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Strengthening Performance of Secondary Students Along Low-Moderate-High Abilities in Physics Using Group Dynamics and Visual Cue Strategies

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ABSTRACT

This study examined how group dynamics and visual cues strategies can foster academic performance of Senior Secondary II students of different cognitive abilities in Physics in Benue State, Nigeria. Specifically, the study determined which of the ability groups (i.e low, moderate and high) gained more when group dynamics and visual cues strategies were used in teaching Physics. The study adopted quasi-experimental design of pre-test, post-test non-randomized control group type. The population for this study comprised 815 SS II students offering Physics in public secondary schools in Makurdi Local Government Area in the 2023/2024 academic session, while a sample of 114 students was selected using multi-stage sampling procedure. The instruments for data collection are Physics Performance Test (PPT) and Student Cognitive Ability Test (SCAT). The PPT SCAT were validated by three experts. The reliability coefficient of the instruments were obtained using K-R_{20} and found to be 0.81 for PPT and 0.72 for SCAT. The collected data were analyzed using mean and standard deviation to answer research questions and ANCOVA to test the null hypotheses at 0.05 level of significance. Findings revealed that the mean gain in academic performance score of students taught Physics using group dynamics strategy was 22.75 for high, 18.47 for moderate and 3.45 for low ability students. There was significant difference in the mean academic performance scores of low, moderate and high cognitive ability students when group dynamics strategy was used in teaching Physics.The mean gain in academic performance score of students taught Physics using visual cues strategy was 22.79 for high, 15.72 for moderate and 3.22 for low ability students. There was significant difference in the mean academic performance scores of low, moderate and high cognitive ability students when visual cues strategy was used in teaching Physics. The study has established that for both experimental groups (that is, group dynamics and visual cues strategies) the performance of the students increases in the order of low ability →moderate ability → high ability. The study concludes that the effectiveness of the two strategies is dependent on cognitive abilities of the students. The high ability students benefited most, followed by the moderate ability students while the low ability students benefited the least from each of the strategies. It was therefore recommended that teachers of Physics should employ group dynamics and visual cues teaching strategies in Physics class to ensure effective teaching and enhance academic performance of students in the subject and to ensure successful teaching and learning of the subject for improved cognitive abilities of students in Physics, among others.

1. INTRODUCTION

The fundamental goal of education is to equip students with the knowledge and skills necessary to think critically, solve complex problems, and succeed in the 21st century society and economy. The measurement of such knowledge and skills is essential to tracking students' development and assessing the effectiveness of educational policies and practices. Science education has used many measures of learning, but recent research from Marti (2023) focuses on standardized achievement tests designed to assess students' mastery with specific content standards in core academic subjects including Physics (Odewumi, 2020)

The term 'Physics' is derived from an ancient Greek word *physics* meaning "nature." It is a natural science that involves the study of matter (Kaiser, 2019) and its motion through space and time, along with related concepts such as energy and force (Zhang & Skoric, 2018). More broadly, it is the general analysis of nature conducted in order to understand how the universe behaves Araki (2015).

Physics as a science subject at the secondary school level is an important subject that enhances the scientific and technological development of any nation. Grob, Rhoneck and Volker (2019) assert that Physics is a vehicle for achieving long-term goals of science because it is instrumental to technological and socio-economic growth across the globe. The role of Physics in the education of scientists, engineers, chemists and practitioners of other physical and biological sciences is enormous as its principles aid in the constructing of artifacts, automobile, bridges, air conditioners and refrigerators, among others (Jehad, 2019). It is a sine qua non to the technological development of any nation and its application is found in all spheres of human life. It is also the foundation of scientific knowledge as it has contributed immensely to the existence and activities of man towards improved standard of living and growth in wealth.

Despite the importance of Physics, there are a number of observable problems pestering the teaching and learning of the subject, especially at the secondary school level. These problems include; poor method of instruction, inadequate instructional materials, insufficiency of qualified science teachers among others (Doff, 2018). Physics students at the secondary school level have therefore, continued to record poor academic performances in the subject. Statistics obtained from the research library of the West African Examinations Council headquarters Lagos show that between 2013 and 2022 in Nigeria, students' performance in Physics at the senior certificate level has been poor as their percentage pass at credit level and above consistently fell below 50%. In 2006 when 58.05% passed at credit level indicating a fairly high percentage passes.

The WAEC Chief Examiners' report for Physics in 2013 for instance, revealed that out of 1,154,266 candidates who registered for WAEC, those who sat for Physics were less than 40 percent of the total candidates while a paltry 30.00 percent of the total passed the subject at credit level. This information is consistent with that of Badmus and Omosewo (2018), whose analysis of the Chief Examiners' Reports (CER) in Physics revealed students' inadequacies in conversion of units (CER, 2013, 2014, 2015, 2020, 2021,2022), arithmetic (CER, 2014, 2016, 2015, 2020, 2021), measurement and computational skill (CER, 2013, 2017s, 2021, 2022) and inability to take precise measurement to required accuracy (2018, 2012, 2020, 2021) in physics examinations. Similarly, in 2020, the CER report stated that most students had difficulty in solving problems on mechanics, sound and heat; could not give the reason for using steel as a compass needle and iron as a core of electromagnets; failed to record length measured with the metre rule to 1 decimal place in centimeters; were unable to make simple deductions from the graphs; and were unable to plot points correctly to the accuracy of chosen scales and these affected their overall results.

