

# Effects Of Guided Inquiry Strategy on Testwiseness and Achievement of Senior Secondary School Two Students' in Physics in Bauchi Metropolis, Nigeria.

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*Abstract- The study seeks to examine the effect of guided inquiry strategy on testwiseness and achievement of senior secondary school two students' in mechanics in Bauchi metropolis, Nigeria. The research design used was quasi experimental pretest and posttest research design. The total number of public schools in Bauchi metropolis is forty-four (44) out of which one school was chosen. The sample of the study consisted of 60 students out of which the experimental consisted of 35 students with 20 Male and 15 Female while the control group consisted of 25 students with 15 Male students and 10 Female students in the control group drawn from the school. The instruments used for data collection were the Physics Testwiseness Questionnaires (PTW-Q) and Physics Student Achievement Test (PSAT) with a reliability coefficient of  $r=0.763$  and  $0.673$  respectively. The tools used for the analysis and answering of research questions and testing of hypotheses were descriptive statistics of mean and standard deviation while analysis of covariance (ANCOVA) was used for the hypotheses testing. The findings showed that students exposed to the treatment had higher achievement towards physics; students in the experimental group had higher achievement mean scores and testwiseness mean score. Moreso, there is a significant difference between the mean academic achievement scores of students taught using treatment and those taught using the conventional method; there is no significant difference in the mean score of male and female students in the treatment before and after exposure. Also, there is no significance difference in the effect of guided inquiry strategy and gender on SS2 students' testwiseness in physics. The study recommended among others that; Seminars, workshop, symposia and training sections should be organized for teachers by their schools and the ministry of education on how to use testwiseness in teaching their students in secondary school. Mention the abstract for the article. An abstract is a brief summary of a research article, thesis, review, conference proceeding or any in-depth analysis of a particular subject or discipline, and is often used to help the reader quickly ascertain the paper's purpose. When used, an abstract always appears at the beginning of a*

*manuscript, acting as the point-of-entry for any given scientific paper or patent application.*

*Index Terms- Guided inquiry strategy, Testwiseness, Students' achievement and School location*

## I. INTRODUCTION

Physics is a branch of science that is concerned with the study of matter, and its relationship with energy. Secondary school education is the second stage of formal education in Nigeria which gives the learners the basic introduction to science education through the developing of technologically literate citizens who understand how science, technology and society influence one another and are able to use the knowledge in their everyday activities (Beyessa, 2014). Science education subjects include physics, chemistry, biology and mathematics amongst others. Muhammed (2017) stated that physics is the study of the properties of matter, energy and their mutual relationships hence it's a major science which deals with the fundamental constituents of the universe, the force they exert on one another and the results produce by these forces. Usman and Opara (2018) opined that physics provides the basic knowledge and understanding of principles whose applications contribute immensely to the quality of life in the society. Lawrence (2015) believes that physics is the heart of science and the hub of all technological activities. Furthermore, Danjuma (2008) sees physics as the soul of science and plays a vital role in all human endeavours and serves as a pre-requisite for courses such as medicine, geology, computer science, agriculture science, pharmacy and engineering amidst many other fields.

The study of physics is important because it is the potential and basic for life and making the world

safer, empowers people, giving them greater control over their lives by providing pathways for finding answers to questions (Tolessa & Mohammad, 2016). Hence, the quality, relevance, methods of teaching, human resource, scientific literacy, science process skills, higher order thinking, science-technology and society teacher's quality, textbooks of science education directly have impacts on the extent of growth and development of science and technology. Physics which is the bedrock for every technological development is paramount to national development and the growth of any nation depends on the level of its technological advancement. They further believe that students of higher school see physics as a difficult concept and tends to lose interest in science due to some certain perceive ills about the subject. Over the years, none involvement of students in teaching and learning processes especially in physics has been a thing of serious concern to the nation at large. The high rate of students' attrition to science education particularly has become more disturbing hence the need for science educators to arise. It is better to learn along with the students because of the level at which the students can retain depends on the extent at which they understand the concept at hand. This could be the reason for the poor performances of secondary school students in physics and even tertiary school students in physics amidst other factors generally. They further stated that practices is the heart of the mastery of science discipline hence if there is no practice either individually or collectively, learning will be inert and the acquire knowledge will die off with time.

Many teaching methodologies have been used over time for the teaching of physics among which is the active learning strategies employed by educationist both locally and internationally for the better understanding of physics at the secondary school level which is the foundation for science generally in our schools.

