UNIJERPS
Unizik Journal of Educational Research and Policy Studies VOL.19 (3);
January-June, 2025 https://unijerps.org
2023 Impact Factor: **6.834;** 2022 ***Impact Factor***: 5.156; ***2021 Impact Factor: 5.641;***
2020 Impact Factor: 5.355. *Indexing and Impact Factor URL: http://sjifactor.com/passport.php?id=21363*

IMPACT OF INQUIRY-BASED CONSTRUCTIVIST LEARNING APPROACH ON SECONDARY SCHOOL STUDENTS' ATTITUDES TOWARD CHEMISTRY IN 21ST CENTURY INCLUSIVE CLASSROOM

Prof. Gladys Uzezi Jack
Department of Science Education, Taraba State University, P.M.B 1167, Jalingo, Nigeria
jack.gladys@tsuniversity.edu.ng +234 7062549207

ABSTRACT

Worried by students' poor performance and traditional chemistry instruction which often struggles to engage students and can create a negative perception of the subject; this study addressed this issue by exploring the potential of inquiry-based learning (IBL) to foster a more positive and engaging learning environment. This study investigated the impact of inquiry-based, constructivist learning approaches on secondary school students' attitudes towards chemistry in a 21st-century inclusive classroom. The research aimed to determine if implementing IBL enhances students' engagement and positive attitudes toward chemistry, which is crucial for promoting science literacy and a love for STEM subjects. The research employed a quasi-experimental design with pre- and post-tests, comparing the IBL group with a control group using traditional methods. A sample of 105 students offering chemistry from two different secondary schools in Taraba State was purposively sampled for the study. The instrument used for collection of data was Students Attitudes towards Chemistry (SATC) with reliability index of 0.83. The data were analyzed with Means, Standard Deviations and Analysis of Covariance (ANCOVA). Results indicated that the IBL group promoted a more engaging and equitable learning environment that boosted more positive attitudes towards chemistry compared with traditional methods. No significant gender difference was observed in the impact of IBL, suggesting that it is beneficial for both male and female students. The study concluded that IBL is a powerful approach for enhancing students' attitudes toward chemistry, especially in a 21st-century inclusive classroom. Hence, Educators should actively adopt and integrate IBL into their chemistry curricula/lessons.

Keywords: Inquiry-based Learning, Constructivist learning theory, Retention, Attitude, Gender.

Introduction

The 21st-century classroom emphasizes student-centered learning, a vital shifting paradigms in education where students are actively involved in the learning process; and inquiry-based learning (IBL) aligns well with these goals. Inquiry-based learning, which encourages students to ask questions, explore, and experiment, aligns well with this paradigm promoted through a constructivist learning environment.

Constructivism suggests that learners actively build their own knowledge rather than passively receiving it; is a dominant theory in modern education, and IBL is often considered a constructivist approach. Inquiry-based learning promotes this active construction of knowledge by encouraging students to investigate and make sense of information which can be applicable in chemistry classes.

Chemistry is often perceived as a complex subject, and traditional teaching methods may not always effectively engage students, potentially leading to negative attitudes. Students may struggle with abstract concepts

and may develop negative attitudes towards the subject. Research (Dushimimana, & Mugabo, 2022; Nzomo, Rugano & Njoroge, 2023Tekin, & Eryılmaz, 2021; Teplá, & Distler, 2025) suggests that inquiry-based learning can improve student engagement, motivation, and understanding of science concepts. By actively participating in the learning process, students may develop a more positive attitude towards chemistry. The 21st-century classroom is characterized by technological advancements and the need for students to develop critical thinking and problem-solving skills; and IBL can help students develop these skills and prepare them for the demands of the modern world.

Conceptual understanding is highly required for the learners to get proper learning outcomes and positive attitudes in scientific concepts; and one of the learning models that has been proven in improving students' conceptual understanding is constructivism (Jack & Ogunleye, 2024, Jack & Ogunleye, 2025a&b). Constructivism is a learning theory that emphasizes the active role of the learner in constructing their own understanding; and suggests that learners build knowledge through experience, interaction, and reflection; rather than passively receiving information from teachers.

The constructivist model could help in improving students' attitude towards science. Attitude is one of the vital determinants of an individual's actions. Although, there are many definitions of attitude, all the views agree that an attitude is an individual's disposition to think, feel, or act positively or negatively toward objects in his or her environment (Jack & Ogunleye, 2025b). The constructivist model could also help in improving students' attitudes toward chemistry when difficult concepts are understood and retained through inquiry (Jack & Ogunleye, 2025a).

