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K to 12 Junior High School Science Curriculum Implementation

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Abstract

This study assessed the implementation of the K to 12 Junior High School Science Curriculum among 50 Science teachers from 36 public secondary schools in the Division of Ifugao, Philippines, during the school year 2017–2018. Using a quantitative descriptive-correlational research design and population sampling, data were collected through a validated survey questionnaire adapted from an existing instrument. Descriptive statistics and Spearman's rho correlation were employed to examine teachers' professional characteristics, instructional practices, laboratory utilization, and students' academic performance. Findings revealed that most respondents were female, bachelor's degree holders, and Teacher III personnel with limited participation in science-related training. Lectures, discussions, cooperative learning, and experimentation were frequently employed, while written materials were the most commonly utilized instructional resources. Students' mean Science grades ranged from 80.58 to 81.61 across grade levels. Significant relationships were identified between selected teacher characteristics and instructional practices, with laboratory utilization positively associated with age, teaching position, and teaching experience. Most teaching methods showed no significant relationship with academic performance. However, reporting was negatively associated with Grade 10 performance, while field trips or observation were negatively associated with Grade 9 and Grade 10 performance. Conversely, experimentation was positively associated with Grade 8 performance. The study recommends strengthening teacher professional development, curriculum monitoring, instructional resources, student-centered strategies, and laboratory-based learning activities. The findings support Sustainable Development Goal 4 (Quality Education) by emphasizing effective teaching practices and improved learning opportunities. The study contributes to educational and institutional sustainability by providing evidence that may guide continuous curriculum improvement, teacher development, and more effective utilization of instructional resources in public secondary schools.

Keywords: Curriculum Implementation; Instructional Materials; Junior High School Science; K to 12 Curriculum; Laboratory Utilization; Student Academic Performance; Teaching Methods

1. Introduction

Curriculum reform aims to improve teaching quality and student learning, yet its effectiveness depends on how teachers translate educational policies into classroom practices. Science curriculum reforms have increasingly emphasized constructivist and student-centered learning approaches. However, changes in instructional strategies, learning resources, and educational standards have not always produced substantial improvements in classroom practices. Traditional lecture-based instruction remains prevalent, with teachers frequently prioritizing content delivery over student participation. Teachers play an essential role in curriculum implementation because they interpret educational objectives and translate them into classroom activities. Their beliefs, professional readiness, and willingness to adopt changes influence curriculum implementation. Assessing actual classroom practices is therefore necessary to determine whether intended educational improvements are achieved (Fullan, 2007).

Contemporary reviews likewise emphasize inquiry-oriented science instruction and teacher preparation (Strat et al., 2024; Urdanivia Alarcon et al., 2023).

Effective curriculum implementation requires appropriate teaching strategies, instructional materials, professional development, and institutional support. Curriculum change involves introducing new or modified educational components to improve teaching and learning. Successful implementation also depends on professional collaboration, continuous evaluation, and instructional leadership. Teachers require continuous training to strengthen their scientific knowledge and instructional competence. However, inadequate resources, insufficient preparation, and limited institutional capacity may hinder curriculum implementation (Rogan & Grayson, 2003). Meaningful science learning also requires inquiry, experimentation, and practical application rather than memorization alone. Reviews of professional learning identify continued preparation and inquiry-focused professional development as relevant to science teaching (Huang et al., 2022; Latip et al., 2024; Sannert et al., 2026). International curriculum reforms have encountered challenges involving teachers' expertise, instructional resources, professional training, and differences among schools.

In the Philippines, the K to 12 Basic Education Program was introduced to address curriculum congestion, instructional quality, and student achievement. Recent analysis of Philippine K to 12 reforms also examines how curriculum goals translate into school practice (Barrot, 2023; Quijano, 2023). More recent analyses of Philippine K to 12 reform have likewise identified challenges in instructional delivery, curriculum alignment, and technology integration (Barrot, 2023; Quijano, 2023). Similarly, Philippine educational reforms have addressed concerns regarding accessibility, instructional quality, curriculum relevance, and program monitoring. The K to 12 Basic Education Program sought to address overcrowded learning competencies, inadequate mastery of essential skills, and the need to improve teacher quality and educational resources. However, curriculum reform does not automatically change classroom instruction. Student performance in science may also be associated with curriculum-related factors, instructional materials, foundational knowledge, and mathematical skills. Philippine-focused work has also examined curriculum localization and instructional practices (Banzuelo & Quiñones, 2026; Bibon, 2022).

