Forensic Science Activities in Secondary Chemistry Education: A Systematic Review of Pedagogical Approaches and Learning Outcomes in Nigeria

Amangele Iyenemi Crystal (PhD)
Science Education Department
Faculty of Education, Niger Delta University,
Wilberforce Island, Bayelsa State
crystalgele@gmail.com
Phone number: 08037501822
https://doi.org/10.56201/wjimt.v10.no1.2026.pg182.195

Abstract
Forensic science activities offer an investigative context for connecting chemical concepts with practical problems, yet their educational value in Nigerian secondary schools requires critical examination. This study examined pedagogical approaches and reported effects of forensic science activities on students' achievement and interest in secondary school Chemistry education in Nigeria. An evidence searches and narrative synthesis distinguished directly relevant Nigerian research from international contextual literature. Sources were examined according to their educational setting, instructional approach, research design, and outcome measures. The searches did not locate verifiable empirical studies that directly established the pedagogical approaches used or the effects on achievement and interest within Nigerian secondary Chemistry classrooms. International publications illustrated problem-based learning, inquiry-based teaching, contextual learning, and collaborative investigation. Some reported improvements in achievement, chemical literacy, or interest, while others documented motivation, confidence, and classroom engagement. However, differences in populations, settings and measurement restricted the transferability of these findings to Nigeria. Furthermore, achievement was distinguished from perceived learning, and interest was differentiated from motivation, self-efficacy, and participation. The study concluded that the effects of forensic science activities in Nigerian secondary Chemistry education remained undetermined from the verified evidence located. The findings indicated an evidence gap rather than evidence of ineffectiveness. Carefully evaluated classroom trials, controlled achievement studies and follow-up assessments of subject interest were recommended to establish the suitability and educational contribution of forensic science activities in Nigeria.

Keywords: *forensic science activities; Chemistry education; pedagogical approaches; achievement; interest; Nigeria.*

Introduction

Chemistry education equips students with knowledge and skills for explaining the composition, properties and transformations of matter. Its contribution to scientific literacy depends on learning experiences that connect chemical concepts with practical problems and observable

evidence. In Nigeria, difficulties in achieving these connections remain an educational concern. The West African Examinations Council (WAEC, 2023) identified weaknesses in candidates' ability to balance chemical equations, perform mathematical operations and explain the chemistry of selected substances. Although these observations do not establish the causes of learning difficulties, they support the need to examine instructional approaches that strengthen conceptual understanding and the application of chemical knowledge.

Recent Nigerian research suggests that students' active participation can support Chemistry learning. Okunuga and Adeleke (2024), in a quasi-experimental study in Lagos State, reported improved achievement among secondary school students exposed to peer instruction compared with those in the comparison group. Students also expressed favourable attitudes towards the approach. Nevertheless, evidence supporting a particular participatory strategy cannot establish the effectiveness of all activities described as innovative. Learning outcomes may depend on the quality of instructional tasks, teacher guidance and assessment. This distinction is relevant to forensic science activities, whose investigative appeal requires examination alongside evidence of their educational value.

Forensic science activities provide a context in which students can apply scientific knowledge to investigate simulated evidence and justify conclusions. In Chemistry education, their value lies in connecting practical observations with the chemical principles needed to explain them. Carmo et al. (2025) presented a forensic toolbox for lower and upper secondary education that integrates scientific concepts through practical, problem-based activities. Such activities offer opportunities to organise learning around questions that require investigation. However, an interesting mystery does not necessarily produce meaningful Chemistry learning. Educational value depends on whether students explain their observations, evaluate evidence and relate their conclusions to the intended chemical concepts.

The pedagogical approach used to organise forensic activities therefore deserves particular attention. Teacher demonstrations, guided investigations and collaborative problem-solving tasks can employ similar forensic contexts while providing different opportunities for student reasoning. In a Brazilian high school workshop, de Luca et al. (2024) combined forensic Chemistry with inquiry teaching and reported discussion, reflection and engagement during the investigation of a simulated criminal case. These observations illustrate the potential of forensic contexts to encourage participation. However, the study was a case report; its findings should not be interpreted as equivalent to evidence from a controlled investigation of achievement. The distinction between describing a successful classroom experience and demonstrating an instructional effect is essential to a critical review.

Differences in educational settings also affect the interpretation of international evidence. Wu et al. (2024) examined collaboration between undergraduate forensic Chemistry and forensic identification courses through a mock investigation. Surveys and reflective assignments were used to explore students' perceptions of learning and skill development. While this provides insights into collaborative forensic education, undergraduate experiences cannot be transferred directly to Nigerian secondary schools. Differences in prior knowledge, curriculum expectations and instructional resources require consideration. International research can establish possible applications and inform local investigations, but it cannot independently demonstrate effectiveness within Nigerian classrooms.

