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Original Research Article

Interplay of Group and Individualized Laboratory Activities in Practical Physics

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Abstract

Advocacy has been made for varied teaching strategies towards enhancing the cognitive attainment of students particularly at high schools. Much has not been done on the engagement of learners in laboratory activities for practical physics. We investigated the effect of laboratory activities on students' performance in practical physics in selected secondary schools focusing on group and individual activities. Two research questions and one hypothesis guided the study. It is a quasi-experimental design using pre-test and post-test with experimental groups. The instrument used was a researchers developed performance test tagged "Practical Physics Performance Test (PPPT). A reliability coefficient of r=0.77 was obtained using Kuder-Richardson KR-21 method. The experiment was conducted for a period of six weeks after which the posttest was administered to the three groups. Research questions were answered using mean and standard deviation. The null hypothesis was tested using Analysis of Covariance (ANCOVA). The result revealed that students taught practical physics using group laboratory activity performed significantly more than students that were taught practical physics using individualized and lecturing activities. Teachers are therefore required re-strategies on how best to involve students into group laboratory activities during practical physics instructions to facilitate high level cognition. Sub-group approach that are monitored by the teacher with hybrid of fast and slow learners can be adopted.

Keyword: Practical Physics, Group and Individualized Laboratory Activities.

BACKGROUND TO THE STUDY

The learning and cognition in science engineering and technology (STEM) field could be facilitated when learners are exposed to practical procedures during instructions. The study of physics and its practical components could then be easier when practical teaching and learning is practiced (Ezeh, 2013). Just as laboratory activities could aid new discovering provided required procedure is followed. As an organized body of knowledge, physics has some concepts, laws, theories, generations and identifying procedure for combination of object using recommended instrument aimed at discovering new knowledge (Michael and Mollmann, 2012). Physics is a cross-cutting discipline that has applications in many sectors of economy development including health, agriculture, water energy and information technology etc. For instance, the principles of radiation used in modern medicine for diagnosis and treatment, the production and use of many appliances such as electronic gadgets, computers, surgical and astronomical instruments are all traceable to the study of Physics and its effective learning is quite desirable through practical (Macmillan, 2012; Ogunleye and Babajide, 2011).

Despite the importance of physics to human existence, the situation of students' performance seems inadequate. The perceived inadequacy appears to be lined with limited practical exposure during instructions. There have been issues of unsatisfactory situation arising from unavailability of laboratory equipment's, functionality of the expected laboratories, non-arranged laboratory activities, poor preservation of the physics tools for laboratory activities due to insecurity are some reasons for observable poor performance in the subject leading to students development of negative attitude towards learning physics as they termed it to be difficult (Michael and Mollmann, 2012; Ezeh, 2013).

The National Examination Council report [NECO] (2022) noted difficulty of students at the national examination to exhibit evidence to have learnt the subject matter. This was indicated by their inabilities to provide correct explanations to concepts like evaporation, working principle of a refrigerator, and conversion of heat energy to mechanical energy. They could hardly state correctly four factors that affect the rate of evaporation and could hardly understand basic concepts such as the boiling point of liquids and principles of physics in heat energy. Adding that many students could hardly go beyond the reproduction of the basic formula for linear expansivity, and were unable to interpret statements into workable diagrams; students exhibited poor manipulation of arithmetic processes and were unable to relate the principle of latent heat of vaporization to the preservation of tomatoes in most jute bags. Furthermore, that report showed that students could not also define specific heat capacity (NECO, 2022). Science teaching and learning cannot be complete without practical, although the teaching and learning process has been carried out by the teachers using the conventional or lecturing activities (Ventimiglia, 2010).

Traditionally, lecture method is the most used and the oldest method in classroom situations. It is a complete verbal presentation of the subject matter. The major advantage of the lecturing activities is that it would be used to cover a large content area within a very short period no matter the class size and may not require the use of the laboratory. However, it is characterized by being one-way mode of communication. Learners are always passive and so inappropriate for the acquisition of practical skills as required in practically oriented courses like Physics (Awolu and Esugbohungbe, 2012). Learners are observed to be passive recipients of information, and there is very little interaction between learners and the teacher, hence this strategy of teaching may not achieve desired objective of physics without practical exposure. However, there has become a search on effective teaching method that is student-centered. This is therefore the place of laboratory activities (Hossain and Tarmizi, 2014; Ventimiglia, 2010).

