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Effects of Guided Practice Instruction on Science Process Skills and Self-Efficacy of Physics Students in Secondary Schools Practical in Ondo State, Nigeria

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Abstract
This research investigated the effects of guided practice instruction on science process skills and self-efficacy in Physics practical among secondary schools' students of Ondo State Nigeria. This was with a view to providing the need to compliment conventional instruction with guided instruction practice in other to enhance science process skills and self-efficacy of physics students during practical activities. The study being a quasi-experimental research adopted pre-test post-test, non-equivalent and non-randomised control group design. The target population of the study comprised of 3508 Physics students in senior secondary school two (SSS II) and a sample size of 63 senior secondary school two (SSS II) Physics students in their intact classes using multi-stage sampling procedures. Physics Science Process Skills Task (PSPST) and Self-efficacy Physics Practical Questionnaire (SePPQ) were subjected to item analysis and validated by three educational who are Physics experts. The reliability coefficient of PSPST and SePPQ are found to be 0.80 and 0.75 on twenty students outside the study area through Kuder Richardson 21 and Cronbach Alpha respectively. The pre-test and post-test of the two instruments were administered on guided practice and conventional groups before and after the treatment respectively. Analysis of Covariance and Post-Hoc analysis were therefore used to test the two null hypotheses raised. Findings from the study revealed that there were statistical significant differences in science process skills and self-efficacy in the two groups. Guided practice instruction had more effect on science process skills and self-efficacy than the conventional group. Based on the findings, it was recommended that that practical activities in secondary schools needed to be guided to enhance students' science process skills and self-efficacy.

Keywords: Guided practice instruction; science process skills; self-efficacy; Physics practical

Introduction

The study of science has received prompt attention in this digital era for the fact that it is a body of knowledge which has aided successes recorded in technology, engineering and telecommunications industry. These have contributed to evolvement of different techniques in which science takes to unravel knowledge to the learners in the universe. The study of science entails processes of verifications, experimentations and explanations of finding facts. Within the spectrum of science is Physics being taught at secondary schools as a subject which establishes its fact on observations and quantitative measurements related to natural events. It is a subject which is directly connected to natural events occurring in daily life and which seeks to explain its fact with aids of mathematics languages. According to Ojo and Owolabi (2020), Physics is a science subject expected to be taught through theory and practical means. The extension of this is that physics students are examined in theory and practical in all external examination at the secondary school's level. This therefore throws weight behind the importance of physics practical at the secondary schools' education.

Practical in science brings about constructive learning which can promote intellectual development and social interactions that can aid students' self-efficacy. Practical class is the time for activities involving observation, measurement and extrapolation of ideas and facts findings from experiments activities. In Physics practical, students process the observed data through the usage of principles and mathematical concepts for practical applications (Adebisi, 2015), this draws the extension of Physics knowledge to its application to engineering and technology field of disciplines making practical activities indispensable. Practical work involves engaging the learners in observing, manipulating and drawing inference from the use of real or virtual objects and materials (Antwi, Sakyl-Hagan, Addo-Wuver & Asare, 2021). This implies that practical class is all demanding and activities oriented in the laboratory laden environment to help learners acquire real knowledge to life situations. The importance of practical in science has been objectified to include observing, measuring and understanding of phenomenon taught theoretically in the classroom (Omeodu, 2018); enhances problem solving skills and improves conceptual understanding in learners (Alkan 2016) In another word, practical activities expose students to first-hand contact with real life materials and objects which can help to develop the ability and skills to identify scientific problems, develop models and proffer adequate solutions to problems. The adequacy and proper implementation of practical activities could arouse scientific literacy and skills for solving immediate life puzzles. Science process skills are underlining and fundamental knowledge required in the practical class which without the mastery of procedures of activities will be difficult to be comprehended.

Science process skills are those skills of knowledge that are needed to help students become more adept at comprehending to new information or concepts and assist in creating the appropriate knowledge, concepts, and values (Prince, 2004; Yang & Heh, 2007). Gultepe (2013) identified the skills that are associated with science process skills as observation, summarization, identification and manipulation of variables, prediction, hypothesizing, organization and interpretation of data, investigation, experimentation needed during investigation. Science process skills are associated with basic skills to actualize the , communication and classification of information (Rauf, Rasul, Mansor, Othman & Lyndon, 2013). Science process skills are refereed to practical skills (Adebisi & Otun, 2022)

With much attention and involvement needed during practical class as a result of science process skills, students are often under burden to exercise self-regulation in the use the science process skills which necessitate self-efficacy in the practical session. Practical session demands self- belief, capability, self-regulation and composure which are elements of self-efficacy. Self-efficacy is the extent of one's belief in one's own skill to complete responsibilities on specific tasks (Ormrod, 2006). Studies have shown that high self-efficacy is related to a number of social, positive physical and psychological performances and these factors are consequential to better outcomes in practical science. Individuals with high self-efficacy are more likely to put up new behaviours and to persist in those behaviours, thereby, increasing their possibility of achievement (Sherer, Maddux, Mercandante, PrenticeDunn, Jacobs, & Rogers, 1982). High self-efficacy students show persistence on tasks given which could result to better achievement (Britner, 2008: Zeldin & Pajarees, 2000). Self-efficacy determines the self- regulation and adaptability of students to education challenging. According to Belykh,and Mayramyan (2016) self-efficacy aids high level of psychodynamic activity and adaptability, self-regulation, flexibility and decrease the level of emotionality, tolerance to unclear tasks.

