PEER ASSESSMENT TECHNIQUE AS AN INSTRUMENT TO ACHIEVE CONTENT COVERAGE IN SENIOR SECONDARY SCHOOL PHYSICS

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Abstract
Assessment is an integral part of teaching/learning and is for several decision making purposes. Time and energy are spent by teachers to grade students' formative assessment. This study sought to find out the extent peer assessment technique enhances content coverage in Physics. Three research questions and two hypotheses guided the study. The design of the study is quasi experimental. Specifically, the pre – test, post – test non-equivalent control group design was used. The sample consisted of 160 (88 males and 72 females) senior secondary school two (SSS2) students who offer Physics and selected from intact groups from four Model coeducational secondary schools out of 48 coeducational secondary schools in Umuahia Education Zone of Abia State, Nigeria. Two of the four schools were randomly assigned to experimental group and the other two to the control group. The experimental group was taught Physics and was assessed using Peer Assessment Technique while the control group was taught Physics and was assessed using Teacher Assessment Technique. The instrument used for the study is a Physics Achievement Test (PAT) selected from the standardized WAEC multiple choice questions. The same PAT was used for both the pretest and post test but was reshuffled during the post test. The instrument was validated and its reliability index obtained as 0.87. Data were analyzed using percentages, mean and standard deviation to answer the research questions while the hypotheses were tested at 0.05 level of significance using ANCOVA. Results show that Peer Assessment Technique increased subject content coverage which in turn resulted to increase in achievement in Physics. It is recommended that teachers should use peers for assessment to provide them with more time for teaching.

Introduction

Science subjects comprise a major part of the subjects that are taught in most post-primary and secondary schools in Nigeria today. Physics which is one of the sciences had been of great importance internationally for sustainable development as well as for technological advancement of nations.

This means that every citizen needs the knowledge of science and technology to surmount the environmental challenges. Such challenges, according to Eze (2009) include effects of genetic experimentation and engineering, ecological impact of modern technology, dangers of nuclear war, emergences of new drug resistant diseases, explosions and global warming among others.

The importance of science subjects can also be seen in the Federal Government National Policy on Education, Section 5, Item 22(c) which states in specific terms that "The Secondary School Education shall provide trained manpower in the applied science and technology. The National Policy on Education further states that science subjects constitute part of the core subjects at both Junior and Senior Secondary School levels. Adeyemi (2003) emphasized that the importance attached to science by the Federal Government could be due to the general belief that science is capable of improving and changing skills, attitudes and cognition by increasing pupils' store of knowledge about themselves, their environment and their world. Unfortunately despite the importance of science and Physics in particular to the development of the nation, the achievement of students in science subjects especially Physics in Nigeria has remained consistently poor over the years (Eze 2009).

Physics is indispensable to technological advancement. Physics has helped in the development of modern technology through the application of its principles to modern invention. Its study enhances an understanding of the interplay of forces in nature because it forms veritable armour against superstition which muddles up technological advancement anywhere. Physics as a course of study is perceived generally to be very interesting, vast, mathematical and experimental. Almost all aspect of life science, both living and nonliving has something to do with physics, ranging from engineering to mathematics, biology, chemistry. Physics is one of the pre-requisite subjects for the study of engineering, technological, medical and other applied science courses in the university. Its study instructs a person in the art of critical thinking, how to pose questions and how to solve problems. The study of physics has been and will remain of tremendous importance to mankind because it is capable of explaining natural phenomenon and everyday occurrences. Physics is the most basic and fundamental of all the sciences and according to Adeyemi (2003) and Oriafor (2005), it plays a very important role in scientific and technological advancement that affects the lives of mankind. The implication of this is that Nigeria cannot develop technologically if Physics is not properly taught in our secondary schools. One of the steps involved in teaching Physics properly is content coverage of this subject.

Improving students' achievement in Physics has featured prominently as a goal of educational reform in many countries, and the methods for monitoring success often center on conducting assessments at the local, national, and international levels (Arora, 2008). Arora (2008) explained that since good curricular practice is part of this monitoring process, it seems important to provide students with an adequate opportunity to learn the material that is being tested. Arora added that there should be alignment across the curriculum, instruction, and assessment and that information about students' opportunities to learn the content targeted by assessments is receiving more and more attention as integral to examining the quality of school instruction.