Laboratory activities enhance learners understanding of concepts of contents, application and acquiring practical skills, as well as understanding science processes and how discoveries are made to work. The teacher guides the students while employing appropriate instructional strategies to achieve the objectives of the activity. Students' exposure to laboratory activities can be a powerful tool in learning situation to teach students. Exposure to laboratory activities can be thought of as student's experimental knowledge which students gain when exposed and working with laboratory activities. Abdurahaman *et al*., (2021), noted that laboratory work is seen as an integral part of most science courses, including practical. Laboratory activities have played a special and central role in science education for a long time. Research suggests that engaging students in laboratory activities has many benefits which includes stimulate creativity, curiosity and critical thinking, promote students' engagement with the scientific methods and encourage active learning and problem-solving approach. Laboratory activities are hands-on-activities that emphasizes learning through inquiry and discovery methods (Abdurahaman *et al*., 2021; Garnett, 2015;). Laboratory has been given a central and distinctive role in science education. Hofstein and Lunetta, 2013; Garnett, 2015). Laboratory practical works provide a way not only for developing varieties of different practical skills but also developing favorable attitudes, interest, pleasure, enthusiasm, imitation, imagination and cooperation among students. Laboratory activities are the strategies used by teachers in order to ensure effective teaching and learning in the laboratory (Nworgu, 2009). As noted by Bajon (2015), there are two laboratory activities vis-à-vis the group and individual laboratory works. These activities of laboratory work maintain an active role and consistent pace of interaction amongst students throughout the laboratory practical period so that students learn what they expect from their teachers (Hossain and Tarmizi, 2014).

Group laboratory activities could be appreciated by learners as it is a mode of interaction that exists in the laboratory, where learners work together for accomplishing a certain goal. Like the cooperative learning approach, learners help one another in an academic subject, in small groups formed both in classroom and in non-classroom environments such as the laboratory to accomplish a task (Venmans, 2010). The approach helps the learner to gain more self-confidence and develop their communication, problem-solving and critical thinking abilities and students actively participate in the learning/ teaching processes. According to Gardner and Gillies (2016), students in group interact with one another, share ideas, and seek additional information and decisions about their findings. Olatoye, *et al.*, (2011) reflected that group laboratory work could help to improve students' achievement and retention, increase self-esteem, intrinsic motivation and also help students develop more positive attitudes towards learning. It could also help students to acquire practical skills, spirit of socialization, leadership and conflict resolution skills that are basic to productive working teams (Venmans, 2010; Macmillan, 2012).

The individual laboratory activities involves only a student and the materials during the process of practical work in the laboratory. In the individual mode of laboratory activities whether an individual accomplishes the goal or not has no effect on the other participants. Johnson and Johnson (2012) emphasize that individual laboratory work is unlike the group laboratory work, which deals with the students working cooperatively with one another. Individual laboratory work is a form of laboratory investigation where contents, instructional materials, and pace of learning are based upon the ability and interest of a learner.

Nonetheless the learner can seek help from the classmates wherever there is ambiguity or need for clarification. Irrespective of the two laboratory activities in this study, Hofstein and Lunetta (2013) assert that science laboratory activities are learning experiences in which students interact with materials and/or with models to observe and understand the natural world. This leads to meta-cognition which Gunstone and Champagne (2017) suggest is an elaboration and application of one's learning which can result in enhanced or improved students' performance. Students' performance is an objective score of attainment after a specified instructional programme. It reveals the extent to which the teacher has taught a particular subject as well as the extent the students were able to grasp the content taught. This implies that achievement is reflected by the extent to which skill and knowledge has been imparted to a learner through exhibition. The results/grades gotten from these tests, quizzes or examinations could be high, average, low or poor. Hence, these grades can be affected by the types of teaching activities the teacher adopts (Prince, 2014).

