

“The Effects of Guided Discovery and Demonstration Methods on the Performance of Students in Physics in Ado Local Government Area of Ekiti State, Nigeria”

## The Effects of Guided Discovery and Demonstration Methods on the Performance of Students in Physics in Ado Local Government Area of Ekiti State, Nigeria

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### Abstract

*Methods are the tools of the teacher for reaching the set goals and objectives. The effective teacher has multiplicity of methods at his disposal and must be prepared to select the ones which will be most effective for leading the learner to desired behaviour. Despite the importance of physics in understanding the natural world and addressing global challenges, students in Ado Local Government Area of Ekiti State continue to perform poorly in the subject, with many showing a lack of understanding of key concepts. Therefore, this study is set out to investigate if appropriate teaching method used in teaching physics could yield a better performance. Such teaching methods are demonstration and guided-discovery methods. The study employed a quasi-experimental design. A total of sixty senior secondary students offering physics were randomly divided into three groups: demonstration, guided-discovery and control (teacher expository method). The result reveals that both guided discovery and demonstration teaching methods are more effective than the teacher expository method. The findings also show that demonstration method appears to be more effective in improving students' performance in physics than guided-discovery method. However, there are mixed opinions about which of these methods is more effective. The students who participated in the study showed a net positive attitude towards physics. The study identified some challenges faced by physics teacher in implementing guided discovery and demonstration methods to include large class size, students' lack of interest, lack of resources and insufficient training, etc. Thus, the findings presented could be attributed to several factors such as teachers' skills and experience as well as students' learning conditions. Hence, to ensure improved performance of students in physics, the government, school administrators, parents as well as students themselves have vital roles to play.*

**Keywords:** Guided Discovery, Demonstration Methods, Performance, Ado Local Government Area.

### Introduction

It has been observed that the educational system in Nigeria has been experiencing some setback due to inconsistency curriculum implementations and political incoherence which is one of the major problems faced by the sector. It can be said that little attention has been given to this sector as a result of the nonchalant attitude of political leaders. Education, the underlining factor of the social life that help people create meaning out of the environment as well as been able to influence the environment to their own benefit (Jacob, 2020). Man is greatly dependent on science and technology, this is because the future hope for a better scientifically and technologically developed countries which lies in science education. A sound knowledge of science education is very important for the management of our natural resources, provision of adequate food and healthy environment. For instance, Biological sciences is essential to all forms of life including plants and animals and other

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living and non-living components, and it also plays important role towards achieving self-reliance in the life of individual (Butticaz & Martí, 2022).

Every develop nation is as a result of science and technology been embraced in their school curriculum. In the teaching of science subjects’ certain methods is being recommended as the appropriate method to be used. These methods stipulated in the science curriculum is to enable the effective teaching and learning of science subjects. Some of the cardinal objectives of the Physics curriculum for senior secondary school syllabus are to prepare pupils to acquire meaningful and relevant knowledge in Physics , also to acquire reasonable and functional scientific attitudes. In accordance with the objectives, the contents and contexts of the syllabus also place emphasis on guided-discovery, techniques and skills coupled with conceptual thinking (Kayode, 2020).

Most teachers use methods apart from the methods stipulated in the curriculum by the Nigeria Educational Research and Development Council (NERDC) and it has contributed to the low performance of student in biology. The repeated records of failures in physics tend to pose some attitude in towards the teaching of Physics by the teacher in the explanation of Physics concept (Falemu & Akinwumi, 2021).

The attitudes of the teachers toward the teaching of physics as a science subject has failed to achieve the stated objectives of Physics as stated in the curriculum (Ambusaidi *et al.*, 2021). From the perspective of promoting standard based science education, the teaching method employed plays important role in learning important ideas and skills if standard based education is to become a reality in the nation classroom (Juanda *et al.*, 2021).

Methods are the tools of the teacher for reaching the set goals and objectives. The effective teacher has multiplicity of methods at his disposal and must be prepared to select the ones which will be most effective for leading the learner to desired behaviour. Educational methods is a process of cognitive, affective and psychomotive development whose aim is to mould the learner towards a total contribution to the development of the learner and the community. In achieving this by the teacher, there is the need to improve on the instructional methods in teaching physics. (Weng, 2020).

Therefore, this study is set out to investigate if appropriate teaching method used in teaching physics could yield a better performance. Such teaching methods are demonstration methods and guided-discovery.

Demonstration method is always accomplished by telling or explaining a concept by the handling or manipulating of real things, equipment or materials or showing pictures.

Demonstrations are useful because they provide concrete reference for objects or events. Students relate terms and concepts to those events which they have observed. If this method is used to carry out a study on students’ performance in physics, it will be observed that student will be able to identify some difficulties they faced in learning physics when they were given problem to

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solve. Demonstration method is an effective means of supplementing and clarifying the content being taught (Daluba, 2013).

Guided-Discovery method likewise is an instructional strategy in which the learner tends to learn more or have better understanding of physics concepts because they are guided to discover things by themselves (Tofi *et al.*, 2022). Discovery learning, when encouraged in the science class also aids problem solving because learning by discovery starts with problem solving. This method also causes creativity in the student which is one of the major objective of science teaching (Yusuf, 2020).

These two methods have a positive effect on the students' level of academic performance but certain factors have been attributed to the poor achievement or performance of students in physics. These include the level of the teacher's knowledge in physics, in the principles and methods of teaching, inability of the teacher to understand his/her student during teaching process or inadequate infrastructure/ instructional materials. (Falemu & Akinwumi, 2021; Gbore & Daramola, 2013).