As reported by the National Teachers Institute, NTI, (2000), the objectives of teaching and learning of Physics in secondary schools include, among others, to raise potential and competent students that will take up the charge of technological advancement. With the repeated poor performance of students in Physics, such laudable objective may not be

sufficiently achieved. It is noteworthy however, that no matter how well a lesson is planned and implemented some students still experience difficulties in achieving the desired learning outcome. This is because without identification and remediation, the difficulties may be compounded until the students become frustrated (Imo, 2012).

There is therefore the need to identify students' difficulties in physics and consequently, remedial activities be provided. Despite the relevance of Physics to national development, a lot of problems are still bedeviling the teaching and learning of Physics in Nigerian Secondary Schools (Ayansina, 2016). Few among many of such problems are ill-equipped laboratories, unqualified Physics teachers, inadequate supply of teaching and learning materials, overcrowded class rooms, students' poor attitude towards Physics, students' phobia towards Practical-related Physics topics (Adedayo, 2010). The provided evidences recorded over the years in Physics at Senior Secondary School Certificate Examinations (SSCE) as posited by Mankilik and Agal (2014) can be linked to these mentioned problems. The SSCE conducted by West Africa Examinations Council (WAEC) and National Examinations Council (NECO) are taken by both private and public secondary schools final year students. The performance of students in physics has not been encouraging (Akuche & Okunola, 2017).

Teaching methods are ways used by teachers to create learning environment and to specify the nature of the activity in which the teacher and the learner will be involved during instructional delivery process. It is primarily a description of learning objective oriented activities and the flow of information between the teacher and the learner(s), David (2015) categorized teaching method into two approaches; namely; student centered approach and teacher centered-approach.

The inquiry based learning method is described as a range of philosophical, curricular and pedagogical approaches to teaching. It is an instructional method developed during the discovery learning movements of the 1960s. It was developed in response to perceived failure of more traditional forms of instruction, where students are required simply to

memorize facts laden instructional materials (Bruner, 1961). Inquiry learning is a form of active learning where progress is assessed by how well students develop experimental and analytical skills rather than how much knowledge they possess. Inquiry based learning can be guided or unguided. Guided inquiry provides specifics-data or facts but wants students to make generalization. It is carefully planned, closely supervised, targeted on-going assessment and intervention by an instructional team of a school. It allows students to discover specific information by themselves before they make generalization. There is no prescribed target result which the students have to achieve; rather students are allowed to discover facts for themselves (Okoli, 2011). In contrary, unguided inquiry allows students to discover specifics by themselves before they make generalizations.

Testwiseness (variously called test-taking skills, test expertise or test sophistication) emanates from testees regular taking of examinations and can confer a significant advantage to the experienced testees over those that are not experienced. Oluwafemi and Ifedayo (2013) had found out in a study that the nature and level of possession of test-taking skills is an important factor in the performance of students especially in Physics tests. However, issues which bother around nature of physics tests and examinations and conditions of testees at the time of examinations are often neglected. Such issues include the level of skills possessed by the student taking the test and the presence or absence of anxiety among the students. These factors have been found to have significant effect on students' achievement and attitude in physics tests. Physics teachers at the secondary school level often neglect the issue of the extents to which students possess the requisite test taking skills to take tests and examinations in physics.

## II. STATEMENT OF THE PROBLEM

The problem that resulted to this study was the poor achievement of students towards physics in Bauchi Metropolis. Precisely, students' achievement in Physics especially at the external examinations has treacherously become a national problem (Omole & Anakaraonye, 2012). According to Adeyemo (2010), physics is considered as the most problematic area

within the realm of science, and it traditionally attracts fewer pupils than chemistry and biology. It is perceived as a difficult course for students from secondary school to university and also for adults in graduate education.

Based on the aforementioned, this study is out to find the effects of guided inquiry strategy on testwiseness and achievement of secondary school II students' in physics in Bauchi metropolis, Nigeria. There is need to explore more into the best methods of teachingspecific topics in physics in other to enhance students' achievement. Therefore, the problem of this study is posed as a question; what is the effect of guided inquiry strategy on testwiseness and achievement of secondary school II students' in physics in Bauchi metropolis?

## Research Questions

The following questions will be answered in this study:

1. What is the testwiseness mean scores of SS2 physics students' in physics before and after exposure to treatment.
2. What is the testwiseness mean scores of male and female in Physics students' before and after exposure to treatment.

