Journal of Theoretical and Empirical Studies in Education
Vol. 10 Issue 1 April, 2025

Application of Inquiry-Based Learning Strategy on Teaching Denudation Processes Among Senior Secondary Schools II of Anchau Zone, Kaduna State

AMINU SALISU, PhD
Department of Science Education, Faculty of Education
Umaru Musa Yar'adua University, Katsina
Alaminaminabdullahi@Gmail.Com
08037446501

Abstract

This study examined the application of Inquiry-Based Learning (IBL) on teaching denudation processes among Senior Secondary School II students in Anchau Zone, Kaduna State. It investigated the impact of IBL on students' understanding, academic performance, and engagement. Using a quasi-experimental research design, 111 students were selected through random sampling, with 58 in the experimental group and 54 in the control group. The study used Achievement Test (Pre-test and Post-test) that included multiple-choice and short-answer questions aligned with the geography curriculum. Data were collected using pre-tests and post-tests through multiple-choice and short-answer questions and analysed using descriptive and inferential statistics (t-test). The study was built based on Kolb's Experiential Learning Theory (1984) which emphasizes that learning occurs through a continuous cycle of experience and reflection Findings revealed that IBL significantly improved students' understanding, academic performance, and engagement in learning denudation processes. The study supports the integration of IBL strategies into the geography curriculum and emphasizes teacher training and resource provision for successful implementation. It recommends further research to evaluate the long-term effectiveness of IBL across other geographical topics and educational contexts, enhancing student-centered learning outcomes in secondary education.

Keywords: Inquiry-Based Learning Strategy, Denudation Processes, physical geography

Introduction

Geography as a discipline plays a crucial role in fostering an understanding of the physical environment and its dynamic processes. A key aspect of physical geography is denudation, which includes weathering, erosion, transportation, and deposition (Gregory, 2010). Teaching these processes is essential within the Senior Secondary School (SSS) Geography curriculum. However, conventional lecture-based methods often fail to foster a deep understanding of these complex processes (Madu, 2014). This highlights the need for more engaging and student-centered

approaches like inquiry-based learning (IBL). IBL is an instructional strategy that promotes active learning by encouraging students to question, investigate, and construct their own knowledge (Pedaste *et al*., 2015). This method contrasts with traditional passive learning by involving students directly in the educational process. Prince and Felder (2016) argue that IBL enhances critical thinking, problem-solving abilities, and knowledge retention. In geography education, IBL allows students to connect theoretical concepts with real-world applications, making abstract topics like denudation more concrete (Ogunniyi, 2017). This approach is especially relevant in Anchau Zone, Kaduna State, where the physical environment offers practical examples of denudation processes. However, many Geography teachers in the region continue to rely on traditional methods, limiting student engagement and comprehension (Aliyu, 2018). Research indicates that students taught using IBL demonstrate higher academic achievement and improved attitudes toward learning (Hmelo-Silver *et al*., 2007). For instance, a study by Olorundare and Akinola (2017) found that IBL strategies significantly enhanced students' understanding of physical geography topics in Nigerian secondary schools. The National Policy on Education supports adopting innovative teaching approaches to improve learning outcomes (Federal Republic of Nigeria, 2014). Despite the benefits of IBL, challenges such as insufficient teacher training, resource shortages, and large class sizes hinder its implementation (Ogunniyi, 2017). This study aims to explore the impact of IBL on teaching denudation processes among Senior Secondary School II students in Anchau Zone. The findings will provide evidence-based recommendations for improving geography instruction and contribute to the ongoing discussion on innovative teaching practices in Nigeria.

Statement of Problem

The application of inquiry-based learning strategy on teaching denudation processes among Senior Secondary School II students in Anchau Zone, Kaduna State, faces several challenges. First, there is a lack of teacher training on effective implementation of inquiry-based methods. Second, inadequate instructional

materials hinder hands-on learning. Third, large class sizes make individualized inquiry difficult. Fourth, time constraints limit the depth of inquiry activities. Lastly, students' limited prior knowledge affects their ability to engage effectively in inquiry-based tasks.