Peer-Assessment Strategy can be referred to as the process whereby students grade assignments or tests, of their mates or peers based on a teacher's benchmarks. Here the teacher is very much involved and must give the benchmark for the assessment. Peer-Assessment Strategy/Technique encourages deep learning by the students and also helps in developing clearer assessment criteria. Explaining further, Orsmond (2005) defined peer assessment as the assessment of student's work by other students and that engaging students in Peer-Assessment can help them in learning to evaluate their own learning and in interpreting assessment criteria. No wonder Juwah (2003) opined that peer assessment is effective and efficient in ensuring the development of the desired knowledge, skills and capabilities science requires and also appropriate and rigorous training must be provided to enable the students familiarize themselves with the process of grading their peers' assignments to meet the teacher's benchmark so that more knowledge would be gained by the student on the subject's contents.

Peer assessment also helps in increasing feedback to students; reducing marking loads for teachers; giving students a sense of ownership of assessment process; encourage critical analysis of students' work, so students see beyond a mark/grade. Loddington (2008) explained that Peer Assessment is used to describe the process undertaken by students to assess the performance/contribution of themselves and their peer group, in relation to a group task and that it could also be described as peer moderated marking of students work based on sets of success criteria from the teacher. According to Asuai and Adeleye (2013), the assessment of students' work should involve both the teachers and students so that the students will be aware of the success criteria and the process of grading. One of the ways in which students internalize the characteristics of quality work is by evaluating the work of their peers. According to Asuai and Adeleye (2013), if the students are to offer meaningful feedback, they must have a clear understanding of what they are to

look for in their peers' work. The implication is that the teacher must have to explain what he expects from the students clearly to the students before allowing the students to start assessing one another. The teacher in this case has to provide a work done with instructions so that the students can practice their grading each other. This means that both the teacher and the students will have confidence in the marking of scripts without bias. The practice of peer assessment is employed to save teacher's time, and improve students' understanding of course materials as well as improve their thinking skills as students would be exposed to each other's work, learn different steps in presenting, analyzing, evaluating, and solving Mathematical problems and understanding physics better.

For improve learning students must be actively involved. This means that peer assessment will actively involve students in their learning and also not only help them in marking their own or each other's work but also will help students to learn from their peers solved work thereby helping them to give each other valuable feedback so that they can learn from and support each other (Ryan, Marshall, Porter, and Jia 2007).

There are processes of peer assessment which according to Black and Williams (1998) include;

1. Establish rapport and creating awareness of the key processes.
2. Give out samples of students work from another class.
3. Distributes instructional rubrics (success criteria) and explain how to grade students work to all participants.
4. Allow students to assess sample work using instructional rubrics as training.
5. Plenary discussion of the sample work on approaches and changes.

Sadler and Eddie (2006) opined that peer assessment is a process whereby students assess assignments or tests of their *peers* based on teacher's benchmark or Instructional Rubrics. They explained that the practice is employed to save teacher's time and improve students' understanding of course materials as well as improve their thinking skills as students would be exposed to each other's work, learn different steps in presenting, analyzing, evaluating, and solving problems. This means that Peer Assessment is much more than students' marking their own or each other's work because it also help students to learn from their peers solved work. To improve learning in Physics, it must be an activity that engages Physics students with the quality of their work and helps them reflect on how to improve on it. This is why Ryan, Marshall, Porter and Jia (2007) in their opinion explained that Peer Assessment enables students to give each

other valuable feedback so that they can learn from and support each other in assessing students' work based on sets of criteria. These activities according to Onuka (2007) also encourage cooperative learning by making weaker students learn from stronger students thereby removing their phobia in Physics.