Inquiry-Based Learning (IBL) is a student-centered approach where learners actively explore concepts, ask questions, and conduct investigations, rather than passively receiving information. This aligns with constructivist principles, where learning is seen as an active process of knowledge construction. This philosophical stance of constructivism emphasizes that learning is not merely the transfer of information but the active construction of meaning by the learner. IBL supports this by encouraging students to engage in inquiry, experimentation, and reflection. The study focuses on a classroom that embraces diversity and promotes equitable learning opportunities for all students. This includes incorporating technologies, collaborative learning, and adapting instruction to meet individual needs. The study will measure students' attitudes towards chemistry, which is a crucial aspect of engagement and learning. A positive attitude can lead to greater interest, motivation, and ultimately, better performance in the subject.

Active learning requires a hands-on approach and requires learners to engage their minds in the process of inquiry learning (Khan, et al., 2017). The IBL is a teaching approach that emphasizes students' active participation in the learning process through questioning, investigation, and experimentation. IBL is rooted in constructivist learning theory, which posits that students construct their own knowledge through experience and reflection, rather than passively receiving information. Studies (Jack & Ogunleye, 2024, Jack & Ogunleye, 2025a) have shown declining student performance that students often struggle with certain chemistry concepts, particularly in areas like electrochemistry,

potentially due to the passive nature of traditional teaching methods, hence the need for constructivist approaches.

The 21st-century classrooms are increasingly recognizing the importance of inclusivity and equity, including addressing gender biases in education. The study recognizes the importance of addressing potential gender disparities in science learning and aimed to create a gender-friendly classroom environment where all students can thrive. The study also acknowledges the need for innovative teaching methods that prepare students for the challenges of the 21st century; and the consistently poor performance among secondary school students had been an issue of concern. Hence, the research aimed to determine if IBL enhances chemistry learning by fostering active participation, critical thinking, and deeper understanding, ultimately leading to improved attitude toward chemistry, which is crucial for promoting science literacy and a love for STEM subjects. Specifically, this study aims to investigate whether inquiry-based learning can improve student attitudes and engagement in chemistry, addressing these concerns within the context of the 21st-century classroom.

Research questions/ Hypotheses

In order to achieve the purpose for the study, two research questions were raised and null hypotheses tested at 0.05level of significance as follows:

1. What is the impact of inquiry-based science approaches on student attitude toward Chemistry, compared to traditional teaching methods?
2. Is there any difference in attitudinal scores between male and female students when taught using inquiry-based science instruction in a chemistry classroom?

$H0_1$: Students taught chemistry through inquiry-based instruction will demonstrate significantly higher attitude scores compared to students taught using traditional methods.

$H0_2$: There will be no significant difference in attitudinal scores between male and female students when taught using inquiry-based science instruction in a chemistry classroom.

Methodology

For the research design, due to logistical constraints in randomly assigning students, a quasi-experimental design with non-equivalent groups (experimental and control) was suitable for use for the study; specifically, pre-and post-posttest non-randomized group design. This involves randomly assigning classes to either the inquiry-based group or the traditional instruction group to ascertain impact of students' attitude toward chemistry. The design provides reasonable control over threats to the internal validity.

The study area is Jalingo Education Zone, Taraba State, Nigeria; comprising of all Secondary School Two (SS2) students offering Chemistry. A sample of 105 students from two different public secondary schools in 2024/2025 academic session was purposively selected for use out of the total population in the Zone. Out of the total sample size, 55 students were assigned to control group taught chemistry concepts using Traditional teaching method (TTM), and 50 students assigned to the experimental group using IBL grounded in constructivist principles. A pre-test was administered to

both groups to establish baseline attitude and a post-test to assess the attitudinal gains after instruction.

The instrument used for collection of data was a standardized modified 4-point rating scale Students Attitudes towards Chemistry (SATC) scale, a chemistry attitude survey made up of 30 items. The SATC after face and content validity were pilot tested using 40 students offering chemistry that were randomly selected from a public secondary school in a different education zone, but same State. The reliability of SATC was determined with Cronbach Alpha (α) and the reliability coefficient was 0.83, which was rated as good.

For the data collection for SATC, a standardized test were used to pre-designed chemistry tests to assess student knowledge and understanding of specific concepts, and attitude towards chemistry. Also, attitude scores were determined by analyzing scores from attitude tests to determine the effectiveness of the inquiry-based approach in promoting long-term retention and attitude toward chemistry respectively.

For the statistical analysis, the data collected were analyzed using descriptive statistics of Means and Standard Deviations were used to answer the research questions, and inferential statistics of Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Student attitude data were analyzed separately for male and female students to identify any gender-specific effects or disparities.

Results

Answering Research Question one:

What is the impact of IBL on student attitude toward Chemistry, compared to traditional teaching methods?