Students ‘self-efficacy should be aroused and this can be achieved through teachers’ initiative and usage of appropriate teaching instruction. Over the years the use of conventional passage of instruction has left the students with big task of using science process skills effectively during the practical class. The practical class in the conventional class is teacher dominated and mostly done towards external examinations, so students lack collaborative effort to ensued science process skills, the emphasis here is mainly in remembering and reproducing facts, principles and theories of learning for solely for examination purposes. Conventional teaching instruction is theoretical and teacher directed (Peter, 2014). The nature of practical in science needs students’ guidance and collaborative effort to set up the experiment, to observe, measure, deduct and communicate the results to conform with scientific theories and principle, therefore students need to be guided through instructions.

The researcher therefore explores the use of Guided Practice Instructional Strategy (GPIS) that can be adopted by Physics teachers in the teaching of Physics practical to enhance science process skills and self-efficacy in Nigerian Secondary schools. The importance of science process skills demands teachers’ use of innovative instructional strategy to the acquisition of relevant science process skills and the self-efficacy of the students in Physics practical. Golden, Gersten, and Woodward (1990) defined guided practice as the instructional phase that follows the introduction of a new skill, concept, or strategy. During this phase, the teacher evaluates students' understanding of the newly presented material. This assessment is carried out by assigning a few tasks that require students to apply the new skill or concept and assessing whether they can do so independently. If students demonstrate a satisfactory level of performance, the teacher assigns independent work related to the new material. However, if students struggle or perform poorly during guided practice, the teacher offers additional explanations, examples, or models to clarify the concept or demonstrate problem-solving techniques (Golden *et al*., 1990).

Guided Practice Instructional Strategy (GPIS) involves interactive instruction between the teacher and the students. Once the teacher introduces new material, he involves the students in a task similar to what they will later perform independently in the lesson. This task is completed collaborative, with the teacher taking the lead but seeking input from students at specified points during activities. As students engage in guided practice, the teacher gradually shifts more responsibility of thinking to the students, reducing the teacher's assistance. This phase is also an opportunity for teachers to identify any areas that may require re-teaching from the initial introduction of new content and to assess when students are ready to work independently.

Bearing the aforementioned in mind, the researchers gathered information from the literature that science process skills is a navigating knowledge for solving Physics practical and science problems. The rigorous academic procedures in terms of science process skills demand high self-efficacy of students in practical. It is with this in view that the researchers carried out a study on the effects of guided practice instruction on science process skills and self-efficacy of physics students in secondary schools practical in Ondo State, Nigeria.

Statement of the Problem

The low performance in Physics at the secondary schools' level of education kept on increasing in spite of the contribution of its knowledge to the field of technology, engineering, medicines and allied disciplines for sustainable development. Although many researches have proffered solutions to enhance the performance of students but with little attention drawn towards the nature of practical aspect of the subject. It is obvious that current researches are not addressing serial phenomenon of activities culminating to science process skills and the method of instruction in physics practical. Besides, many students dread Physics as a result of their low self-efficacy in the nature of physics practical. It is therefore pertinent to research into instruction passage besides conventional mode of instruction in Physics practical at this time when high premium is placed on science, technology and Information Communication and Technology (ICT)) as the bedrock of sustainable development. The researchers therefore, sought to investigate effects of guided practice instruction on science process skills and self-efficacy of physics students in secondary schools practical in Ondo State, Nigeria.

Purpose of the Study

The purpose of the study was to investigate effects of guided practice instruction on science process skills and self-efficacy of physics students in secondary schools practical in Ondo State, Nigeria. Specifically, the study sought to:

i) compare the effects of guided practice instruction and conventional instruction on science process skills in physics practical in the study area.

(ii). compare the effects of guided practice instruction and conventional instruction on the self-efficacy of physics students in the study area.