This study is hinged on the Social constructivist learning theory by Vygotsky (1962). According to this theory, Vygotsky believed that learners actively construct their knowledge. He viewed cognitive development as a result of a dialectical process, where the child learns through shared problem-solving experiences with someone else, such as teachers, parents, siblings and peers. As a social constructivist theorist, Vygotsky emphasizes the social contexts of learning and the fact that knowledge is mutually built and constructed. It also emphasizes the benefits of collaboration in group work and with a more skilled tutor; an individual will facilitate transition from learners' zone of proximal development to new levels of skills and competences. Zone of proximal development (ZPD) is Vygotsky's term for the range of tasks that are too difficult for children to master alone, but can be learnt with the guidance and assistance from adults or more skilled children working independently (Venmans, 2010; Ventimiglia, 2010). This implies that the science teacher are expected to act as a facilitator by gradually withdrawing explanation, hints and demonstrations until the student is able to perform the skill alone. This will encourage the students to learn from previous knowledge they had before coming to school or the knowledge they already have to build the new knowledge (Vygotsky, 1962; Vaidya, 2008; Macmillan, 2012).

In respect of the above assertion, it is evident from this theory that science should be taught in such a way that students will be able to apply the knowledge outside the classroom. Practical work in the laboratory can help achieve this. Looking at the constructivist theory as postulated by Vygotsky in the context of this study we find that achievement in physics largely depends on the learner and the environment itself and then the interactions that exist between the learners. The implication of this is that the science teacher must give the learners the opportunities to construct, produce and use experience that is meaningful to their understanding of their environment (Garnett, 2015). When this is done, then they can comfortably think, reason, perceive, talk and reflect about their environment. The expectation within this study may require that learners are given the opportunities to interact with their peers, classmates and teachers in order to socially construct meaningful knowledge about their environment. Such knowledge construction will equally enhance the practical skills and subsequently better achievement in physics (Ventimiglia, 2010). The child's interaction with other people is important in the development of the child's view of the world. Through exchange of ideas with other people the learner becomes aware that self-criticism is possible only in the social interaction (Vygotsky, 1962; Macmillan, 2012).

Vygotsky's theory is related to the present study which is the effect of laboratory activities on secondary school students' achievement in practical physics because in laboratory, students interact with the materials or with one another in the course of practical work. The theory also encouraged the group laboratory activities because it gives the students the opportunity to carry out practical's in peers which is a potent way to improve students' interest in physics thereby ensuring high science process skills. Hence the result of this study will help to validate the emphases portrayed in this theory (Hofstein and Lonetta, 2013; Gunstone and Chmpagne, 2017).

Abidoye (2021) reported that the impact of Laboratory practical was significant to the students' performance. Research suggest that differences could exist between students taught with practical approach and those with lecturer method (Abdurahamam *et al*., 2021). Similarly, chemistry students could attain high academic performance because they were taught with practical particularly in the chemistry designed laboratory (Macmillan, 2012: Umoh 2021).

The fact that individual laboratory activities has aided cognition and subsequent academic performance among learners has been established in STEM learning irrespective of the gender of participants (Ugwu *et al*., 2020; Agaba and Ugwu, 2020). There are also instances where students will be more happy to engage in laboratory activities provided the opportunities are given, it usually results in quality performance among learners particularly in sciences thereby allowing learners to exhibiting positive attitude towards the content of instruction (Agaba and Ugwu, 2020; Ugwu *et al*., 2020). In chemistry learning like acid-base titration, laboratory teaching approach could facilitate learning and subsequent performance of learners if properly implemented (Ezeano and Ugwu, 2019; Isha and Magaji, 2018)

Researchers had reported that the development of physics laboratory skills is quite related to the exposure of learners to practical contents during instructions (Isha and Magaji, 2018; Agaba and Ugwu, 2020). Laboratory practical is an active ingredient in the teaching and learning of physics that leads to the acquisition of physics concept and scientific skills. This makes the production and development of quality professionals in the field of sciences, especially physics, a vital tool in achieving sustainable economic growth and technological development of the nation. There could be difference in the performance and achievement of students exposed to practical strategy and those exposed to conventional strategy physics subject (Agaba and Ugwu 2020; Adegoke, 2017).