There is tendency that each of these two methods will create an effect on the academic performance of student in physics.

**Purpose of the Study**

The main objective of this study is to investigate the effects of guided discovery and demonstration methods on the performance of students in physics in Ado Local Government Area of Ekiti State. Specifically, the aims of the study are to:

Determine the effect of guided discovery method on students' performance in physics.

Examine the impact of demonstration method on students' understanding of physics concepts.

Compare the effectiveness of guided discovery and demonstration methods on students' performance in physics.

Identify the challenges faced by teachers in implementing guided discovery and demonstration methods in physics teaching.

**Research Questions**

To guide this study, the following research questions are stated.

- i. What is the effect of guided discovery method on the performance of students in physics?
- ii. How do the demonstration method influence students understand and retention of physics concepts?
- iii. Is there a significant difference in the performance of students taught physics using guided discovery method and those taught using demonstration method?

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- iv. What are the challenges faced by physics teachers in implementing guided discovery and demonstration methods?

### **Review of Related Literature**

Relevant literature was examined in the study on the effectiveness of Guided Discovery and Demonstration methods on students' performance in physics:

#### **Guided Discovery Method**

The guided discovery method is a student-centered teaching approach that encourages active learning, critical thinking, and problem-solving (Koehler *et al.*, 2019). This method involves guiding students through a process of discovery, allowing them to explore and learn concepts independently (Huang *et al.*, 2020). The guided discovery method is characterized by student-centered learning, where students take an active role in their learning process (Bae *et al.*, 2020). Active exploration and investigation are essential components, facilitated by guided instruction and feedback from the teacher (Wouters *et al.*, 2017). Collaborative learning is also a key aspect, promoting peertopeer interaction and teamwork (Liu *et al.*, 2018).

The guided discovery method offers several benefits, including improved academic achievement (Cakir *et al.*, 2020), enhanced critical thinking and problem-solving skills (Kim *et al.*, 2018), increased student motivation and engagement (Dichev *et al.*, 2019), and development of independent learning skills (Zhang *et al.*, 2020). However, the guided discovery method has some limitations. It requires significant teacher planning and preparation (Wiggins & McTighe, 2018), and may be challenging for students with limited prior knowledge (Alao & Afolabi, 2015; Bruckman *et al.*, 2019). Additionally, it can be time-consuming (Mendez *et al.*, 2020).

Effective guided discovery involves providing clear instructions and guidance (Koehler *et al.*, 2019), encouraging active exploration and investigation (Huang *et al.*, 2020), offering feedback and support (Wouters *et al.*, 2017), and fostering collaborative learning (Liu *et al.*, 2018).

The guided discovery method has various applications across disciplines, including science education (Cakir *et al.*, 2020), mathematics education (Kim *et al.*, 2018), and language arts (Graves *et al.*, 2020).

#### **Demonstration Method**

The demonstration method is a widely used teaching strategy that involves showing students how to perform a task, experiment, or procedure (Adebayo *et al.*, 2020). This method is particularly effective in subjects that require hands-on experience, such as science, technology, engineering, and mathematics (STEM) fields (Alimi *et al.*, 2019). The demonstration method allows students to observe and learn from the teacher's expertise, promoting deeper understanding and retention of complex concepts (Ertmer & Newby, 2017).

The demonstration method is primarily teacher-centered, where the teacher performs the demonstration (Huang *et al.*, 2020). Demonstrations often

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involve visual aids, such as equipment, models, or diagrams, to enhance understanding (Afolabi *et al.*, 2020). The teacher provides a clear, step-by-step explanation of the process, and students observe and take note of key steps and procedures (Oyinloye, 2019).

The demonstration method has several advantages. It improves understanding and retention of complex concepts (Alimi, 2019), develops practical skills (Adebayo *et al.*, 2020), and is time-efficient (Ertmer & Newby, 2017). Additionally, demonstrations can reduce costs associated with individual student experiments (Huang, 2020). Despite its advantages, the demonstration method has some limitations. Students may not actively participate in the learning process (Afolabi *et al.*, 2020), and demonstrations rely heavily on the teacher's expertise (Oyinloye, 2019). Furthermore, students may not receive immediate feedback on their understanding (Alimi *et al.*, 2019).

There are various types of demonstration methods, including live demonstration, video demonstration, and model demonstration (Adebayo *et al.*, 2020). Live demonstrations involve real-time demonstration by the teacher, while video demonstrations use pre-recorded videos (Huang *et al.*, 2020). Model demonstrations utilize models or simulations to illustrate complex concepts (Ertmer & Newby, 2017). To ensure effective demonstrations, teachers should provide clear explanations (Afolabi *et al.*, 2020), use visual aids (Alimi *et al.*, 2019), and perform demonstrations slowly and deliberately (Oyinloye, 2019). Repetition of complex steps or procedures and encouraging student involvement through questioning are also essential (Huang *et al.*, 2020).

The demonstration method has various applications across disciplines, including science education (Adebayo *et al.*, 2020), vocational training (Alimi *et al.*, 2019), medical education (Ertmer & Newby, 2017), and language teaching (Oyinloye, 2019).

### **Comparison of the Guided Discovery Method and Demonstration Method**

The Guided Discovery Method and Demonstration Method are two instructional approaches widely used in education. While both methods aim to enhance student learning, they differ significantly in their underlying philosophies, implementation strategies, and outcomes.