Null Hypotheses

The following hypotheses were formulated in line with the objectives of the study at 0.05 level of significance:

1. There is no significant difference in science process skills of students exposed to guided practice instruction and those exposed to conventional instruction in physics practical in the study area.
2. There is no significant difference in self-efficacy of students exposed to guided practice instruction and those exposed to conventional instruction in physics practical in the study area

Methodology

Research Design

The study adopted the pretest, post-test, non-equivalent, control group quasi-experimental research design. The two groups in the study are the Guided Practice Instructional Group (GPIG) and the Conventional Instructional Group (CIG). A pre-test was administered on the two groups before the commencement of the treatment. The two groups received treatment for six weeks after which the post-test was administered on them.

Participants

The population for this study was all the Physics students in Ondo state senior secondary schools. However, the target population for the study was 3508 Physics students in senior secondary school two (SSS II) students and 63 Physics students constituted the sample size selected through the multi-stage sampling procedure. In the first stage, one Senatorial District was selected from the three Senatorial District in the states through the simple random sampling technique. In the second stage, one local government area was selected from the selected senatorial district through the simple random sampling technique. In the last stage, four senior secondary schools were selected from the local government through simple random sampling technique. Two of the selected schools were assigned to experimental group of 33 students while the other two were assigned to the control group of 30 students in their intact classes.

Research Instruments

Two research response instruments were used by the researchers for the collection of data for the study. The first one is Physics Science Process Skills Task (PSPST) which was used to collect data on the science process skills of the students in Physics practical. The Physics Science Process Skills Task (PSPST) examined the observation, measurement, manipulation, recording, graphing, mathematical calculations, interpreting and reporting consisting of 10, 2, 5, 1, 1, 4,1,1, and (40 %,) (8 %), (20 %), (4 %), (4 %), (16%), (4%), (4%)

items and percentages respectively. The second one is the students' Self-efficacy towards Physics Practical Questionnaire (SePPQ). (SePPQ) was used to collect data on the self-efficacy of the students in Physics practical on the response of strongly agreed, Agreed, Disagreed and strongly disagreed. The conventional teaching instruction package was the treatment for the control group while the guided teaching package was the treatment for experimental group.The two groups were taught the same contents but with different procedures.

Validation of Research Instruments

Three experts from the Department of Science and Technology Education, Obafemi Awolowo University established the face and content validity of the research instruments. The instruments were vetted in terms of clarity, suitability and compliance with curriculum of senior secondary schools II to elicit the required information for the study. The corrections, criticisms and useful suggestions of the experts were incorporated into the final draft of the instrument. The trial testing was conducted by the researchers on a sample of twenty senior secondary school (SSSII) students outside the study area to evaluate the reliability coefficients of the instrument. This was determined by using Kuder Richardson 21 formula for PSPST while Cronbach Alpha for SePPQ respectively. A reliability index of 0.80 and 0.75 were obtained for PSPST and SePPQ respectively and considered appropriate for the study. The two instructional packages validated by three experts ascertained the conformation to guidelines of the groups. The input from the experts were used to adjust the packages.

Procedure for Data Collection

The researchers visited the schools to seek permission for the study and to discuss the purpose of the study. The subject teachers were used for research assistant and their involvement went as far as organising and preparing the intact classes for the study. The period of the research lasted for six weeks. The pre-test of the PSPST and SePPQ was administered on both groups in the first week of the research after which the intervention, the guided practice and conventional teaching packages were carried out on the students.The class teachers were initially briefed on the detail and direction to each group. The items of the PSPST and SePPQ were reshuffled and the post-test were administered on the groups after the completion of the intervention stage through the assistance of class teachers.

Results

Null Hypothesis 1: There is no significant difference in science process skills of students exposed to guided practice instruction and those exposed to conventional instruction in physics practical in the study area

This hypothesis was tested by comparing the science process skills scores of the students that were taught Physics practical using guided practice and those taught using conventional instruction. The result of the analysis is presented in Table 1.

Table 1: ANCOVA showing the pre-test and post-test scores of students' science process skills scores.

Dependent Variable: Post-PSPSTQ

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	729.557[a]	2	364.778	16.337	.000	.353
Intercept	3710.875	1	3710.875	166.194	.000	.735
PREPSPSTQ	295.181	1	295.181	13.220	.001	.181
Instructional Strategy	379.305	1	379.305	16.987	.000	.221
Error	1339.713	60	22.329			
Total	53555.000	63				
Corrected Total	2069.270	62				

a. R Squared = .353 (Adjusted R Squared = .331)

Table 1 shows that there is significant difference between the effects of guided practice instruction and conventional instruction on the science process skills of senior secondary schools students in Physics practical (F (1,63) = 16.987, P=0.000), therefore, the researchers reject the null hypothesis that was earlier stated. To further determine the direction of the interventions and to ascertain which of the instruction is better a pairwise comparison of the post-test was conducted using Bonferroni. The result is presented in Table 2.

Table 2: Pairwise comparison of post-test of science process skill scores of guided practice instruction and conventional instruction.

