmoh24@gmail.com

BAWA, Swafiyah³

bawaswafiyah@gmail.com

MADU, Peter Chijioke⁴

chijioke madu06@gmail.com

IDIRISU, Jibril Limangba⁵

chemistlimangba@gmail.com

EKUNKE, Unyime-Abasi Raphael⁶

eyounyimeraphael@gmail.com

SHEHU, Mohammed⁷

muhammadsgini@gmail.com

ABDULMALIK, Mohammed Katun⁸

mohammedkatunabdulmalik@gmail.com

¹Department of Physics, Dr Umaru Sanda Ahmadu College of Education Minna, Niger State, Nigeria

²Department of Physics, Federal University of Education, Kontagora Niger State, Nigeria

³Department of Chemistry, Federal University of Education Zaria, Kaduna State, Nigeria

⁴Department Of Educational Foundation, University of Cross River State, Nigeria

⁵Department of Chemistry, Baze University, Abuja, Nigeria

⁶Department of Basic Science and Technology, Federal College of Freshwater Fisheries Technology, New Bussa Niger State, Nigeria

⁷Department of General and Allied Studies, College of Health Technology Minna, Niger State, Nigeria

⁸College of Agriculture, Mokwa, Niger State, Nigeria

Abstract

In order to produce science literate citizens, science must be taught and effectively taught in schools. Unfortunately, quality of science teaching continues to be an area of concern within the Nigerian education system. This study investigated how pedagogical content knowledge (PCK) and attitudes towards inquiry-based learning (IBL) predict science teaching effectiveness among pre-service science teachers in Niger State, Nigeria. The study employed a correlational research design. A sample of 100 final year pre-service teachers was randomly selected from two Colleges of Education in Niger State. Data were collected using three instruments which were validated: the Pedagogical Content Knowledge Questionnaire (PCKQ), Attitudes towards Inquiry-Based Learning Scale (AIBLS), and Science Teaching Effectiveness Scale (STES) with a Cronbach alpha coefficient ranging from 0.78 to 0.88. Data were analysed using simple linear regression and multiple linear regression analysis with 0.05 level of significance. Significant positive correlation was found between PCK and science teaching effectiveness ($r=.541$, $p<.05$) and also between attitudes towards IBL and science teaching effectiveness ($r=.495$, $p<.05$). Multiple regression analysis shows that PCK and attitudes toward IBL together predicted 41.3% variance in the predictor of science teaching effectiveness $F(2,97)=34.218$, $p<.05$. The variables are found to be stronger predictors of science teaching effectiveness in order: PCK ($r=.441$), attitude towards IBL ($r=.341$). The study recommends that teaching subject specific pedagogies as well as providing pre-service teachers with practical exposure to inquiry-based learning would best prepare pre-service science teachers in Niger State Colleges of Education for effective science teaching.



Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

Keywords: Pedagogical Content Knowledge, Inquiry-Based Learning, Teaching Effectiveness, Pre-service Teachers

Introduction

In today's world, science education has become the propelling force for innovation of technology, economic viability and the accomplishment of the Sustainable Development Goals (SDGs). The pivotal element that affects any science curriculum is teachers' effectiveness which is a multifaceted construct and it strongly correlates with student learning, science literacy and long-term retention of science talent (Ashiwere et al., 2024). World-wide, there is a paradigm shift in discussions on reform in education from focus on infrastructure to that of teacher training quality, arguing that no education system can ever be greater than the quality of its teachers. But in Sub-Saharan Africa and most especially in Nigeria, efforts to achieving teacher effectiveness have been hampered by limitations of old-fashioned methods of teaching, paucity of teaching resources and an old tradition of rote learning (Abiodun and Oduali, 2026). Although the National Policy on Education laid emphasis on the importance of science education functioning appropriately in Nigeria, it has been observed that students' performance in external examinations continues to be unimpressive, which can largely be explained by teachers' in ability to conceptualize and concretize abstract scientific concepts and turn them into learner-centred situations (Adam et al., 2025). A foundational concept in the study of instructional quality is Pedagogical Content Knowledge (PCK). Coined by Shulman (1986) and refined by Magnusson et al. (1999), PCK is the amalgam of subject matter expertise and pedagogical understanding. Specifically, PCK refers to the teacher's skill to transform the disciplinary knowledge to pedagogically potent but contextually sensitive ways of knowing. Within science education, this may include an understanding of representations of science, typical student conceptions, or particular pedagogical strategies effective in making seemingly daunting topics like genetics or thermodynamics comprehensible. Following in close suit to PCK is Inquiry-Based Learning (IBL). IBL is a constructivist instructional approach based on the practice of science inquiry. It encourages students to ask questions, develop designs, and build explanations based on evidence (National Research Council, 2012). While IBL is internationally celebrated for its promotion of higher order thinking skills, teachers' disposition towards this approach has a great impact on its effectiveness. The training of pre-service teachers in Nigeria, especially in North-Central region (Niger State) cannot be undermined. Niger State has a concentration of high-calibre colleges of education and universities; hence it's considered an important region in the training of teachers. Nevertheless, there is a problem with the transition between actual class delivery and the theoretical training received; more so when they are to join a labour force that expects scientific competence from its teachers. It is therefore crucial to identify the cognitive and affective variables that influence pre-service teachers' readiness to teach and teaching effectiveness.