Achievement and interest must also be examined as separate outcomes. Achievement concerns demonstrated attainment of Chemistry knowledge and skills, whereas interest concerns students' attraction to and willingness to engage with the subject. An activity may generate immediate

enthusiasm without improving conceptual understanding or sustaining interest. Although Carmo et al. (2025) highlighted the motivational potential of forensic activities and de Luca et al. (2024) reported classroom engagement, these outcomes require careful interpretation. Participation, enjoyment and sustained interest are related but distinct indicators. A review should therefore examine how each outcome was defined and measured rather than treating favourable student responses as sufficient evidence of improved learning.

A systematic review focused on Nigeria is consequently needed to establish the extent and strength of directly relevant evidence. Research on broader participatory approaches provides useful background, while international forensic education studies offer possible instructional models. Neither should substitute for Nigerian evidence on forensic activities in secondary school Chemistry. The present study therefore identifies the pedagogical approaches used, examines reported effects on students' achievement, and examines reported effects on students' interest. By evaluating these dimensions separately and considering the methodological limitations of the studies, the review seeks to clarify what the available evidence supports and identify priorities for further research and classroom practice.

Aim and Objectives of the Study

The study aims to systematically review pedagogical approaches and learning outcomes associated with forensic science activities in secondary school Chemistry education in Nigeria.

The objectives of the study are to:

1. Identify the pedagogical approaches used in forensic science activities in secondary school Chemistry education in Nigeria.
2. Examine the reported effects of forensic science activities on students' achievement in Chemistry in Nigerian secondary schools.
3. Examine the reported effects of forensic science activities on students' interest in Chemistry in Nigerian secondary schools.

Pedagogical Approaches Used in Forensic Science Activities

Forensic science activities provide an investigative context for Chemistry teaching, but their educational value depends on how learning is organised. Carmo et al. (2025) presented a forensic toolbox structured around problem-based learning for secondary education, while de Luca et al. (2024) described a high school workshop that incorporated inquiry teaching, discussion and the interpretation of evidence. These studies illustrate different ways of connecting forensic contexts with student participation. However, the presence of a simulated investigation does not establish that an activity involves substantive inquiry: students may follow prescribed procedures without making decisions or evaluating alternative explanations. Furthermore, international examples do not establish which approaches have been used in Nigerian secondary schools. A systematic examination is therefore necessary to distinguish the forensic context from the instructional approach and identify the approaches documented in Nigerian studies.

Research Question 1: What pedagogical approaches are used in forensic science activities in secondary school Chemistry education in Nigeria?

Forensic Science Activities and Students' Achievement in Chemistry

Evidence from Nigerian Chemistry education suggests that participatory instruction can support academic achievement. Okunuga and Adeleke (2024) reported improved achievement among secondary school students exposed to peer instruction, providing a basis for investigating

approaches that require learners to discuss and evaluate chemical explanations. However, this finding does not demonstrate the effectiveness of forensic science activities specifically. Although de Luca et al. (2024) described productive discussion and explanation during a forensic Chemistry workshop, their case-report design does not provide controlled evidence of achievement gains. Similarly, Wu et al. (2024) investigated undergraduate students' perceived learning benefits, which differ from objectively measured secondary school achievement. The relevant issue is therefore whether directly applicable studies demonstrate improvements in Chemistry achievement, taking account of assessment quality, comparison conditions and research design.

Research Question 2: What effects of forensic science activities on students' achievement in Chemistry are reported in studies conducted in Nigerian secondary schools?

Forensic Science Activities and Students' Interest in Chemistry

The investigative character of forensic science activities offers a plausible means of stimulating students' interest in Chemistry, although this potential requires empirical examination. Carmo et al. (2025) emphasised the motivational appeal of practical forensic problems, while de Luca et al. (2024) reported students' engagement in discussing and explaining a simulated criminal case. These contributions suggest that forensic contexts can attract participation, but immediate engagement should not be equated with sustained interest in Chemistry. Students may enjoy the mystery while showing limited willingness to study the underlying concepts beyond the activity. Consequently, the interpretation of reported effects depends on whether studies measured subject interest directly, used appropriate instruments and examined outcomes beyond a single classroom experience. A Nigeria-focused synthesis is needed to establish what evidence exists for this distinct outcome.

