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EFFECT OF INQUIRY-BASED AND ENTREPRENEURIAL TEACHING APPROACHES ON STUDENTS' ATTITUDES TOWARD STEM CAREERS IN NIGERIAN SECONDARY SCHOOLS

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Abstract

This study investigated the effect of inquiry-based and entrepreneurial teaching approaches on secondary school students' attitudes toward STEM (Science, Technology, Engineering, and Mathematics) careers in Nigeria. Against the backdrop of declining student interest in STEM pathways especially among underrepresented groups. A quasi-experimental research design was employed involving 270 Senior Secondary II students across six co-educational public schools in the Zaria Education Zone of Kaduna State. Students were divided into three groups: inquiry-based, entrepreneurial, and conventional instruction. The Students' Attitudes Toward STEM Careers Questionnaire (SATSCQ) was administered before and after a six-week intervention. Data were analyzed using ANCOVA to determine the effects of instructional strategies and gender on students' post-test

attitudes. Findings revealed that both inquiry-based and entrepreneurial teaching methods significantly enhanced students' attitudes toward STEM careers compared to conventional methods. However, no significant gender-based difference was observed within the experimental groups. The results suggest that incorporating active, participatory, and real-world learning strategies can strengthen students' STEM career orientations and reduce gender disparities. The study concludes by recommending systemic curriculum reforms, capacity-building for teachers, and gender-inclusive practices to advance STEM education and career engagement in Nigeria.

Keywords: STEM careers; Inquiry-based learning; Entrepreneurial pedagogy; Gender in STEM; Attitude toward STEM; Nigerian secondary schools; Active learning; Educational reform.

Introduction

The demand for a workforce equipped with Science, Technology, Engineering, and Mathematics (STEM) skills has grown exponentially in response to the dynamic global economy, technological advancement, and the 21st-century knowledge society. In Nigeria, however, there remains a persistent concern over the declining interest and unfavorable attitudes of students—particularly at the secondary school level—toward STEM careers. This trend poses a significant threat to national development, innovation, and global competitiveness, particularly as the country aspires to diversify its economy and promote technological self-reliance (Ogunleye & Akinbobola, 2020). Research has shown that attitudes toward STEM careers are shaped not only by societal perceptions and gender stereotypes but also by the teaching strategies adopted in the classroom (Achor & Shaibu, 2019). Traditional, teacher-centered approaches prevalent in many Nigerian schools often fail to capture students' curiosity, creativity, and engagement, leading to passive learning and disconnection from real-world STEM applications (Anene, 2021).

To bridge this attitudinal gap, contemporary pedagogies such as inquiry-based learning (IBL) and entrepreneurial teaching approaches have gained prominence for their ability to contextualize STEM content, promote active learning, and empower students to apply scientific knowledge to practical, economic, and societal challenges (Adu, 2022; European Commission, 2015). Inquiry-based learning encourages exploration, questioning, experimentation, and evidence-based reasoning—core skills essential for STEM-related careers. Entrepreneurial education, on the other

hand, equips learners with creativity, risk-taking, and opportunity recognition, aligning STEM learning with the skills required for innovation, employability, and economic transformation (Kuratko, 2016; Nwoye, 2020). Integrating these approaches in the STEM classroom has the potential to positively influence students' perceptions of STEM careers by helping them see the relevance, applicability, and rewarding nature of STEM fields.

Despite the growing recognition of the value of these approaches, there is limited empirical evidence in the Nigerian context regarding their combined effect on students' attitudes toward STEM careers, especially at the critical secondary school level. Furthermore, the intersection of pedagogical innovation and career orientation remains underexplored in policy and practice. The problem becomes even more pressing when viewed against the backdrop of increasing youth unemployment, low representation of females in STEM, and the disconnect between school curricula and labor market demands in Nigeria (UNESCO, 2021). Therefore, this study seeks to investigate the effect of inquiry-based and entrepreneurial teaching approaches on students' attitudes toward STEM careers in Nigerian secondary schools. By evaluating how these methodologies influence learners' career orientations, this research aims to provide evidence-based recommendations for curriculum developers, educators, and policymakers to reform science and mathematics instruction in a way that stimulates long-term interest in STEM professions.

