

Sporting Equipment and Students' Academic Performance in the Concept of Projectile in Nigerian Senior Secondary School Physics

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Abstract

This study investigated the effect of sporting equipment on students academic performance in the concept of projectile in Nigerian senior secondary school Physics in Uyo Local Government Area of Akwa Ibom State, Nigeria. A total of 183 senior secondary two (SS2) Physics students were involved in the study. The design adopted in the study was non randomized pretest – posttest control group design. The instrument used in gathering data for the study was Test On Projectile (TOP). The reliability coefficient of TOP was 0.79 using Kuder Richardson formula-21. The result showed that javelin was found to be the most effective in facilitating students' academic performance in the concept of projectile in secondary school Physics. This was followed by discus while shot-put was seen to be the least facilitative. The results also showed an insignificant gender difference in the academic performance of Physics students taught the concept of projectile using sporting equipment (javelin, discus and shot-put). Also, the facilitating influence of sporting equipment on students' academic performance in the concept of projectile in Physics is about the same at all levels of gender. It is recommended that teachers should adopt the use of sporting equipment in the teaching of the concept of projectile in secondary school Physics.

Keywords: Sporting Equipment, Students' Performance, Projectile, Physics

Introduction

Physics as a science subject has been acknowledge as a pre-requisite for the study of several courses in the Universities in Nigeria. For example, engineering, medical and other applied science courses need Physics. In view of the obvious importance of Physics in scientific and technological advancement of any nation, and its usefulness in nearly all fields of human endeavour, the poor performance of students in the subject at both secondary and post-secondary levels in Nigeria has been a source of concern to various people and government of Nigeria at various times (Akinbobola, 2006). Onwioduokit (1996) observed that, out of 124 concepts in senior secondary school Physics, 96 (77.42%) concepts were considered difficult. Some of these difficult concepts highlighted are heat, waves, projectile, radioactivity among others. It is no wonder that the results of students in Physics in Senior Secondary Certificate Examination (SSCE) have remained constantly poor every year in Nigeria. The students should have been taught to see how ideas are generated, how concepts originate and how theories came to be validated and accepted. The understanding of Physics concepts by students is often blocked probably because of individuals' pre-conceptions that the subject is a difficult one.

To arouse the students' interest in the subject, Physics should be brought to the doorsteps of the students, that is, it should be linked with the students' locality, using materials from their environment. Apart from the normal classroom teaching, activities like sports offer a wide opportunity for various styles in teaching. Physics being a practical subject would lend itself to better understanding if taught as an activity (Udoh, 2006). Projectile as one of the difficult concepts can be taught and learnt by teachers and students

respectively if linked up with sporting activities such as javelin throw, discus throw and shot-put throw.

Freeman (1986) in his definition of projectile stated that an ideal projectile is any particle that is thrown into space near the surface of the earth and then left to itself under the influence of gravity only. Olumuyiwa and Okunola (1992) defined a projectile as a body moving along a curved path known geometrically as a parabola. According to Ndupu and Okeke (1998), a projectile is a two dimensional motion under the action of gravity. That is, if a body is projected with initial velocity U at an angle θ , then the horizontal (X) and vertical (Y) distances covered in time t are given by

$$X = U \cos \theta t \dots\dots\dots (1)$$

$$Y = U \sin \theta t - \frac{1}{2}gt^2 \dots\dots\dots (2)$$

By eliminating t from the two equations above, we have

$$Y = X \tan \theta - \frac{g}{2(U \cos \theta)^2} X^2 \dots\dots\dots (3)$$

Where: θ = angle of projection
 t = time to reach the maximum height
 g = gravitational force

Equation (3) above describes the path of a projectile which is trajectory.

Most topics in science can neither be effectively learnt nor judiciously evaluated without the "doing" aspect of it. To acquire the relevant skills and knowledge in such topics therefore demands practicalizing them in real or simulated situations. This requires the use of right tools in the right way at the right time, based on universally acceptable standards (Akinbobola, 2005). Sporting equipment as instructional materials can go a long way to assist in teaching or explaining certain concepts in science. Javelin is equipment in sport with

a metal point on a long shaft for throwing. A javelin points upwards at an angle of between 42° and 49° . If the angle is less than 42° or above 49° , it will not cover a long distance (Ituh, 1991). On the other hand, Abbot (1985) stated that, to attain maximum range in projectile, the angle of projection must be 45° .