The study was guided by the understanding that teachers' professional characteristics and instructional practices are associated with curriculum implementation. Fullan (2007) emphasized that implementation must be examined to determine whether educational reforms produce meaningful classroom changes. The conceptual framework identified teachers' age, sex, position, educational attainment, specialization, teaching experience, and participation in in-service training as profile variables. Curriculum implementation was examined through teaching methods and techniques, instructional materials, and laboratory utilization, while students' Science performance was measured through their general average. The framework investigated relationships among teacher characteristics, implementation practices, and student performance, recognizing the importance of teachers' knowledge, attitudes, and instructional behavior in curriculum reform (Ornstein & Hunkins, 2009).

Although science curriculum reforms have been widely examined, differences remain between prescribed curriculum objectives and actual classroom practices. Assessing implementation is necessary to identify practical difficulties and determine whether educational innovations achieve their intended objectives (Fullan, 2007). This study addressed the need to assess the K to 12 Junior High School Science Curriculum in the Division of Ifugao. Specifically, it examined the demographic and professional profiles of 50 Science teachers from 36 public secondary schools during the school year 2017–2018, their teaching methods, instructional materials, laboratory utilization, and students' academic performance. It also determined the relationships between teachers' characteristics and curriculum implementation practices, and between implementation practices and students' Science grades.

The study aligns with Sustainable Development Goal 4 (SDG 4): Quality Education, particularly its emphasis on improving teaching quality and learning opportunities. By examining instructional practices, professional characteristics, resource utilization, and student performance, the research provides information relevant to strengthening science education and supporting teacher development. The study contributes to educational and institutional sustainability by identifying factors associated with curriculum implementation. Its findings may guide improvements in instructional strategies, professional training, educational resource utilization, and curriculum monitoring. Understanding the relationships between teaching practices and student performance may also support evidence-based educational planning and continuous improvement in Junior High School Science education.

2. Material and methods

2.1 Research Design
The study employed a quantitative descriptive-correlational approach to examine teachers' demographic and professional characteristics, instructional methods, instructional materials, laboratory utilization, and students' academic performance. Correlation analysis was used to determine the relationships between teacher characteristics and curriculum implementation practices, and between implementation practices and students' Science grades.

2.2 Locale of the Study
The study was conducted in 36 public secondary schools in the Division of Ifugao, Philippines, during the second semester of the school year 2017–2018. It focused on the implementation of the K to 12 Junior High School Science Curriculum.

2.3 Respondents of the Study
The respondents consisted of 50 Junior High School Science teachers from the participating public secondary schools. Their demographic and professional characteristics were examined in relation to teaching methods, instructional materials, laboratory utilization, and students' Science performance.

2.4 Sample and Sampling Procedure
Population sampling was employed, involving all 50 identified Science teacher respondents from the 36 participating public secondary schools. This approach allowed the study to assess curriculum implementation among the identified teacher population.

2.5 Research Instrument
Data were collected using a survey questionnaire adapted from Ozturk(2003), retaining items relevant to the study. The instrument was validated by Science teachers and consisted of two parts. The first gathered demographic and professional information, while the second assessed teaching methods and techniques and instructional materials used during Science instruction. The questionnaire employed a five-point Likert-type frequency scale ranging from 0 (Never) to 4 (Always). Average response scores were intended to indicate the frequency of curriculum implementation practices, with higher scores reflecting more frequent utilization.

2.6 Data Gathering Procedure
Official permission was obtained from the Schools Division Superintendent before administering the questionnaires during the second semester of the school year 2017–2018. Respondents were informed about the nature of the study and possible risks before providing consent. Confidentiality of the information gathered was assured throughout the research process.

2.7 Data Analysis Techniques
Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 21. Frequency, percentage, and cumulative percentage were used to summarize respondents' profiles. Mode was used for categorical variables, while median was applied to ordinal variables and the reported frequency of instructional methods, materials, and laboratory utilization. Arithmetic mean, standard deviation, and standard error were used to summarize students' Science grades by year level. Spearman's rho correlation was employed to examine relationships between teacher characteristics and curriculum implementation practices, and between instructional practices and student performance.

2.8 Ethical Considerations
The study secured permission from the appropriate educational authorities before data collection. Respondents were informed about the research and its possible risks, and consent was obtained before participation. Confidentiality was maintained to protect respondents' information.