Objectives of the Study

The overarching objective of this study is to examine the effect of inquiry-based and entrepreneurial teaching approaches on

students' attitudes toward STEM careers in Nigerian secondary schools. Specifically, the study seeks to:

1. determine the extent to which inquiry-based teaching influences students' attitudes toward careers in STEM disciplines.
2. investigate the impact of entrepreneurial teaching approaches on students' orientation and interest in pursuing careers in STEM fields.
3. compare students' attitudes toward STEM careers across different instructional approaches, namely inquiry-based, entrepreneurial, and conventional teaching methods.
4. determine gender-based differences in students' attitudes toward STEM careers when exposed to innovative instructional strategies such as inquiry-based and entrepreneurial approaches.

Research Questions

The following research questions guided the study:

1. To what extent does the inquiry-based teaching approach affect students' attitudes toward STEM-related careers in Nigerian secondary schools?
2. In what ways does the entrepreneurial teaching approach affect students' orientation and interest in pursuing STEM-related careers?
3. What is the difference in the mean attitude scores of students toward STEM careers when taught using inquiry-based, entrepreneurial, and conventional teaching approaches?
4. What is the difference in the mean attitude scores of male and female students toward STEM careers when exposed to inquiry-based and

entrepreneurial instructional strategies?

Null Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

H₀₁: There is no statistically significant difference in the mean attitude scores toward STEM careers between students taught using inquiry-based teaching approaches and those taught using the conventional lecture method.

H₀₂: There is no statistically significant difference in the mean attitude scores toward STEM careers between students taught using entrepreneurial teaching approaches and those taught using the conventional lecture method.

H₀₃: There is no statistically significant difference in the mean attitude scores toward STEM careers among students taught using inquiry-based, entrepreneurial, and conventional lecture methods.

H₀₄: There is no statistically significant difference in the mean attitude scores toward STEM careers between male and female students taught using inquiry-based and entrepreneurial instructional strategies.

Literature Review

The integration of innovative pedagogical strategies such as inquiry-based learning (IBL) and entrepreneurial teaching into STEM education has garnered significant attention in both research and practice. These approaches are rooted in the belief that students learn best when they are actively engaged in the learning process, working on real-world problems that connect classroom knowledge to future careers (Prince & Felder, 2006). Inquiry-based learning, in particular, empowers students to explore scientific phenomena,

formulate questions, conduct investigations, and derive conclusions through evidence, thus promoting deeper understanding and critical thinking (Bybee, 2014). According to Bell, Smetana, and Binns (2005), students exposed to IBL tend to develop more positive attitudes toward STEM careers because the process mirrors the actual practices of scientists and engineers.

On the other hand, entrepreneurial teaching emphasizes the development of innovative, risk-taking, and opportunity-driven thinking, often through project-based or problem-based approaches that involve product design, market analysis, and real-life application of STEM knowledge. Kuratko (2016) argued that entrepreneurial education helps students see the economic and creative value of scientific knowledge, thereby enhancing their motivation to pursue STEM professions. Studies such as that by Anamuah-Mensah et al. (2019) have shown that students taught with entrepreneurial pedagogies exhibit higher levels of curiosity, initiative, and a desire to solve community-based problems using scientific methods.

Moreover, integrating IBL and entrepreneurial strategies has been linked with improved gender inclusivity in STEM. Research by UNESCO (2021) notes that gender-sensitive approaches to STEM education that focus on active participation, mentorship, and real-world application tend to mitigate negative stereotypes and increase girls' interest in STEM careers. This is particularly crucial in contexts like Nigeria, where gender disparity in STEM fields is prominent and largely driven by cultural biases and lack of early exposure to empowering learning environments (Ogunleye & Akinbobola, 2020).