Generally prior exposure to laboratory apparatus activities on acquisition of process skills are considered to be more effective in enhancing students' science process skills and academic performance on difficult concepts than those not prior exposed (Babafemi, 2016). Familiar tasks evoke positive emotions and increase learners' confidence, while unfamiliar tasks evoke negative emotions (Cogliano *et al*., 2019; Mahdavirad *et al*., 2016; Xu & Qiu, 2021). Leaners taught using group laboratory activities are discovered to performed better than their counterparts taught using individual laboratory activities. However, the mode of laboratory activities and its fluences in different cognitive levels is a ground for further research (Bajon, 2015; Bonah, 2015). Research suggest that there are influences of cooperative learning and traditional methods on students' academic achievements and identifications of laboratory equipment in science technology laboratory course as experimental group, might score higher in terms attainment when compared to the control group, in the identification of laboratory equipment (Suleyman, 2011; Mahdavirad *et al*., 2016).

Statement of the Problem

There have been records of persistent fluctuations and not too impressive achievement outcomes in physics examinations. This persistent fluctuations have also been attributed to ineffective methods of teaching physics and limited practical approach. The conventional lecturing activities, employed by teachers in the classroom, among others can also determine the cognitive level of leaners. The consequences of allowing the afore-mentioned problems to persist cannot be underestimated. This is because the gradual and subsequent decline in the understanding of practical physics will affect other physics-related fields such as medicine, agriculture and engineering which will lead to a decline in the knowledge base for humanity survival. This study therefore tried to see if group laboratory activities could improve secondary school students' performance in the field of practical physics.

Research Question

1. What are the mean performance scores of students taught practical physics using group laboratory activities and lecturing activities at the pretest and posttest?
2. What are the mean performance scores of students taught practical physics using individual laboratory activities and lecturing activities at the pre test and posttest?

Hypothesis

Ho1: There is no significant difference between the mean performance of students taught practical physics using group laboratory activities and lecturing activities.

METHODOLOGY

This study employed the quasi-experimental design using pre-test and post-test with experimental groups. This design was used because intact classes were considered so that school activities would not be disturbed as the exercise lasted for six weeks. The design was considered appropriate because it established a cause-effect relationship between the independent variables (teaching activities) and dependent variables (students' performance in practical physics). Fraenkel and Wallen (2018) asserted that in the nonequivalent control group design; the treatment group and the comparison group are compared using pretest and posttest measures. If all the groups are similar in their pretest scores prior to treatment but differ in their posttest scores following treatment, studies can be more confident about the effect of treatment.

The population of the study was made up of 3,285 SSII students (2,113 males and 1,174 females) in all the 65 public secondary schools in the 8 Local Government Areas in Orlu Education Zone I of Imo State namely: Ideato North, Ideato South, Isu, Njaba, Nkwerre, Nwangele, Orlu and Orsu Local Government (Department of Research and Statistics, Imo State Secondary Education Management Board, 2019/2020).

The sample was 112 students who offered practical physics using purposive sampling technique. Purposive sampling technique was used to select the schools. The SSII students were considered because they are supposed to be more exposed and by implication, more knowledgeable in practical physics concepts than SS I students who have not yet gained much academic experience while the SS III students may be busy preparing for SSCE examinations. Specifically, there were 44 students (24 males and 20 females) in the experimental group I, 32 students (14 males and 18 females) in the experimental group II, and 36 students (19 males and 17 females) in the experimental group III.

The instrument used was a researcher developed achievement test tagged "Practical Physics Performance Test (PPPT). PPPT was used to measure students' performance in practical physics both at pretest and posttest. The only difference is that at each phase, the items on the instrument were reshuffled to avoid test-wiseness. The items covered selected content areas or topics in the scheme of work for practical physics from the senior secondary school curriculum of Federal Ministry of Education (2013). These topics include temperature, heat, properties and wave theory of light and current electricity. The instrument had five (5) practical items instrument. Each item is scored 10 points with maximum point being 50 marks. A table of specification was constructed in the allocation of questions (at the required level of cognition) with their corresponding marks.