Similarly, NECO Chief Examiners' report for Physics in 2021 revealed that .the number of candidates that registered for the examination is 60,133 with 31,392 (53.14 percent) male and 28,241 (46.96 percent) female. The number of candidates that sat were 59,124 (52.96 percent) male and 27,808 (47.03 percent) female, those who sat for Physics were less than 35 percent of the total candidates while a paltry 27.30 percent of the total passed the subject at credit level. According to the report, out of 59, 124 candidates who sat for the examination, only 33,914 candidates representing 34.72 percent got five credits and above in Physics.

This puts to question the level of poor performance and by extension the quality and effectiveness of the teaching/learning process in schools which is detrimental to the development of Nigeria as a nation. This is because the trend of poor performance in Physics can implies that the students are not well-equipped to perform effectively as professionals since Physics is a core Science subject, hence students poor performance in the subject entails poor foundation which could lead to ill-preparation for advanced Science education with inadequate technological skills.

Agomuoh and Nzewi (2013) attribute the deterioration in students' performance in physics to ineffective method of teaching. In particular, researchers such as Estysomo (2017) and Kim and Holzer (2015) pointed out that students' performance in heat and temperature as well as modern physics concepts, particularly waves and mechanics, have been unimpressive. Mvula (2020) also observed that many students skip questions on waves and mechanics while writing physics examinations, and among the few students who attempt these questions, majority of them usually score below average. Based on this deplorable trend of poor performance in the subject, physics educators have used some instructional strategies over the years to curb the problem of under-performance in the subject. For instance, Ochogba, Ogide and Ogide (2019) reported that constructionist problem-based learning techniques have the potentials of curbing the problem of under performance among students of varying cognitive ability in Nigerian secondary schools.

Cognitive ability is a general mental capability involving reasoning, problem solving, planning, abstract thinking, complex idea comprehension, and learning from experience (Nandana, 2015). Probably the most comprehensive taxonomy for cognitive abilities is the three strata model derived by Carroll (1993). The first stratum consists of specific and narrow abilities, the second includes group factors and broad abilities, and the third stratum is general intelligence. Specifically, cognitive ability could be categorized as low, moderate and high. While low cognitive ability involve deficits in knowledge and reasoning skills which often interferes primarily with the acquisition of positive social skills, contributing to deficits in communication and pro-social play skills (Pope & Bierman, 2019), moderate cognitive ability is intellectual functioning that is considerably below average and that exists concurrently with significant deficits in adaptive behavior, how individuals adapt to environmental demands compared to others of the same age. High cognitive ability is characterized by the display of rapid learning and easy recall of factual information, quick perception of cause-effect relationships, long attention span with high retention of information, seeking complex and challenging activities and display of abstract thinking skills, among others (Jehad, 2019).

The National Policy on Education in Nigeria (2013) has emphasized the role of education to students' cognitive development (He et al, 2020). Science education has therefore, used measures of several cognitive concepts to assess variation in domain-independent mental skills, including processing speed, how efficiently information can be processed (Kail & Salthouse, 2014), working memory capacity, how much information can be simultaneously processed and maintained in mind. (Cowan, 2015; Gathercole et al, 2019), and fluid reasoning how well novel problem can be solved (Engle et al, 2019). The present study shall adopt the fluid approach to ascertain how well students are able to solve novel Physics problems presented to them. This approach involves dynamic teaching strategies that could carry every student along for enhanced performance.

Scholars such as Jehad (2019) and Sternberg, (2017) have treated cognitive abilities as foundational constructs, presupposing that cognitive abilities are primary and can determine academic outcomes that enhances students performance. The other set of factors important for academic performance consists of cognitive abilities, including but not limited to working memory, simultaneous information storage and manipulation; (Peng, 2020). Reasoning; the capacity to solve novel and complex problems (Sternberg, Kaufman, & Grigorenko, 2008), and executive function; cognitive and social-emotional processes that underlie goal-directed behaviour such as flexible thinking, self-control, and self-regulation (Best & Miller, 2010).

Cognitive ability helps to predict academic performance such that schools that improve academic performance could also improve students' cognitive abilities. Generally, the fundamental goal of education is to equip students with the knowledge and skills necessary for critical think which helps in solving complex problems. Thus, the measurement of cognitive abilities is essential to tracking students' developments and assessing the effectiveness of science and technical education (Fin et al, 2014).

It is therefore, imperative to find out if innovative teaching strategies like group dynamics and visual cues could stimulate students of different cognitive abilities towards enhanced performance in Physics. Group dynamics refers to the relationships between learners in a group and the impact that this has on the way they work. In group dynamic teaching strategy, the teacher recognizes which of the factors contributing to group dynamics are within his or her control such as groups member resources, structure (group size, group roles, group norms, and group cohesiveness), group processes communication, group decision making processes, power dynamics, conflicting interactions, family background, sex, age, and level of intelligence, among others. Group tasks (complexity and interdependence). Alikhani and Bagheridoust (2017) examined the effect of group dynamics-oriented instruction on developing Iranian English as a foreign language (EFL) learners' speaking ability and willingness to communicate and found that group dynamics-oriented instruction was reliably effective in improving speaking ability and uplifting willingness to communicate. Similarly, Muzaki, Madina and Ejuu's (2020) study on group dynamics and students cognitive engagement in class tasks in institutions of higher learning found that cognitive engagement among students in group tasks can be effective with the knowledge of group dynamics and their management. These suggest that group dynamics teaching strategy can be used to enhance the performance of students of different cognitive abilities.