Guided Discovery Method is rooted in constructivist theory, emphasizing student centered learning, active exploration, and discovery (Koehler *et al.*, 2019). This approach views learners as active participants in the learning process. In contrast, Demonstration Method is grounded in behavioural theory, focusing on teacher-centered instruction, demonstration, and imitation (Ertmer & Newby, 2017). This approach positions the teacher as the primary authority.

Guided Discovery Method involves open-ended inquiry, collaborative learning, and teacher facilitation (Cakir *et al.*, 2020; Liu *et al.*, 2018; Wouters *et al.*, 2017). Teachers guide students through a process of discovery, encouraging critical thinking and problem-solving. Demonstration Method, on the other hand, involves step-by-step demonstration, clear instructions, and teacher-centered

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instruction (Adebayo *et al.*, 2020; Alimi *et al.*, 2019; Oyinloye, 2019). Teachers demonstrate procedures, and students imitate.

Research suggests that Guided Discovery Method enhances critical thinking and problem-solving, fosters independent learning skills, and promotes student motivation and engagement (Dichev *et al.*, 2019; Zhang *et al.*, 2020; Huang *et al.*, 2020). In contrast, Demonstration Method improves student understanding and retention, enhances practical skills and application, and supports differentiated instruction (Adebayo *et al.*, 2020; Oyinloye, 2019; Afolabi, 2020).

While Guided Discovery Method offers several benefits, its implementation can be time-consuming and challenging for teachers (Wiggins & McTighe, 2018). Demonstration Method, on the other hand, may lead to passive learning and limited student interaction (Ertmer & Newby, 2017).

### **Research Design**

The study employed a quasi-experimental design with three groups of students, two experimental groups and a control group.

### **Population**

The population consists of all senior secondary school students studying Physics in public and private schools in Ado Local Government Area of Ekiti State. Ado-Ekiti Local Government Area is one of the sixteen local government that make up Ekiti State of Nigeria. The capital city is Ado-Ekiti a one town Local Government and its' predominant peoples group are the Yoruba's. The educational sector in this local government consists of primary schools, secondary schools and tertiary institutions such as the Ekiti State University, Ado-Ekiti (EKSU) Federal Polytechnic Ado-Ekiti and Afe Babalola University Ado-Ekiti (ABUAD).

### **Sample and Sampling Techniques**

A sample size of sixty (60) students were purposively selected using stratified random sampling technique from four secondary schools (Sugiyono, 2018). The sample used in this study were selected from two public senior secondary schools and two private senior secondary school randomly selected to represent the secondary schools in the local government area.

The selected schools are:

Vinpet Standard College, Olorunda Community, Ado-Ekiti.

Ikigbinsin Community Secondary School, Ikingbinsin, Ado-Ekiti.

God's Covenant Secondary School, Olorunda Community, Ado-Ekiti.

Anglican Secondary School, off Housing Road, Adebayo, Ado-Ekiti.

These schools were randomly assigned to two experimental groups: guided discovery teaching method, demonstration teaching method and the control group: teacher expository teaching method.

**Research Instrument**

The instrument for data collection in this study contained Questionnaire on Attitudes of Students towards Physics (QASTP), a thirty (30) item Physics Achievement Test (PAT) drawn from lesson plan on the Electromagnetism to test the students' performance, and the Teacher Questionnaire (TQ) designed by the researcher (Hale & Simpson, 2014; O'Neil & Baker, 2017). The instrument was divided into three sections, A, B and C. Section A seeks for students' personal information with respect to age, class and sex. Section B contains 20 items on respondents' attitude towards Physics, and section C contains questions on the topic taught. The Teacher Questionnaire (TQ) was administered to Physics teachers to gather information about their teaching methods and challenges.

**Validity and Reliability of Instrument**

The instrument used for the research was drawn from an already existing instrument which had been scrutinized by experts in Physics and Test and Measurement for purpose of ensuring its face and content validity as well as its measure of consistency and suitability for the target sample.

**Procedure for Data Collection**

The Physics Achievement Test was administered in each of the schools on the students that form part of the study. The administered test helped to determine their performance. The same content of questions was administered to the control group and the two experimental groups once.

**Data Analysis Technique**

The data collected were analyzed using Microsoft Excel version 13 and IBM SPSS version 20 to determine mean, standard deviation, and ANOVA.

**Data analysis and Results****Analysis of Demographic Data of the Respondents**

The study revealed the demographic characteristics of the respondents. The main variables under consideration include gender, age and Attitudes Score of Students towards

Physics and Physics Achievement Test (PAT) score.

Gender distribution of respondents is shown in Table 1.

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Table 1: Gender of Respondents

GENDER	Frequency	Percent
MALE	23	38.3
FEMALE	30	50.0
OTHERS	7	11.7
Total	60	100.0

Table 1 shows that 38.3% of respondents were males, 50.0% were females and 11.7% did not indicate their gender.