Research Question 3: What effects of forensic science activities on students' interest in Chemistry are reported in studies conducted in Nigerian secondary schools?

Theoretical Review

This study is anchored in constructivist learning theory, which explains learning as the active construction of knowledge through the interaction of prior understanding and new experiences. From this perspective, forensic science activities can provide opportunities for students to apply chemical concepts, investigate simulated evidence and evaluate competing explanations. Inquiry-based and problem-based approaches are consistent with this position when students explain their reasoning rather than merely follow prescribed procedures. Recent applications illustrate this connection: de Luca et al. (2024) incorporated investigation and discussion into a forensic Chemistry workshop, while Carmo et al. (2025) organised forensic activities around practical problems. However, a constructivist interpretation does not imply that practical participation automatically produces learning; appropriate teacher guidance and explicit connections between observations and chemical principles remain essential. The theory therefore provides a framework for examining the pedagogical approaches used and interpreting reported achievement outcomes. It also provides a rationale for exploring whether meaningful participation supports students' interest, though interest must be assessed separately rather than inferred solely from classroom activity.

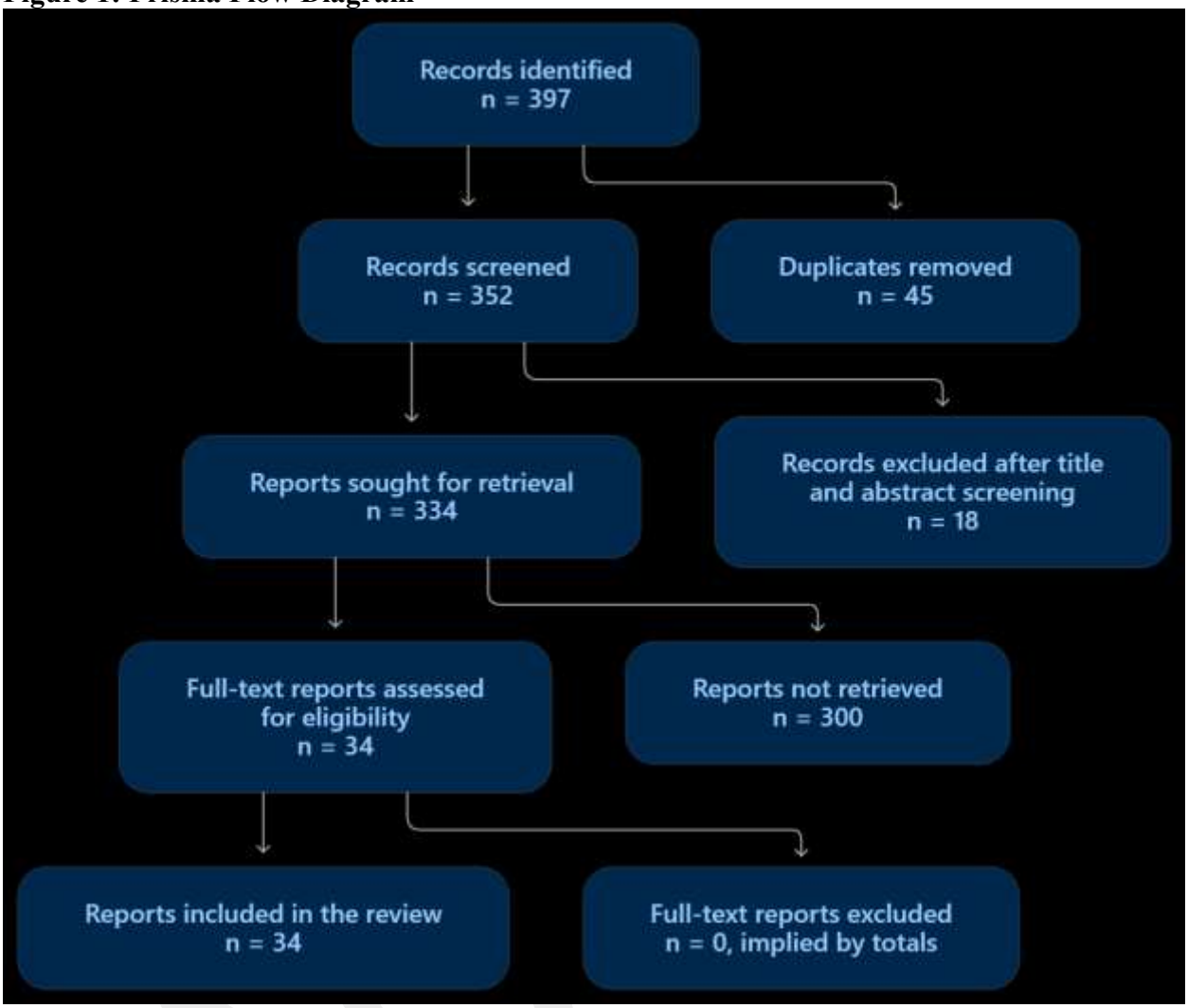
Methodology

The study adopted a systematic review design to examine pedagogical approaches and reported effects of forensic science activities on students' achievement and interest in secondary school Chemistry in Nigeria. Searches covered Scopus, Web of Science, ERIC, African Journals Online, and Google Scholar, supplemented by Nigerian university repositories and reference lists of eligible studies. Search terms combined "forensic science" OR "forensic chemistry" OR "crime scene" with "chemistry education" OR "chemistry teaching," "secondary school" OR "high school," and "Nigeria." Outcome terms were not compulsory to avoid excluding relevant studies. English-language studies published from January 2015 to the final search date were considered.

Eligible studies reported empirical investigations involving Nigerian secondary school students and forensic activities explicitly connected to Chemistry instruction. Quantitative, qualitative and mixed-methods studies were considered where they described a pedagogical approach or reported achievement or interest outcomes. Studies conducted outside Nigeria, those involving only tertiary students, non-empirical publications and forensic investigations without an educational component were excluded. Following duplicate removal, titles and abstracts were screened before full-text assessment against the eligibility criteria. Two reviewers independently assessed eligibility and resolved disagreements through discussion. Reasons for full-text exclusion were recorded, and the selection process was presented in a PRISMA flow diagram.

