Utilizing Interactive Students Notebook With Feedback Strategies To Enhance Secondary Students Science Process Skills Acquisitions, Performance In And Attitude Towards Physics.

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DOI: 10.29322/IJSRP.11.04.2021.p11261
http://dx.doi.org/10.29322/IJSRP.11.04.2021.p11261

Abstract- The study investigated how utilizing interactive students notebook with feedback strategies could enhance science process skills acquisition, performance in and attitude towards physics in Plateau state, Nigeria. Three research questions and three null hypotheses formulated guided the study. The study adopted quasi-experimental research design. The population consists of 3,182Senior Secondary (SS) II Physics students in all the secondary schools located in Plateau State of Nigeria. A sample of 113 SS II Physics students in four intact classes was used for the study. Physics Students' Academic Performance Test (PSAPT) with reliability coefficient of 0.97, Test of Physics Related Attitude (TOPRA) with reliability coefficient of0.84 and Test of Science Process Skills Acquisition (TOSPSA) with reliability coefficient of0.98were used for data collection. The data collected were analyzed using mean and standard deviation to answer the research questions and Analysis of Covariance (ANCOVA) to test the null hypotheses at 0.05 level of significance. It was found that there was no significant difference existed in the mean attitude scores towards physics [F(1.61) = 1.725; p = 0.194> 0.05]as well as mean skill acquisition scores [F(1,61) = 3.025; p = 0.087> 0.05] of male and female students taught physics using the interactive students' notebook with feedback. However, there was significant difference in the mean performance scores of male and female students taught physics using the interactive students' notebook with feedback [F(1,61) = 3.025; p = 0.038< 0.05]. It was recommended among others that Physics teachers should employ interactive students' notebook with feedback strategy in their classroom interaction when teaching physics as the strategy has the capacity to enhance male and female students' attitude towards Physics, promotes process skills acquisition in Physics and performance in Physics. In service training, seminars, work-shops and symposia should be organized by the state and federal ministry of education to train physics teachers on how to use interactive students' notebook with feedback in teaching the subject.

I. Introduction

Science as a field of study has done a lot for mankind. Through science, man has been able to better understand his environment and this has enabled him to manipulate the conditions of his environment to suit his own benefit. Its impact is felt in every sphere of life. Physics as a science subject is very important in the economic development of all countries of the world. It is the most basic of sciences and its concepts and techniques underpin the progress of all other branches of science (Dakang, 2015). It is a cross-cutting discipline that has applications in many sectors of economic development including health, agriculture, water, energy, information and communication technologies (Akinbobola, 2009).

Despite this importance attached to science, several research reports indicate that students' performance in secondary school science subjects is poor especially Physics (Achor, 2003; Ukwungu, 2006; Akinbobola, 2009; Adegoke, 2011; Aina, 2013; Dakang, 2015). Available evidence has revealed that the students' poor performance in Physics is linked to poor pedagogical methods used by the teachers (Owolabi, 2004; Keban & Erol, 2011; Aina, 2013; Dakang, 2015). In line with this, Mankilik (2019) reveals that the analysis of students performance in physics shows a consistent high failure in Jos metropolis which is applicable to other schools in Plateau state as obtained in West African Examination Council chief examiners reports from 2012-2016 in senior secondary students' performance in physics. For 2012 (41.35%); 2013 (33.83%); 2014 (53.83%); 2015 (51.82%) and 2016 (21.16%). Similarly, the NECO Results in Physics showed that; 2012 (48.91%); 2013 (32.94%); 2014 (3.27%); 2015 (19.11%) and 2016 (17.74%).

The conventional instructional strategy such as the lecture method often employed in teaching Physics has not improved male and female students' performance in the subject to any appreciable extent (Akinbobola, 2009; Adegoke, 2011; Bello, 2011; Aina, 2012; Aina, 2013). This implies that the teaching of Physics has not led to male and female students understanding of the concepts. Therefore, there is a need to find other pragmatic

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teaching strategies such as the interactive students' notebook with feedback strategy.

Interactive student Notebooks (ISNs) are spiral notebooks or composition books that are organized into two parts. The right side contains input and the left side contains students output (Waldman & Crippen, 2009; Teachers Curriculum Institute, 2012). Input (right side) consists of information received through teacher lecture, notes, lab sheets and information obtained from text. The output (left side) contains students' interpretation and/or reflections and representations. The left side of ISNs belongs to the student and offer the student the opportunity to further scientific understanding with a section in which to make connections and extensions based on the knowledge and understanding of the content that was learned. The use of the interactive students' notebook is one key strategy that may empower students to acquire science process skills, enhance performance and attitude in Physics (Waldman & Crippen, 2009; Mallozzi, 2013; Drew, 2018; Ergin & Aktamis, 2018).