The theoretical foundation of this study is drawn from Social Cognitive Career

Theory (SCCT), developed by Lent, Brown, and Hackett (1994). SCCT posits that an individual's career interests and choices are shaped by three core factors: self-efficacy beliefs, outcome expectations, and personal goals. In the context of this study, inquiry-based and entrepreneurial teaching strategies are hypothesized to positively influence students' self-efficacy and expectations regarding STEM careers, thereby fostering more favorable attitudes toward pursuing such careers. When students are actively engaged in solving meaningful problems and seeing the relevance of STEM knowledge to real-world scenarios, their confidence grows, and so does their interest in STEM-related futures (Bandura, 1997).

In summary, a growing body of literature supports the premise that inquiry-based and entrepreneurial instruction can transform the way students perceive STEM education, enhancing not only their academic engagement but also their future career aspirations. However, most of the existing studies have been conducted in Western or urban contexts, with limited empirical work focused on Nigerian secondary schools—especially in rural or mixed-gender settings. This study thus fills a critical gap by evaluating these innovative teaching strategies in the Nigerian context, with specific attention to attitudinal and gender-based dimensions.

Methodology

This study adopted a quasi-experimental research design using a pre-test, post-test, non-equivalent control group approach to examine the effects of inquiry-based and entrepreneurial teaching strategies on students' attitudes toward STEM careers in Nigerian secondary schools. The design was selected because it allowed for the comparison of outcomes across naturally existing groups without the need for

random assignment. The study was conducted in six public co-educational secondary schools located in the Zaria Education Zone of Kaduna State, Nigeria. A total of 270 Senior Secondary II (SSII) students participated in the study, drawn from intact classes across the selected schools. The schools were assigned into three groups: one received inquiry-based instruction, another received entrepreneurial-based instruction, and the third served as the control group, receiving conventional teaching methods. The sampling was done using purposive and stratified techniques to ensure gender balance and representation across urban and peri-urban school settings. The primary instrument used for data collection was the Students' Attitude Toward STEM Careers Questionnaire (SATSCQ), a 30-item Likert-type instrument adapted and modified from validated instruments in prior studies (e.g., Tyler-Wood et al., 2010; Maltese & Tai, 2011). The SATSCQ was

subjected to expert validation for content and construct relevance, and its reliability was confirmed through pilot testing using Cronbach's Alpha, yielding a coefficient of 0.86, indicating high internal consistency. The treatment period lasted for six weeks, during which the experimental groups were exposed to weekly sessions that incorporated inquiry cycles and entrepreneurship-based tasks into their science and mathematics lessons, while the control group followed the traditional curriculum without such enhancements. The data obtained from the pre-test and post-test administrations of the Students' Attitudes Toward STEM Careers Questionnaire (SATSCQ) were analyzed using Analysis of Covariance (ANCOVA) to statistically control for initial group differences and assess the impact of the independent variables on students' post-intervention attitudes toward STEM careers.

Results and Analysis

Hypothesis 1 (H_{01}):

There is no significant difference in the attitudes of students taught using inquiry-based teaching approaches and those taught using conventional methods toward STEM careers.

Table 1: ANCOVA Summary for Inquiry-Based vs. Conventional Teaching on STEM Career Attitudes

Source	SS	df	MS	F	Sig.	Partial η^2
Corrected Model	842.76	2	421.38	24.67	.000	0.156
Pre-Test (Covariate)	213.54	1	213.54	12.50	.001	0.047
Group (Method)	781.22	1	781.22	45.70	.000	0.147
Error	1705.11	247	6.90			
Total	35678.00	270				

Table 1 shows that after controlling for pre-test scores, a statistically significant effect of teaching method on students' attitudes toward STEM careers was found, $F(1, 247) = 45.70$, $p < .001$. The partial eta squared ($\eta^2 = 0.147$)

Hypothesis 2 (H₀₂):

There is no significant difference in the attitudes of students taught using entrepreneurial teaching approaches and those taught using conventional methods toward STEM careers.