Discus when used as an instructional material in science teaching (the concept of projectile) helps not only to explain the lesson points clearly but also makes it practical (Weston & Cranton, 1986). A shot-put as an equipment in sport if properly used can equally create a friendly and conducive classroom situation in the teaching and learning of the concept of projectile in Physics. Uche and Umoren (1998) in enumerating the importance of instructional materials stated that, instructional materials make room for discussion and interaction thereby creating a friendly and conducive classroom situation. Leinhardt (1999) observed that, appropriate motion pictures, objects and events concretize learners' experience and make their learning real and immediate. These help to broaden the students' knowledge and increase their understanding. Agboola (1986) stated that as a way of improving learning situation, the learner must be encouraged to have greater participation in the teaching presentation of the lesson.

Statement of the Problem

In spite of the great emphasis on science teaching and learning in Nigeria, students can not still perform well in majority of the Physics concepts simply because they lack understanding of these concepts. According to West African Examination Council (WAEC) Chief Examiner's Report (2000), students do not like to answer questions on projectile in both external and internal examination in Nigeria. The cause of this attitude by students has been attributed to lack of

understanding of this concept due to the fact that it is not taught or learnt practically in the laboratory. This makes it imperative to suggest an approach for teaching of projectile that aids understanding rather than memorizing and juggling of facts. There is need to find a strategy in which the teacher will help the students to make connections to the concept in question by bringing in activities from other fields of endeavour. Hence, to what extent will the use of sporting equipment enhance students' academic performance in the concept of projectile in Physics?

Purpose of the Study

The purpose of the study is to investigate the effect of sporting equipment on students' academic performance in the concept of projectile in Physics.

Specifically, the study is designed to achieve the following objectives:

1. To determine the effect of sporting equipment on students' academic performance in the concept of projectile in Physics.
2. To examine the effect of gender on students' academic performance in the concept of projectile in Physics after being taught using sporting equipment.
3. To assess the interaction effect of sporting equipment and gender on students' academic performance in the concept of projectile in Physics.

Research Hypotheses

1. There is no significant difference in the academic performance of Physics students taught using sporting

equipment (javelin, discus and shot-put) and those taught without sporting equipment in the concept of projectile.

2. There is no significant difference in the academic performance of male and female Physics students in the concept of projectile when taught using javelin, discus, shot-put and those taught without sporting equipment.
3. There is no significant interaction effect of sporting equipment and gender on students' academic performance in the concept of projectile in Physics.

Research Method

The research design adopted for this study is pretest-posttest control group design. All the 864 senior secondary two (SS2) Physics students in the 12 co-educational secondary schools in Uyo Local Government Area of Akwa Ibom State, Nigeria constituted the population of the study.

Purposive sampling technique was used to select schools from the population. The criteria are:

- Schools that have at least one graduate Physics teacher with at least three years of teaching experience.
- Schools that are currently presenting candidates for Senior Secondary School Certificate Examination (SSCE).
- Schools in which the concept of projectile has not been taught already.

Seven schools met the above criteria. Four schools among those that met the above criteria were randomly selected by balloting. In all, 183 students constituted the sample for the study. All the Physics students in the four selected schools were used in their intact classes for the study. Three (3) out of four (4) schools were used as experimental group while one (1) school was used as control

group. Test On Projectile (TOP), comprised of 25-multiple choice items in the concepts of projectile and motion was used to gather data for the study. The TOP was developed by the researchers and served as pretest and posttest but rearranged in different order. The instrument was validated by two Physics teachers and two Physics experts. All their comments and corrections were incorporated into the final forms of the instrument.

To further strengthen the validity of the instrument, the TOP was administered to a trial test group which was not selected for the main study but was within the chosen population. The data obtained in the administration was subjected to Kuder Richardson formula-21 to estimate the reliability of the instrument. The result showed a reliability coefficient of 0.79.