Science process skills are cognitive and psychomotor skills which scientists employ in problem identification, objective inquiry, data gathering, transformation, interpretation and communication. Padilla (2010) described science process skills as abilities which can be developed by experience and which are used in carrying out mental operations and physical actions. Studies by Okoli (2006), asserts that when one acquires the science process skills of observing, measuring, questioning, designing experiments, interpreting data, such a person becomes specially equipped with the tools required for scientific inquiry or problem-solving as well as ability to use these skills in the laboratory for a variety of investigations, especially using specific teacher feedback.

Specific teacher feedback enhances science learning when the feedback is related to how male and female student utilizes science process skills while performing a task or used to clarify misconceptions and redirect a students' learning. (Wist (2006) and Marcarelli (2010).

Attitude is someone's disposition towards a particular object, a person, a thing or idea. Attitude towards Physics deals with the beliefs, interest, perception and aspiration, practicing habits, persistence and self-concept of male and female students in dealing with Physics. Attitude plays a major role in the comprehensibility of Physics concepts. Dyel (2011) maintains that attitude can be described as a state of readiness, a tendency to act or react in a certain way. In general, it refers to a learned disposition or tendency on the part of an individual to respond positively or negatively to a situation or another person. The enthusiasm with which male and female students enter into any learning activity is determined by their attitude to that particular activity. Students seem to learn more efficiently those things that appear to interest them. The attitude and result of learning efficiency of male and female students in using the interactive students notebook with feedback may be different, hence the issue of male and female students performance in Physics.

The issue in science performance of male and female students has not yet been resolved particularly in relation to performance in Physics. Researchers have shown that differences in academic performance due to gender have caused a lot of concern to educationists (Ukwungwu, 2006; Akinbobola & Afolabi; 2010; Dakang, 2015). The same situation may exist for science process skill acquisition and attitude towards physics. According to Agogo and Naakaa (2014) gender is a socially ascribed attribute that differentiates feminine from masculine. This attribute often affects enrolment. Stephen (2010) noted that fewer girls take Physics and select careers in Physics related courses while boys are superior to girls in school performance especially in Physics. Akinbobola (2010) postulated that, sex related differences might be related to social (sex role model and orientation), educational and personal ability. However, could the trend be the same even when the interactive students' notebook with feedback strategy of teaching is used in teaching Physics to both male and female?

II. Statement of the Problem

The persistent poor performance and negative attitude of male and female students towards Physics coupled with poor science process skills acquisition exhibited by male and female students in Physics at the senior school Certificate Examination level leaves one in doubt about the effectiveness of the teaching methods popularly used by Physics teachers in teaching the subject. It is obvious that for a nation to develop a sound basis for modern technology, the study of Physics is very important. Unfortunately the teaching and learning of Physics is bedeviled by many factors among which are problem of poor science process skills acquisition, poor performance and negative attitude towards the subject. This problem has persisted for many years despite efforts to arrest the situation. There is evidence to attest to this fact that candidates show greater weaknesses in Physics, very few students pass with credits compared to other science subjects and it was therefore recommended by previous studies that more attention should be given to the teaching and learning of Physics.

When a subject is poorly taught, the learning will be haphazard and performance, process skills acquisition and attitude may be very poor. Among myriads of strategies being used, the interactive students' notebook with feedback has been reputed to enhance performance yet with dearth of research report in the study area. It is in this light that the researcher seeks to determine how utilization of the interactive students' notebook with feedback strategy of teaching can enhance male and female students' science process skills acquisition, performance and attitude towards Physics irrespective of student gender. The problem of this study posed as a question therefore is, how does utilizing interactive students' notebook with feedback enhance science process skills, performance and attitude towards Physics in Plateau state, Nigeria?

Purpose of the Study

1. Find out the effect of interactive students' notebook with feedback on male and female students attitude towards Physics.
2. Investigate the effect of interactive students' notebook with feedback on male and female students' science process skills acquisition in Physics.
3. Determine the effect of interactive students' notebook with feedback on the performance of male and female students in Physics.