(I) instructional strategy	(J) instructional strategy	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
CIS	GPIS	-4.927*	1.195	.000	-7.319	-2.536
GPIS	CIS	4.927*	1.195	.000	2.536	7.319

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 2 shows the pairwise comparison between the science process skills scores of students taught using guided practice(GPIS) instruction and those taught with conventional instruction (CIS). The shows that the mean difference between guided practice instruction and conventional instruction is 4.927. this therefore implies that guided practice instruction has more effect on the science process skills than the conventional instruction.

Hypothesis 1: There is no significant difference in self-efficacy of students exposed to guided practice instruction and those exposed to conventional instruction in physics practical in the study area. To test the hypothesis, the self-efficacy of students taught Physics practical with conventional instruction was compared to that of those taught using conventional instruction. The result of the analysis is presented in Table 3.

Table 3: ANCOVA showing the pretest and post-test of self-efficacy of students taught Physics practical with guided practice instruction and those taught with conventional instruction

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	789.809[a]	2	394.904	17.718	.000	.371
Intercept	2434.254	1	2434.254	109.219	.000	.645
Pre-self-Efficacy	384.957	1	384.957	17.272	.000	.224
Instructional strategy	517.555	1	517.555	23.221	.000	.279
Error	1337.271	60	22.288			
Total	205562.000	63				
Corrected Total	2127.079	62				

a. R Squared = .371 (Adjusted R Squared = .350)

Table 3 shows that there is a significant difference between the effects of guided practice instruction and conventional instruction on the self-efficacy of senior secondary school students in Physics practical (F (1,63) = 23.221, P=0.000), therefore, we reject the null hypothesis that was earlier stated. To further determine the direction of the interventions, a pairwise comparison of the posttest was conducted using Bonferroni. The result is presented in Table 4

Table 4: Pairwise comparison of posttest of self-efficacy of guided practice instruction and conventional instruction.

(I) instructional strategy	(J) instructional strategy	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
CIS	GPIS	-5.800*	1.204	.000	-8.208	-3.392
GPIS	CIS	5.800*	1.204	.000	3.392	8.208

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4 shows the pairwise comparison between the self-efficacy of students taught using guided practice instruction and those taught with conventional instruction. This shows that the mean difference between guided practice instruction and conventional instruction is

5.800. this therefore implies that GPIS has more effect on the self-efficacy of students in Physics practical than the CIS.

Discussion of Findings

The research investigated investigates the effects of guided practice instruction on science process skills and self-efficacy of physics students in secondary schools practical. The result of hypothesis one shows significance differences in the science process skills of senior secondary schools' students in Physics practical when they were taught with guided practice instructional and conventional instructional. The results further show that guided practice instruction group had better effect on science process skills than the conventional instructional group. This result is in agreement with the findings of Mulyeni, Jamaris & Supriyati, (2018) who found out that inquiry-based approach improved science process skills of students in Physics practical. This result also agrees with the findings of Sreelekha (2018) who believed that in order to bring about acquisition of practical skills, the teachers should endeavour to make use of instructional strategies outside of the conventional instructional strategy which can enhance learning procedure in which science process skills is a type. This was confirmed in the study conducted by Ogunleye and Babajide (2010) when they found out that predict-observe-explain instructional strategy was effective in improving the practical skills of students.

The result of the second hypothesis which states that there is no significant difference in self-efficacy of students taught Physics practical with guided practice instruction and those taught with conventional instruction in the study area was rejected. Further analysis shows that the students that were taught using guided practice instructional had better self-efficacy than those that were taught using conventional instructional. This shows that when the students are being taught Physics practical using an instructional strategy that is more learner-centred, they have more tendency of performing better and have a better belief in themselves to tackle difficult problems after they must have been taught. . Guided instruction makes the students to be more active, growing the inquiry attitude, developing problem solving and giving space for student-teacher interaction which can consolidate learning promoting self-capability. The finding is in support of Syarafina and Mahmudi (2019) that implementation of learning using guided instruction improved student self-efficacy after learning. Based on the other research, the implementation of guided learning improves students' skill of doing observation, discussion and conclusions and communication (Yurniwati, & Hanum, 2017) which are relevant to build the belief during the practical activties .This research result supports the finding of Bada and Akinbobola (2020) who found out that experiential teaching instruction was effective in improving the self-efficacy of students in Physics.

Conclusion

It was found out in the study that science process skills acquisition is better enhanced through guided instruction than conventional instruction and students' self-efficacy is significant with guided instruction among Physics students in Ondo State Nigeria

Recommendations

(i) Physics teachers should be informed on research findings such as this to see the necessity to be flexible in the mode of their instructions on the usage of guided instruction during practical session.

(ii) Educational organization such as Science Teacher Association of Nigeria (STAN) and National Education Research and Development Centre (NERDC) should organize seminars and workshop on guided instructions practice and science process skills for physics teachers at secondary schools to keep them abreast of these phenomena.

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