Another teaching strategy considered to affect the performance of students of different cognitive abilities is visual cues which are concrete objects, pictures, symbols, or written words that provide a child with information about how to do a routine, activity, behavior, or skill. Visual cues can help a child learn a new skill or become more independent with a skill. The teacher who adopts visual cues teaching strategy actively encourages students to decode still images such as documentary or advertising photography, and moving images such as commercials, newscasts, and dramatic or comic television programmes and films. He or she explores with students the signs and symbols in art and visual media. Kaswa (2015) examined the effect of visual learning aids on students' academic performance in public secondary schools and found that students who used visual learning aids in classrooms performed better than students who did not use visual learning aids. In the same vein, Escalada (2017) investigated the effect of using interactive digital video in Physics classroom on students' learning and attitudes and found that students' initial feelings of comfort/anxiety in using computer applications were significantly related to the students' computer experience but students' initial feelings of computer application usefulness was not significantly related to students' computer experience. This suggests that visual cues teaching strategy can significantly predict the performance of students of different cognitive abilities. Both group dynamics and visual cues teaching strategies are learner-centred, hence, it is imperative to also explore the effect of demonstration as a learner-centred teaching strategy on the performance of students of different cognitive abilities.

The present study examined the effect of group dynamics and visual cues teaching strategies on the performance of students with different cognitive abilities. Attempt will therefore, be made to find out whether group dynamics and visual cues as innovative teaching strategies have the ability to bridge the performance gap between students with low, moderate, and high cognitive abilities.

Statement of the Problem

Group dynamics and visual cues are considered to be among the innovative teaching strategies considered in this study. Despite the application of innovative teaching strategies in teaching Physics such as guided inquiry, field work and peer group learning in Benue State, students' performance has continued to be poor. The persistent failure of students in Physics examinations in Benue State has therefore, become a source of worry to all well-meaning individuals. The West African Examinations Council (WAEC) and National Examinations Council (NECO) results of 2013-2022 show that students' performances in Physics have been poor as the percentage pass at credit level and above consistently fell below 50% except in 2006 that it was 58% (WAEC, 2013 - 2022) (See Appendices A & B). This could reflect students' with different cognitive abilities. Students of low cognitive abilities may record lower performances than those who have moderate or high cognitive abilities if the use of innovative teaching strategies to enhance their cognitive abilities and improve their performances is ineffective. The question is whether these poor performances of students in the certificate examination in the State could be a function of their cognitive abilities.

Previous studies on the academic performance of students with varying cognitive abilities using innovative teaching strategies such as Ellah and Achor (2015), Estysono (2017, Olufunmiyi (2018), Lusweti et al (2018) and Ellah, Achor and Enemarie (2019) have found that the instructional strategies have significant effect on students' academic performance, with high ability students indicating high academic performance than moderate and low ability students.

Research Questions

The following research questions were answered in this study:

1. Which of the ability groups (i.e low, moderate and high) gain more in the mean academic performance score when group dynamics strategy is used in teaching Physics?
2. Which of the ability groups (i.e low, moderate and high) gain more in the mean academic performance score when visual cues strategy is used in teaching Physics?

Hypotheses

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

1. There is no significant difference in the mean academic performance scores of low, moderate and high cognitive abilities students when group dynamics strategy was used in teaching Physics.
2. There is no significant difference in the mean academic performance scores of low, moderate and high cognitive abilities students when visual cues strategy was used in teaching Physics.

2. THEORETICAL FRAMEWORK

The theoretical framework for the study comprises Piaget's theory of cognitive development, Walberg's theory of academic performance and Bloom's Taxonomy(1956). Jean Piaget's theory of cognitive development (1956) was propounded in his thesis 'La naissance de l'intelligence chez l'enfant' translated . The theory states as follows:

i. cognitive development is a progressive reorganization of mental processes resulting from biological maturation and environmental experience;
ii. cognitive development is at the center of the human organism and
iii. language is contingent on knowledge and understanding acquired through cognitive development.

Piaget's stages are: Sensori-motor stage: birth to 2 years; Preoperational stage: ages 2 to 7; Concrete operational stage: ages 7 to 11; and Formal operational stage: ages 12 and above. The stages are discussed in detail as follows

Piaget's theory of cognitive thought is therefore, related to the present study because it provides the cognitive abilities of children at different stages of development which is in line with the focus of the present study in fostering academic performance of students with different cognitive abilities. The theory suggests that students' performance depends on their chronological ages which mark differences in their cognitive abilities. When applied to the present study, it indicates that students of different cognitive abilities will perform differently in Physics instruction.

Walberg's theory of academic performance was propounded by Walberg (1981). The theory talks about the influences on learning that affects the academic performance of a student. It is an exploration of academic achievement wherein Walberg used a variety of methods on how to identify the factors that affect the academic performance of a student. The theory classified 11 influential domains of variables, 8 of them affected by social-emotional influences namely, classroom management, parental support, student-teacher interactions, social-behavioural attributes, motivational-effective attributes, the peer group and exposure to media. The variables in Walberg's theory are reflected with different representation. The first three variables (ability, motivation, and age) reflect characteristics of the student. The fourth and fifth variables reflect instruction (quantity and quality), and the final four variables (classroom climate, home environment, peer group and exposure to media) represent aspects of the psychological environment.

The theory has strong linkage with the present study since it identifies that the quality and quantity of instructional strategies affect students' academic performance. Thus, even students' of same cognitive abilities but different Walbergian domains (different characteristics, instructions and psychological environment) could differ in their level of academic performance in Physics. Thus, while teaching strategies like Group Dynamics and Visual Cues can help student achieve high level of attitude (ability, development and motivation) towards enhancing their performances in Physics, the quality and quantity of instruction could subject the students to low, moderate and high performances. These strategies are expected to be of high quality and so could be leveraged upon for enhanced academic performances in Physics through affective, behavioural and cognitive learning. The study is therefore co-anchored on Walberg's theory of academic performance since it suggests that academic performance of students is affected by many factors.