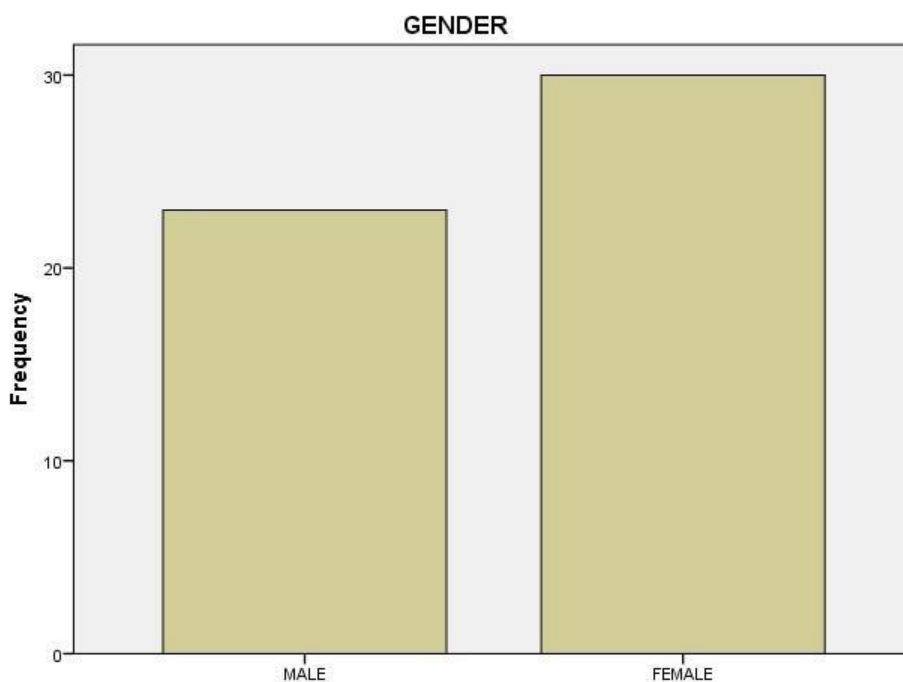


Figure 1: A bar chart showing gender distribution of respondents

Age distribution of respondents is shown in Table 2.

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Table 2: Age of Respondents

AGE	Frequency	Percent
10-14 Years	35	58.3
15-19 Years	24	40.0
Missing	1	1.7
Total	60	100.0

Table 2 shows that 58.3% of respondents fall within 10 to 14 years, 40.0% are 15 to 19 years while the remaining 1.7% did not indicate age range.

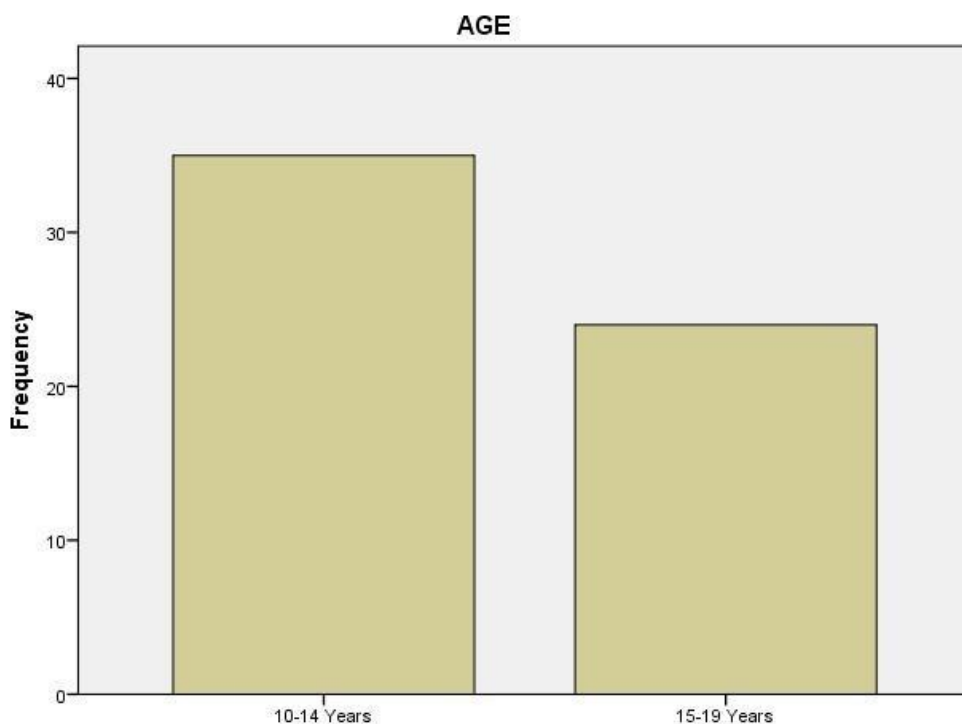
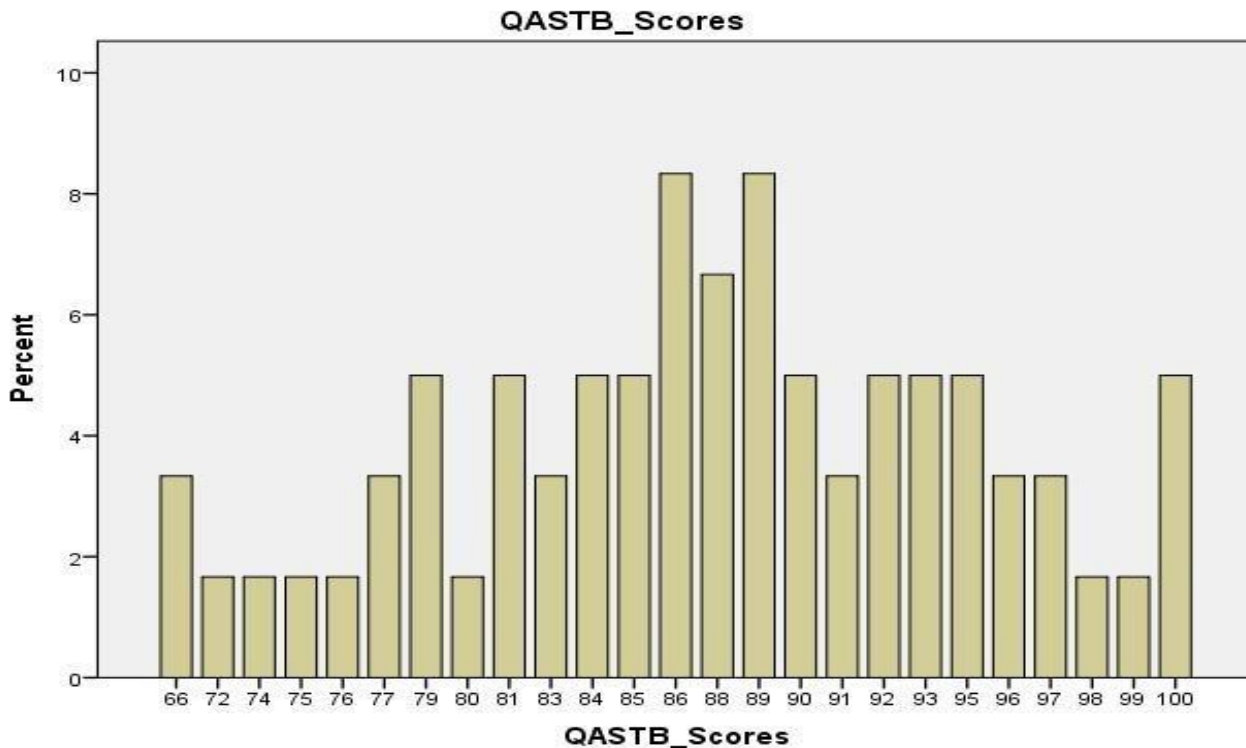