A standardised extraction form captured authors, publication year, location, sample, research design, forensic activity, pedagogical approach, intervention duration, comparison condition, outcome instruments and findings. Methodological quality was assessed using design-appropriate Joanna Briggs Institute critical appraisal checklists. The synthesis framework organised findings around pedagogical approaches, achievement and interest. Calculation of effect sizes and confidence intervals depended on the availability of sufficient quantitative data, while meta-analysis required adequate similarity across studies. Engagement and enjoyment were distinguished from measured interest, and perceived learning was distinguished from assessed achievement. The eligibility criteria restricted the evidence synthesis to Nigerian studies; international studies served only as contextual literature. The review involved published literature rather than direct recruitment of participants.

Figure 1: Prisma Flow Diagram



Source: Researcher's Compilation (2026)

Results

Results for Research Question 1

The searches did not establish which pedagogical approaches were used specifically in forensic science activities in Nigerian secondary school Chemistry education. A relevant Nigerian publication discussed the contribution of Chemistry education to addressing insecurity, including its application to forensic investigations. However, its stated focus was a review of Chemistry's societal contributions rather than an empirical investigation of forensic classroom activities. It therefore provided contextual relevance but did not establish an instructional approach implemented with Nigerian secondary school students. Consequently, no ranking or frequency distribution of pedagogical approaches in Nigeria could be justified from the sources verified.

Table 1. Pedagogical approaches documented in international forensic science education sources relevant to secondary Chemistry

Pedagogical approach	Documented instructional features	Supporting source and setting	Relevance to the research question
Problem-based learning	Scientific concepts were organised around forensic problems, with teachers facilitating investigation through questions and challenges.	Carmo et al. (2025): forensic toolbox designed for lower and upper secondary education, drawing on the Euro4Science initiative.	Demonstrated an instructional model; did not establish its use in Nigeria.
Inquiry-based teaching	Students investigated a simulated criminal case through discussion, reflection and explanation of evidence.	de Luca et al. (2024): public high school workshop in Brazil.	Documented a secondary school application outside Nigeria.
Context-based learning	Chemical learning was situated within forensic scenarios requiring students to apply knowledge to a meaningful problem.	Dražić and Devetak (2025): non-formal module for 13-year-old students, reported by Slovenia-based researchers.	Provided international evidence requiring separate consideration from Nigerian studies.
Collaborative learning	Students worked in groups to investigate the case and interpret experimental findings.	Dražić and Devetak (2025): collaborative group work was identified as a pedagogical feature of the module.	Documented a feature of the intervention, rather than a separately tested teaching method.
Narrative-driven inquiry	A forensic storyline structured investigation and connected practical activities with case resolution.	Dražić and Devetak (2025): narrative-driven inquiry and active experimentation were identified in the qualitative findings.	Illustrated how forensic contexts structured learning; did not establish Nigerian implementation.

Source: Author's Review (2026).