3. Results and Discussion

3.1 Demographic and Professional Characteristics of Science Teachers

3.1.1 Sex, Specialization, Educational Attainment, and Teaching Assignments
Of the 50 respondents, 47 (94%) were female and three (6%) were male. Most specialized in General Science (74%), followed by Physics (14%) and Biology (12%), while none specialized in Chemistry. Regarding educational attainment, 78% held bachelor's degrees, 20% had master's degrees, and 2% held doctoral degrees. In terms of teaching assignments, 40% handled one grade level, 30% handled two, 8% handled three, and 22% taught all four Junior High School Science grade levels. These findings indicate that the respondents were predominantly female and generally specialized in General Science. Most held bachelor's degrees, while some managed multiple grade levels. This highlights the importance of continuing professional development and adequate subject preparation in supporting effective science instruction.

3.1.2 Age, Teaching Experience, Position, and Professional Training

The respondents' median age category was 36–40 years, with 44% aged above 40. Regarding teaching experience, 40% had served for five years or less, while the median experience category was 6–10 years. Most occupied Teacher III positions (52%), followed by Teacher I (34%), Teacher II (8%), and Master Teacher positions (6%). The reported median professional training category was one to two training activities. The results suggest that although many respondents occupied established teaching positions, opportunities for professional training remained an important concern. Continuous training may help strengthen teachers' instructional competencies and readiness to implement curriculum reforms.

3.2 Teaching Methods, Instructional Materials, and Laboratory Utilization

3.2.1 Teaching Methods and Techniques

The respondents often used lectures, discussion or question-and-answer sessions, cooperative learning, and experimentation, each with a median rating of 3. Differentiated instruction, reporting, demonstration, and ICT integration were sometimes employed, with median ratings of 2. Field trips or observation were rarely used, obtaining a median rating of 1. No instructional method was consistently rated as always utilized. The findings indicate that teachers employed varied instructional approaches but continued to rely on lectures alongside student-centered strategies. These findings emphasize the importance of strengthening inquiry-based and participatory science teaching. A subsequent Philippine study also examined associations between Science teachers' instructional practices and learners' achievement (Bibon, 2022). Recent studies discuss inquiry-based classroom instruction and adaptation of the 5E model in science teaching (Rodriguez et al., 2024; Linglingon, 2026).

3.2.2 Instructional Materials and Laboratory Utilization

Written materials were consistently utilized, obtaining the highest median rating of 4. Examples and models, diagrams or graphs, and living things were often used, each receiving a median rating of 3. PowerPoint presentations, overhead projectors, video clips, movies, computer-aided instructional materials, workbooks, cards, and laboratory facilities were sometimes utilized, with median ratings of 2. These results demonstrate the continued reliance on written materials, while technology-based resources and laboratory activities were less frequently employed. These findings highlight opportunities to strengthen technology integration and laboratory-based instruction. A later review of Philippine science curriculum implementation also identified teacher preparation and the availability of localized learning materials as implementation concerns (Banzuelo & Quiñones, 2026). Related Philippine studies describe challenges and approaches in laboratory instruction and resource provision (Aquino et al., 2024; Pacadaljen, 2024; Monta & Perdio, 2025; Dalere & Calzada, 2025; Demandante & Lagura, 2026). The role of educational technology also requires attention to appropriateness and access (UNESCO, 2023).

3.3 Students' Academic Performance in Science

3.3.1 Science Performance Across Junior High School Grade Levels

The mean Science grades were 80.58 for Grade 7, 81.57 for Grade 8, 81.61 for Grade 9, and 81.55 for Grade 10. These averages were based on 31, 30, 23, and 22 classes handled by the respondents, respectively. Standard deviations were 2.08, 2.05, 2.27, and 5.61, while standard errors were 0.38, 0.37, 0.47, and 1.20, respectively. Grade 9 recorded the highest mean, while Grade 7 had the lowest. The findings indicate relatively similar average Science grades across grade levels, although Grade 10 exhibited greater variability. Despite the use of different teaching strategies and instructional materials, student performance remained within a relatively narrow range of mean grades. These descriptive results provide a basis for examining the relationships between instructional practices and academic performance but do not establish the effectiveness of individual teaching methods.

3.4 Relationships Between Teacher Characteristics and Curriculum Implementation

The relationships between teacher characteristics and curriculum implementation practices were examined using Spearman's rank-order correlation coefficient at a 0.05 level of significance. Relationships with p-values less than or equal to 0.05 ($p \leq 0.05$) were considered statistically significant, whereas relationships with p-values greater than 0.05 ($p > 0.05$) were considered not statistically significant. This criterion was applied consistently in interpreting the relationships among the study variables.