Figure 2: A bar chart showing age distribution of respondents

**Attitude of Students towards Physics**

The mean score of Students Attitude towards Physics is 86.97, indicating a net positive attitude towards Physics. However, 11 out of the 60 respondents, representing 18.3% showed Neutral attitude towards Physics while the remaining 49 respondents (81.7%) showed positive attitude. Figure 3 shows the attitude score distribution.

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PAT Scores	Grade	Frequency	Percent	Cumulative Percent
20 -37	F9	8	13.3	13.3
40 -43	E8	8	13.3	26.6
47	D7	1	1.7	28.3
50 -53	C6	2	3.3	31.6
57	C5	3	5.0	36.6
60-63	C4	7	11.7	48.3
67	B3	4	6.7	55.0
70 – 73	B2	8	13.3	68.3

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77 – 90	A1	19	31.7	100.0
Total		60	100.0	

Figure 3: A bar chart showing Attitude score distribution of respondents

**Students’ Performance in Physics (PAT Score)**

PAT score distribution and performance of respondents are shown in Table 3.

Table 3: PAT score distribution and performance of respondents

Table 3 shows that 13.3% of respondent scored less than 40 (that is, failed the Physics Assessment Test) according to SSCE grading system, 28.3% of participants scored less than 50% (that is, failed to get a credit pass) while 71.7% secured at least a credit pass. However, 6.7% had B3 grade, another 13.3% had B2 and 31.7% of students had A1 grade. The result is represented in figure 4.

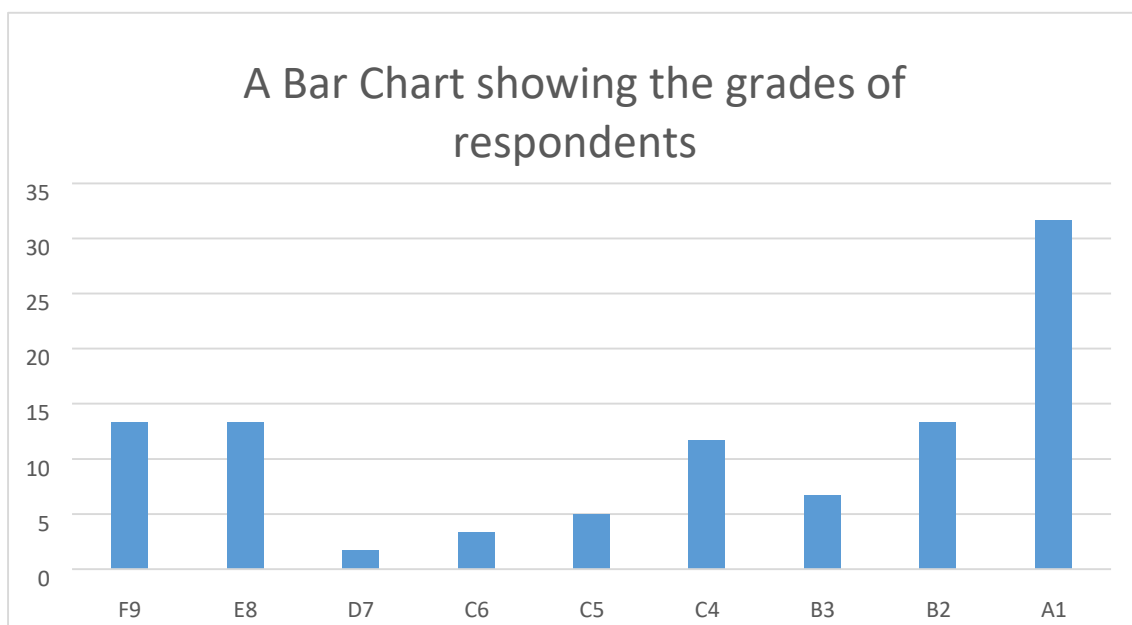


Figure 4: A Bar Chart showing the grades of respondents

The mean score across three groups are presented in table 4.