This framework developed by Bloom and colleagues for categorizing educational goals, elaborated by Bloom and his collaborators consisted of six major categories: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. The categories after Knowledge were presented as "skills and abilities," with the understanding that knowledge was the necessary precondition for putting these skills and abilities into practice. While each category contained subcategories, all lying along a continuum from simple to complex and concrete to abstract, the taxonomy is popularly remembered according to the six main categories.

Bloom's taxonomy, especially the revised edition is relevant to the present study because of its thrust which centers on cognitive domains. The present study also focuses on students' cognitive abilities, thus, the domains suggested by the model: knowledge, comprehension, application, analysis, synthesis, and evaluation can be used to model the instrument used to assess the performance of students with different cognitive abilities in Physics.

The taxonomy provides a framework for SSII students such that those who perform high (a minimum of 70 percent score) in the identified domains such as retain at least 70 percent of what they were taught two weeks ago, or score at least 70 percent in comprehension of Physics and a minimum of 70 percent in Physics practicals (application), including those who are able to score at least 70 percent in analysis of Physics problems by efficiently summarizing, comparing and contrasting the problems, breaking down complex physics problems with ease and those who have the ability of adopting the most efficient methods of solving Physics problems, for instance, with which they score at least 70 percent can be regarded as having high cognitive abilities. This also includes those who obtain a composite minimum score of 70 percent for all domains.

Meanwhile students who either obtain dis-aggregated or composite scores below 70 percent but at least 40 percent will be regarded as having moderate cognitive abilities. However, the taxonomy suggests that SSII students who either obtain dis-aggregated or composite scores of below 40 percent can be regarded as having low cognitive abilities.

Moreover, the study suggests that high ability students systematically adopt most or all the stages outlined in Bloom's Taxonomy as they create new meanings to the instruction, evaluates the content, analyze Physics concepts and apply the result by taking that enhances understanding and retention. Moderate ability students on the other hand, adopt only an average number of stages such that they may for instance, create without evaluation and analyze without application. They may also understand without retention or remembering the applied content for a longer period of time. Low ability students may adopt only a few of the stages during learning. These students may create and analyze or try to understand without prior creating ideas, evaluating the content and analysis results.

3. RESEARCH METHOD

The study adopted a quasi-experimental design of pre-test, post-test non-randomized control group type. This design is recommended where it is not possible to conduct a true experiment because neither full control over the scheduling experimental condition nor randomization can be realized (Agogo & Achor, 2019). The reason for using this design is also to establish cause-effect between the study variables. The design will be plausible because students will be assigned to classes on the basis on school subject offerings so intact classes will be used.

The dependent variable in this study was academic performance while the independent variables were the instructional strategies (group dynamics and visual cues) treated at two levels (experimental and control groups). Group Dynamics and Visual Cues teaching strategies were used for the experimental group, while demonstration strategy will be used for the control group. Cognitive ability served as the moderator on three levels (low, moderate and high).

The area of study is Makurdi Local Government Area, which is both the headquarters of Makurdi Local Government Area and capital of Benue State, Nigeria. The population for this study comprises 815 SS II students offering Physics in public secondary schools in Makurdi Local Government Area (Benue State Ministry of Education, 2022). Private and Community Secondary Schools were excluded from the study because they differ in characteristics hence their inclusion will not provide a homogenous population. The SS II class was chosen because it is a level when secondary school students take Mock SSCE preparatory for their WASSCE and NECO certificate examinations. This gives the researcher the opportunity to present the treatments as a preparation strategy for the Mock SSCE so as to grasp students' attention and seriousness.

A sample of 114 students is selected from three secondary schools in the study area. Multi-stage sampling procedure was adopted. In stage one, purposive sampling technique was engaged to enable the researcher select three schools based on the availability of manpower and facilities to support science teaching in these schools, given that Physics is a subject of interest. Based on this criterion, Special Science Secondary School Makurdi, Mount Saint Gabriel Secondary School Makurdi and Government College Makurdi were used.

In stage two, random sampling through hat and draw was used to select one intact classes from the schools selected. In stage three, purposive sampling technique was also employed to select all the 114 students in the intact class selected in each of the three schools.

Instrumentation, Validation and Reliability

Two instruments were used for this study. They are: Physics Performance Test (PPT); and Students' Cognitive Ability Test (SCAT)

The Physics Performance Test (PPT) is a self-developed 35-item instrument with five options lettered A-E. It was developed using WAEC and NECO past question papers. The items are drawn from topics particularly meant for SSII students including Heat and temperature, Wave, Molecular properties of matter, Basic motion and types of force as well as Current electricity. PPT was designed to measure SSII students' performance in Physics. To assess performance in Physics, students wrote the PPT papers within 45 minutes and submitted their scripts to the research assistants. The marking scheme was used as a guide for the scoring of students' scripts. The grading was 1 mark for correct option and total score is 35 marks.

SCAT is a 30-item instrument with five options lettered A-E. SCAT was adapted from the Wechsler Intelligence Scale for Children Fifth Edition (WISC-V, 2014) used to measure cognitive ability for children aged 17 years and below. The WISC-V domains are verbal comprehension, visual-spatial index, short-term memory, long-term memory, working memory, processing speed and fluid intelligence. The current study modified the scale by focusing on verbal comprehension, quantitative reasoning and abstract reasoning domains since these are most relevant to the objectives of the current study in terms of categorizing their cognitive abilities into low, moderate and high to be administered to students prior to the administration of pre-test. To achieve this, it is important to assess their verbal abilities, abstract thinking abilities and quantitative reasoning. The researcher prepared lesson plans and table of specification, clearly stating the lesson objectives and specific domains to reduce teaching effect for both groups.