There seems to be an argument that effective teaching of science depends on teaching being a cognitive and an affective experience. Theoretically this work is based on the Teacher Cognition Theory and Social Cognitive Theory (Bandura, 1997; Borg, 2015) where a teacher's knowing (PCK) combined with what he or she believes (attitudes) influences his or her teaching behaviour. It is therefore being argued that PCK is the foundational cognitive requirement for teaching effectiveness; that teachers need to understand ways in which science phenomena could be represented to bring about conceptual change in students. There are researches that show that teachers with higher PCK are better at identifying students' misconceptions and at utilizing analogies to build bridges from abstract to concrete concepts (Kind, 2019; Mapulanga and Jita, 2025). Nevertheless, cognitive competency alone is insufficient. It is hypothesized in this study that attitudes toward IBL is the



Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

catalyst that ignites PCK. A teacher might have an abundance of PCK, yet ineffective if he or she holds a negative attitude toward student-led inquiry and prefers the security of teacher-centred lecturing. It is a basic tenet of constructivist thought that learning is an active process, thus, alignment of the teacher's beliefs and the principles of inquiry-based instruction which treats students as active knowledge constructors not passive receptors of information is prerequisite to effective instruction (Vygotsky, 1978). Recent scholarship posits a synergistic relationship; a positive attitude toward inquiry motivates teachers to more readily use pedagogical knowledge in creative ways, whereas robust PCK is necessary to prevent teachers from "floundering" amid the "chaos" that a successful inquiry-based science classroom can entail (Ogegbo, 2021). As such, teaching effectiveness in science cannot be explained through a study of variables operating in isolation, but is the product of the interplay between what the teacher knows and what the teacher values.

Despite the theoretical importance of the above construct and their attendant relationships, gaps continue to exist in the current literature. Firstly, while considerable attention has been paid to PCK and instructional attitudes both individually and jointly as predictors of effective teaching, there is a paucity of research utilizing predictive modelling of these two variables. Most of the studies within the Nigerian context are descriptive, establishing the presence of teacher knowledge without delineating its specific weight and significance to teaching effectiveness (Aina et al., 2021). Secondly, there is a significant cultural and geographic bias within Nigeria research on teacher effectiveness. Most high impact research tends to be found within the southern geopolitical zones, ignoring entirely the cultural specificities of northern Nigeria, Niger State included. Information about northern Nigerian classroom practices, teacher-training curriculum, and resource limitations can significantly influence PCK and attitudes. Finally, much of the previous research relies on self-report rather than empirically valid, multidimensional measurement of pre-service teachers' actual instruction. Methodological simplicity through the use of simple correlation, rather than predictive modelling that considers cognitive and affective antecedents as predictors of teaching effectiveness, has prevented a comprehensive examination of factors contributing to science teaching effectiveness in Nigerian classroom environments. Addressing the above gaps can allow for refined pre-service teacher training and ensure that future science teachers are adequately prepared not only with subject matter knowledge but also with the appropriate pedagogical content knowledge and positive affect toward student-centred approaches.