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Table 4: The mean score across three groups

GROUP	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Control	54.44	17.580	3.210	47.88	61.01
Guided Discovery Method	60.00	16.232	4.191	51.01	68.99
Demonstration Method	79.33	7.037	1.817	75.44	83.23

**Research Question One: What is the effect of guided discovery method on the performance of students in physics?**

The results showed a higher average performance for respondents in the Guided Discovery Method group with a mean PAT score of 60.00% against those in the control group with a mean score of 54.44%. This shows that the guided discovery teaching method is more effective than the teacher expository method. However, the observed difference is not statistical significant ( $p > 0.05$ ). Figure 5 represents the effect of Guided Discovery teaching method.

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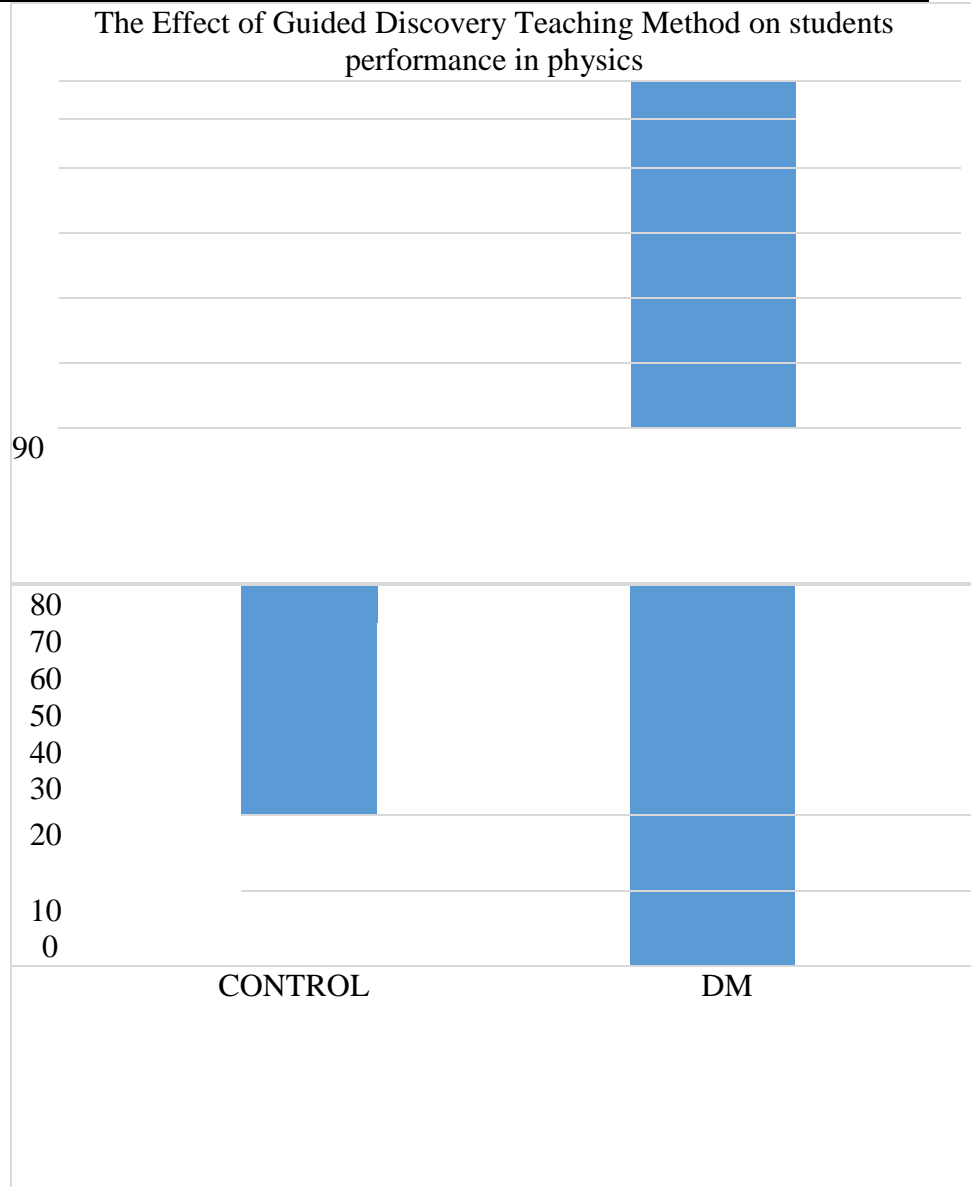


Figure 5: A Bar Chart Showing the Effect of Guided Discovery Teaching Method on students’ performance in physics.

Research Question Two: How does the demonstration method influence students' understanding and retention of physics concepts?

The results showed a higher average performance for students in the Demonstration Method group with a mean PAT score of 79.33% against those in the control group with a mean score of 54.44%. This shows that the demonstration teaching method is more effective than the teacher expository method. Interestingly, the observed difference is statistical significant ( $p < 0.05$ ). This obviously indicates that demonstration method influences students’ understanding and retention of physics concepts in a positive way.

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Figure 6 represents the effect of Demonstration teaching method on students’ performance in physics.