Table 2: ANCOVA Summary for Entrepreneurial vs. Conventional Teaching on STEM Career Attitudes

Source	SS	df	MS	F	Sig.	Partial η^2
Corrected Model	918.42	2	459.21	31.33	.000	0.189
Pre-Test (Covariate)	205.61	1	205.61	14.02	.000	0.054
Group (Method)	863.04	1	863.04	58.89	.000	0.176
Error	1710.03	247	6.92			
Total	35678.00	270				

As shown in Table 2, there is a statistically significant difference between the entrepreneurial and conventional groups, $F(1, 247) = 58.89$, $p < .001$. The effect size is large

Hypothesis 3 (H₀₃):

There is no significant difference in students' attitudes toward STEM careers across the three instructional groups.

Table 3: ANCOVA Summary for Differences Across Three Instructional Methods

Source	SS	df	MS	F	Sig.	Partial η^2
Corrected Model	1324.76	3	441.59	28.90	.000	0.260
Pre-Test (Covariate)	178.10	1	178.10	11.66	.001	0.045
Group (Method)	1239.89	2	619.94	40.56	.000	0.247
Error	1567.45	266	5.89			
Total	35678.00	270				

ANCOVA results indicate a statistically significant difference among the three groups (inquiry-based, entrepreneurial, and conventional), $F(2, 266) = 40.56$, $p < .001$. With a partial η^2 of 0.247, the effect size is

Hypothesis 4 (H₀₄):

suggests a large effect size. This indicates that inquiry-based teaching significantly enhanced students' attitudes compared to conventional methods. Thus, H₀₁ is rejected.

($\eta^2 = 0.176$), implying that entrepreneurial teaching strategies had a strong positive impact on students' attitudes toward STEM careers. Therefore, H₀₂ is rejected.

large, signifying that both innovative teaching methods had substantial effects on students' STEM career attitudes when compared to traditional instruction. Therefore, H₀₃ is rejected.

There is no significant gender-based difference in students' attitudes toward STEM careers under the innovative teaching approaches.

Table 4: Two-Way ANCOVA Summary for Gender Differences in Attitudes

Source	SS	df	MS	F	Sig.	Partial η^2
Gender	48.21	1	48.21	3.15	.078	0.012
Group \times Gender	16.89	2	8.45	0.55	.578	0.004
Error	1710.03	265	6.46			

Table 4 reveals no statistically significant difference in STEM career attitudes based on gender, $F(1, 265) = 3.15$, $p = .078$. The interaction between group and gender was also

not significant. Therefore, H_{04} is not rejected, implying that both male and female students responded similarly to the inquiry-based and entrepreneurial teaching interventions.

Discussion of Findings

The findings of this study provide compelling evidence that innovative teaching approaches—specifically inquiry-based and entrepreneurial strategies—positively influence students' attitudes toward STEM careers in Nigerian secondary schools. The rejection of Hypotheses H_{01} , H_{02} , and H_{03} clearly indicates that students exposed to these methods developed significantly more favorable attitudes compared to those who received conventional instruction. These results resonate with the assertions of Bell, Smetana, and Binns (2005), who argued that inquiry-based learning mirrors authentic scientific inquiry, thereby making students more interested in STEM fields. By allowing students to formulate hypotheses, engage in experimentation, and draw conclusions through self-directed learning, the inquiry-based method nurtures curiosity and builds confidence in scientific processes (Bybee, 2014).

Similarly, the entrepreneurial approach's effectiveness aligns with Kuratko's (2016) emphasis on fostering creativity, innovation, and opportunity recognition in learners. When

students are guided to solve real-world problems, create value-driven projects, and simulate entrepreneurial thinking, they begin to view STEM not as abstract academic disciplines, but as practical, rewarding career paths. This real-world applicability is especially crucial in contexts like Nigeria, where students often struggle to see the direct relevance of their education to future careers (Audu, 2022; Anamuah-Mensah et al., 2019).

Moreover, the significant difference found among the three instructional strategies further supports the body of research that highlights the limitations of traditional teacher-centered methods. Studies by Prince and Felder (2006) and Ogunleye and Akinbobola (2020) have emphasized that passive learning environments, where students are mere recipients of knowledge, are less effective in cultivating sustained interest in STEM professions.