## Research Hypotheses

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

1. There is no significant difference in the effect of guided-inquiry strategy on SSII students' testwiseness in Physics in Bauchi metropolis, Nigeria.
2. There is no significant difference in the interaction effects of guided-inquiry strategy and gender on SSII students' testwiseness in physics in Bauchi metropolis, Nigeria.

## III. METHODOLOGY

The study adopted the use of quasi-experimental design of pretest, posttest and non-equivalent control group design with the purpose of ascertaining the effect of guided inquiry strategy on testwiseness and achievement of secondary school. The target population for this study consists of all senior

secondary two physics students of the forty-four (44) public senior secondary schools located in Bauchi Education Zone of Bauchi State. In an attempt to minimize the effect of school type and to ensure the similarity of school conditions, only public Secondary Schools in Bauchi metropolis were considered. Simple random sampling technique was used to select the sample of boys and girls in the school. In all, 60 students are proposed to be used in the study.

Purposive sampling technique was used to obtain the sample schools. This technique was use because it allows collection of data to be done under natural setting and relatively quicker and cheaper to undertake. A sample of 212 was selected out of which 60 were used in government day secondary school Sa'adu Zungur Bauchi. 25 students were used in S.S 2 A and 35 students sample were used in S.S 2 B for data analysis. This technique is fundamental to the quality of data gathered; thus, reliability and competence of the informant must be ensured.

Two research instruments and two sets of instructional tools will be used. The Physics Achievement Test (PAT) was used as a multiple-choice test question gotten from the concept of Projectile motion and vector. It consisted of 40-items drawn the concept of projectile motion and vector with 4 response options. The items covered the prescribed scheme for senior secondary school form SS2 curriculum. The test would be graded like the final WAEC and NECO SSCE examinations thus: 0-39 (F), 40-44 (E8), 45-49 (D7), 50-54 (C6), 55-59 (C5), 60-64 (C4), 65-69 (B3), 70-74 (B2), and 75-100 (A1).

Also, Physics Testwiseness Questionnaires (PTW-Q) was used to measure level of possession of

testwiseness and rated using the Likert scale- Strongly Agreed (SA); Agreed (A); Undecided (U); Strongly Disagreed (SD); and Disagreed (D) which were scored 4, 3, 2 1, and 0 respectively for positive items and the other way round for negative items.

A table of specification developed by the researcher was articulately followed when constructing Physics Achievement Test (PAT). The PAT questions drawn from the concept of projectile motion and vector. The validation of the PAT was done by three experts, two in Physics education and one in educational measurement and evaluation with a validation index of 0.85 which renders the instrument valid. The purpose of the study, research questions, research hypotheses, the instruments and tools were made available to those experts by the researcher. This gives the experts an appropriate direction for adequate scrutiny on where to add, delete or modify items.

The reliability of PAT was determined through test trial. The PAT was administered to 10 SS2 students in the target population but outside the sample of the study. The test re-test method of estimating reliability of a test was employed for the PAT. The test (test and re-test) were conducted in interval of one week. The two results were then correlated using Pearson's correlation method with a reliability coefficient of 0.75. This renders the instrument reliable.

#### IV. RESULTS

Research question One

What is the testwiseness mean scores of SS2 physics students' before and after exposure to treatment?

Table 1: Mean and Standard Deviation for treatment and Control Group

Group	N	Pretest		Posttest		Main Gain
		Mean	SD	Mean	SD	
Treatment	25	12.50	3.76	25.58	7.50	13.08
Control	35	7.05	2.01	11.54	3.89	4.49
Mean Diff.		5.45		14.04		8.59

Table 1 shows the experimental group pretest and posttest mean achievement scores of 12.50 and 25.58 with a standard deviation of 3.76 and 7.50 respectively. However, the control group has a pretest and posttest mean score of 7.05 and 11.54 with a standard deviation of 2.01 and 3.89 respectively. The result showed a mean achievement gain score for both experimental and control group as 13.08 and 4.49 respectively. Therefore, students in the experimental group had a higher achievement mean

score compared to the control group as a significant mean score was gain before and after exposure to treatment.

Hypothesis One

There is no significant difference in the effect of guided inquiry strategy on SSII students' testwiseness in physics in bauchi metropolis, Nigeria.

Table 2: Analysis of covariance (ANCOVA) of students' achievement scores by treatment group and conventional group.