Objectives of The Study

To address these gaps, the present study investigates the extent to which Pedagogical Content Knowledge and attitudes toward Inquiry-Based Learning predict the science teaching effectiveness of pre-service teachers in Niger State, Nigeria. The study is guided by three primary objectives to:

1. Assess the levels of PCK and attitudes toward IBL among pre-service science teachers;
2. Determine the relationship between these constructs and teaching effectiveness; and
3. Evaluate the relative and joint contribution of PCK and IBL attitudes to the variance in teaching effectiveness.

Null Hypothesis

In line with the predictive framework of this study, the following null hypotheses were formulated and tested at a 0.05 level of significance:

H₀₁: There is no significant relationship between pre-service teachers' Pedagogical Content Knowledge (PCK) and their science teaching effectiveness in Niger State.



Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

H₀₂: Attitudes toward Inquiry-Based Learning (IBL) do not significantly predict the science teaching effectiveness of pre-service teachers in Niger State.

H₀₃: Pedagogical Content Knowledge and attitudes toward Inquiry-Based Learning do not jointly explain a significant proportion of the variance in the science teaching effectiveness of pre-service teachers.

Methodology

This study used a correlational research design where a non-experimental predictive approach was employed to examine the relationships between cognitive and affective teacher variables and the teaching effectiveness of pre-service science teachers. It was adopted in order to establish the predictive ability of PCK and attitude towards IBL on the science teaching effectiveness of pre-service science teachers. With this design, individual and collective contributions of independent variables to the variation in dependent variable can be accounted for, without altering the participants' situation hence providing good ecological validity (Creswell and Guetterman, 2019). The study was conducted in Niger State of Nigeria. The state is characterized by large land area and is educationally central to the Northern part of the country. It is identified as one of the pivotal areas for teacher education with some Colleges of Education that provide science teachers for Northern schools. The population of the study was all final year pre-service science teachers of the Colleges of Education within the state. Final year pre-service teachers were used as their pedagogical, subject content and teaching practice courses have been concluded, hence ready for an evaluation of teaching effectiveness.

The sample size used for this study was 100 pre-service science teachers. Participants were drawn from Dr Umaru Sanda Ahmadu College of Education Minna and Federal College of Education Kontagora using a simple random sampling technique, which gave each final year science teacher an equal and independent chance of being selected. This size of 100 was chosen because it is adequate for a multiple regression with 2 predictors. As is well established in statistics, based on certain heuristic measures for power analysis, this sample size is enough to enable the study detect a medium effect size and provide stable regression coefficients, reducing over-fitting. Data collection was achieved through three purposefully designed instruments. Firstly, the Pedagogical Content Knowledge Questionnaire (PCKQ) contained 25 items, designed to assess the teachers' capacity for transforming science subject matter to learnable forms. Using a 4-point likert scale, PCKQ measures covered knowledge of content, of pedagogy and of students' misconception. An example of a question on the questionnaire reads as: 'I know how to translate abstract scientific information into useful teachable units for junior secondary school science teaching, e.g. by explaining atomic structure using analogies'. Secondly, was the Attitudes toward Inquiry-Based Learning Scale (AIBLS), a 25-item questionnaire on a 4-point Likert scale, measuring the teachers' attitudes in the affective realm (i.e. Perceived usefulness of IBL, interests in IBL and self-efficacy to do IBL). An example item on AIBLS reads: 'I think students will learn science better if allowed to design their own science experiments as opposed to follow rigidly guided ones found in manuals'. Thirdly, the STES contained 25-items and it was used to measure teachers' quality of teaching (the domain of observable behaviour: clarity of instruction, learner engagement and quality of assessment) through its 3 sub-scales: Instructional Clarity, Learner Engagement and Quality of Assessment. A sample item for STES is: 'The teacher used an open-ended question to assess the understanding of the learner' in the course of the lesson. The instruments were validated both face and content-wise by three experienced lecturers in the subject of science Education and Measurement and Evaluation from the Federal University of Technology, Minna, Niger State before they were administered on the teachers.



Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

These teachers critiqued each item in relation to relevance and clarity of language and the validity of the items were refined accordingly.