Literature Review

Inquiry-based learning (IBL) is a student-centered approach that emphasizes active exploration and critical thinking (Hmelo-Silver *et al*., 2007). This method allows students to investigate concepts through questioning and hands-on experiences, promoting a deeper understanding of complex topics. In geography, particularly in physical geography topics like denudation processes, IBL enhances conceptual grasp by connecting theoretical knowledge with practical applications (Pedaste *et al*., 2015). Studies suggest that IBL improves spatial reasoning and helps students relate abstract processes such as weathering and erosion to real-world phenomena (Areepattamannil, 2014). Denudation processes, including weathering, erosion, and mass movement, are dynamic and require interactive learning strategies for better comprehension (Banchi & Bell, 2008). Research by Prince and Felder (2006) indicates that students exposed to inquiry-based methods show higher retention of complex physical geography concepts. IBL facilitates the development of scientific literacy and analytical skills by engaging students in hypothesis formation, data collection, and evidence evaluation (Chin & Osborne, 2008).

The implementation of IBL has been linked to improved academic performance in geography (Furtak *et al*., 2012). Through inquiry-driven instruction, students become active participants in their learning process, which fosters a deeper understanding and improved academic outcomes (Walker & Leary, 2009). According to Minner *et al*. (2010), students who engage with inquiry-based strategies perform significantly better in assessments compared to those taught using traditional lecture methods. In geography education, IBL supports the development of spatial thinking and the ability to analyze environmental systems (Kim & Hannafin, 2011). This aligns with findings from a study by Marshall and Horton

(2011), which demonstrated that inquiry-based approaches led to a marked improvement in test scores and long-term knowledge retention. Furthermore, inquiry-based strategies promote the transfer of knowledge across different geographical contexts, enhancing both conceptual understanding and practical application (Hmelo-Silver *et al*., 2007). Student engagement and participation are crucial indicators of effective learning environments. Inquiry-based learning encourages active involvement by fostering curiosity and enabling students to drive their learning process (Kuh *et al*., 2006). According to Chinn and Malhotra (2002), IBL increases motivation by providing learners with autonomy and opportunities to engage with meaningful tasks.

Research has shown that IBL promotes collaborative learning and critical thinking skills (Hmelo-Silver *et al*., 2007). When students are actively involved in inquiry-based tasks, they exhibit higher levels of engagement and better problem-solving abilities (Lazonder & Harmsen, 2016). In geography, such approaches enhance participatory learning, where students collaboratively explore physical processes and their impacts (Pedaste *et al*., 2015). The active nature of IBL aligns with Vygotsky's (1978) social constructivist theory, which emphasizes learning through social interaction and shared experiences.

Conceptual Framework

The conceptual framework of this study examines the relationship between the Inquiry-Based Learning (IBL) strategy and three key dependent variables: understanding of denudation processes, academic performance in geography, and student engagement and participation. IBL emphasizes active learning through questioning, investigation, and problem-solving, fostering deeper comprehension of complex topics (Pedaste *et al*., 2015). In the context of geography education, the use of IBL enhances students' understanding of denudation processes by promoting hands-on exploration and inquiry-based tasks (Hmelo-Silver *et al*., 2007). This approach also improves academic performance, as evidenced by increased assessment scores and overall achievement (Prince & Felder, 2006). Furthermore,

IBL encourages active student engagement and collaboration, facilitating meaningful participation in the learning process (Bell *et al*., 2010). Thus, the framework suggests that integrating IBL into geography instruction leads to improved comprehension, better academic outcomes, and greater student involvement.

Theoretical Framework

The study is built based on Kolb's Experiential Learning Theory (1984) which emphasizes that learning occurs through a continuous cycle of experience and reflection. This model consists of four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). Inquiry-based learning aligns with this theory by encouraging students to engage actively in real-world experiences, reflect on their observations, conceptualize new ideas, and apply their knowledge through practical experiments. This cyclical process promotes deeper academic understanding and enhances active participation in learning (Kolb, 1984). For example, in science education, students might conduct experiments (concrete experience), reflect on the results (reflective observation), develop scientific theories (abstract conceptualization), and test their hypotheses through further experiments (active experimentation). This hands-on, reflective approach fosters critical thinking and independent learning, making it particularly effective in inquiry-based learning environments (Kolb, 1984). By integrating experiential learning principles, educators can create engaging and meaningful learning experiences that promote long-term knowledge retention.