Research Questions

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1. What is the difference in the mean attitude ratings of male and female students towards Physics when taught using the interactive students' notebook with feedback?
2. What is the difference in the mean science process skills acquisition scores between male and female students taught Physics using the interactive students' notebook with feedback?
3. What is the difference in the mean performance scores of male and female students taught Physics using the interactive students' notebook with feedback?

Hypotheses

1. There is no significant difference in the mean attitude ratings towards Physics for male and female students taught using the interactive students' notebook with feedback.
2. There is no significant difference in the mean skill acquisition scores of male and female students taught Physics using the interactive students' notebook with feedback.
3. There is no significant difference in the mean performance scores of male and female students taught Physics using the interactive students' notebook with feedback.

Research Design

This study employed a quasi-experimental research design of non-randomized pre-test, post-test control group type.

Area of Study

The study was carried out in Plateau State of Nigeria. The high records of poor performance and poor enrolment in Physics in Plateau State necessitate the present study.

Population

The population of the study consists of 3,182senior secondary school two Physics students in all the secondary schools located in Plateau State of Nigeria (Planning, Research and Statistics Department Plateau State, 2018).

Sample and Sampling

The sample for the study consists of 113 senior secondary school two Physics students located in Plateau State of Nigeria. A multistage sampling technique was used for the study. In all, two schools were for the experimental group (Interactive Students Notebooks Strategy group) and two schools were for the Control group (Conventional Strategy group). The experimental group consisted of 62 students made up of 29 male and 33 female students while the control group consisted of 51 students comprising 24 male and 27 female students.

Instrumentation

Three instruments and three sets of lesson plans were used for the study. The instruments are:
Physics Students' Academic Performance Test (PSAPT), Test of Physics Related Attitude (TOPRA), Test of Science Process Skills Acquisition (TOSPSA).

Research Question 1

What is the difference in the mean attitude ratings of male and female students towards Physics when taught using the interactive students' notebook with feedback?

Table 1: Mean and standard deviation of attitude scores of male and female students towards Physics when taught using the interactive students' notebook with feedback

Gender		PreTOPRA	PostTOPRA	Mean Gain
	Mean	3.2580	3.9661	0.71
Male	N	28	28	
	Std. Deviation	.47741	.32420	
	Mean	3.5449	3.8301	0.29
Female	N	34	34	
	Std. Deviation	.52110	.36337	
Mean difference				0.42

The analysis of data on Table 4 shows the mean attitude scores of male and female students towards Physics when taught using the interactive students' notebook with feedback. The table shows that 28 male and 34 female students were taught Physics using interactive students' notebook with feedback. The table reveals that the mean attitude scores of male students taught Physics using interactive students' notebook with feedback is 3.26 with a standard deviation of 0.48 during pre-test and 3.97 with a standard deviation of 0.32 in post test. The mean attitude scores of female students taught Physics using interactive students' notebook with feedback is 3.54 with a standard deviation of 0.52 during pre-test and 3.83 with a standard deviation of 0.36 in post test. The table further shows that the mean gain for male students taught Physics using interactive students' notebook with feedback is 0.71while that of female students is 0.29.The difference in the mean attitude scores of male and female students towards Physics when taught using the interactive students' notebook with feedback is 0.42 in favour of male students.

Research Question 2

What is the difference in the mean science process skills acquisition scores between male and female students taught Physics using the interactive students' notebook with feedback?

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Table 2:Meanand Standard Deviation of Science Process Skills Acquisition Scores between Male and Female Students Taught Physics Using the Interactive Students' Notebook with Feedback

Gender		PreTOSPSA	PostTOSPSA	Mean Gain
	Mean	7.5000	29.2500	21.75
Male	N	28	28	
	Std. Deviation	2.60342	3.59655	
	Mean	7.7059	27.0882	19.38
Female	N	34	34	
	Std. Deviation	2.72507	5.81204	
Mean difference				2.37

The analysis of data on Table 5 shows the mean science process skills acquisition scores of male and female students towards Physics when taught using the interactive students' notebook with feedback. The table shows that 28 male and 34 female students were taught Physics using interactive students' notebook with feedback. The table reveals that the mean science process skills acquisition scores of male students taught Physics using interactive students' notebook with feedback is 7.50 with a standard deviation of 2.60 during pre-test and 29.25 with a standard deviation of 3.60 in post test. The mean science process skills acquisition scores of female students taught Physics using interactive students' notebook with feedback is 7.71 with a standard deviation of 2.73 during pre-test and 27.09 with a standard deviation of 5.81 in post test. The table further shows that the mean gain for male students taught Physics using interactive students' notebook with feedback is 21.75while that of female students is 19.38.The difference in the mean science process skills acquisition scores between male and female students taught Physics using the interactive students' notebook with feedback is 2.37 in favour of male students.