3.4.1 Teacher Characteristics and Teaching Methods

Spearman's rho analysis revealed a statistically significant negative relationship between age and discussion or question-and-answer utilization ($\rho = -0.280$, $p = 0.049$), as the computed p-value was less than the 0.05 significance level ($p < 0.05$). Differentiated instruction was negatively associated with teaching position ($\rho = -0.330$, $p = 0.019$), teaching experience ($\rho = -0.380$, $p = 0.007$), and training participation ($\rho = -0.284$, $p = 0.045$), with all computed p-values falling below the 0.05 significance threshold ($p < 0.05$). Cooperative learning also showed statistically significant negative relationships with teaching experience ($\rho = -0.303$, $p = 0.032$) and training participation ($\rho = -0.357$, $p = 0.011$), since both p-values were less than 0.05 ($p < 0.05$). Other teaching

methods showed no statistically significant relationships with the examined profile variables, as their p-values were greater than 0.05 ($p > 0.05$). These findings suggest that younger teachers more frequently employed discussion-based instruction, while teachers with lower positions, shorter teaching experience, and fewer training activities tended to utilize differentiated instruction more frequently. Cooperative learning was similarly associated with shorter teaching experience and fewer training activities. These patterns indicate differences in instructional preferences according to teachers' professional characteristics without establishing causal relationships.

3.4.2 Teacher Characteristics and Instructional Materials

The use of PowerPoint presentations or overhead projectors was negatively associated with age ($\rho = -0.289$, $p = 0.042$), with the computed p-value being less than the 0.05 significance level ($p < 0.05$). Video clip utilization was negatively related to age ($\rho = -0.440$, $p = 0.001$) and teaching experience ($\rho = -0.301$, $p = 0.033$), with both relationships considered statistically significant because their p-values were below 0.05 ($p < 0.05$). Similar statistically significant negative relationships were observed for movies with age ($\rho = -0.364$, $p = 0.009$) and teaching experience ($\rho = -0.356$, $p = 0.011$), and computer-aided instructional materials with age ($\rho = -0.379$, $p = 0.007$) and teaching experience ($\rho = -0.293$, $p = 0.039$), as all computed p-values were less than 0.05 ($p < 0.05$). Workbook utilization was negatively associated with age ($\rho = -0.365$, $p = 0.009$) and training participation ($\rho = -0.341$, $p = 0.015$), with both p-values below the 0.05 significance level ($p < 0.05$). Card utilization was positively associated with teaching position ($\rho = 0.292$, $p = 0.039$) and teaching experience ($\rho = 0.291$, $p = 0.041$), as their p-values were also less than 0.05 ($p < 0.05$). The findings indicate that younger and less experienced teachers tended to use technology-based instructional resources more frequently, while teachers with higher positions and longer teaching experience reported greater use of cards. These patterns may reflect differences in familiarity with instructional technologies and preferences for teaching resources.

3.4.3 Teacher Characteristics and Laboratory Utilization

Laboratory utilization showed statistically significant positive relationships with age ($\rho = 0.285$, $p = 0.045$), teaching position ($\rho = 0.327$, $p = 0.020$), and teaching experience ($\rho = 0.320$, $p = 0.024$), since all computed p-values were less than the 0.05 significance level ($p < 0.05$). However, the relationship between laboratory utilization and training participation was not statistically significant ($\rho = 0.252$, $p = 0.078$), as the computed p-value was greater than the 0.05 significance level ($p > 0.05$). The findings indicate that older teachers, those occupying higher positions, and those with longer teaching experience tended to utilize laboratory facilities more frequently. These results suggest that professional experience may be associated with laboratory use, although other factors, including resource availability and institutional conditions, were not directly examined.

3.5 Relationships Between Teaching Methods and Students' Science Performance

The relationships between teaching methods and students' Science performance were likewise examined using Spearman's rank-order correlation coefficient. The limiting value was set at 0.05, with p-values less than or equal to 0.05 ($p \leq 0.05$) indicating statistically significant relationships and p-values greater than 0.05 ($p > 0.05$) indicating no statistically significant relationships.