A pilot study with 30 pre-service teachers, studying at an institution similar to the research institution but not included in the main sample, was conducted to validate the instruments. The data obtained from the pilot test were analysed for internal consistency using Cronbach's alpha coefficient. The findings showed high reliability indices as it resulted to $\alpha=0.80$ for PCKQ, $\alpha=0.78$ for AIBLS and $\alpha=0.88$ for STES. This means that the instruments used are highly reliable for collecting the same results throughout the samples of interest. Data collection was spread over a period of six weeks. The first two weeks of data collection were used to seek permission, expert validation and pilot testing. The rest of four weeks were used to administer the instruments. Researchers visited colleges selected, gave out questionnaires to the selected sample, administered and collected them in a face-to-face, personally monitored and highly supervised context to ensure 100% return and clarify all directions on questionnaires. Ethical procedures were adhered to strictly such as consent from the participants, voluntary participation, and assurance of not linking participants to their responses. The participants were not required to write their personal identifiable information on the instruments to ensure confidentiality and anonymity.

Statistical analysis was carried out using SPSS (2020) version 26.0. Inferential statistics, including simple linear regression and multiple linear regression were used to test the null hypotheses at significance level 0.05. Multiple linear regression was utilized to assess the combined predictive ability of PCK and attitude towards IBL on teaching effectiveness. Several key assumptions related to multiple linear regression were tested prior to the actual analysis. They were; normalcy tested using p-p plot and shapiro-wilk test, linearity tested through scatterplots, multicollinearity examined using VIF and Tolerance scores. It revealed that VIF was within tolerance ($VIF < 10$). This indicated that predictors are distinct concepts. These statistics confirmed that all assumptions about the use of the model have been satisfied.

Presentation Of Results

The results of the statistical analyses are presented in this section, organized according to the research objectives and hypotheses. The data were analysed using descriptive statistics (Mean and Standard Deviation), Pearson Product-Moment Correlation, and Multiple Linear Regression analysis. All hypotheses were tested at a 0.05 level of significance.

Descriptive Statistics

The descriptive statistics for the variables of Pedagogical Content Knowledge (PCK), Attitudes toward Inquiry-Based Learning (IBL), and Science Teaching Effectiveness (STE) are summarized in Table 1. The data represent the responses of 100 pre-service science teachers in Niger State.

Table 1: Descriptive Statistics of PCK, Attitudes toward IBL, and Science Teaching

Effectiveness		
Variables	Mean (M)	Std. Deviation (SD)
Pedagogical Content Knowledge (PCK)	2.84	0.52
Attitudes toward IBL	3.02	0.47
Science Teaching Effectiveness (STE)	2.76	0.58

The results in Table 1 show that pre-service teachers attained a mean score of 2.84 ($SD = 0.52$) in Pedagogical Content Knowledge and a mean score of 3.02 ($SD = 0.47$) for their attitudes toward Inquiry-Based Learning. The dependent variable, Science Teaching Effectiveness, recorded a mean score of 2.76 ($SD = 0.58$).

Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

Correlation Analysis

To determine the direction and strength of the relationships between the variables, a Pearson Product-Moment Correlation (PPMC) was conducted. The correlation matrix is presented in Table 2.

Table 2: *Correlation Matrix for PCK, Attitudes toward IBL, and Science Teaching Effectiveness*

Variables	PCK	Attitudes toward IBL	Science Teaching Effectiveness
PCK	1	.382**	.541**
Attitudes toward IBL		1	.495**
Science Teaching Effectiveness			1

Note: $p < .00$ (2-tailed)

As shown in Table 2, there was a significant moderate positive correlation between Pedagogical Content Knowledge and Science Teaching Effectiveness ($r = .541$, $n = 100$, $p < .01$). Similarly, a significant positive relationship was observed between attitudes toward Inquiry-Based Learning and Science Teaching Effectiveness ($r = .495$, $n = 100$, $p < .01$). Furthermore, a positive correlation existed between the two independent variables ($r = .382$), suggesting they are related but distinct constructs.

Test of Research Hypotheses

Hypothesis One

H_{01} : There is no significant relationship between pre-service teachers' Pedagogical Content Knowledge (PCK) and their science teaching effectiveness in Niger State. The correlation analysis in Table 2 reveals a significant positive relationship ($r = .541$, $p < .05$). Consequently, the null hypothesis (H_{01}) is rejected. The result indicates that higher levels of PCK are associated with increased science teaching effectiveness among pre-service teachers.