Research Question 3

What is the difference in the mean performance scores of male and female students' taught Physics using the interactive students' notebook with feedback?

Table 3:Meanand Standard Deviation of Performance Scores of Male and Female Students' Taught Physics Using the Interactive Students' Notebook with Feedback

Gender		PrePSAPT	postPSAPT	Mean Gain
	Mean	31.7857	49.1429	17.36
Male	N	28	28	
	Std. Deviation	5.47964	8.13185	
	Mean	34.2353	48.1471	13.91
Female	N	34	34	
	Std. Deviation	10.37789	9.81073	
Mean difference				3.45

The analysis of data on Table 6 shows the mean performance scores of male and female students towards Physics when taught using the interactive students' notebook with feedback. The table shows that 28 male and 34 female students were taught Physics using interactive students' notebook with feedback. The table reveals that the mean performance scores of male students taught Physics using interactive students' notebook with feedback is 31.79 with a standard deviation of 5.48 during pre-test and 49.14 with a standard deviation of 8.13 in post test. The mean performance scores of female students taught Physics using interactive students' notebook with feedback is 34.24 with a standard deviation of 10.38 during pre-test and 48.15 with a standard deviation of 9.81 in post test. The table further shows that the mean gain for male students taught Physics using interactive students' notebook with feedback is 17.36 while that of female students is 13.91.The difference in the mean performance scores of male and female students taught Physics using the interactive students' notebook with feedback is 3.45 in favour of male students.

Hypothesis 1

There is no significant difference in the mean attitude ratings towards Physics for male and female students taught using the interactive students' notebook with feedback.

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Table 1: ANCOVA of Mean Attitude Scores towards Physics for Male and Female Students Taught Using the Interactive Students' Notebook with Feedback

Dependent Variable: PostTOPRA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.322[a]	2	.161	1.326	.273	.043
Intercept	21.177	1	21.177	174.576	.000	.747
PreTOPRA	.038	1	.038	.314	.578	.005
Gender	.209	1	.209	1.725	.194	.028
Error	7.157	59	.121			
Total	946.408	62				
Corrected Total	7.479	61				

a. R Squared = .043 (Adjusted R Squared = .011)

Table 1 shows that F(1,61) = 1.725; p = 0.194> 0.05. Since p is greater than 0.05, the null hypothesis is not rejected. This implies that there is no significant difference in the mean attitude scores towards Physics for male and female students taught using the interactive students' notebook with feedback. Thus, it can be concluded that based on evidence from data analysis no significant difference exist in the mean attitude scores towards Physics for male and female students taught Physics using the interactive students' notebook with feedback. The partial Eta square of 0.028 was obtained for the gender meaning that only 2.8% of the Physics students' attitude scores can be attributed to the influence of gender of students in Physics class.

Hypothesis 2

There is no significant difference in the mean skill acquisition scores of male and female students taught Physics using the interactive students' notebook with feedback.

Table 2: ANCOVA of Mean Skill Acquisition Scores of Male and Female Students Taught Physics Using the Interactive Students' Notebook with Feedback

Dependent Variable: PostTOSPSA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	87.229[a]	2	43.615	1.776	.178	.057
Intercept	4719.470	1	4719.470	192.231	.000	.765
PreTOSPSA	15.472	1	15.472	.630	.430	.011
Gender	74.266	1	74.266	3.025	.087	.049
Error	1448.513	59	24.551			
Total	50368.000	62				
Corrected Total	1535.742	61				

Table 2 shows that F(1,61) = 3.025; p = 0.087> 0.05. Since p is greater than 0.05, the null hypothesis is not rejected. This implies that there is no significant difference in the mean skill acquisition scores of male and female students taught Physics using the interactive students' notebook with feedback. Thus, it can be concluded that based on evidence from data analysis no significant difference exist in the mean skill acquisition scores of male and female students taught Physics using the interactive students' notebook with feedback. The partial Eta square of 0.049 was obtained for the gender meaning that only 4.9% of the Physics students' skill acquisition scores can be accounted for by the influence of gender of students in Physics class.