The first draft copies of the instrument were submitted for scrutiny to three specialists. The reliability of the rating scale was established using the test-retest method. The instrument was given to 30 male and female SS II students who were not part of sample, invariably from two public senior secondary schools in Orlu Education Zone II, Imo State. The aim of this test-retest was to determine the characteristics of the test items which include their clarity and reliability coefficient. With the test-retest, the researchers was able to determine the appropriate timing (duration) for each test as well as identify any problem which may affect the effective administration of the instruments during the actual experiment. Practical Physics Performance Test (PPPT) took sixty minutes. This was the average time it took the first and the last student to finish the paper (test) during the test-retest. The data obtained from the test-retest was used to estimate the reliability of the instrument. Practical Physics Performance Test was found to have a reliability coefficient of r=0.72 Kuder-Richardson KR-20 method.

Pretest was administered to the students before the commencement of the treatment. The treatment lasted for four weeks, after which the posttest was administered. The treatment procedure was as follows: six intact classes were used for this study, two for experimental group I, two for experimental group II and two others for experimental group III. The experimental group I worked together in small groups as a team to solve a problem or accomplish a common goal during the practical work, in the experimental group II, individual students worked independently without team effort, while in experimental group III, the students were taught practical physics using the lecturing activities. The science teachers assigned to teach the subject in the sampled schools helped in carrying out the experiment. The teachers were provided with lesson plans prepared by the researchers and used in teaching the three groups.

Research questions were answered using mean and standard deviation. The null hypothesis was tested using Analysis of Covariance (ANCOVA) whereby the pre-test scores on the students' performance test served as covariates to the post-test scores at 0.05 level of significance.

RESULTS

Research Question One

What are the mean performance scores of students taught practical physics using group laboratory activities and lecturing activities at pre-test and post-test?

Table 1: Mean analysis of students taught practical physics using group laboratory activities and lecturing activities at pre test and post test

Test: Achievement		**Pretest**		**Posttest**	
Teaching activities	**N**	$\bar{X}$	**S**	$\bar{X}$	**S**
Group laboratory activities	44	15.25	2.796	31.82	4.642
Lecturing activities	36	15.14	2.653	15.28	2.732

Sample Size (n), Mean ($\bar{X}$), and Standard Deviation (S) at pre-test and post-test

Table 1, shows the result of the analysis with respect to research question 1 indicating the mean performance scores of students taught practical physics using group laboratory activities and lecturing activities at pre test and post test. It was shown in the table that students who were taught practical physics with group laboratory activities had pre test and post test mean scores of 15.25 and 31.82 respectively. On the other hand, the students that were taught practical physics with lecturing activities had pre-test and post-test mean scores of 15.14 and 15.28 respectively. The scores in the distribution are homogenous because there is a tangible distance between the mean scores and standard deviation. The gaps among the mean scores of the groups from pretest and post test indicate that group laboratory activities is effective in the improvement of students' performance scores in practical physics more than the lecturing activities.

Research Question Two

What are the mean performance scores of students taught practical physics using individual laboratory activities and lecturing activities at the pre test and post test?

Table 2: Mean analysis of students taught practical physics using individual laboratory activities and lecturing activities at the pre test and post test

Test: Achievement		Pretest		Posttest	
Teaching activities	N	$\bar{X}$	S	$\bar{X}$	S
Individual laboratory activities	32	15.47	2.462	24.56	3.464
Lecturing activities	36	15.14	2.653	15.28	2.732

Sample Size (n), Mean ($\bar{X}$), and Standard Deviation (S) at pre-test and post-test

Table 3, shows the result of the analysis with respect to research question 2 indicating the mean performance scores of students taught practical physics using individual laboratory activities and lecturing activities at the pre test and post test. It was shown in the table that students who were taught practical physics with individual laboratory activities had pre test and post test mean scores of 15.47 and 24.56 respectively. On the other hand, the students that were taught practical physics with lecturing activities had pre test and post test mean scores of 15.14 and 15.28 respectively. The scores in the distribution are homogenous because there is a tangible distance between the mean scores and standard deviation. The gaps among the mean scores of the groups from pretest and post test indicate that individual laboratory activities is effective in the improvement of students' performance scores in practical physics more than the lecturing activities.

Hypothesis:

Ho_1: There is no significant difference between the mean performance scores of students taught practical physics using group laboratory activities and lecturing activities at the pre test and post test.