Objectives of the Study

1. To examine the impact of inquiry-based learning on students' understanding of denudation processes.
2. To assess the effect of inquiry-based learning in improving students' academic performance in geography.
3. To evaluate students' engagement and participation using inquiry-based learning.

Research Questions

1. What is the impact of inquiry-based learning on students' understanding of denudation processes?
2. How does inquiry-based learning affect students' academic performance in geography?
3. To what extent does inquiry-based learning influence students' engagement and participation in learning denudation processes?

Hypotheses

i. There is no significant effect of inquiry-based learning on students' understanding of denudation processes.
ii. There is no significant effect of inquiry-based learning on students' academic performance in geography.
iii. There is no significant effect of inquiry-based learning on students' engagement and participation in learning denudation processes.

Methodology

The study used a quasi-experimental research design to investigate application of inquiry-based learning strategy on teaching denudation processes among Senior Secondary School II students in Anchau Zone, Kaduna State. The study population comprised 8,811 Senior Secondary School II (SSII) students from 14 public secondary schools in Anchau Zone, Kaduna State where Geography is part of the curriculum. A total of 111 students were selected using a simple random sampling technique. Two schools were chosen from the 14 public secondary schools offering Geography in Anchau Zone, Kaduna State. Of these, 54 SSII students formed the control group, while 58 students were assigned to the experimental group to evaluate the effects of application of inquiry-based learning strategy.

Achievement Test (Pre-test and Post-test) was used to evaluate students' understanding of denudation processes and geography performance. This included multiple-choice and short-answer questions aligned with the geography curriculum. A pre-test was given to both experimental and control groups before the

intervention, followed by a post-test after implementing the inquiry-based learning strategy. Experts in education and Geography reviewed the research instruments to ensure validity. Their feedback, aligned with the research objectives, was incorporated to confirm the instruments accurately measured student engagement, motivation, and academic performance. The instrument's reliability was established through a pilot study with 10 students outside the sample. Cronbach's Alpha was used, ensuring consistency in measuring understanding, engagement, and academic performance.

Data collection began with a pre-test to establish baseline levels of engagement, motivation, and academic performance for both groups. The experimental group underwent collaborative learning interventions, while the control group followed traditional teaching methods. After six weeks, a post-test was administered to assess changes and evaluate the effect of application of inquiry-based learning strategy. Descriptive statistics (mean and standard deviation) were used to address the research questions, while inferential statistics (t-test) were applied to test the hypotheses. This approach determined the significance of collaborative learning on student engagement, motivation, and academic performance.

Results

Table 1: ANOVA Inquiry-Based Learning on Denudation Processes

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value
Between Groups	197.99	1	197.99	17.76	0.000
Within Groups (Error)	1316.24	118	11.16		
Total	**1514.23**	**119**			

The ANOVA results show a significant effect of Inquiry-Based Learning on Denudation Processes ($F = 17.76$, $p = 0.000$). The higher between-groups variance (197.99) compared to within-groups variance (11.16) indicates that the experimental

and control groups differ significantly, confirming the effectiveness of the Inquiry-Based Learning strategy. Therefore, the hypothesis that stated that there is no significant effect of inquiry-based learning on students' understanding of denudation processes was rejected.

Table 2: Inquiry-Based Learning on Academic Performance

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value
Between Groups	207.42	1	207.42	32.28	0.001
Within Groups (Error)	759.04	118	6.43		
Total	**966.46**	**119**			

The ANOVA results in Table 2 reveal a significant effect of Inquiry-Based Learning on Academic Performance ($F = 32.28$, $p = 0.001$). The between-groups variance (207.42) is substantially larger than the within-groups variance (6.43), indicating that the Inquiry-Based Learning strategy significantly improves students' academic performance. Therefore, the hypothesis that stated that there is no significant effect of inquiry-based learning on students' academic performance in geography was rejected.