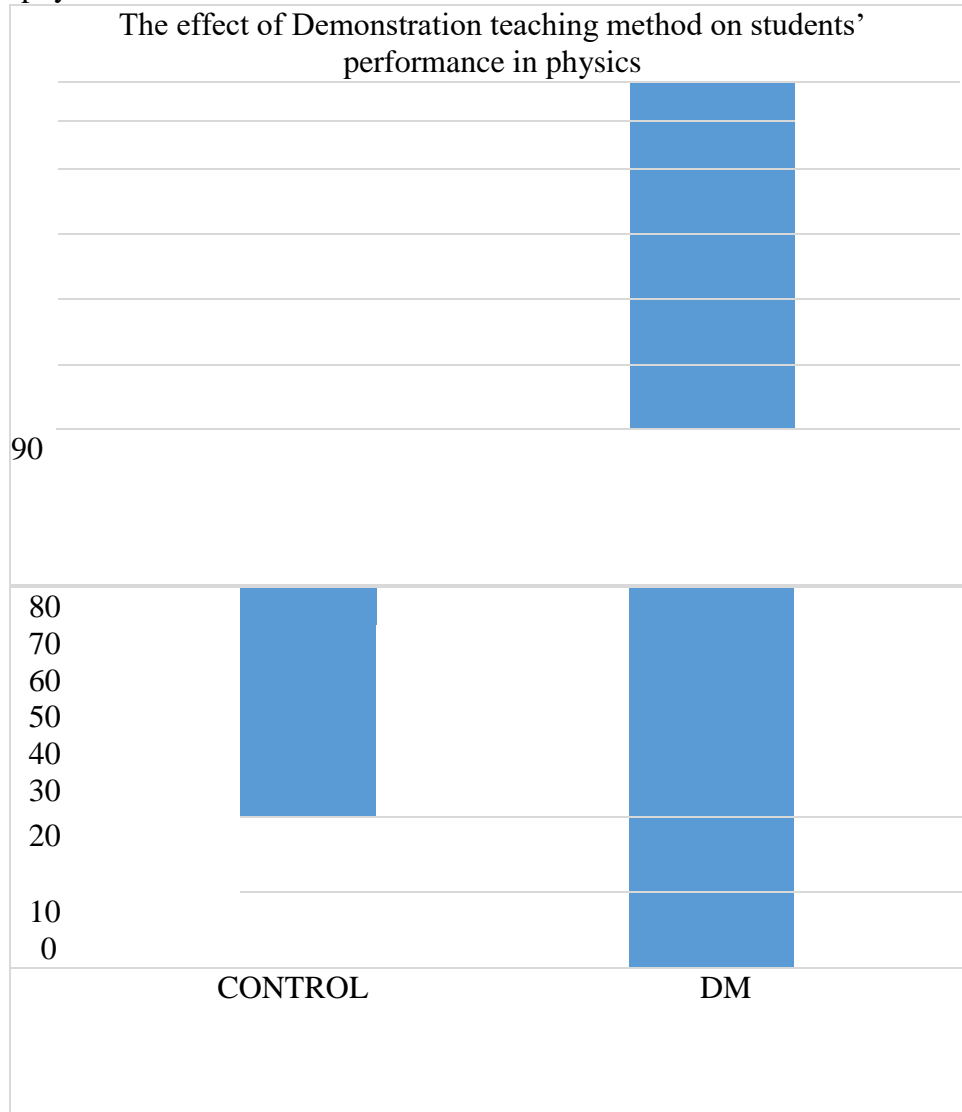


Figure 6: A Bar Chart Showing the effect of Demonstration teaching method on students’ performance in physics

**Research Question Three:** Is there a significant difference in the performance of students taught physics using guided discovery method and those taught using demonstration method?

The results showed a higher average performance for students in the Demonstration Method group with a mean PAT score of 79.33% than those in the Guided Discovery group with a mean score of 60.00%. This shows that the demonstration teaching method is more effective than the guided discovery method. Remarkably, the observed difference between these two experimental groups is statistical significant ( $p < 0.05$ ). This suggests that demonstration method

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is more effective than the guided discovery teaching method as represented in Figure 7.

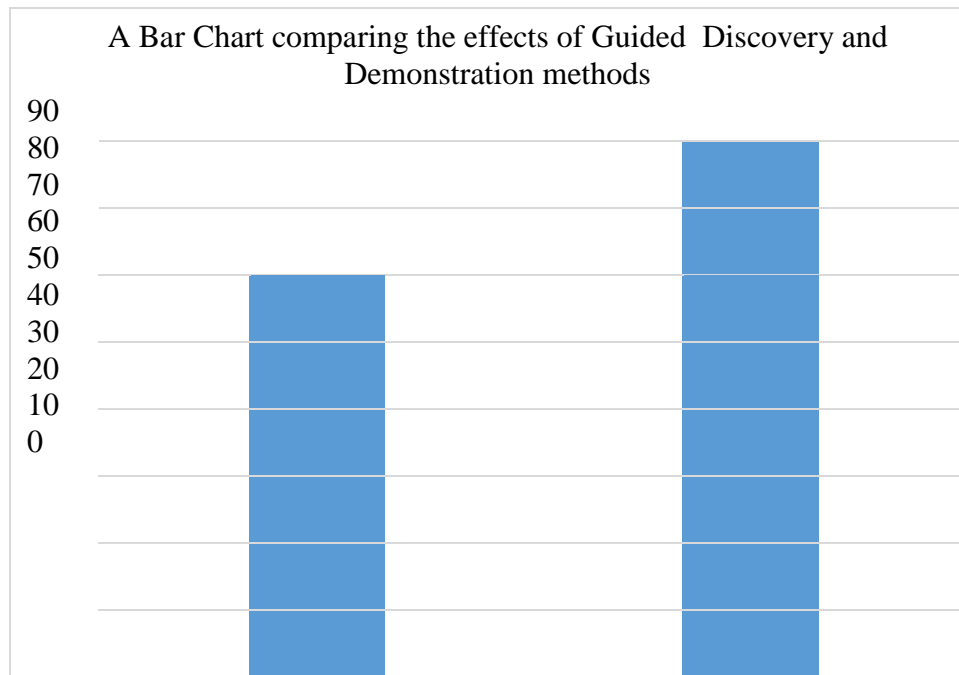


Figure 7: A Bar Chart comparing the effects of Guided Discovery and Demonstration methods