Hypothesis Two

H_{02} : Attitudes toward Inquiry-Based Learning (IBL) do not significantly predict the science teaching effectiveness of pre-service teachers in Niger State. Based on the regression coefficients (see Table 5), attitudes toward IBL significantly predicted science teaching effectiveness ($\beta = .341$, $t = 4.162$, $p < .05$). Therefore, the null hypothesis (H_{02}) is rejected. This finding suggests that a positive disposition toward inquiry-based methods is a significant individual predictor of instructional quality.

Hypothesis Three

H_{03} : Pedagogical Content Knowledge and attitudes toward Inquiry-Based Learning do not jointly explain a significant proportion of the variance in the science teaching effectiveness of pre-service teachers.

To test this hypothesis, multiple linear regression analysis was performed. The model summary, ANOVA, and coefficients are presented in Tables 3, 4, and 5, respectively.

Table 3: *Model Summary of the Predictive Relationship*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.643	.413	.401	.452

Predictors: (Constant), Attitudes toward IBL, PCK

Table 3 shows a multiple correlation coefficient $R = .643$, indicating a strong overall relationship between the combined predictors and the dependent variable. The coefficient of determination (R^2) of



Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

.413 indicates that Pedagogical Content Knowledge and attitudes toward IBL jointly explain 41.3% of the variance in science teaching effectiveness.

Table 4: ANOVA for the Regression Model

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	13.982	2	6.991	34.218	.000
Residual	19.818	97	.204		
Total	33.800	99			

Predictors: (Constant), Attitudes toward IBL, PCK

Dependent Variable: STE

The ANOVA regression results indicate that the regression model is statistically significant ($F(2, 97) = 34.218$, $p < .05$). This confirms that the joint contribution of the independent variables is not due to chance.

Table 5: Regression Coefficients

Model	Unstandardized B	Std. Error	Standardized Beta (β)	t	Sig.
(Constant)	0.842	.245		3.437	.001
PCK	0.458	.085	.441	5.388	.000
Attitudes toward IBL	0.421	.101	.341	4.162	.000

As presented in Table 5, both PCK ($\beta = .441$, $p < .05$) and attitudes toward IBL ($\beta = .341$, $p < .05$) are significant contributors to the model. PCK emerged as the stronger predictor of science teaching effectiveness compared to attitudes toward IBL. H_{03} is rejected: PCK and attitudes toward IBL jointly and significantly predict science teaching effectiveness among pre-service teachers in Niger State ($p < .05$).

Discussion of Results

The findings of this study provide empirical evidence for the multi-dimensional nature of science teaching effectiveness, highlighting the critical roles played by both cognitive and affective variables. The results demonstrated that Pedagogical Content Knowledge (PCK) and attitudes toward Inquiry-Based Learning (IBL) are significant positive predictors of instructional quality among pre-service science teachers in Niger State. Notably, the correlation analysis revealed that as pre-service teachers' grasp of pedagogical transformations and their disposition toward inquiry-oriented instruction improved, their overall teaching effectiveness increased. Furthermore, the regression model established that these two constructs jointly account for a substantial proportion of the variance in teaching effectiveness, suggesting that neither content-specific pedagogical skill nor instructional belief is sufficient in isolation to produce high-quality science instruction.

The significant relationship found between PCK and science teaching effectiveness aligns with the foundational theoretical frameworks of Shulman (1986) and Magnusson et al. (1999), which posit that effective teaching resides at the intersection of content expertise and pedagogical transformation. This finding is consistent with the work of Mapulanga and Jita, (2025), who argued that the ability to identify student misconceptions and employ context-specific analogies is the hallmark of a competent science educator. In the context of Niger State, this result suggests that pre-service teachers who possess a sophisticated understanding of how to represent scientific concepts such as utilizing local examples to explain biological diversity or chemical bonding exhibit



Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

higher instructional clarity and engagement. In contrast to studies that emphasize general pedagogical skills or pure subject-matter knowledge as the primary drivers of effectiveness, this result underscores that transformed knowledge is the most potent cognitive predictor. This finding partially aligns with the observations of Kind (2019), who noted that while content knowledge is a prerequisite, it is the pedagogical packaging of that knowledge that directly influences student learning outcomes. The strength of PCK as a predictor in this study likely stems from the fact that pre-service teachers in Nigerian Colleges of Education are increasingly exposed to micro-teaching exercises and teaching practice requirements that emphasize the translation of theory into practice, a trend highlighted in recent Nigerian educational reforms (Adam et al., 2025).