Source	Type III sum of squares	Df	Mean square	F	Sig	Partial Eta square
Corrected model	11654.221 <sup>a</sup>	2	4237.300	104.604	.000	.604
Intercept	2340.947	1	2340.947	103.442	.000	.444
Pre-Achievement test	2327.695	1	2327.695	117.130	.000	.130
Group	3595.562	1	3595.562	375.555	.000	.604
Error	2616.193	58	19.953			
Total	274310.00	60				
Corrected total	12600.893	59				

P<0.05 significant level

Table 2 shows that F (375.555) is significant at .000 for the groups at 1 and 60 degrees of freedom (df) since .000 is less than .05 significant level used for the hypothesis testing. This result implies that the null hypothesis is rejected and the alternative which states that there is a significant difference between the mean academic achievement scores of students taught using treatment and those taught using the conventional method.

Research Question Two

What is the testwiseness mean scores of male and female students in physics before and after exposure to treatment?

Table 3: Mean and Standard Deviation for Treatment (male and female) Group

Group	N	Pretest		Posttest		Main Gain
		Mean	SD	Mean	SD	
Male	15	13.72	3.14	35.27	5.01	22.55
Female	10	9.43	3.63	19.14	4.96	9.71
Mean		4.29		16.14		12.84
Diff.						

The results in Table 3 revealed that for the pretest, posttest, male students have higher achievement mean score of 13.72 and 35.27 with a standard deviation of 3.14 and 5.01 while the female students had a lower achievement mean score of 9.43 and 19.14 with a standard deviation of 3.63 and 4.96 respectively giving rise to a mean achievement gain of 22.55 in the male and 9.71 for the female students with the result skewed towards the male students with a mean difference of 12.84 which shows that the

male students had a higher mean achievement score compared to their female counterparts.

There is no significant difference in the interaction effects of guided inquiry strategy and gender on SSII students' testwiseness in physics in Bauchi metropolis, Nigeria.

Hypothesis Two

Table 4: Analysis of covariance (ANCOVA) of male and female students' attitude scores when exposed to treatment

Source	Type III sum of squares	Df	Mean square	F	Sig	Partial Eta squared
Corrected model	2932.596 <sup>a</sup>	2	1966.298	106.910	.000	.440
Intercept	3837.983	1	4837.983	263.047	.000	.468
Pre-interaction test	3344.911	1	226.069	205.790	.000	.443
Gender	.200	1	.200	0.33	.843	.000
Error	92.779	23	18.392			
Total	211055.00	25				
Correctional total	568.279	24				

P<0.05 significant level

Table 4 shows that F (0.33) is significant at .440 for gender at 1 and 25 degree of freedom (df) since .440 is more than .05 level of significance hence the null hypothesis is rejected which states that there is no significant difference in the mean score of male and female students in the treatment.

## V. DISCUSSION

Table 1 shows a mean achievement gain score for both experimental and control group as 13.08 and 4.49 respectively. Therefore, students in the experimental group had a higher achievement mean score compared to the control group as a significant mean score was gain before and after exposure to treatment. This agrees with the findings of Peter (2017) that students expose to the use of guided inquiry strategy have better mean achievement than those expose to conventional method which was in line with the findings of Mudasiru (2010).

Furthermore, Table 2 shows that the null hypothesis is rejected and the alternative which states that there is a significant difference between the mean academic achievement scores of students taught using treatment and those taught using the conventional method. This finding concurs with those of Peter (2012) and Khan (2015) who reported significant difference in the mean performance of students taught using guided learning strategy.

Table 3 shows that , male students have higher achievement mean score and standard deviation than female students respectively. The result skewed towards the male students with a mean difference of 12.84 which shows that the male students had a higher mean achievement score compared to their female counterparts. This finding is in consonance with the findings of Obiekwe (2012) in line with Okoro (2015) which states that male tends to perform better than their female counterparts

Furthermore, Table 4 shows that the null hypothesis is rejected which states that there is no significant difference in the mean score of male and female students in the treatment. This is in line with the findings of Yusuf and Afolabi (2010) shows that there is no significant difference in the mean achievement score of male and female student in physics.

## VI. CONCLUSION

Guided Inquiry Strategy have statistically significant effect on students' academic achievement in teaching and learning of physics in secondary schools and as a form of active learning strategy is gender friendly and does not discriminate between genders in terms of achievement, testwiseness and retention. The strategy can enhance students' testwiseness ability in secondary school physics compared to the conventional method of teaching and learning physics.

## VII. RECOMMENDATIONS

Based on the findings of this study, the following recommendations were proffered:

1. Testwiseness should be encouraged in our schools as a way of improving students' academic achievement.
2. Teachers should be encourage on the need to use study question for effecting improvement of student achievement and testwiseness abilities in physics.

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