The assessment and mode of teaching in most of the secondary schools in Nigeria is teacher centered approach where the teacher struggles to assess students alone and coverage of the content of the subject thereby not giving the students the opportunity to be creative and independent and understanding of physics and solving of mathematical problems and some of the assess one another in terms of their strengths and weaknesses. There is therefore the need to investigate the use of peer assessment in content coverage in Physics. The purpose of this study is to examine the extent of content coverage of Physics and students achievement using peer assessment technique.

The following research questions and hypotheses guided the study

1. What is the extent of Physics content coverage of teachers using students exposed to Peer Assessment Technique and those exposed to Teacher Assessment Technique?
2. What are the post Physics achievement scores of students exposed to peer assessment technique and those not exposed to peer assessment technique?
3. What are the posts Physics Achievement scores of students due to gender and experimental conditions?

1. There is no significant difference in the post Physics achievement scores of students exposed to Peer Assessment Technique and those exposed to Teacher Assessment Technique.
2. There is no significant difference in the post Physics Achievement scores of students due to gender and experimental conditions.

The null hypotheses were tested at 0.05 level of significance.

Method

Quasi experimental pre-test/ post test control group design was used to investigate the extent of content coverage in Physics and senior secondary Physics students achievement using Peer Assessment Technique. The sample consists of 160 (88 males and 72 females) senior secondary school two (SSS2) students who offer Physics in 4 intact groups from four Model coeducational secondary schools out of forty-eight coeducational secondary schools in Umuahia Education zone of Abia State, Nigeria. The sampling technique of the study was a combination of purposive and simple random sampling techniques.

Purposive sampling technique was used to sample Umuahia Education Zone of Abia State, Nigeria. Four coeducational Model Senior Secondary Schools in Umuahia Education Zone were selected through simple random sampling from forty-eight coeducational secondary schools. All the Physics students in these schools were used for the study. Two of the schools were assigned as the experimental group while the other two was assigned to be the control group. The experimental group consists of 45 males and 35 females while the control group consists of 43 males and 37 females. The instrument for data collection was a Physics Achievement Test (PAT) of fifty multiple choice items with 4 options adopted from the standardized WAEC multiple choice questions and attracted 50 marks. This PAT was constructed from the topics in the scheme of work taught during the period of the treatment. The instrument was validated and its reliability co-efficient was obtained as 0.87. The PAT was used as pre-test for both the control and experimental groups to measure the entry behavior of the students before exposing them to training. The same instrument was used for post test to measure achievement after being exposed to training.

The experimental group was taught using Peer Assessment Technique. Here the teacher continued teaching and the students who have been taught on peer assessment technique assessed their work while in the control group the teacher teaches the subject as well as assessed the students himself. The teacher for the experimental group was trained on how to train the students for peer assessment. Such training included the teacher setting the benchmark for assessment by defining Peer Assessment Technique and explaining the processes involved in assessing work in Physics, distribution of sample work in Interaction of Matter, Space and Time in Physics and instructional guide, discussing how participants can learn from sample responses in Interaction of Matter, Space and Time, teaching participants how they can assess each other's work in Physics, teaching participants how to work on the problem on their own, encouraging participants to work together to improve their work or sample work, making participants exchange their work to see how they can help each other and grading participants as: 1 for poor, 2 for fair, 3 for good, and 4 for excellent.

The treatment lasted for three months which is the duration of a term. Three research questions and two hypotheses formulated guided the study. Data were analyzed using percentages, mean and standard deviation to answer the research questions while the hypotheses were tested at 0.5 level of significance using ANCOVA.

Results

Table 1: Percentage of Physics Content Coverage of Students Exposed to Peer Assessment Technique and those Exposed to Teacher Assessment Technique