SCAT was divided into three domains: verbal reasoning, quantitative reasoning and abstract/visual reasoning. Verbal reasoning which involved ten items derived from a comprehension prose on Physics phenomenon. Students were requested to answer the questions based on their understanding of the story. Quantitative reasoning which contains ten items was premised on questions involving calculations that the students were requested to solve while abstract reasoning which also consists of ten items focused on questions involving diagrams and the students were requested to establish the interrelationships between them. The marking scheme adopted from the study of Yenilmez, Sungur and Tekkaya (2006) as follows: 70% - 100% = High Cognitive Ability, 40% – 69% = Moderate Cognitive Ability while < 40% = Low Cognitive Ability.

The Physics Performance Test (PPT) and Student Cognitive Ability Test (SCAT) were given to lecturers who are experts in the Department of Science and Mathematics Education, Benue State University Makurdi, Joseph Saawuan Tarka University Makurdi and a secondary school Physics teacher among the sampled schools to check face and content validation of the instruments, ambiguity of items, difficulty level, the construct being measured, appropriateness of scale of measurement, and other observation that may come up. The experts were also requested to assess the instruments with respect to relevance to the research questions and hypotheses, language used in the items, appropriateness of the content, time allocation, appropriateness of age and class of the students being tested. After the validation exercise, the researcher modified and selected the final set of items based on the comments of the validators. The validators observed that the maximum scores for low, moderate and high cognitive abilities should be stated clearly. The scores were clearly specified for each level of cognitive ability and summed to 100%.

Psychometric analysis was carried out on Physics Performance Test (PPT). This psychometric analysis was an attempt to determine the quality of a test in terms of how difficult, discriminating and deflating, the test items may be and how the options function in distracting examinees. An item analysis allows one to determine whether a multiple-choice question discriminates between students who know the material from those who do not and consists of calculating two indices for each question: a difficulty index and a discrimination index (Salkind, 2017). Items that scale through the analysis were featured in the PPT while the ones that failed were discarded. Two items (Items 5 and 8) were not selected while the rest were selected .

Trial testing was conducted on 35 students from a school outside those sampled for the main study to avoid interference with the actual sample for the study. The aim of the trial testing was to determine the reliability of the research instruments. The estimate the internal consistency of the instruments was established using Kudder-Richardson formula-20 and found to be 0.81 for PPT and 0.72 for SCAT (Appendix J & K, p. 135 and 136). The choice of Kudder-Richardson is based on the fact that instruments are dichotomously scored. According to Kwahar and Onov (2017) the coefficient of 0.70 above is considered reliable.

Method of Data Collection

In order to achieve the study objectives, 12 lesson plans were prepared from Physics content domain. Four (4) lesson plans each using group dynamics, visual cues and demonstration strategies were constructed. Data was obtained through the administration of pre-test and post-test on SSII students of the selected schools in the study area. An intact class were assigned to group dynamics, visual cues and demonstration instructional strategies respectively. In order to determine students' performance in Physics, pre-test will be administered at the beginning of students' first term in SSII after the administration of SCAT.

The researcher met with research assistant for three days. Three regular teachers were used as research assistants. The researcher organised a three-day orientation programme for the research assistants who are regular physics teachers of the sampled schools on the mode and procedure for administering PPT and SCAT including how they could apply group dynamics, visual cues and demonstration strategies, and allowed to administer pre-test on the students. Group dynamics and visual cues teaching strategies were used for experimental group I and II, while demonstration strategy was used for the control group. The research assistants taught the students for eight weeks before the post-test was administered. The researcher's role was mainly supervisory. The scripts collected for both pre-test and post-test from the three groups were marked and the scores recorded and used for analysis. PPT was scored out of 35 marks.

The experimental procedure involves the systematic administration of group dynamics, visual cues and demonstration instructional strategies by three trained research assistants, each focusing on a teaching strategy (group dynamics, visual cues or demonstration). While presenting group dynamics strategy, students were organized in four heterogeneous groups of different characteristics, each comprising 5 to 10 carefully selected students. In each group, the researcher shall group students in their natural class setting irrespective gender, age, socio-economic background.

Visual cues strategy on the other hand, was administered to the students without prior group manipulation through visual aids including projectors and symbols. While instructions were presented verbally to the students, some cues on the verbal presentation were projected visually for the students to see. Available symbols were displayed to enhance students' understanding. The aim was to provide some cues to targeted objects such as amplitude of a wave, wave length, the period of a wave, simple pendulum, open electric circuit and current electricity.

Week I: Orientation exercise, training of research assistants on the administration of group dynamics, visual cues and demonstration teaching strategies and general assessment of the performance of research assistant from the training exercise
Week 2: Administration of SCAT and Pre-PPT
Week 3 - 7: Treatment
Week 8: Administration of Post-PPT

4. ANALYSIS AND RESULTS

The data presented are analyzed using means, bar graphs and standard deviations to answer research questions. The null hypotheses of the study were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. The decision rule was that null hypotheses were rejected if the P-value was less than 0.05 and not rejected if otherwise.

Research questions 1

Which of the ability groups (i.e low, moderate and high) gain more in the mean academic performance score when group dynamics strategy is used in teaching Physics?