**Research Question Four:** What are the challenges faced by physics teachers in implementing guided discovery and demonstration methods?

The study identified some challenges faced by physics teacher in implementing guided discovery and demonstration methods as follows: Sometimes most of the students do not easily comprehend lessons taught directly using guided discovery method except it is brought down to their level by hard and consistent explanation. More so, it is difficult to guide some students who do not have prior knowledge about the topic of discussion as they cannot relate when teaching them with the method of guided discovery. Other challenges include lack of attentiveness and cooperation with the teacher.

In using demonstration method, physics teachers face the challenge of inadequate facilities as well as distractions. One teacher said students are often carried away with the demonstration, forgetting the primary reason for the practical lesson. Hence, may not get the best from the method.

Other general challenges that affect both method as mentioned by participating biology teachers include large class size, students' lack of interest, and lack of resources and insufficient training.

### Summary of Major Findings

The study revealed the background characteristics of the respondents. The main variables under consideration include gender, age and Attitudes Score of Students towards Physics and Physics Achievement Test (PAT) score. The result shows that 38.3% of respondents were males, 50.0% were females and 11.7% did not indicate their gender. In addition, 58.3% of respondents fall within 10 to 14 years, 40.0% are 15 to 19 years while the remaining 1.7% did not indicate age range.

The mean score of Students Attitude towards Physics is 86.97, indicating a net positive attitude towards Physics. However, 11 out of the 60 respondents, representing 18.3% showed Neutral attitude towards Physics while the remaining 49 respondents (81.7%) showed positive attitude.

The study also shows that 13.3% of respondent scored less than 40 (that is, failed the Physics Assessment Test) according to SSCE grading system, 28.3% of participants scored less than 50% (that is, failed to get a credit pass) while 71.7% secured at least a credit pass. However, 6.7% had B3 grade, another 13.3% had B2 and 31.7% of students had A1 grade.

Moreover, the study recorded a higher average performance for respondents in the Guided Discovery Method group with a mean PAT score of 60.00% against those in the control group with a mean score of 54.44%. This shows that the guided discovery teaching method is more effective than the teacher expository method. However, the observed difference is not statistical significant ( $p > 0.05$ ).

The results revealed a higher average performance for students in the Demonstration Method group with a mean PAT score of 79.33% than those in the control group with a mean score of 54.44%. This shows that the demonstration teaching method is more effective than the teacher expository method. Interestingly, the observed difference is statistical significant ( $p < 0.05$ ). This obviously indicates that demonstration method influences students' understanding and retention of physics concepts in a positive way.

The results showed a higher average performance for students in the Demonstration Method group with a mean PAT score of 79.33% than those in the Guided Discovery group with a mean score of 60.00%. This shows that the demonstration teaching method is more effective than the guided discovery method. Remarkably, the observed difference between these two experimental groups is statistical significant ( $p < 0.05$ ). This suggests that demonstration method is more effective than the guided discovery teaching method.

Furthermore, the study identified some challenges faced by biology teacher in implementing guided discovery and demonstration methods to include large class size, students' lack of interest, lack of resources and insufficient training. A teacher said that sometimes most of the students do not easily comprehend lessons taught directly using guided discovery method except it is brought down to their level by hard and consistent explanation. More so, it is difficult to guide some students who do not have prior knowledge about the topic

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of discussion as they cannot relate when teaching them with the method of guided discovery. Other challenges include lack of attentiveness and cooperation with the teacher. In using demonstration method, physics teachers face the challenge of inadequate facilities as well as distractions. One teacher said that students are often carried away with the demonstration, forgetting the primary reason for the practical lesson. Hence, may not get the best from the method.

### **Conclusions**

This study reveals that both guided discovery and demonstration teaching methods are more effective than the teacher expository method. The findings also show that demonstration method appears to be more effective in improving students' performance in physics than guided-discovery method. There are mixed opinions about which of these methods is more effective. The students who participated in the study showed a net positive attitude towards physics. The study identified some challenges faced by physics teacher in implementing guided discovery and demonstration methods to include large class size, students' lack of interest, lack of resources and insufficient training, etc. Thus, the findings presented could be attributed to several factors such as teachers' skills and experience as well as students' learning conditions.

### **Recommendations**

Based on the research findings, the following recommendations are necessary:

The government and private school owners should equip schools with adequate laboratory equipment, instructional materials, funding, and technical support.

School administrators should avoid overcrowded classrooms by building more infrastructures and employing more competent physics teachers.

The government should also invest more in teachers' training and retraining.

Parents should motivate their children, and not coerce them to offer physics.

School administrators and teachers should orientate physics students to eliminate distractions during lessons.

Teachers should make each physics class engaging, experimental, interactive and inspiring to further stimulate students' interest and enhance their performance in the subject

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