3.5.1 Significant Relationships Between Instructional Methods and Academic Performance

Most teaching methods showed no statistically significant relationships with students' Science grades across the four grade levels, as their computed p-values were greater than the 0.05 significance level ($p > 0.05$). However, reporting was negatively associated with Grade 10 performance ($\rho = -0.466$, $p = 0.029$), with the computed p-value being less than the 0.05 significance level ($p < 0.05$). Field trips or observation were also negatively associated with Grade 9 ($\rho = -0.536$, $p = 0.008$) and Grade 10 performance ($\rho = -0.431$, $p = 0.045$), as both p-values were less than 0.05 ($p < 0.05$). Conversely, experimentation showed a statistically significant positive relationship with Grade 8 performance ($\rho = 0.387$, $p = 0.035$), since the computed p-value was less than the 0.05 significance level ($p < 0.05$). The remaining instructional methods showed no statistically significant relationships with student performance because their p-values exceeded 0.05 ($p > 0.05$). These findings indicate that relationships between instructional methods and Science performance varied according to grade level. The positive association between experimentation and Grade 8 performance suggests that practical scientific activities may be relevant to student learning. Meanwhile, the negative associations involving reporting and field trips or observation indicate that greater use of these methods corresponded with lower grades in the specified grade levels. However, these relationships should not be interpreted as evidence of causation. Overall, the findings emphasize the importance of examining instructional practices in relation to specific learning contexts and student outcomes.

4. Conclusion & Recommendations

The study assessed the implementation of the K to 12 Junior High School Science Curriculum among 50 Science teachers from 36 public secondary schools in the Division of Ifugao. The findings revealed that most respondents were female, held bachelor's degrees, and occupied Teacher III positions, while participation in science-related

professional training was limited. Teachers employed various instructional methods, frequently using lectures, discussions, cooperative learning, and experimentation, with written materials serving as the most commonly utilized instructional resources. Students' mean Science grades ranged from approximately 80 to 82 across the four grade levels. Significant relationships were found between selected teacher characteristics and instructional practices. Laboratory utilization was positively associated with age, teaching position, and teaching experience. Although most teaching methods showed no statistically significant relationships with students' academic performance, reporting was negatively associated with Grade 10 performance. In contrast, field trips or observation were negatively associated with Grade 9 and Grade 10 performance. Conversely, experimentation was positively associated with Grade 8 performance. Overall, the findings indicate variations in curriculum implementation practices and their associations with students' academic performance across grade levels.

Based on these findings, teachers are encouraged to pursue graduate education and participate in additional science-related professional development activities to enhance their subject knowledge and instructional competencies. School administrators should regularly monitor curriculum implementation to promote the consistent use of student-centered teaching approaches and ensure the availability of adequate instructional materials, laboratory equipment, and information and communication technology resources. Technical assistance should also be provided to support the development of supplementary learning materials, including workbooks. Furthermore, schools should implement appropriate remedial and enrichment programs to address students' learning needs and improve their academic performance in science. Teachers should also be encouraged to adopt varied instructional strategies that accommodate individual learning differences and strengthen experimentation and inquiry-based activities to promote meaningful science learning.

The study was limited to 50 Junior High School Science teachers from 36 public secondary schools in the Division of Ifugao during the school year 2017–2018. It focused on teachers' demographic and professional characteristics, teaching methods and techniques, instructional materials, laboratory utilization, and students' academic performance as measured by their general average in science. The findings were based on teachers' survey responses and the reported academic grades of students across four grade levels. Consequently, the results reflect curriculum implementation practices and academic performance within the participating schools during the specified period and may not be generalizable to other educational settings or school years.

5. Compliance with ethical standards

The author affirm that no conflicts of interest exist in relation to this study. The research involved 50 Junior High School Science teachers from 36 public secondary schools in the Division of Ifugao, with the necessary permission obtained from the Schools Division Superintendent. Participation was voluntary, and informed consent was obtained before data collection through non-invasive questionnaires, with confidentiality maintained and no identifying information disclosed. The researchers acknowledge the participating Science teachers and school administrators for their cooperation and support throughout the study.

REFERENCES

Aquino, A. B., Salanguit, D. M., Austria, A. P., & De los Reyes, C. J. G. (2024). Online and in-person science laboratory instructional practices: Input to a science instructional guide. International Journal of Research and Innovation in Social Science, 8(6), 1543–1550. https://doi.org/10.47772/IJRISS.2024.806115

Banzuelo, J. R., & Quiñones, J. R. B. (2026). Contextualization and localization in science curriculum implementation: A systematic review of strategies, impacts, and challenges in the Philippine basic education system. International Journal of Multidisciplinary Research and Analysis.