Table 1. Mean Academic Performance Score of Low, Moderate and High Ability Students Taught Physics Using Group Dynamics Strategy

Abilities		PrePPT	PostPPT	Mean gain
High ability students	Mean	9.62	32.37	22.75
	N	8	8	
	Std. Deviation	2.13	14.27	
Moderate ability students	Mean	8.26	26.73	18.47
	N	19	19	
	Std. Deviation	2.40	10.74	
Low ability students	Mean	10.36	13.81	3.45
	N	11	11	
	Std. Deviation	4.56	10.47	

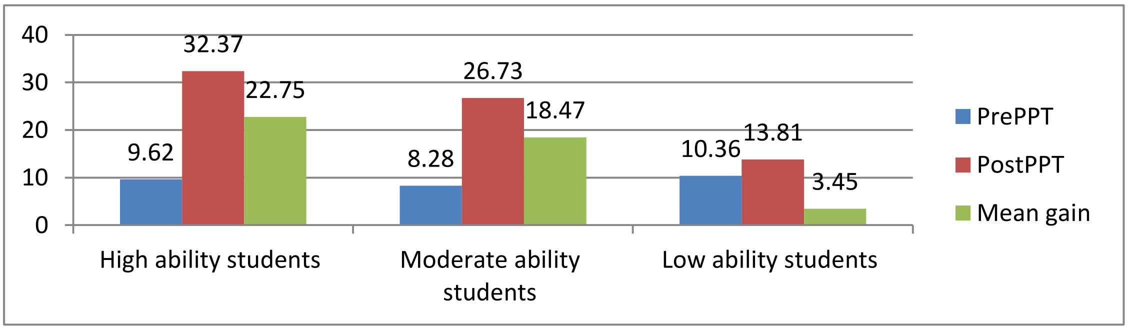

Figure 2: Pretest, Posttest and Mean Gain in Academic Performance Score of Low, Moderate and High Ability Students taught Physics using Group Dynamics Strategy

Table 1 shows the mean academic performance score of low, moderate and high ability students taught physics using group dynamics strategy. The table shows that 11 *low, 19 moderate and 8* high ability students were taught physics using group dynamics strategy. *The mean academic performance of* high ability students taught Physics using group dynamics strategy is 9.62 with standard deviation of 2.13 in pretest and 32.37 with standard deviation of 14.27 in posttest. The mean academic performance of moderate ability students taught Physics using group dynamics strategy is 8.26 with standard deviation of 2.40 in pretest and 26.73 with standard deviation of 10.74 in posttest. The mean academic performance of low ability students taught Physics using group dynamics strategy is 10.36 with standard deviation of 4.56 in pretest and 13.81 with standard deviation of 10.47 in posttest. The table further shows that mean gain in academic performance score of students taught Physics using group dynamics strategy is 22.75 for high, 18.47 for moderate and 3.45 for low ability students. The summary of the pretest, posttest and mean gain in academic performance score of low, moderate and high ability students taught physics using group dynamics strategy is as shown in Figure 2.

Research Question 2

Which of the ability groups (i.e low, moderate and high) gain more in the mean academic performance score when visual cues strategy is used in teaching Physics?

Table 2. Mean Academic Performance Score of Low, Moderate and High Ability Students Taught Physics Using Visual Cues Strategy

Abilities		PrePPT	PostPPT	Mean gain
High ability students	Mean	7.92	30.71	22.79
	N	14	14	
	Std. Deviation	3.14	4.68	
Moderate ability students	Mean	9.35	25.07	15.72
	N	14	14	
	Std. Deviation	3.69	11.14	
Low ability students	Mean	11.44	14.66	3.22
	N	9	9	
	Std. Deviation	3.20	11.24	

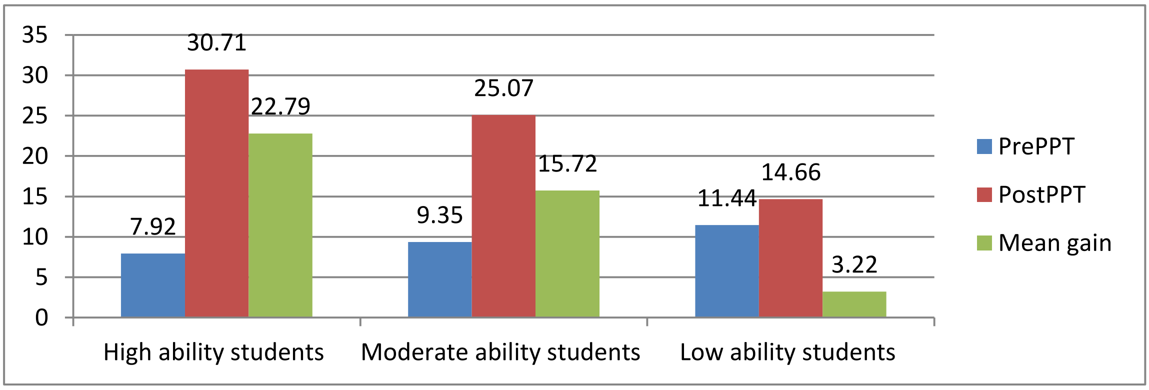

Figure 3: Pretest, Posttest and Mean Gain in Academic Performance Score of Low, Moderate and High Ability Students taught Physics using Visual Cues strategy

Table 2 shows the mean academic performance score of low, moderate and high ability students taught physics using visual cues strategy. *The table shows that 9* low, 14 moderate and 14 high ability students were taught physics using visual cues strategy. The mean academic performance of high ability students taught Physics using visual cues strategy is 7.92 with standard deviation of 3.14 in pretest and 30.71 with standard deviation of 4.68 in posttest. The mean academic performance of moderate ability students taught Physics using visual cues strategy is 9.35 with standard deviation of 3.69 in pretest and 25.07 with standard deviation of 11.14 in posttest. *The mean academic performance of* low ability students taught Physics using visual cues strategy is 11.44 with standard deviation of 3.20 in pretest and 14.66 with standard deviation of 11.24 in posttest. The table further shows that mean gain in academic performance score of students taught Physics using visual cues strategy is 22.79 for high, 15.72 for moderate and 3.22 for low ability students. The summary of the pretest, posttest and mean gain in academic performance score of low, moderate and high ability students taught physics using visual cues strategy is as shown in Figure 3.

