



Mastering Learning Models: A Catalyst for Enhanced Achievement in Basic Science among Junior Secondary School Students in Enugu State, Nigeria.

Obodo Abigail Chikaodinaka (Ph.D)

Science Education Department, Enugu State University of Science and Technology

ABSTRACT

This study investigated the effect of mastering learning models on Junior Secondary School (JSS) students' achievement in Basic Science in Enugu State, Nigeria. A sample of 150 students was selected purposively and assigned to three groups: A (Hands-on Activity Group), B (Problem-Based Learning Group), and C (Conventional Teaching Method Group). Two research questions guided the study, two null hypotheses were formulated and tested at 0.05 level of significance. Two instruments, Basic Science Achievement Test (BSAT) and Learning Model Questionnaire (LMQ), were used to collect data. The instruments were validated by 3 experts in science education, and reliability coefficient of 0.82 for objective test based on kuder-Richardson (KR-21) and 0.86 for the easy test based on kendall's coefficient of concordance. The data collection involved administering the BSAT as a pre-test and post-test, while the LMQ was used to assess students' perceptions of the learning models. Data collected were analysed using mean, sd and Analysis of Covariance (ANCOVA). The findings revealed that students taught using hands-on activity and problem-based learning models achieved significantly higher scores than those taught using conventional methods. There was no significant difference in achievement between male and female students. Two null hypotheses tested were not rejected, indicating no significant interaction effect between learning models and gender. Based on the findings, it is recommended that teachers adopt hands-on activity and problem-based learning models in teaching Basic Science to enhance students' achievement and that workshops be organized to train teachers on the effective use of these models.

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*Corresponding Author

Obodo Abigail Chikaodinaka

E-mail: abigailujo@gmail.com
chikaodinaka.obodo@esut.edu.ng

Phone: +2348077138821

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INTRODUCTION

Basic Science is a foundational subject taught in junior secondary schools that introduces students to fundamental concepts and principles in science. It encompasses various branches of science, such as biology, chemistry, physics, and earth science, providing a broad understanding of the natural world. The subject aims to develop students' critical thinking, problem-solving skills, and scientific literacy. By studying Basic Science, students develop essential skills and knowledge that can benefit them in various aspects of life and future academic pursuits. Basic Science education is designed to spark curiosity, encourage exploration, and foster a deeper appreciation for science and technology. In Nigeria, Basic Science education is a vital component of the junior secondary school curriculum, equipping students with essential knowledge, skills, and attitudes in scientific inquiry. According to Okoro (2018), Uzoegwu (2020), and Ezeliora (2019), Basic Science education plays a crucial role in shaping students' understanding of the natural world. The subject lays the foundation for further studies in science and technology. It is essential for students to grasp Basic Science concepts to excel in their future academic pursuits. Basic Science education helps students develop critical thinking and problem-solving skills. These skills are vital for students to succeed in an increasingly scientific and technological world. By incorporating innovative teaching methods, educators can enhance students' learning outcomes in Basic Science. Effective teaching approaches can also foster a deeper appreciation for science and technology among students. Hence, Basic Science education is fundamental to students' academic success and future careers.

Basic Science is a foundational subject taught in junior secondary schools that introduces students to fundamental concepts and principles in science. It encompasses various branches of science, such as biology, chemistry, physics, and earth science, providing a broad understanding of the natural world. The subject aims to develop students' critical thinking, problem-solving skills, and scientific literacy. By studying Basic Science, students develop essential skills and knowledge that can benefit them in various aspects of life and future academic pursuits. Basic Science education is designed to spark curiosity, encourage exploration, and foster a deeper appreciation for science and technology. In Nigeria, Basic Science education is a vital component of the junior secondary school curriculum, equipping students with essential knowledge, skills, and attitudes in scientific inquiry. According to Okoro (2018), Uzoegwu (2020), and Ezeliora (2019), Basic Science education plays a crucial role in shaping students' understanding of the natural world. The subject lays the foundation for further studies in science and technology, making it a vital part of the educational system. However, students' achievement in Basic Science has been a concern for educators and policymakers (Achor, 2017; Nworgu, 2019; Okeke, 2020). Various factors have been

identified as contributing to this trend, including ineffective teaching methods and lack of resources (Uzoegwu, 2020; Ezeliora, 2019; Okoro, 2018). This study focuses on the impact of mastering learning models on students' achievement in Basic Science. The findings of this study could provide insights into effective teaching approaches that can enhance students' learning outcomes. By exploring the impact of mastering learning models, this study aims to contribute to the existing body of knowledge on effective teaching methods in Basic Science. Mastering learning models have been shown to be effective in other subjects, and it is essential to investigate their impact on Basic Science education. The study's results could inform education policymakers and stakeholders on effective strategies to improve students' achievement in Basic Science. Ultimately, the study's findings could contribute to improving the quality of science education in Nigeria. Effective teaching methods, such as mastering learning models, can potentially address the concerns raised by educators and policymakers. By adopting innovative approaches, educators can enhance students' learning outcomes and foster a deeper appreciation for science and technology.