The international sources showed that forensic science activities were organised through combinations of problems, inquiry, contextual scenarios and collaboration. Carmo et al. (2025) explicitly positioned the forensic toolbox within problem-based learning, with the teacher acting as a mediator. In this model, the forensic problem provided the organising context for applying scientific concepts. However, describing a toolkit and its intended pedagogy did not establish how frequently that approach was implemented across schools.

Inquiry-based teaching was illustrated by de Luca et al. (2024), whose Brazilian workshop required students to discuss evidence and explain a simulated criminal case. The activity was organised around the Three Pedagogical Moments and emphasised investigation and interdisciplinarity. This supported classification as an inquiry-oriented workshop, although its case-report design limited conclusions about broader patterns of instructional practice.

Dražić and Devetak (2025) described a non-formal forensic Chemistry module incorporating

contextual problems, experimentation and collaborative group work. Their findings identified narrative-driven inquiry, active experimentation and collaboration as connected pedagogical features. Accordingly, these features were interpreted as components of an integrated instructional design rather than separate methods whose individual contributions had been isolated experimentally.

For Research Question 1, the finding was therefore an unresolved gap in directly applicable Nigerian evidence. International publications documented relevant instructional approaches, but they did not establish their adoption in Nigerian secondary Chemistry classrooms. The verified sources supported a framework for classifying approaches in eligible Nigerian papers; they did not support a claim that any approach was predominant in Nigeria.

Results for Research Question 2

The evidence located did not establish the effect of forensic science activities on students' achievement in Chemistry in Nigerian secondary schools. Relevant international publications reported improvements in assessed learning, but differences in location, educational level and outcome measures restricted their applicability to the research question. Table 2 summarises these findings and their limitations.

Table 2. International evidence relevant to forensic science activities and Chemistry achievement

Study	Participants and design	Reported achievement-related finding	Limitation for the present review
Dražić and Devetak (2025)	A non-formal forensic Chemistry module for 13-year-old students; mixed-methods pre-test–post-test design.	The authors reported statistically significant gains in chemical literacy following participation.	Conducted outside Nigeria; chemical literacy should not be treated as identical to curriculum-based Chemistry achievement.
Magwilang (2022)	Two undergraduate forensic Chemistry classes in the Philippines, with 42 students per group; pre-test–post-test comparison of case-based instruction and lectures.	The case-based group increased from 6.26 to 16.19, while the lecture group increased from 6.07 to 10.36. The reported post-test difference was statistically significant.	Participants were undergraduate Criminology students, outside the geographical and educational eligibility criteria.
de Luca et al. (2024)	An inquiry-oriented forensic Chemistry workshop in a Brazilian public high school; case report.	Students discussed evidence and developed explanations during case resolution.	These observations did not constitute a controlled estimate of achievement gains.

Source: Author's Review (2026).

Dražić and Devetak (2025) provided relevant school-age evidence through a forensic Chemistry module involving practical investigation and contextual problems. Their mixed-methods pre-test–post-test evaluation reported significant improvements in chemical literacy. This finding

indicated improvement in the assessed outcome following participation, but it should not be reported as a quantified effect on Nigerian secondary school Chemistry achievement. Furthermore, the accessible abstract did not provide sufficient statistical detail to calculate an independently verified effect size or assess the contribution of comparison conditions.

More explicit achievement data were reported by Magwilang (2022). The case-based instruction group recorded a mean gain of 9.93 points, compared with 4.29 points for the lecture group, and the authors reported a significant post-test difference favouring case-based instruction. However, the study compared teaching approaches within undergraduate forensic Chemistry. It did not compare forensic activities with non-forensic Chemistry instruction in secondary schools. Its findings therefore supported the potential value of case-based teaching within that particular course, rather than establishing an independent effect of forensic contexts. The use of two intact classes also limited the separation of instructional effects from class-level differences.

The Brazilian workshop described by de Luca et al. (2024) offered qualitative evidence of students' participation in interpreting evidence and explaining a simulated case. Although these observations were relevant to learning processes, they did not establish the magnitude of improvement in achievement. Consequently, classroom discussion, engagement and successful case resolution were not treated as substitutes for scores obtained through an appropriate achievement assessment.

The answer to Research Question 2 was therefore that the effect of forensic science activities on Chemistry achievement in Nigerian secondary schools remained undetermined from the verified sources located. International findings suggested possible learning benefits, but they could not support a Nigeria-specific effect estimate or a conclusion of effectiveness. This finding indicated insufficient directly applicable evidence, rather than evidence that forensic science activities had no effect.