Table 3: ANCOVA F-test Analysis for the Test of Hypothesis 1

Tests of Between-Subjects Effects					
Dependent Variable: Post Test					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	5422.102[a]	2	2711.051	176.511	.000
Intercept	1196.901	1	1196.901	77.928	.000
Pre_Test	5.119	1	5.119	.333	.565
Teaching_Activity	5407.893	1	5407.893	**352.098**	**.000**
Error	1182.648	77	15.359		
Total	54136.000	80			
Corrected Total	6604.750	79			
a. R Squared = .821 (Adjusted R Squared = .816)					

Source of Variation, Sum of Squares, Degree of Freedom, Mean Square, F-cal and its Significance level

Table 2, shows the result of the analysis with respect to the hypothesis for the significant difference between the mean performance scores of students taught practical physics using group laboratory activities and lecturing activities at the pre test and post test. The result on the table indicated that the F-calculated (F-cal) value is high at 352.098. The p-value of 0.000 is less than 0.05 level of significance. Since the p-value is less than 0.05 level of significance, the researcher rejected the null hypothesis thereby accepting the alternative, concluding that there is a significant difference between the mean performance scores of students taught practical physics using group laboratory activities and lecturing activities at the pre test and post test.

DISCUSSION OF FINDINGS

Research question one revealed that students taught practical physics using group laboratory activities performed significantly more than students that were taught practical physics using lecturing activities. This is a confirmation that practical teaching is more potent in the improvement of students' performance scores in practical physics than the lecturing method and that when learners are in their peers, positive learning interaction usually take place. The reason for this effectiveness is because learners help one another in an academic subject, in small groups formed both in classroom and in non-classroom environments such as the laboratory to accomplish a task. The teaching approach is activity oriented which made them engage in in-depth critical thinking and process skills. In agreement with this finding, Umoh (2021) found that students exposed to chemistry practical (Experimental Group) performed significantly better than those taught with alternative-to-practical (Control Group). Similarly, Ugwu, *et al*., (2020) revealed that students taught biology using group laboratory activities performed better than their counterparts. Also, Ezeano and Ugwu (2019) revealed that there was a significant difference between achievement of learners that were exposed to group practical strategy than those exposed to conventional strategy. The result showed that there is a significant difference between the mean performance scores of students taught practical physics using group laboratory activities and lecturing activities. The similarities recorded in this finding could be attributed to power of the improved teaching method over the lecturing activities in the improvement of students' performance scores and that positive interactions would have taken place during instructions.

Result from research question 2 showed that students that were taught practical physics using individual laboratory activities performed significantly more than students that were taught practical physics using lecturing activities. This would have given room for learners to directly get involved in laboratory activities in situations of limited pace and facilities and reported in many developing countries. Leaning has been reported to be more appropriate when students need to observe learned material usage directly. In this respect, the individual laboratory activities enables laboratory investigation where contents, instructional materials, and pace of learning are based upon the capacities and interest of learners. At this point, the individual laboratory activities allows the students inquire information using the materials made available to them by the teacher. This, quite confirmed the findings, of Abidoye (2021) that individualized students laboratory practical experience was better appreciated by the learners. Also, Abdurahaman, *et al*., (2021) reported that differences exist in performance when students have been exposed to laboratory and lecturing activities in favour of the experimental group. Similarly, Ezeano and Ugwu (2019) affirmed this findings when they reported that laboratory teaching method had much more effect on Chemistry students' achievement. The similarities recorded in this finding could be attributed to power of the improved individualized and grouped laboratory activities as a teaching method over the lecturing activities in the improvement of students' performance scores in practical physics.

Educational Implications of the Findings

The outcomes of this research carry significant implications for education, especially the teaching of applied physics in secondary schools. These implications underscore the need for a more robust instructional approach in teaching practical physics. The study revealed that group laboratory activities was more effective in enhancing students' achievement in practical physics than the lecturing activities and that individualized strategy will go a long way in aiding cognition. It is therefore incumbent on physics teachers to continuously use strategies and the options of sub-grouping learners for the purpose of laboratory activities as well as individually engage learners in the laboratory instructions.