The results also established that pre-service teachers' attitudes toward IBL significantly predict their teaching effectiveness. This finding is consistent with Teacher Cognition Theory (Borg, 2015) and Social Cognitive Theory (Bandura, 1997), which suggest that teachers' internal belief systems act as filters for their classroom behaviours. In this study, a positive attitude toward inquiry characterized by high perceived usefulness and self-efficacy translated into more effective, student-centered instructional practices. This result mirrors the findings of Ogegbo (2021), who established that teachers with a constructivist orientation are more likely to create a learning environment where students pose questions and design investigations. However, this finding stands in contrast to the historical reliance on rote memorization and teacher-centric lectures often documented in Sub-Saharan African contexts (Zoupidis et al., 2023). While traditional Nigerian science education has frequently been criticized for its talk-and-chalk approach, the current results suggest a generational shift among pre-service teachers in Niger State. This positive disposition toward IBL indicates an emerging alignment with international standards for science instruction, such as those advocated by the National Research Council (2012). The significant predictive power of these attitudes implies that when pre-service teachers value the inquiry process, they are more resilient in navigating the logistical challenges such as large class sizes or limited laboratory equipment prevalent in many Nigerian secondary schools.

The multiple regression analysis revealed that PCK and attitudes toward IBL jointly explained 41.3% of the variance in science teaching effectiveness. This finding addresses a critical gap identified by Aina et al. (2021), who noted that many Nigerian studies fail to account for the simultaneous influence of cognitive and affective domains. The results demonstrate that the synergy between "what a teacher knows" and "what a teacher values" creates a more robust predictor of performance than either variable alone. This supports the argument that instructional quality is a holistic construct where cognitive competence (PCK) provides the tools for teaching, while affective disposition (attitudes toward IBL) provides the motivation to use them. Interestingly, the standardized beta coefficients showed that PCK was a slightly stronger predictor ($\beta=.441$) than attitudes toward IBL ($\beta=.341$). This suggests that while beliefs are vital, they cannot compensate for a lack of pedagogical depth. In the challenging educational landscape of Northern Nigeria, a teacher may passionately believe in student-led inquiry, but without the PCK necessary to manage student misconceptions or simplify abstract scientific phenomena, their classroom effectiveness remains constrained. This finding reinforces the notion that PCK is the "gatekeeper" of effective science instruction (Kind, 2019). Situating these findings within the global science education discourse reveals a convergence between the realities in Niger State and international trends. The shift toward recognizing teacher quality as a function of specific pedagogical knowledge rather than general intelligence is a universal theme in contemporary educational research (Yilmaz and Sahin, 2025). The results from Niger State echo



Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

findings from both developed and developing countries, suggesting that the components of effective science teaching are, to a large extent, culturally transcendent. However, the specific highlight of the Nigerian context such as the urgent need for scientific literacy to drive national development give these findings a unique regional importance.

The study confirms that the challenges faced in Sub-Saharan Africa regarding teacher preparation are not insurmountable. By focusing on the dual development of PCK and inquiry-based attitudes, teacher education programs in Niger State can bridge the gap between theoretical knowledge and classroom practice. This is particularly relevant in Northern Nigeria, where educational outcomes have historically lagged behind other regions; these findings provide an evidence-based pathway for narrowing that disparity through targeted teacher preparation.

Conclusion

This study examined the relative effectiveness of Pedagogical Content Knowledge (PCK) and attitudes toward Inquiry-Based Learning (IBL) as predictors of effective science teaching among pre-service teachers in Niger State of Nigeria. This study confirmed both PCK and attitudes toward IBL to be a viable set of both unique and combined predictors of instructional quality. While PCK was confirmed as the most powerful cognitive determinant of teacher effectiveness, teachers' attitudes toward inquiry served as the most salient affective factor influencing teacher effectiveness. Conceptually, the present study confirmed that the separation of cognitive and affective components of teacher cognition is not sufficient. Practically, this study contributes a statistically valid measurement of teacher preparedness for the task in North-Central Nigeria and helps fill a gaping geographic hole in the literature, while the practical implication of the study confirms that the existing bifurcated approach to teacher training is an impediment to a successful practice.