Table 3: Inquiry-Based Learning on Students' Engagement and Participation

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value
Between Groups	292.82	1	292.82	36.85	0.001
Within Groups (Error)	937.1	118	7.94		
Total	**1229.92**	**119**			

The ANOVA results in Table 3 show a significant effect of Inquiry-Based Learning on Students' Engagement and Participation ($F = 36.85$, $p = 0.001$). The between-groups variance (292.82) is much higher than the within-groups variance (7.94), indicating that Inquiry-Based Learning significantly enhances student engagement and participation. Therefore, the hypothesis that stated that there is no

significant effect of inquiry-based learning on students' engagement and participation in learning denudation processes was rejected.

Discussion of Findings

Inquiry-Based Learning (IBL) has been shown to enhance students' comprehension of complex geographical concepts, such as denudation processes. Maonga (2015) investigated the influence of reflective inquiry-based teaching on students' performance in geography map work in Kenyan public secondary schools. The study revealed a significant improvement in students' understanding when taught using reflective inquiry methods compared to traditional approaches. The relationship between IBL and academic performance has been explored in various contexts. Kaçar *et al*. (2021) conducted a meta-analysis examining the impact of IBL on academic success across different grade levels. The findings indicated that IBL significantly enhances academic achievement, with the most pronounced effects observed at the high school level. This underscores the potential of IBL to improve performance in subjects like geography, where critical thinking and analytical skills are paramount. Conversely, Saba *et al*. (2020) investigated the effects of the inquiry method on students' academic performance in upper basic social studies in Kwara State, Nigeria. The study found no significant difference between students taught using the inquiry method and those taught through conventional methods. This discrepancy may be attributed to factors such as implementation fidelity, teacher proficiency, and contextual variables, highlighting the need for careful consideration when integrating IBL into the curriculum. IBL's impact on student engagement and participation is a critical area of study. Abdullahi (2021) assessed the effects of incorporating an inquiry-based approach during field trips in Nigerian tertiary institutions. The research demonstrated that combining IBL with experiential learning significantly improved student engagement and knowledge retention compared to traditional teaching methods. This finding suggests that IBL encourages active participation and fosters a more interactive

learning environment, which is essential for subjects requiring practical understanding, such as geography.

Therefore, the findings of the study demonstrate that Inquiry-Based Learning (IBL) significantly enhances students' understanding of denudation processes, improves their academic performance **i**n geography, and increases engagement and participation in the learning process. The experimental group consistently outperformed the control group across all measured areas, indicating that IBL fosters deeper comprehension, critical thinking, and active learning. Despite some variations in the literature, the study confirms that inquiry-based strategies can positively transform traditional classroom practices if properly implemented and supported.

Conclusion

This research highlights the significant impact of Inquiry-Based Learning (IBL) on students' understanding of denudation processes, academic performance in geography, and engagement. The findings suggest that IBL enhances comprehension through active exploration, improves academic outcomes, and increases student participation. Grounded in constructivist, social constructivist, and experiential learning theories, the study supports the integration of IBL in geography education to foster deeper learning and better academic performance.

Recommendations

1. **Integrate Inquiry-Based Learning into the Geography Curriculum:** Educational policymakers should formally incorporate IBL strategies into the senior secondary school geography curriculum to enhance students' understanding of complex topics like denudation processes.
2. **Teacher Training and Professional Development:** Regular training programs should be provided to equip teachers with the necessary skills to effectively implement inquiry-based learning in their classrooms.
3. **Provide Adequate Resources and Support:** Schools should be equipped with instructional materials and resources that facilitate student-centered

learning, including fieldwork opportunities for hands-on exploration of denudation processes.

4. **Adopt a Blended Learning Approach:** Combining inquiry-based strategies with traditional methods can cater to diverse learning needs, ensuring a balanced approach that fosters both conceptual understanding and academic performance.
5. **Further Research and Continuous Evaluation:** Future studies should explore the long-term impact of IBL across other geographical topics and different educational zones to provide broader insights into its effectiveness and applicability.

References

Abdullahi, N. (2021). Assessing the Impact of Incorporating an Inquiry-Based Approach During a Field Trip on Students' Engagement, Retention of Knowledge and Learning Outcomes in Nigerian Tertiary Institutions. *International Journal of Social Sciences and Management Review*. Retrieved from https://ijssmr.org/vol-8-issue-1/assessing-the-impact-of-incorporating-an-inquiry-based-approach-during-a-field-trip-on-students-engagement-retention-of-knowledge-and-learning-outcomes-in-nigerian-tertiary-institutions/

Adeyemi, B. (2012). *Effective Teaching of Geography: Innovations and Challenges*. Lagos: Sunshine Press.