Hypothesis 1

There is no significant difference in the mean academic performance scores of low, moderate and high cognitive abilities students when group dynamics strategy was used in teaching Physics.

Table 3: ANCOVA of *Academic Performance Scores of Low, Moderate and High Cognitive Ability Students taught Physics using Group Dynamics Strategy*

Dependent Variable: PostPPT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1890.253[a]	3	630.084	4.703	.007	.293
Intercept	1504.842	1	1504.842	11.232	.002	.248
PrePPT	47.739	1	47.739	.356	.555	.010
Ability	**1888.958**	**2**	**944.479**	**7.049**	**.003**	**.293**
Error	4555.457	34	133.984			
Total	28671.000	38				
Corrected Total	6445.711	37				

a. R Squared = .293 (Adjusted R Squared = .231)

Table 3 shows that $F(2,34) = 7.049$; $P = 0.003 < 0.05$. The null hypothesis is rejected. Thus, there is significant difference in the mean academic performance scores of low, moderate and high cognitive abilities students when group dynamics strategy was used in teaching Physics. The partial eta square of 0.293 obtained means that 29.3 percent of mean academic performance scores of students can be accounted for by their abilities when group dynamics strategy was used in teaching Physics.

Hypothesis 2

There is no significant difference in the mean academic performance scores of low, moderate and high cognitive abilities students when visual cues strategy was used in teaching Physics.

Table 4: ANCOVA of Academic Performance Scores of Low, Moderate and High Cognitive Ability Students taught Physics using Visual Cues Strategy

Dependent Variable: PostPPT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1554.941[a]	3	518.314	6.172	.002	.359
Intercept	1187.922	1	1187.922	14.146	.001	.300
PrePPT	140.618	1	140.618	1.675	.205	.048
Ability	**1542.573**	**2**	**771.286**	**9.185**	**.001**	**.358**
Error	2771.167	33	83.975			
Total	26855.000	37				
Corrected Total	4326.108	36				

a. R Squared = .359 (Adjusted R Squared = .301)

Table 4 shows that $F(2, 33) = 9.185$; $P = 0.001 < 0.05$. The null hypothesis is rejected. Thus, there is significant difference in the mean academic performance scores of low, moderate and high cognitive abilities students when visual cues strategy was used in teaching Physics. The partial eta square of 0.358

obtained means that 35.8 percent of mean academic performance scores of students can be accounted for by their abilities when visual cues strategy was used in teaching Physics.

5. DISCUSSION OF FINDINGS

Findings arrived at in this study are discussed in this section. The study examined how group dynamics and visual cue strategies can foster academic performance of Senior Secondary II students of different cognitive abilities in Physics in Benue State. The sample comprised students of different cognitive abilities therefore students' ability was incorporated as a moderator variable. Discussion of findings was tailored along the variables in the study as guided by the answers to the research questions and test of null hypotheses.

Finding on the use of group dynamics strategy revealed mean gain in academic performance score of students taught Physics using group dynamics strategy is 22.75 for high, 18.47 for moderate and 3.45 for low ability students. There was significant difference in the mean academic performance scores of low, moderate and high cognitive ability students when group dynamics strategy was used in teaching Physics. This implies that the use of group dynamics strategy in Physics class is cognitive ability sensitive. The finding agrees with Andala, Ng'umbi and Swai (2016) that teaching methods used had significant mean differences in the students' cognitive ability. The finding agrees with Grob, Rhôneck and Vôlker (2019) that increasing abilities, better study habits and attitudes and a positive climate of the class-room lead to better achievements. The finding agrees with Muzaki, Madinah and Ejuu (2020) that members of mixed ability in a group significantly influence cognitive engagement among group members.

The finding agrees with Alekseeva et al (2021) that data given by using the WISC–V had more correlations with school marks than data given by using the KABC–II. The finding agrees with Ezema et al (2022) that cognitive capacity had a substantial impact on conceptual change. The finding agrees with Etukakpan (2022) that Students with low cognitive ability level performed significantly better than those with high and average cognitive ability level. The finding agrees with Etukakpan (2022) that male students with average cognitive ability level significantly performed better than those with high and low cognitive ability. The finding agrees with Etukakpan (2022) that female with low cognitive ability level performed significantly better than those with high and average cognitive ability level. However, the finding disagrees with Akinbobola (2018); Olufunminiyi (2018) that the use of mastery and action learning strategies has been found to close the achievement gap between low and average cognitive ability levels.

Ability stereotyping permeates students' mean academic performance scores when group dynamics strategy was used to teach Physics. The present study found significant difference in the mean academic performance scores of low, moderate and high cognitive ability students when group dynamics strategy was used in teaching Physics. This implies that the use of group dynamics strategy in Physics class is cognitive ability sensitive with reference to students' mean academic performance. This is because the group infused team spirit among members differently and the attitude, insights and ideas of members depend on group dynamism. Absenteeism and abstinence due to emotional attachment among the group members are potent factors.