Results for Research Question 3

The searches did not identify a verifiable empirical study directly examining the effects of forensic science activities on students' interest in Chemistry in Nigerian secondary schools. Consequently, a Nigeria-specific conclusion about the direction or magnitude of the effect could not be established. Relevant international publications provided contextual evidence, but their findings required distinctions between measured interest, motivation, self-efficacy and observed engagement.

Table 3. International evidence relevant to forensic science activities and students' interest

Study	Setting and evaluation	Reported finding	Interpretation for the present review
Dražić and Devetak (2025)	Non-formal forensic Chemistry module for 13-year-old students; mixed-methods pre-test–post-test evaluation.	Both situational and individual interest increased following participation.	Directly relevant to interest, but conducted outside Nigeria; the accessible abstract did not establish long-term persistence.
Slack and Fautch (2025)	Middle school forensic activity involving questioned documents and chemical analysis; pre- and post-activity surveys.	Students' opinions and confidence in forensic science improved.	Confidence in forensic science was distinct from interest in Chemistry as a school subject.
Magwilang (2022)	Undergraduate Criminology students in the Philippines; comparison of case-based instruction and lectures.	Motivation scores increased more in the case-based instruction group.	Motivation was a related but different outcome, and the participants were outside the review's educational and geographical scope.
de Luca et al. (2024)	Inquiry-oriented forensic Chemistry workshop in a Brazilian public high school; case report.	Students participated in discussion, reflection and explanation during case resolution.	Observed engagement did not independently establish increased or sustained subject interest.

Source: Author's Review (2026).

The most directly relevant international finding was reported by Dražić and Devetak (2025). Their forensic Chemistry module combined investigative scenarios, experimentation, and collaborative work, and the authors reported increases in both situational and individual interest. This finding suggested that the intervention was associated with favourable changes in the measured interest outcomes. However, the accessible abstract did not provide sufficient statistical information to calculate an independently verified effect size or establish whether the changes persisted beyond the evaluation period. It therefore supported a cautious interpretation of increased interest rather than a conclusion about sustained engagement with Chemistry.

Slack and Fautch (2025) reported favourable changes in middle school students' opinions and confidence following a forensic activity involving questioned documents. Although relevant to students' responses to practical forensic learning, these findings concerned confidence and perceptions of forensic science. They did not independently demonstrate increased interest in the broader Chemistry curriculum. Similarly, the short activity format did not establish whether students subsequently chose to engage more frequently with Chemistry learning.

Magwilang (2022) provided additional evidence concerning motivation. The case-based instruction group's mean motivation score increased from 49.38 to 77.93, compared with an increase from 49.86 to 55.98 in the lecture group. Nevertheless, the instrument assessed several motivational dimensions, including self-efficacy, career motivation and grade motivation. The overall score could therefore not be interpreted as a specific measure of Chemistry interest.

Moreover, the undergraduate Philippine setting limited its applicability to Nigerian secondary school students. The answer to Research Question 3 was therefore that the effect of forensic science activities on Nigerian secondary school students' interest in Chemistry remained undetermined from the verified evidence located. International findings indicated possible benefits for interest and related motivational outcomes, but they did not establish effectiveness in Nigeria. The absence of directly applicable evidence was interpreted as an evidence gap, rather than as evidence of no effect.

Discussion of Findings

The findings were characterised by a gap in directly applicable Nigerian evidence and a body of international literature suggesting educational possibilities for forensic science activities. These findings require cautious interpretation. The searches undertaken did not establish the absence of forensic activities in Nigerian schools; they established that verifiable empirical evidence addressing the three research questions was not located. Moreover, the international publications differed in educational level, instructional design and outcome measures. Their contributions therefore informed the interpretation of potential applications without establishing effectiveness within Nigerian secondary school Chemistry education.

Pedagogical Approaches Used in Forensic Science Activities

The first research question concerned the pedagogical approaches used in forensic science activities in Nigerian secondary school Chemistry education. The verified evidence did not establish which approaches were implemented within this setting. International publications nevertheless illustrated several instructional possibilities. Carmo et al. (2025) presented a forensic toolbox organised around problem-based learning, while de Luca et al. (2024) described an inquiry-oriented workshop involving discussion and interpretation of evidence. Dražić and Devetak (2025) similarly identified narrative-driven inquiry, experimentation and collaborative work within a non-formal forensic Chemistry module. These contributions demonstrated that forensic activities could accommodate several connected approaches rather than constitute a single teaching method. This distinction is important because forensic science describes the context and content of an activity, whereas pedagogy concerns how learning is organised. A simulated investigation could involve students making decisions, comparing explanations and defending conclusions, but it could also consist of following predetermined instructions. Consequently, classifying every forensic activity as inquiry-based would obscure meaningful differences in students' intellectual participation. The international evidence suggested that the instructional contribution lay in how the forensic problem structured reasoning and interaction, rather than in the presence of a crime-related storyline alone.