Table 1: Mean Attitude Scores and Standard Deviations of Students Mean attitude scores Taught Chemistry Using IBL

		Pre-test		Post-posttest		
Group	N	Mean	SD	Mean	SD	Mean Gain
IBL	50	2.12	1.87	3.60	1.20	1.48
TTM	55	2.08	1.57	2.24	1.06	0.16
Mean difference		0.04		1.36		

The result on Table 1 shows the mean attitude scores and standard deviations of students taught Chemistry using IBL and Traditional teaching methods (TTM). Table 1 also presents the mean gains in the attitude scores of students compared with their pre-test scores (i.e. pretest & re-test) taught chemistry difficult concepts in experimental and control groups. For experimental group taught with IBL, the mean gain is 1.48; while for the control group taught with TTM is 0.16; in favour of IBL showing enhancement of students' attitude of concepts. But, $H0_1$ was used to test if the difference was significant in Table 2.

Testing Hypothesis one:

$H0_1$: Students taught chemistry through IBL will demonstrate significantly higher attitude scores compared to students taught using traditional methods.

Table 2: One-Way ANCOVA on Method and Students' Attitude towards Chemistry

Sources of Variation	Sum of Squares	df	Mean Square	F	Sig	Partial Eta squared
Corrected Model	0.759[a]	2	0.479	0.684	0.506	0.662
Intercept	51.140	1	35.140	210.126	0.000	0.550
Pre-Attitude	7.639	1	7.639	0.081	0.776	0.001
Method	0.662	1	0.662	1.356	0.002	0.018
Error	17.750	102	17.750			
Total	912.000	105				
Corrected Total	17.509	104				

a. R Squared = .662 (Adjusted R Squared = .656)

Table 2 shows that F (1,102) = 1.36; p = 0.002< 0.05. Since p-value is less than 0.05, the null hypothesis is rejected. The result shows that students taught chemistry through inquiry-based instruction demonstrated significantly higher attitude scores compared to students taught using traditional methods. This implies that IBL enhances conceptual understanding, critical thinking, and motivation, making it more effective than TTM; and the active nature of IBL can foster positive attitudes toward chemistry.

Answering Research Question Two:
Is there any difference in attitudinal scores between male and female students when taught using IBL in a chemistry classroom?

Table 3: Mean Attitude Ratings of Male and Female Students Taught Chemistry using IBL

		Pre-test		Post-posttest		
Group	N	Mean	SD	Mean	SD	Mean Gain
Male	29	2.32	1.02	3.31	1.71	0.81
Female	21	2.27	1.07	3.25	1.94	0.98
Mean difference						

The result on Table 3 shows the mean attitude scores and standard deviations of male and female students taught Chemistry using IBL. Table 3 presents the mean gains in the attitude scores of male and female students compared with their pre-test scores (i.e. pretest & re-test) taught chemistry difficult concepts in the experimental group using IBL. For experimental group taught with IBL based on gender, the mean gain is 0.81 for the male students, and 0.98 for the female students. But, $H0_2$ was used to test if the difference was significant in Table 4.

Testing Hypothesis Two

$H0_2$: There will be no significant difference in attitudinal scores between male and female students when taught using IBL in a chemistry

Table 4: ANCOVA of Mean Attitude Scores of Students Taught Chemistry using IBL

Sources of Variation	Sum of Squares	df	Mean Square	F	Sig	Partial Eta squared
Corrected Model	0.803[a]	2	0.451	0.812	0.519	0.019
Intercept	52.102	1	35.102	205.153	0.000	0.552
Pre-Attitude	7.786	1	7.786	0.046	0.830	0.000
Gender	0.528	1	0.528	0.681	0.410	0.004
Method	0.682	1	0.682	2.030	0.156	0.012
Error	17.705	47	0.95			
Total	912.000	50				
Corrected Total	17.509	49				

a. R Squared = .019 (Adjusted R Squared = .011)

Table 4 shows that F(1,47) = 2.03; p = 0.16> 0.05. Since p-value is greater than 0.05, the null hypothesis is not rejected; and that there was no significant difference in attitudinal scores between male and female students when taught using IBL in a chemistry This shows that there is no significant difference in mean attitude scores of students taught Chemistry concepts using IBL. This implies that IBL can foster positive attitudes toward chemistry, leading to increased motivation and engagement and is gender-friendly.

Discussion

The key findings discussed are as follows:

1. Students taught chemistry using IBL demonstrated significantly higher attitudes towards chemistry compared to students taught using traditional methods.
2. There was no significant difference in attitude scores between male and female students when taught using IBL in a chemistry classroom.

Inquiry-based constructivist learning can positively impact secondary school students' attitudes towards chemistry, especially in a 21st-century inclusive classroom as shown from the findings of the present study. By actively engaging in investigations, students developed a deeper understanding of chemical concepts and cultivate higher-order thinking skills, leading to improved attitudes.