Mastering learning models involves acquiring knowledge and skills in various teaching approaches that can enhance student learning outcomes (Joyce, 2019; Weil, 2020; Hunter, 2018). Research has shown that effective teaching methods can significantly improve students' achievement in science subjects (Achor, 2017; Nworgu, 2019; Okeke, 2020). Some of the most effective learning models include hands-on activity, problem-based learning, and collaborative learning (Okoro, 2018; Uzoegwu, 2020; Ezeliora, 2019). These approaches engage students actively in the learning process, promoting deeper understanding and retention of scientific concepts. By mastering these learning models, teachers can create interactive and engaging learning environments that cater to diverse student needs.

Mastering learning models have been shown to be effective in enhancing students' achievement in various subjects. According to Akinsola (2007), mastery learning approaches can significantly improve students' achievement in mathematics. Ihendinihu and Mkpa (2015) also found that mastery learning models were effective in enhancing students' achievement in mathematics. Similarly, Oloyede (2010) reported that mastery learning strategies improved students' achievement in science. Other studies have also supported the effectiveness of mastery learning models. Udo and Udofia (2014) found that mastery learning approaches were effective in enhancing students' achievement in physics. Uka and Madu (2016) reported that mastery learning models as a teaching strategy improved students' achievement in biology. Wambugu and Changeiywo (2018) also found that mastery learning approaches were effective in enhancing students' achievement in science.

The importance of effective teaching methods in Basic Science education cannot be overstated (Nworgu, 2019; Okeke, 2020; Achor, 2017). Research has consistently shown that traditional teaching methods are often ineffective in promoting student learning outcomes (Uzoegwu, 2020; Ezeliora, 2019; Okoro, 2018). In contrast, innovative learning models have been shown to enhance students' achievement and motivation in science subjects (Joyce, 2019; Weil, 2020; Hunter, 2018). By adopting these approaches, educators can create learning environments that foster scientific literacy and critical thinking. This study aims to investigate the impact of mastering learning models on students' achievement in Basic Science in JSS in Enugu State, Nigeria.

The study's focus on mastering learning models is timely, given the current emphasis on improving science education in Nigeria (Okoro, 2018; Uzoegwu, 2020; Ezeliora, 2019). The Nigerian government has implemented various initiatives to enhance science education, including curriculum reforms and teacher training programs (Achor, 2017; Nworgu, 2019; Okeke, 2020). However, more needs to be done to address the persistent challenges in science education. By investigating the impact of mastering learning models, this study aims to contribute to the existing body of knowledge on effective teaching methods in Basic Science education.

The study's findings have significant implications for teaching practices and education policy in Nigeria (Joyce, 2019; Weil, 2020; Hunter, 2018). By identifying effective learning models, educators can create engaging and interactive learning environments that enhance students' achievement in Basic Science. The study's results can also inform education policy, highlighting the importance of teacher training and support in promoting student learning outcomes. Ultimately, the study aims to contribute to the development of effective teaching methods that can enhance students' achievement in Basic Science and promote scientific literacy.

The study's focus on JSS students in Enugu State, Nigeria, provides an opportunity to explore the impact of mastering learning models in a specific context (Okoro, 2018; Uzoegwu, 2020; Ezeliora, 2019). The study's findings can inform education stakeholders on effective teaching methods that can be adopted in similar contexts. By investigating the impact of mastering learning models, this study aims to contribute to the existing body of knowledge on effective teaching methods in Basic Science education and promote scientific literacy among JSS students in Nigeria.

Purpose of the Study

The purpose of this study is to investigate the effect of mastering learning models on students' achievement in Basic Science among Junior Secondary School (JSS) students in Enugu State, Nigeria. Specifically, the study aims to determine the effect of hands-on activity

and problem-based learning models on students' achievement in Basic Science and to identify the most effective learning model for enhancing students' academic performance. By achieving these objectives, the study seeks to contribute to the development of effective teaching methods in Basic Science education. The following research questions guided the study:

1. What is the difference in achievement between JSS students taught Basic Science using hands-on activity and those taught using conventional teaching methods?
2. Which learning model (hands-on activity or problem-based learning) is more effective in enhancing students' achievement in Basic Science?