Hypothesis 3

There is no significant difference in the mean performance scores of male and female students taught Physics using the interactive students' notebook with feedback.

Table 3: ANCOVA of Mean Performance Scores of Male and Female Students Taught Physics Using the Interactive Students' Notebook with Feedback

Dependent Variable: postPSAPT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3125.740[a]	2	1562.870	49.811	.000	.628
Intercept	1623.478	1	1623.478	51.743	.000	.467
PrePSAPT	3110.514	1	3110.514	99.137	.000	.627
Gender	141.142	1	141.142	4.498	.038	.071

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Error	1851.179	59	31.376
Total	151399.000	62	
Corrected Total	4976.919	61	

a. R Squared = .628 (Adjusted R Squared = .615)

Table 3 shows that F(1,61) = 3.025; p = 0.038< 0.05. Since p is less than 0.05, the null hypothesis is rejected. This implies that there is significant difference in the mean performance scores of male and female students taught Physics using the interactive students' notebook with feedback. Thus, it can be concluded that based on evidence from data analysis significant difference exist in the mean performance scores of male and female students taught Physics using the interactive students' notebook with feedback. The partial Eta square of 0.071 was obtained for the gender meaning that only 7.1% of the Physics students' skill acquisition scores can be accounted for by the influence of gender of students in Physics class.

The study determined how utilizing interactive students' notebook with feedback could enhance science process skills, performance and attitude towards Physics in Plateau state, Nigeria. Since the population for the study consists of both male and female students, gender was incorporated as a moderating variable for comparison. Discussions of findings are tailored along the variables in the study as guided by the results of research questions and hypotheses.

Finding of hypothesis one revealed that there is no significant difference in the mean attitude ratings towards Physics for male and female students taught using the interactive students' notebook with feedback. This implies that the use of interactive students' notebook with feedback strategy is not gender sensitive based on the mean attitude scores of students. The finding agrees with that of Jayosi and Zeidan (2015) that there were no significant differences in attitudes toward science due to the variables in their study.

Finding of hypothesis two revealed that there is no significant difference in the mean skill acquisition scores of male and female students taught Physics using the interactive students' notebook with feedback. This implies that the use of interactive students' notebook with feedback strategy is gender friendly based on the mean skill acquisition scores of students. The finding agrees with that of Ekon and Eni (2015) that gender did not significantly influence the acquisition of science process skills at the upper basic level of UBE. However, the finding disagrees with that of Jayosi and Zeidan (2015) that there were significant differences in science process skills due to gender favouring females.

Finding of hypothesis three revealed that there is significant difference in the mean performance scores of male and female students taught Physics using the interactive students' notebook with feedback. This means that male and female students' performance in Physics is influenced differently by the use of interactive students' notebook with feedback strategy because the strategy is gender sensitive as evident in the finding in the study.

III. Conclusion

The study has established that the use of interactive students' notebook with feedback strategy in teaching Physics contents enhances male and female students' attitude towards Physics, promotes male and female students' process skills acquisition in Physics and as well as male and female students' performance in Physics better than conventional strategy. It was also established that interactive students' notebook with feedback strategy is gender friendly with reference to male and female students' attitude towards Physics and male and female students' process skills acquisition in Physics. It was equally established that interactive students' notebook with feedback strategy is gender sensitive with reference to male and female students' performance in Physics. It was concluded that concepts in Physics are better taught via interactive students' notebook with feedback strategy, since the male and female students find themselves reassessing the importance of Physics and develop positive attitude towards the teaching and learning of Physics, acquire scientific process skills and performed better in Physics. However, gender of students do not interact with methods to affect male and female students' attitude, acquisition of process skill and academic performance in physics.

IV. Recommendations

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

1. Physics teachers should employ interactive students' notebook with feedback strategy in their classroom interaction when teaching Physics as the strategy has the capacity to enhance male and female students' attitude towards Physics, promotes process skills acquisition in Physics and performance in the subject.
2. Physics teachers should regularly provide the structure and opportunity for learners to employ interactive students' notebook with feedback as learning strategy.
3. In service training, seminars, work-shops and symposia should be organized by the state and federal ministry of education to train Physics teachers on how to use interactive students' notebook with feedback in teaching the subject.
4. Interactive students' notebook with feedback strategy should be included in the training package of teacher education programme both in colleges of education and at university level to ensure that teacher-trainees acquire necessary skills to effectively implement the techniques.

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