Recommendations

Based on the findings and implications of this study, the following recommendations were made:

1. Teachers should re-strategies on how best to involve students into group laboratory activities during practical physics instructions to facilitate high level cognitive achievement in physics. This can be through Sub-group approach that are monitored by the teacher with hybrid of fast and slow learners.
2. More provision should be made for availability of laboratory materials including consumables to enable students learn many topics as contain in the curriculum with varied sub-groups
3. School administrators should prepare and monitor laboratory teaching schedules to make it effective for secondary school learners.

REFERENCES

- Abdurahaman, S. A., Danjuma, O. I., Ibrahim, M. A., Ibrahim, O. O., Kabir-Muhammad, I., & Abdullahi, T. A. (2021). Effect of laboratory activities on academic achievement among secondary school Biology students in Sabon Gari LGA, Kaduna State. *Journal of Studies in Education, 10*, 35-46.
- Abidoye, F. O. (2021). Effect of laboratory practical on senior secondary school students performance in Biology in Ilorin South LGA, Kwara State. *Eurasian Journal of Science and Environmental Education, 1*(1), 43-49.
- Adegoke, B. A. (2017). Survey of laboratory activities in senior secondary school Physics in Nigeria. *British Journal of Education, Society & Behavioural Science, 19*(3), 1-10.
- Agaba, K. C., & Ugwu, M. N. (2020). Identifying issues concerning the conduct of laboratory activities in science in Nigeria Certificate in Education (NCE) program in Nigeria. *World Wide Journal of Multidisciplinary Research and Development, 6*(5), 83-88
- Awolu, S. P., & Esugbohungbe, N. C. (2012). Impact of metacognitive strategy on attitude, retention and performance in calculus among colleges of education students in North-central Zone, Nigeria. *South Eastern Journal of Research and Sustainable development, 4*(1), 140- 156.
- Babafemi, A. J. (2016). Impact of prior exposure to laboratory apparatus activities on acquisition of process, skills and achievement in Chemistry at secondary level in Giwa Zone Kaduna State Nigeria. *American Journal of Educational Research, 4*(12), 903-906.
- Bajon, R. H. (2015). *Effect of mode of laboratory work on senior secondary school students' achievement in biology in Jalingo Local Government Area of Taraba State.* Being a masters project presented to the Department of Science Education, Faculty of Education, University of Nigeria Nsukka in fulfillment of the requirement for the award of Masters Degree (M.Ed.) in Science Education.
- Bonah, I.Y. (2015). *Effects of laboratory exercises on science secondary school students' performance in chemistry, in Kaduna State, Nigeria.* Being a dissertation submitted to the Postgraduate School Usmanu Danfodiyo University, Sokoto, Nigeria.