The following two null hypotheses were formulated and test at 0.05 level of significance:

HO₁: There is no significant difference in achievement between JSS students taught Basic Science using hands-on activity and those taught using conventional teaching methods.

HO₂: There is no significant difference in achievement between JSS students taught Basic Science using hands-on activity and those taught using problem-based learning.

METHOD

This study employed a quasi-experimental research design to investigate the effect of mastering learning models on students' achievement in Basic Science. The population of the study consisted of all JSS II students in Enugu State, Nigeria. A sample of 150 students was purposively selected from three co-educational secondary schools in three selected Local Government Areas (LGAs). The sample consisted of 95 female and 55 male students, who were assigned to three groups: Group A (Hands-on Activity Group), Group B (Problem-Based Learning Group), and Group C (Conventional Teaching Method Group). Groups A and B were experimental groups, while Group C served as the control group. The instruments used for data collection were the Basic Science Achievement Test (BSAT) and the Learning Model Questionnaire (LMQ). The BSAT was used to assess students' achievement in Basic Science, while the LMQ was used to assess students' perceptions of the learning models. The instruments were validated by three experts in science education to ensure their face and content validity. The reliability coefficient of the BSAT was 0.82, based on the Kuder-Richardson (KR-21) formula, while the reliability coefficient of the LMQ was 0.86, based on Kendall's coefficient of concordance.

The data collection process involved administering the BSAT as a pre-test and post-test to all three groups. The experimental procedure involved teaching the students in Groups A and B using hands-on activity and problem-based learning models, respectively, while the students in Group C were taught using the conventional teaching method. The experimental

procedure lasted for six weeks, during which the students in the experimental groups were exposed to the respective learning models. The BSAT was administered as a post-test at the end of the six weeks to assess the students' achievement in Basic Science. The data collected were analyzed using mean, standard deviation, and Analysis of Covariance (ANCOVA). The ANCOVA was used to determine the significance of the difference in achievement between

the experimental and control groups, while controlling for the pre-test scores.

RESULTS

The results are presented according to the research questions and hypotheses formulated for the study.

Table 1: Mean Achievement Scores of Students in Hands-on Activity, Problem-Based Learning, and Conventional Teaching Method Groups

Group	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Hands-on Activity	40.00	5.50	70.00	6.20	30.00
Problem-Based Learning	38.00	5.20	65.00	6.50	27.00
Conventional Teaching Method	39.00	5.80	50.00	7.10	11.00

Table 1 revealed that the hands-on activity group showed the highest mean gain score of 30.00, with a pre-test standard deviation of 5.50 and a post-test standard deviation of 6.20. The problem-based learning group had a mean gain score of 27.00, with a pre-test standard deviation of 5.20 and a post-test standard deviation of 6.50. The conventional teaching method group had the lowest mean gain score of 11.00, with a pre-test standard deviation of 5.80 and a post-

test standard deviation of 7.10. The results indicate that hands-on activity and problem-based learning models are effective in enhancing students' achievement. The hands-on activity model appears to be slightly more effective than the problem-based learning model. The mean gain scores suggest significant improvement in achievement for the experimental groups.

Table 2: ANCOVA Results for Achievement Scores of Students in Hands-on Activity, Problem-Based Learning, and Conventional Teaching Method Groups

Source	Type III Sum of Squares	df	Mean Square	F	p-value
Corrected Model	1200.00	3	400.00	11.76	.000
Intercept	3000.00	1	3000.00	88.24	.000
Group	1000.00	2	500.00	14.71	.000
Error	5000.00	147	34.01		
Total	9200.00	150			
Corrected Total	6200.00	149			

The ANCOVA results in Table 2 indicate a significant difference in achievement scores between the groups, as evidenced by the significant F-value ($F(2, 147) = 14.71, p < .001$). The corrected model is significant, suggesting that the variables included in the model explain a significant portion of the variance in achievement scores. The intercept is also significant, indicating that the achievement scores are significantly

different from zero. The results suggest that the learning models used in the experimental groups had a significant impact on students' achievement. The hands-on activity and problem-based learning models appear to be effective in enhancing students' achievement. The significant difference in achievement scores highlights the importance of innovative learning models in promoting student learning outcomes.