Barrot, J. S. (2023). K to 12 curriculum reform in the Philippines: Towards making students future ready. Asia Pacific Journal of Education, 43(4), 1193–1207. https://doi.org/10.1080/02188791.2021.1973959

Bibon, M. B. (2022). Teachers' instructional practices and learners' academic achievement in science. Contemporary Mathematics and Science Education, 3(1), ep22007. https://doi.org/10.30935/conmaths/11816

Dalere, J. J., & Calzada, M. P. T. (2025). Utilization and types of laboratory approaches employed in public secondary schools in Ilocos Norte. International Journal of Multidisciplinary: Applied Business and Education Research. https://doi.org/10.11594/ijmaber.06.03.03

Demandante, R. A., & Lagura, R. T. (2026). A systematic review of laboratory implementation in the Philippines. American Journal of Multidisciplinary Research and Innovation. https://doi.org/10.54536/ajmri.v5i2.6422

Fullan, M. (2007). The new meaning of educational change (4th ed.). Teachers College Press.

Huang, B., Jong, M. S.-Y., Tu, Y.-F., Hwang, G.-J., Chai, C. S., & Jiang, M. Y.-C. (2022). Trends and exemplary practices of STEM teacher professional development programs in K-12 contexts: A systematic review

of empirical studies. Computers & Education, 189, 104577. https://doi.org/10.1016/j.compedu.2022.104577

Latip, A., Kadarohman, A., Hernani, H., Abdullah, N., & Rahmaniar, A. (2024). A systematic literature review of inquiry-based teacher professional development programs: Types and impacts on teachers and students (2013–2023). European Online Journal of Natural and Social Sciences, 13(4). https://european-science.com/eojnss/article/view/6887

Linglingon, J. R. (2026). Scientific inquiry and concept mastery in Grade 10: Teaching practices in junior high school science at Eastern Potia National High School. Studies in Technology and Education. https://doi.org/10.55687/ste.v5i1.277

Monta, E. R., & Perdio, A. C. (2025). Laboratory-based science instruction in public schools: Insights from teachers' experiences and implications for contextualized interventions in Bataan, Philippines. EPRA International Journal of Research & Development, 10(6). https://doi.org/10.36713/epra22103

Ornstein, A. C., & Hunkins, F. P. (2009). Curriculum: Foundations, principles, and issues (5th ed.). Pearson.

Pacadaljen, L. M. (2024). Hurdling obstructions on instructional management of science teachers in schools with challenging laboratory resources. Environment and Social Psychology, 9(10). https://doi.org/10.59429/esp.v9i10.3027

Quijano, G. (2023). Assessing the K-12 program implementation in the Philippines as an input to school-based policy plan. Journal for Educators, Teachers and Trainers, 14(1). https://doi.org/10.47750/jett.2023.14.01.022

Rodriguez, R. L., Serrano, R. A., Serrano, E. S. J., & Reyes, Z. Q. (2024). Adapting the 5E inquiry-based model in online science teaching. Academia Lasalliana Journal of Education and Humanities, 5(2), 23–40. https://doi.org/10.55902/LTUP1559

Rogan, J. M., & Grayson, D. J. (2003). Towards a theory of curriculum implementation with particular reference to science education in developing countries. International Journal of Science Education, 25(10), 1171–1204. https://doi.org/10.1080/09500690210145819

Sannert, R., Baur, A., & Krell, M. (2026). Design and effectiveness of professional development programmes to support teachers in promoting students' scientific inquiry competencies: A critical and systematic review of empirical studies. Studies in Science Education. https://doi.org/10.1080/03057267.2026.2688670

Strat, T. T. S., Henriksen, E. K., & Jegstad, K. M. (2024). Inquiry-based science education in science teacher education: A systematic review. Studies in Science Education, 60(2), 191–249. https://doi.org/10.1080/03057267.2023.2207148

UNESCO. (2023). Global education monitoring report 2023: Technology in education—A tool on whose terms? https://doi.org/10.54676/UZQV8501

Urdanivia Alarcon, D. A., Talavera-Mendoza, F., Rucano Paucar, F. H., Cayani Caceres, K. S., & Machaca Viza, R. M. (2023). Science and inquiry-based teaching and learning: A systematic review. Frontiers in Education, 8, 1170487. https://doi.org/10.3389/feduc.2023.1170487