Aliyu, M. (2018). "The Challenges of Teaching Physical Geography in Kaduna State Secondary Schools." *Journal of Educational Studies*, 5(2), 45-58.

Areepattamannil, S. (2014). Effects of inquiry-based science instruction on science achievement and interest. Journal of Educational Research, 107(5), 401-417.

Banchi, H., & Bell, R. (2008). The many levels of inquiry. Science and Children, 46(2), 26-29.

Bell, R. L., Smetana, L., & Binns, I. (2010). Simplifying inquiry instruction: Assessing the inquiry level of classroom activities. Science Teacher, **77(1)**, 34-39.

Chin, C., & Osborne, J. (2008). Students' questions: A potential resource for teaching and learning science. Studies in Science Education, 44(1), 1-39.

Federal Republic of Nigeria. (2014). *National Policy on Education.* Abuja: NERDC Press.

Furtak, E. M., Seidel, T., Iverson, H., & Briggs, D. C. (2012). Experimental and quasi-experimental studies of inquiry-based science teaching. *Review of Educational Research*, 82(3), 300-329.

Gregory, K. J. (2010). *The Earth's Land Surface: Landforms and Processes in Geomorphology*. London: Sage Publications.

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). "Scaffolding and Achievement in Problem-Based and Inquiry Learning." *Educational Psychologist*, 42(2), 99-107.

Kaçar, T., Terzi, R., Arıkan, İ., & Kırıkçı, A. C. (2021). The Effect of Inquiry-Based Learning on Academic Success: A Meta-Analysis Study. *International Journal of Education and Literacy Studies*. Retrieved from https://www.aiac.org.au/journals/index.php/IJELS/article/view/6633/0

Kim, P., & Hannafin, M. J. (2011). Scaffolding problem-solving in technology-enhanced learning environments. *Educational Technology Research and Development*, 59(2), 143-165.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice-Hall.

Kuh, G. D., Kinzie, J., Schuh, J. H., & Whitt, E. J. (2006). Student success in college: Creating conditions that matter. Jossey-Bass.

Lazonder, A. W., & Harmsen, R. (2016). Meta-analysis of inquiry-based learning: Effects on learning outcomes. *Review of Educational Research*, 86(3), 681-718.

Madu, O. (2014). "Innovative Teaching Strategies in Nigerian Classrooms." *African Journal of Educational Research*, 12(4), 23-32.

Maonga, T. W. (2015). Influence of Reflective Inquiry-Based Teaching on Public Secondary School Students' Performance in Geography Map Work in Kenya. *University of Nairobi*. Retrieved from http://hdl.handle.net/11295/94540

Marshall, J. C., & Horton, R. M. (2011). The relationship of teacher-facilitated, inquiry-based instruction to student higher-order thinking. *School Science and Mathematics*, 111(3), 93-101.

Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction: What is it and does it matter? *Journal of Research in Science Teaching*, 47(4), 474-496.

Ogunniyi, M. B. (2017). *Science Education and the Inquiry Approach*. Ibadan: University Press.

Olorundare, A. S., & Akinola, B. O. (2017). "Inquiry-Based Learning and Students' Academic Performance in Geography." *Journal of Science Education*, 15(3), 67-78.

Pedaste, M., *et al*. (2015). "Phases of Inquiry-Based Learning: Definitions and the Inquiry Cycle." *Educational Research Review*, 14, 47-61.

Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A., Kamp, E. T., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, **14**, 47-61.

Prince, M., & Felder, R. (2006). "Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases." *Journal of Engineering Education*, 95(2), 123-138.

Saba, B. K., Bayero, H. I., & Abubakar, I. D. (2020). Effects of Inquiry Method on Students' Academic Performance in Upper Basic Social Studies in Kwara State, Nigeria. *Al-Hikmah Journal of Education*. Retrieved from https://alhikmah.edu.ng/ajhir/index.php/aje_path/article/view/72