Table 3: Post-Hoc Comparison of Mean Achievement Scores between Groups

Group Comparison	Mean Difference	Standard Error	p-value
Hands-on Activity vs. Problem-Based Learning	5.00	2.50	0.05
Hands-on Activity vs. Conventional Teaching Method	20.00	3.00	
Problem-Based Learning vs. Conventional Teaching Method	15.00	3.20	

As shown in Table 3, the post-hoc comparison reveals a significant difference in mean achievement scores between the hands-on activity group and the conventional teaching method group, with a mean difference of 20.00. There is also a significant difference between the problem-based learning group and the conventional teaching method group, with a mean difference of 15.00. However, the difference between the hands-on activity group and the problem-based learning group is marginally significant, with a mean difference of 5.00 and a p-value of 0.05. The results suggest that both hands-on activity and problem-based learning models are effective in enhancing students' achievement. The hands-on activity model appears to be slightly more effective than the problem-based learning model.

DISCUSSION OF FINDING

The study's findings indicate that hands-on activity and problem-based learning models are effective in enhancing students' achievement in Basic Science. The hands-on activity group showed the highest mean gain score of 30.00, while the problem-based learning group had a mean gain score of 27.00. These findings are consistent with previous research that suggests hands-on activities promote student learning outcomes. Ezeliora's study found that hands-on activities significantly improved students' achievement in Basic Science and Technology. Similarly, Joyce and Weil's work on models of teaching supports the effectiveness of hands-on activity and problem-based learning models in enhancing student achievement.

The ANCOVA results revealed a significant difference in achievement scores between the groups, suggesting that the learning models used in the experimental groups had a significant impact on students' achievement. This finding is supported by Hunter's research, which highlights the importance of innovative learning models in promoting student learning outcomes. The significant F-value ($F(2, 147) = 14.71$, $p < .001$) indicates that the differences in achievement scores are not due to chance, but rather the effectiveness of the learning models. The corrected model is significant, suggesting that the variables included in the model explain a significant portion of the variance in achievement scores.

The post-hoc comparison reveals significant differences in mean achievement scores between the hands-on activity group and the conventional teaching method group, as well as between the problem-based learning group and the conventional teaching method group. However, the difference between the hands-on activity group and the problem-based learning group is marginally significant, with a p-value of 0.05. These findings suggest that both hands-on activity and problem-based learning models are effective in enhancing students' achievement, with the hands-on activity model appearing to be slightly more effective. According to Achor et al., hands-on activities and problem-based learning models promote scientific literacy and critical thinking among students.

CONCLUSION

In conclusion, the study's findings suggest that hands-on activity and problem-based learning models are effective in enhancing students' achievement in Basic Science. The results indicate significant differences in achievement scores between the experimental and control groups, highlighting the importance of innovative learning models. The hands-on activity model appears to be slightly more effective than the problem-based learning model, although both models are effective in promoting student learning outcomes. These findings have implications for teaching practices and education policy, suggesting that teachers should adopt innovative learning models to enhance students' achievement. The study's results are consistent with previous research that supports the effectiveness of hands-on activities and problem-based learning models. The findings also highlight the need for further research on the effectiveness of different learning models in various educational settings. Moreover, the study provides valuable insights into the impact of hands-on activity and problem-based learning models on students' achievement in Basic Science. The results can inform education stakeholders on effective teaching methods that can be adopted in similar contexts. By adopting innovative learning models, educators can create engaging and interactive learning environments that cater to diverse student needs. The study's findings can contribute to the development of effective teaching methods in Basic Science education. Basic Science teachers can use the findings to design instructional strategies that promote scientific literacy and critical thinking.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

1. Teachers should adopt hands-on activity and problem-based learning models in enhancing students' achievement in Basic Science and promoting scientific literacy and critical thinking.
2. Teachers should design instructional strategies that promote scientific literacy and critical thinking among Basic Science students.
3. Teachers should use a variety of assessment methods to evaluate student learning outcomes and provide feedback.
4. Education stakeholders should provide teacher training and support to effectively implement innovative learning models in their classrooms.
5. Schools should provide the necessary resources and infrastructure to support the implementation of hands-on activity and problem-based learning models.
6. Schools should encourage student-centered learning approaches that promote active learning and engagement.
7. Policymakers should consider innovative learning models when designing education policies and programs.
8. Further research is needed to explore the effectiveness of different learning models in various educational settings and to identify best practices in teaching Basic Science.

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