Recommendation

To be pragmatic, teacher-training institutions in Niger State should embrace the integration of PCK modules and offer pre-service teachers (PST) with direct experiences on inquiry-based learning in the early stages of their education. Future researches need to adopt longitudinal study designs to trace the impact of these PST-predictors on long-term student outcomes in secondary schools. By equipping the Nigerian pre-service science teachers with not only subject specific knowledge but also with strong professional commitment towards inquiry-based instruction, the future Nigerian nation will have its future science teachers who will lead science literacy and innovation.

References

- Abiodun, S., & ODUALI, O. G. (2026). Influence of Innovative Pedagogical Approaches (IPA) on Academic Achievement of Pre-Service Mathematics Teachers in Colleges of Education in Oyo State. *Journal of Vocational, Informatics and Computer Education*, 132-140.
- Adam, S., Umar, M., Musa, F., Haruna, H. O., Mohammed, M. K., Daniel, A. O., & Jibril, I. L. (2025). Digital Literacy and Technological Pedagogical Content Knowledge as Predictors of Pre-Service Science Teachers' Readiness For 21st Century Instruction in Kwara State, Nigeria. *UMYU Journal of Educational Research*, 13(2), 36-44.
- Aina, J. K., Abdulrahman, A. O., Olanipekun, S. S., & Olaoye, O. T. (2021). Nigerian higher education research and the challenges of sustainable development. *American Journal of Creative Education*, 4(1), 1-9.
- Ashiwere, I. O., Imong, A. O., Inah, R. A., Obi, M. B., & Asu, P. A. (2024). Teachers' TPACK and Pedagogic Knowledge as Predictor of Acquisition of Science Process Skills in Biology among Senior Secondary School Students in Adamawa State, Nigeria. *The Researcher's Journal: A Journal of Contemporary Educational Research*, 1(1), 21-41.
- Bandura, A. (1997). Self-efficacy: The exercise of control. W. H. Freeman.
- Borg, S. (2015). Teacher cognition and language education: *Research and practice*. Continuum.



www.foefugusau.com.ng

des@fugusau.edu.ng

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Correlation Between Pedagogical Content Knowledge and Attitudes towards Inquiry-Based Learning on ... Musa, A., Et. al. (2026)

- Creswell, J. W., & Guetterman, T. C. (2019). Educational research: *Planning, conducting, and evaluating quantitative and qualitative research* (6th ed.). Pearson.
- Green, S. B. (1991). How many subjects does it take to do a regression analysis? *Multivariate Behavioral Research*, 26(3), 499–510.
- Kind, V. (2019). Development of evidence-based, student-learning-oriented rubrics for pre-service science teachers' pedagogical content knowledge. *International Journal of Science Education*, 41(7), 911-943.
- Magnusson, S., Krajcik, J., & Borko, H. (1999). Nature, sources, and development of pedagogical content knowledge for science teaching. In *Examining pedagogical content knowledge: The construct and its implications for science education* (pp. 95-132). Dordrecht: Springer Netherlands.
- Mapulanga, T., & Jita, L. C. (2025). A Systematic Review of Studies Using the Topic-Specific Pedagogical Content Knowledge Framework in Science Education. *Education Sciences*, 15(11), 1417.
- National Research Council, Board on Science Education, & Committee on a Conceptual Framework for New K-12 Science Education Standards. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. national academies press.
- Nunnally, J., & Bernstein, I. (1994). *Psychometric Theory* 3rd edition (MacGraw-Hill, New York).
- Ogegbo, A. A. (2021). Relationships between High School Teachers' Understanding and their Reported Practices of Inquiry-based Pedagogy in Science Classrooms in Nigeria. *African Journal of Research in Mathematics, Science and Technology Education*, 25(2), 125-136.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, 15(2), 4-14.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Yilmaz, Y. Ö., & Sahin, M. (2025). Enhancing Science Teaching Efficacy of Pre-Service Preschool Teachers through Inquiry-Based Science Course. *Journal of Baltic Science Education*, 24(4), 670-683.
- Zoupidis, A., Tselfes, V., & Kariotoglou, P. (2023). Pre-service early childhood teachers' beliefs that influence their intention to use inquiry-based learning methods. *International Journal of Early Years Education*, 31(3), 738-752.