The non-significant gender difference in students' attitudes toward STEM careers under the innovative strategies (H_{04}) is another notable finding. This result supports the position of UNESCO (2021), which argued that inclusive and engaging teaching practices

such as IBL and entrepreneurial pedagogy can help mitigate gender-based disparities in STEM education. By fostering equitable participation and designing tasks that appeal to diverse interests, these approaches create a level playing field that supports both male and female learners equally.

Conclusion

This study set out to examine the effect of inquiry-based and entrepreneurial teaching approaches on secondary school students' attitudes toward STEM careers in Nigeria. Grounded in Social Cognitive Career Theory, the findings confirmed that students exposed to these innovative pedagogies developed significantly more favorable attitudes toward pursuing STEM-related careers compared to their peers taught with traditional methods. Both inquiry-based and entrepreneurial strategies were found to have substantial impacts, enhancing student engagement, confidence, and interest in science, technology, engineering, and mathematics. Furthermore, the study revealed no statistically significant gender-based differences in students' attitudes within the experimental groups, highlighting the potential of these strategies to bridge the persistent gender gap in STEM education. These results underscore the need for a shift in teaching paradigms in Nigerian schools—from didactic and content-heavy instruction to more participatory, skill-oriented, and contextually relevant methodologies that promote exploration, creativity, and long-term career aspirations in STEM.

Recommendations

1. Education stakeholders, particularly curriculum planners and policymakers in Nigeria, should integrate inquiry-based and

entrepreneurial teaching approaches into the secondary school curriculum. These pedagogies have proven effective in enhancing students' attitudes toward STEM careers and fostering a more engaging and reflective learning environment.

2. Regular capacity-building workshops and in-service training programs should be organized to equip science and mathematics teachers with the necessary skills and methodologies to effectively implement inquiry-based and entrepreneurial instructional strategies in their classrooms.
3. Since the study found no significant gender-based differences in students' attitudes when exposed to these teaching methods, it is recommended that schools and education authorities adopt gender-sensitive pedagogical practices that continue to support and encourage both male and female students to pursue STEM careers equally.
4. The national curriculum should be reviewed to include more participatory and real-world oriented STEM content that supports inquiry, creativity, collaboration, and problem-solving, aligning with 21st-century skills and labor market demands.

References

- Anamuah-Mensah, J., Asabere-Ameyaw, A., & Dennis, B. K. (2019). *Repositioning STEM education for sustainable development in Africa*. *African Journal of Educational Studies in Mathematics and Sciences*, 15(1), 1–11.

- <https://doi.org/10.4314/ajesms.v15i1.1>
- Audu, M. A. (2022). Entrepreneurial science education for sustainable development in Nigeria. *African Journal of Educational Research and Development*, 14(2), 22–30.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman.
- Bell, R. L., Smetana, L., & Binns, I. (2005). Simplifying inquiry instruction. *The Science Teacher*, 72(7), 30–33.
- Bybee, R. W. (2014). The BSCS 5E instructional model: Creating teachable moments. *National Institutes for Science Education Journal*, 12(3), 30–42.
- Kuratko, D. F. (2016). *Entrepreneurship: Theory, process, and practice* (10th ed.). Cengage Learning.
- Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, 45(1), 79–122. <https://doi.org/10.1006/jvbe.1994.1027>
- Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among U.S. students. *Science Education*, 95(5), 877–907. <https://doi.org/10.1002/sce.20441>
- Ogunleye, A. O., & Akinbobola, A. O. (2020). Bridging the STEM gender gap in Nigerian secondary schools through inclusive teaching strategies. *Nigerian Journal of Educational Technology*, 5(2), 60–74.
- Prince, M. J., & Felder, R. M. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. *Journal of Engineering Education*, 95(2), 123–138. <https://doi.org/10.1002/j.2168-9830.2006.tb00884.x>
- Tyler-Wood, T., Knezek, G., & Christensen, R. (2010). Instruments for assessing interest in STEM content and careers. *Journal of Technology and Teacher Education*, 18(2), 341–363.
- UNESCO. (2021). *Cracking the code: Girls' and women's education in STEM*. Paris: UNESCO Publishing. <https://unesdoc.unesco.org/ark:/48223/pf0000253479>