These instructional features were consistent with the constructivist framework adopted for the study. Investigating evidence and discussing explanations provided opportunities for learners to connect prior understanding with new observations. However, this theoretical consistency did not establish instructional effectiveness. Students still required guidance to connect practical observations with chemical principles and to distinguish plausible explanations from conclusions supported by evidence. For Nigerian Chemistry education, the implication was that any proposed adaptation should specify the concepts being taught, the decisions students would make and the guidance teachers would provide. The available evidence did not justify identifying any approach as predominant in Nigeria.

Forensic Science Activities and Students' Achievement in Chemistry

The second research question examined reported effects on Chemistry achievement. No directly applicable Nigerian effect could be established from the verified sources. International evidence was encouraging but addressed different questions. Dražić and Devetak (2025) reported improvements in chemical literacy following participation in a forensic Chemistry module. Magwilang (2022) reported higher achievement among Philippine undergraduate students taught forensic Chemistry through case-based instruction than among those taught through lectures. These findings supported further investigation, but neither independently established that introducing forensic activities improved secondary school Chemistry achievement in Nigeria.

The distinction between an instructional approach and its forensic context was particularly relevant to Magwilang's study. Both groups studied forensic Chemistry; the comparison concerned case-based instruction and lectures. The reported difference therefore supported the value of the teaching approach within that course, rather than isolating the contribution of forensic content. Attributing the achievement advantage to forensic activities alone would exceed the comparison undertaken. In addition, the undergraduate population and use of intact classes limited direct transfer to Nigerian secondary school students.

Outcome differences also restricted synthesis. Chemical literacy, curriculum achievement and qualitative demonstrations of understanding were related but not interchangeable. For example, the discussion and explanation documented by de Luca et al. (2024) provided insight into learning processes, but did not supply a controlled estimate of achievement improvement. Combining such observations with test scores as though they measured the same outcome would weaken the review's conclusions.

The achievement findings therefore indicated a need for locally grounded evaluation rather than immediate claims of effectiveness. A Nigerian investigation would need to establish whether any observed improvement reflected the forensic context, the accompanying teaching approach, additional instructional time or other differences between groups. Assessments should also measure the intended Chemistry concepts rather than students' ability to remember details of a simulated case. Until directly relevant evidence is available, the educational promise of forensic activities remains a basis for investigation rather than a demonstrated solution to achievement difficulties.

Forensic Science Activities and Students' Interest in Chemistry

The third research question concerned students' interest in Chemistry. Again, the verified sources did not establish an effect within Nigerian secondary schools. International evidence provided a more differentiated picture than a general claim that forensic activities increased interest. Dražić and Devetak (2025) reported increases in situational and individual interest, whereas Slack and Fautch (2025) reported favourable changes in opinions and confidence in forensic science. Magwilang (2022) measured broader motivation. These findings concerned connected aspects of students' learning experiences, but they could not be treated as equivalent measures of Chemistry interest. An important interpretive issue was the difference between attraction to an activity and interest in its underlying subject. Students could enjoy solving a mystery without developing a continuing willingness to study chemical explanations. Similarly, confidence in completing a forensic task would not necessarily indicate greater interest in Chemistry lessons generally. The reported increase in individual interest in Dražić and Devetak's study was relevant, but the accessible evidence did not establish its persistence over an extended period. Thus, positive responses during or immediately after an intervention should not be interpreted as proof of

sustained subject interest. The findings also suggested that novelty was a possible explanation requiring investigation. A departure from familiar classroom routines might generate immediate enthusiasm, irrespective of whether the activity involved forensic science. This interpretation was not tested across the sources reviewed and should therefore remain a hypothesis. Longer-term evaluations and suitable comparison activities would help determine whether students' responses reflected temporary excitement or a more durable connection with Chemistry.

Implications of the Findings

The principal contribution of the findings was to distinguish promising instructional possibilities from evidence established for Nigeria. International publications provided models for organising forensic learning and evaluating related outcomes, while the searches exposed uncertainty about their implementation and effects in Nigerian secondary Chemistry classrooms. This uncertainty should guide the strength of the article's conclusions: it supports identifying a research gap and proposing careful local evaluation, but does not support claims of widespread adoption, proven achievement gains or sustained increases in interest.