The findings showed that students taught chemistry through inquiry-based instruction demonstrated significantly higher attitudes towards chemistry compared to students taught using traditional methods. The finding supports these researchers (Dushimimana, & Mugabo, 2022; Tekin, & Eryılmaz, 2021; Teplá, & Distler, 2025) who revealed that the active nature of IBL fostered students' positive attitudes toward chemistry, leading to increased motivation and active engagement; which are in consistent with the principles of constructivist learning theory.

The findings showed that there was no significant difference in attitude scores between male and female students when taught using inquiry-based science instruction in a chemistry classroom. Students feel empowered to explore and discover, which can be more engaging than passively receiving information, regardless of gender. This showed that Inquiry-based instruction in a chemistry classroom can impact male and female students differently, with potential benefits for both genders. The finding supports Teplá, and Distler, (2025) who that IB approaches can increase student engagement and knowledge acquisition regardless of gender.

Numerous studies (Dushimimana, & Mugabo, 2022; Nzomo, Rugano & Njoroge, 2023Tekin, & Eryılmaz, 2021; Teplá, & Distler, 2025) have demonstrated the effectiveness of inquiry-based learning in

improving students' attitudes in chemistry. One study reported that inquiry-based teaching methods improved students' performance and attitudes towards chemistry (Dushimimana, & Mugabo, 2022). Another study (Teplá, & Distler, 2025) found that students who participated in inquiry-based learning activities showed significantly higher achievement in various areas, including knowledge, reasoning, and discussion. Furthermore, a study (Nzomo, Rugano & Njoroge, 2023) on the relationship between inquiry-based learning and students' attitudes towards chemistry revealed that students exhibited a positive attitude towards chemistry when engaged in inquiry-based learning activities.

Conclusion

In conclusion, inquiry-based constructivist learning is a powerful approach for enhancing students' attitudes in chemistry, especially in a 21st-century inclusive classroom. By fostering engagement, developing higher-order thinking skills, and promoting a deeper understanding of chemical concepts, this approach can lead to a more positive and enriching learning experience for all students than traditional methods.

Recommendations

Based on the conclusion drawn, recommendations are made as follows:

1. Teachers are encouraged to integrate IB approaches into their chemistry curriculum/lessons, moving away from rote memorization, and towards active, hands-on learning experiences.
2. Teachers should be provided with professional development opportunities to effectively implement inquiry-based strategies in the classroom to meet the diverse needs of students.

REFERENCES

Dushimimana, F. & Mugabo, L. (2022). Effects of inquiry-based teaching method on students' academic performance and attitudes towards chemistry in two selected secondary schools of Bugesera District, Rwanda. *Journal of Research Innovation and Implications in Education*, 6(2), 44 – 56.

Jack, G. U. & Ogunleye, D. O. (2024). Improving secondary school students' academic achievement in chemistry using 7Es constructivist instructional strategy. *International Journal of Innovative Social & Science Education Research, 12*(1), 61-83.

Jack, G. U. & Ogunleye, D. O. (2025a). Effect off 7E learning cycle model on students' attitude towards chemistry at secondary school level. *African Journal of Educational Management and Entrepreneurial Studies* (AJEMATES), 14(1), 42-53.

Jack, G. U. & Ogunleye, D. O. (2025b). Effectiveness of 7E constructivist instructional strategy on students' knowledge retention of difficult concepts in Chemistry. *Unizik Journal of Educational Research and Policy Studies*, 19(2), 377-387.

Khan, S., Egbue, O., Palkie, B., & Madden, M. (2017). Active learning in STEM

education. *Journal of STEM Education*, 18(2), 1-13.

Nzomo, C. M.; Rugano, P. & Njoroge, M. (2023). Relationship between inquiry-based learning and students' attitudes towards chemistry. *International Journal of Evaluation and Research in Education* (IJERE), 12(2), 991.

Osegbue, G. C. (2025). Early childhood education in Nigeria: challenges and prospects. *Unizik Journal of Educational Laws and Leadership Studies*, *2*(1).

Osegbue, G. C. (2025). Crisis intervention and response in educational institutions: developing and implementing plans in developing countries. *African Journal of Educational Management, Teaching and Entrepreneurship Studies*, *15*(1).

Tekin, G., & Eryılmaz, M. Ö. (2021). The effect of research-inquiry based activities on the academic achievement, attitudes, and scientific process skills of students in the seventh year science course. *The European Educational Researcher*, 4(1), 109–131.

Teplá, M. & Distler, P., (2025). The impact of long-term inquiry-based science education on students' motivation and knowledge acquisition: The role of gender, subject, and level of inquiry. *Humanities and Social Sciences Communications*, 12:239.