Finding on the use of visual cue strategy revealed mean gain in academic performance score of students taught Physics using visual cues strategy is 22.79 for high, 15.72 for moderate and 3.22 for low ability students. There was significant difference in the mean academic performance scores of low, moderate and high cognitive ability students when visual cues strategy was used in teaching Physics. This means that the use of visual cues strategy in Physics class is cognitive ability sensitive. The finding agrees with Akinbobola (2018); Olufunminiyi (2018) that mastery learning strategy was the most effective in facilitating students' achievement in the concept of heat energy in physics. This was followed by action learning strategy while conventional learning strategy was found to be the least facilitative. Cognitive ability levels had significant effect on students' achievement. The finding agrees with Berkowitz and Stern (2018) that there is predictive power of individual differences in cognitive abilities within highly competent groups and that cognitive ability role in advanced STEM learning, at least in Mathematics-Physics intensive subjects, is less critical than numerical and verbal reasoning abilities. The finding agrees with Okeke and Orji (2022) that students' conceptual change was significantly influenced by cognitive ability. However, the finding disagrees with Akinbobola (2018); Olufunminiyi (2018) that there was no significant difference in the mean achievement scores of physics students with low and average cognitive ability levels.

Ability typecasting permeates students' mean academic performance scores when visual cues strategy was used to teach Physics. The present study found significant difference in the mean academic performance scores of low, moderate and high cognitive ability students when visual cues strategy was used in teaching Physics. This means that the use of visual cues strategy in Physics class is cognitive ability sensitive with reference to students' mean academic performance in Physics. This is because ideas, concepts, data and other information are associated with images and techniques and learners gain knowledge and understanding explicitly through, visual tools that include, printed words, paintings, drawings, sculpture, photography, cartography, diagrams, video, television, graphs, charts, images, films, newspapers, signs, slides, depending on their cognitive ability.

Walbergian theory is strongly linked in the present study since it identifies that the quality and quantity of instructional strategies affect students' academic performance. Thus, even students' of same cognitive abilities but different Walbergian domains (different characteristics, instructions and psychological environment) were found to differ in their level of academic performance in Physics. The study has equally satisfied the tenets of Bloom taxonomy of educational objectives as high ability students systematically adopt most or all the stages outlined in Bloom's Taxonomy as they were able to create new meanings to the instruction, evaluate the content, analyze Physics concepts and apply the result by taking steps that enhances understanding and retention. Moderate ability students on the other hand, adopted only an average number of stages such that they could create without evaluation and analyze without application. They could also understand without retention or remembering the applied content for a longer period of time. Low ability students adopted only a few of the stages during learning which reflected in their performance.

Implication of the Findings and Limitation of this Study

Implications of the findings of this study are obvious. First the assumption that studies involving abilities are mere repetition of intelligence is implicated in this study. For both experimental groups (that is, group dynamics and visual clues the performance of the students increases in the order of low ability →moderate ability → high ability. This means that the high ability students benefited most, then followed by the moderate ability students while the low ability students benefited the least from each of the strategies. On the other hand, the two strategies have demonstrated the fact that their effectiveness is dependent on cognitive abilities of the students. When a student is too weak academically, the impact of a good strategy like group dynamics and visual clue strategies will only be to an extent. It means strategies like peer tutoring and other cooperative strategies where students are made to work with their peers may yield better result in this wise but has to be considered in a study as this to enable supported conclusion. Finally, the two strategies appear to be fair to all categories of the students abilities. Thus, all the ability groups benefited from both strategies at a level commensurate with their ability. Though the strategies do not have the potential to level up the students in their knowledge gained, they appropriately facilitated performance to an extent. One foresees a situation whereby high ability students are put together in class that their performance or mean gain could be very high after use of any of the two strategies. In this situation, the two strategies could be very advantageous.

From the findings using the two strategies, the study suggests that high ability students systematically adopt most or all the stages outlined in Bloom's Taxonomy (1956) as they create new meanings to the instruction, moderate ability students on the other hand, adopt only an average number of stages such that they create without evaluation and analyze without application. They may also understand without retention or remembering the applied content for a longer period of time. Low ability students effectively utilised only a few of the stages during learning. Thus the students created and analyzed or try to understand without prior creating ideas, evaluating the content and analysing results. For future teaching of physics, the choice of a strategy alone is not sufficient as some other differences in the learners' cognitive abilities do wade influence on the effectiveness of the strategy especially with use of group dynamic and virtual clue strategies.

The researcher ensured that the research assistants from the sampled schools were professional teachers of Physics. However, it was not possible to have the Physics teachers with the same level of teaching experience for all the selected schools. The two day training notwithstanding, the limitation arising from the varying teachers' experience might have had little differential impact on the experimental procedure as well as data collected, and hence, on the results of the study.

6. CONCLUSION AND RECOMMENDATIONS

The study has established that for both experimental groups (that is, group dynamics and visual cues strategies) the performance of the students increases in the order of low ability →moderate ability → high ability. The study concludes that the effectiveness of the two strategies is dependent on cognitive abilities of the students. The high ability students benefited most, followed by the moderate ability students while the low ability students benefited the least from each of the strategies. When a student is too weak academically, the impact of a good strategy like group dynamics and visual cues strategies may only be to an extent. The study further concludes that the differences in performance between students taught Physics using group dynamics and visual cues strategies for low, moderate and high abilities were not tangible.

The following recommendations were made in the light of the findings of this study:

1. Teachers of Physics should employ group dynamics and visual cues teaching strategies in Physics class to ensure effective teaching and enhance academic performance and cognitive abilities of students in the subject.
2. Workshops should be organized by school administrators to sensitize teachers of Physics on how to use group dynamics and visual cues teaching strategies in Physics class for optimal benefit among secondary students irrespective of cognitive abilities.
3. Curriculum developers should incorporate group dynamics and visual cues teaching strategies in the Physics curriculum for effective implementation.

Future research directions in teaching and learning of physics at secondary school level should focus on taking care of students' individual differences and characteristics like cognitive abilities and other learning differences to ensure smooth progression in class when using any innovative or activity loaded strategy.

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