Content Coverage of Physics Scheme of Work

S/N	Content	Experimental Group Coverage	Experimental Group % Coverage	Control Group Coverage	Control Group % Coverage
1.	Fundamental Quantities	Yes			Yes
2.	Fundamental Units.	Yes			Yes
3.	Derived Quantities.	Yes			Yes
4.	Derived Units	Yes			Yes
5.	Measurement of Distance.	Yes			Yes
6.	Concept of Deflection	Yes			Yes
7.	Distinction between Distance And Displacement	Yes			Yes
8.	Concept of Time.	Yes			Yes
9.	Ways of Measuring Time.	Yes			Yes
10.	Types of Motion	Yes			Yes
11.	Concept of Speed.	Yes			Yes
12.	Concept of Velocity. 13/20* 100=	Yes	19/20 * 100=		Yes
13.	Distance time Graph/ Displacement Time Graph.	Yes	**95%**	No	**65%**
14.	Concept of Acceleration.	Yes			No
15.	Uniform/Non uniform acceleration.	Yes			No
16.	Velocity time graph	Yes			No
17.	Analysis of Rectilinear motion.	Yes			No
18.	Concept of Scalar.	Yes			No
19.	Concept of Vectors.	Yes			No
20.	Distinction between scalars and vectors	No			No

Table 1 showed that the teachers who taught Physics using students exposed to Peer Assessment Technique covered 19 out of the 20 topics taught thereby covering 95% of the content while the teachers who taught Physics using students exposed to Teacher Assessment Technique covered 13 out of the 20 topics taught thereby covering 65%of the content while the teacher.

This means that Peer Assessment Technique enhanced the coverage of Physics content more than Teacher Assessment Technique.

Table 2: Mean Achievement and Standard Deviation Scores of Physics Students in Experimental and Control groups.

		Gender			Gender		
		Pretest Male	Pretest Female	Overall Mean	Posttest Male	Posttest Female	Overall Mean
Treatment Experimental Group (Peer Assessment Technique)	Mean	23.90	23.81	23.87	70.20	69.77	70.01
	SD	4.42	3.67	3.67	12.21	11.33	11.77
	N	45	35	80	45	35	80
Control Group (Teacher Assessment Technique)	Mean	21.53	21.31	21.42	59.39	65.00	61.98
	SD	2.80	2.85	2.81	10.06	8.04	9.55
	N	43	37	80	43	37	80

Table 2 shows an overall mean pretest score of the experimental group of 23. 87 with a standard deviation score of 3.67 while that of the control group is 21.42 with a standard deviation score of 2.81. The table also shows that the post-test score of the students taught using Peer Assessment Technique (Experimental Group) was 70.01 with standard deviation (SD) of 11.77 while the groups taught using Teacher Assessment Technique (Control Group) had an overall mean post-test score of 61.98 with SD of 9.55.

Table 3: Analysis of Covariance on Physics Students Post Achievement Scores on Physics Achievement Test

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	3304.480[a]	4	826.120	7.354	.000
Intercept	46892.842	1	46892.842	417.447	.000
PRETEST	100.131	1	100.131	.891	.347
METHOD	2436.904	1	2436.904	21.694	.000
GENDER	250.569	1	250.569	2.231	.137
METHOD* GENDER	299.665	1	299.665	2.688	.104
Error	17411.520	155	112.332		
Total	717676.000	160			
Corrected Total	20716.000	159			

The results presented in Table 3 indicate that Peer Assessment Technique as a factor in the study had a significant effect on the achievement of physics students. This is because the calculated F value of 21.694 in respect of treatment as main effect has a probability value of .000 and therefore significant at 0.05 level of significance. This means that the null hypothesis of no significant difference in the mean post Physics achievement scores of students taught Physics using Peer Assessment Technique and those taught Physics using Teacher Assessment Technique is rejected. Implying that there is a significant difference in the mean post Physics achievement scores of students taught Physics using Peer Assessment Technique and those taught Physics using Teacher Assessment Technique. This suggests that using Peer Assessment Technique in the teaching of Physics significantly improved students' achievement in Physics. This equally suggests that the earlier observation in the difference between the means of the two groups was not by chance but was due to the treatment in the experimental group.