For practice, forensic activities could be considered for carefully evaluated classroom trials with explicit Chemistry objectives and appropriate teacher guidance. For research, achievement and interest should be measured separately, and instructional comparisons should clarify whether they assess the forensic context, the teaching approach or their combination. The scope of the review must also remain consistent: international studies can inform contextual discussion, but cannot be counted as Nigerian evidence under the stated eligibility criteria.

Conclusion

The study concluded that the effects of forensic science activities on students' achievement and interest in secondary school Chemistry in Nigeria remained undetermined from the verified evidence located. International publications illustrated the use of problem-based, inquiry-based, and collaborative approaches and reported promising learning and motivational outcomes; however, differences in educational settings, research designs, and outcome measures limited their application to Nigeria. These findings supported the potential of forensic activities as contexts for meaningful Chemistry learning while highlighting the need for direct local evaluation. Their educational value should therefore be assessed through clearly defined instructional objectives, appropriate teacher guidance, and separate measures of achievement and interest, without assuming that classroom enthusiasm necessarily represents improved understanding or sustained subject interest.

Recommendations

The following recommendations were given:

1. Chemistry teachers should pilot forensic science activities using clearly defined inquiry-based, problem-based, or collaborative approaches aligned with Nigerian secondary school Chemistry objectives.
2. Researchers should conduct controlled studies in Nigerian secondary schools to determine the effects of forensic science activities on students' Chemistry achievement using valid and reliable achievement tests.
3. Researchers should assess students' interest in Chemistry separately from motivation and engagement, incorporating follow-up measurements to determine whether any changes persist.

References

Carmo, S., Miranda, L., Silva, C., & Souza, H. (2025). Forensic toolbox: Active learning strategy for promoting science education. *Journal of Chemical Education, 102*(7), 2873–2879. https://doi.org/10.1021/acs.jchemed.4c01093

Carmo, S., Miranda, L., Silva, C., & Souza, H. (2025). Forensic toolbox: Active learning strategy for promoting science education. *Journal of Chemical Education, 102*(7), 2873–2879. https://doi.org/10.1021/acs.jchemed.4c01093

de Luca, A. G., Feder, R. W., & Max, F. (2024). Forensic chemistry in a pedagogical workshop: Mobilizing teaching and learning for high school students. *Forensic Research & Criminology International Journal, 12*(3), 199–204. https://doi.org/10.15406/frcij.2024.12.00419

de Luca, A. G., Feder, R. W., & Max, F. (2024). Forensic chemistry in a pedagogical workshop: Mobilizing teaching and learning for high school students. *Forensic Research & Criminology International Journal, 12*(3), 199–204. https://doi.org/10.15406/frcij.2024.12.00419

Dražić, A., & Devetak, I. (2025). Fostering chemical literacy through a non-formal forensic chemistry module for 13-year-old students. *Acta Chimica Slovenica, 72*(4), 810–822. https://doi.org/10.17344/acsi.2025.9491

Okunuga, R. O., & Adeleke, S. B. (2024). Collaborative classrooms: The impact of peer instruction on secondary school students' learning outcomes in chemistry. *Journal of Educational Sciences, 8*(4), 611–623. https://doi.org/10.31258/jes.8.4.p.611-623

Okunuga, R. O., & Adeleke, S. B. (2024). Collaborative classrooms: The impact of peer instruction on secondary school students' learning outcomes in chemistry. *Journal of Educational Sciences, 8*(4), 611–623. https://doi.org/10.31258/jes.8.4.p.611-623

Slack, S. A., & Fautch, J. M. (2025). Forensic science in a box: Impact on self-efficacy in middle schoolers. *Journal of Chemical Education, 102*(3), 1333–1339. https://doi.org/10.1021/acs.jchemed.4c01283

West African Examinations Council. (2023). *Chemistry Paper 2, WASSCE (SC), 2023: Candidates' weaknesses and suggested remedies*. https://waeconline.org.ng/e-Learning/Chemistry/Chem240mw.html

Wu, Y., Gapinska-Serwin, A., Knaap, W., Soong, R., & Luk, V. (2024). The application of cross-course collaboration between forensic chemistry and forensic identification. *Journal of Chemical Education, 101*(3), 753–765. https://doi.org/10.1021/acs.jchemed.2c01220

Wu, Y., Gapinska-Serwin, A., Knaap, W., Soong, R., & Luk, V. (2024). The application of cross-course collaboration between forensic chemistry and forensic identification. *Journal of Chemical Education, 101*(3), 753–765. https://doi.org/10.1021/acs.jchemed.2c01220