- Cogliano, M., Kardash, C. M., & Bernacki, M. L. (2019). The effects of retrieval practice and prior topic knowledge on test performance and confidence judgments. *Contemporary Educational Psychology, 56*(1), 117-129.
- Ezeano, C. A., & Ugwu, M. I. (2019). Effect of laboratory teaching method on the academic achievement in inorganic chemistry (acid-base titration) of senior secondary school students in Enugu Education Zone of Enugu State, Nigeria. *IMT International Journal of the Arts and Sciences (IJOTAS), 3*(5), 14-26.
- Ezeh, A. A. (2013). Effect of Gender on Senior Secondary School Students' Academic Achievement in Geography in Ganye Educational Zone, Nigeria. *European Journal of Education Studies, 3*(4), 349-410
- Federal Ministry of Education. (2013). National Policy on Education. (3rd edition), Lagos: Federal Government Press.
- Fraenkle, J. R., & Wallen, N. E. (2018). *How to design and evaluate research in Education. (3rd Edition).* McGraw Hill, New York, 22-46.
- Gardner, B., & Gillies, R. (2016). Teachers' and students' verbal behaviours during cooperative and small –group learning. *British, Journal of Educational Psychology, 76*(1), 271-287.
- Garnett, P. J. (2015). Refocusing the chemistry laboratory: A case for laboratory-based investigations. *Australian Science Teachers' Journal, 41*(3), 26-32.
- Gunstone, O. O., & Champagne, E. O. (2017). Science Education and Sustainable Development in Nigeria. *American Journal of Educational Research, 8*(2), 34-41.
- Hofstein, A.V., & Lunetta, V. N. (2013). *The laboratory in science education*: foundation
- Hossain, D. R., & Tarmizi, T. H. (2014). Effect of cooperative learning on students' achievement and attitudes in secondary school mathematics. *Journal of Science Teacher Education, 17*(3), 165-178
- Imo State Secondary Education Board (2020). Enrollment status report. Retrieved from:www.imo state secondary education board.com on the October 12, 2023.
- Isha, S. U., & Magaji, S. (2018). Impact of Laboratory Practical Skills on Students' Achievement in Physics in College of Education Azare, Bauchi State, Nigeria. *KIU Journal of Humanities, 3*(2), 205–210.
- Johnson, D. M., & Johnson, R. T. (2019). Effect of cooperative, competitive and individualistic learning on students' achievement in science class. *Journal of Research in Science Teaching, 19*(1), 351-356.
- Johnson, D. M., & Johnson, R.T. (2012). *Cooperative in the classroom*. Edina, MN: Interaction Book Company.
- Macmillan, M. J. (2012). School Location versus Academic Achievement in Physics: Does Computer Assisted Instruction (CAI) has any effect? *Journal of Education and Social Research, 2*(8), 162-168.
- Mahdavirad, F. (2016). The Effect of Personal Familiar vs. Impersonal Less Familiar Topic on Expository Writing Task Performance. *Linguistics Journal, 10*(1), 24-39
- Micheal, V., & Molmann, K. P. (2012). Low cost Hands-on Experiments for Physics Teaching. *Latin American Journal of Physics Education, 3*(1), 6-18.
- National Examination Council (2022). Annual National Stakeholders Report on science education: Issues and Prospects: Abuja.
- Nworgu, L. N. (2009). *Fundamental principles and methods of teaching biology.* Published by Global publishers (Nig.) Ltd. 32 Ogui Road Enugu.
- Ogunleye, B. O., & Babajide, V. F. T. (2011). Commitment to Science and Gender as determinants of Students' Achievement and Practical Skills in Physics. *Journal of Science Teachers' Association of Nigeria STAN, 46*(1), 125-135.
- Olatoye, R. A., Aderogba, A. A., & Aanu, E. M. (2011). Effect of co-operative and individualized teaching activities on senior secondary school students' achievement in organic chemistry. *Pacific Journal of Science and Technology, 12*(2), 310-319.
- Prince, M. (2014). Does active learning work? A review of the Research. *Journal of English Education, 93*(3), 223-231.
- Suleyman, A. (2011). Effect of cooperative learning and traditional methods on students' achievement and identification of laboratory equipmentin science and technology laboratory course. *Journal of Educational Research 6*(9), 639-644.
- Ugwu, C. B. A., Ngwu, A. N., Eze, N. E., & Ezea, C. C. (2020). Effects of group and individual laboratory activities on students' achievement in biology. The study was carried out in Nsukka L. G. A. of Enugu State. *Sapientia Foundation Journal of Education, Sciences and Gender Studies (SFJESGS), 2*(3), 13 – 23
- Umoh, S. W. (2021). Effect of laboratory practical on academic achievement of chemistry students in selected secondary schools in Eket Local Government Area of Akwa Ibom State. *World Journal of Interactive Research (WJIR), 4*(1), 1-12
- Vaidya, S. (2008). Restructuring elementary and middle school science for improved teaching and learning. *Educational Research, 114*(1), 63-70.
- Venmans, S. (2010). Cooperative learning and teacher education. *Journal of Association of Teacher Education Nigeria, 18*(1), 87-108.
- Ventimiglia, A. (2010). Cooperative procedural learning: Effects of prompting and previous distributed learning activities. *Journal of Educational Psychology, 80*(2), 167-171.

- Vygosky, L. S. (1978). *Mind in the society. The development of higher psychological processes,* Cambridge, MA: Harvard University press.
- Xu, J., & Qiu, X. (2021). Engaging L2 learners in information-gap tasks: How task type and topic familiarity affect learner engagement. *RELC Journal*, 00336882211061628.