From Table 2 also, the post-test score of the students taught using Peer Assessment Technique (Experimental Group) was 70.01 with standard deviation (SD) of 11.77 while the groups taught using Teacher Assessment Technique (Control Group) had an overall mean post-test score of 61.98 with SD of 9.55. The difference between the experimental group and control group was 8.03. This suggested that students assessed with Peer Assessment Technique have higher academic achievement than students assessed using Teacher Assessment Technique. Table 2 also showed that the post test scores of male students in the experimental group is 70.20 and that of the female students is 69.77 with standard deviation scores of 12.21 and 11.33 respectively while the post test scores of the male students in the control group is 59.39 and that of their female counterparts is 65.00 with standard deviation scores of 10.06 and 8.04 respectively. The differences in the mean scores 4.84 for Peer Assessment Technique group and 4.77 for Teacher Achievement Technique group were in favour of the females. This therefore appears to indicate that female students scored higher than the male students.

The results presented in Table 3 indicate that gender as a factor had no significant effect on the achievement of students in Physics. The calculated F value of 2.231 in respect of gender as a factor in the study has a probability value of .137 and therefore not significant at 0.05 level of significance. This means that the null hypothesis of there is no significant difference in the post-test scores of Physics Achievement Test scores of students due to gender and experimental conditions is accepted. This implies that though female students appeared to achieve more than their male counterparts, the achievement was not statistically significant.

Discussion

Results in Table 1 showed that the teachers who taught Physics using students exposed to Peer Assessment Technique covered 19 out of the 20 topics taught thereby covering 95% of the content while the teachers who taught Physics using students exposed to Teacher Assessment Technique covered 13 out of the 20 topics taught thereby covering 65%of the content while the teacher. This means that Peer Assessment Technique enhanced the coverage of Physics content more than Teacher Assessment Technique. This is in agreement with Eze (2009) who asserted that peer assessment technique makes the teacher's job more enjoyable, releases the teacher from some routine task and gives him more time for other difficult tasks which in turn enables him to cover more content.

Results in Table 2 revealed that students taught using Peer Assessment Technique achieved significantly better than students taught using Teacher Assessment Technique. This higher achievement of the students taught using Peer Assessment Technique can be said to be contributed by the fact that these students were involved in their own learning which must have excited them and increased their interest to learn Physics. This result agrees with the findings of Race (2001) who opined that Peer Assessment Technique encourages deep learning by students which leads to improvement in students' performance. The result also agreed with Juwah (2003) and Sadler & Good (2006) who stated that Peer Assessment Technique apart from being an effective and efficient assessment strategy which leads to students' high academic achievement, saves the teacher's time, improves students' meta cognitive skills and also improves students' understanding of the course materials.

The findings in hypothesis 1 showed that there is a significant difference in the mean post Physics achievement scores of students taught Physics using Peer Assessment Technique and those taught Physics using Teacher Assessment Technique. This result agreed with Asuai and Adeleye (2013) who stressed that Peer Assessment training was efficacious in enhancing students in Mathematics because students were able to learn from each other as they grade each other's work.

Findings in hypothesis 2 showed that there is a significant difference in the post-test scores of Physics Achievement Test scores of students due to gender and experimental conditions. This result agrees with Alade and Olagunju (2014), who in their study on gender and achievement concluded that there is no significant gender difference in the achievement scores of Economics students when exposed to the Peer-Assessment Technique. The

findings is also in agreement with Sprigler and Alsup (2003) who found no gender difference on Mathematics reasoning ability at elementary level in his study on gender achievement.

Conclusion

The findings of this study have shown that Peer Assessment Technique improves academic achievement of students. It could be concluded that if Peer Assessment Technique is proper used by Physics teachers , students academic achievement will not only improve but students will have better understanding of Physics contents which will in turn improve their performance in both internal and external examinations.

Recommendations

Based on this, the following recommendations are made:

1. Secondary school Physics students should ensure the use of Peer Assessment Technique in the teaching and assessment of Physics students.
2. Peer Assessment Technique should be consistently and explicitly emphasized in the teaching of different subjects in the secondary schools to aid the process of learning.
3. The Government, Ministry of Education, Head of schools, teachers and other stake holders should ensure that teachers implement the use of Peer Assessment Technique to assess students since it involves self evaluation.
4. Parents and teachers should be aware of the fact that there is no gender influence on students' academic achievement as long as they are taught and assessed with effective teaching and assessment techniques which will aid their understanding of the subject content and consequently make them excel academically.

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