The research assistants (Physics teachers in each school) were trained on how to use the sporting equipment through the help of the Physical Education teachers in each school. The research assistants were provided with detailed instructions and well-articulated lesson packages on the concept of projectile. Pretest was administered to both experimental and control groups and the results were used as covariates measures in order to take care of possible initial difference in groups. After the pretest, treatment was given to the experimental group. The experimental group 1 was taught the concept of projectile with javelin; the experimental group 2 was taught with discus while the experimental group 3 was taught with shot-put. The control group was taught without sporting equipment. The posttest was administered to the two

groups immediately after the teaching of the concept for three weeks.

The data collected were analyzed using Analysis of Covariance (ANCOVA) using pretest scores as covariates. All hypotheses were tested at .05 level of significance.

Results

Hypothesis One

There is no significant difference in the academic performance of Physics students taught using sporting equipment (javelin, discus and shot-put) and those taught without sporting equipment in the concept of projectile. The analysis is as shown in Table 1.

Table 1: One-way Analysis of Covariance (ANCOVA) of posttest scores of physics students taught with sporting equipment and those taught without sporting equipment

Source of Variation	Sum of Squares	DF	Mean Square	F-cal.	F-critical	Discussion at P<.05
Covariates – pretest	1181.86	1	1181.86	74.03	3.90	*
Main effects	5337.97	3	1779.32	111.46	2.66	*
Explained	6519.83	4	1629.96	102.10	2.42	*
Residual	2841.69	178	15.97			
Total	9361.52	182	51.44			

* = Significant at $P < .05$ alpha level.

The analysis in Table 1 shows that the calculated F-value of main effect, 111.46 is greater than the critical F-value of 2.66 at $P < .05$ alpha level. Thus, the null hypothesis stating a non-significant difference in the academic performance of Physics students taught using sporting equipment (javelin, discus and shot-put) and those taught without sporting equipment in the concept of projectile was rejected.

Consequent upon the observed difference in the main effects, further analysis was performed using Multiple Classification Analysis (MCA) in order to determine the specific contribution of the levels of sporting equipment to the gain in students' academic performance in the concept of projectile in Physics. The analysis is as shown in Table 2.

Table 2: Multiple Classification Analysis (MCA) of posttest scores of students taught with sporting equipment and those taught without sporting equipment

	N	Unadjusted	Adjusted fo independent Variable and covariates		
Variable + Category		Dev'n	Eta	Dev'n	Beta
Grand mean = 33.80					
Sporting Equipment			.75		.76
Javelin	47	6.90		6.58	
Discus	48	2.08		2.29	
Shot-put	45	-1.84		-1.38	
Without sporting Equipment	43	-7.94		-8.31	
Multiple R. = .84					
Multiple R. Squared = .70					

Table 2 shows a multiple regression index (R) of .84 with a multiple regression-squared index (R^2) of .70. This implies that 70% of the total variance in the academic performance of Physics students in the concept of projectile is attributable to the influence of sporting equipment.

To find the order of effectiveness of sporting equipment and direction of significance under investigation, the posttest scores were subjected to Scheffe multiple comparison test for a post hoc analysis as shown in Table 3.

Table 3: Results of Scheffe's post hoc test for multiple comparison of sporting equipment on students' academic performance in the concept of projectile

Dependent Variable: POST TEST SCORES						
(I) Sporting Equipment	(J) Sporting Equipment	Mean Difference (I-J)	Std.	Sig.	95% confidence Interval	
					Lower Bound	Upper Bound
Javelin	Discus	4.83*	.974	.000	2.08	7.58
	Shot-put	8.75*	.990	.000	5.95	11.54
	None	14.79*	.996	.000	11.98	17.60
Discus	Javelin	-4.83*	.974	.000	-7.58	-2.08
	Shot-put	3.92*	.985	.002	1.14	6.70
	None	9.97*	.990	.000	7.14	12.76
Shot-put	Javelin	-8.75*	.990	.000	-11.54	-5.95
	Discus	-3.92*	.985	.002	-6.70	-1.14
	None	6.05*	1.01	.000	3.21	8.89
None	Javelin	-14.79*	.996	.000	-17.60	-5.95
	Discus	-9.97*	.991	.000	-12.76	-1.14
	Shot-put	-6.05*	1.01	.000	-8.89	-3.13

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

As shown in Table 3, the mean difference between javelin and discus was 4.83; between javelin and shot-put was 8.75; between javelin and none sporting equipment was 14.97; between discus and shot-put was 3.92; between discus and none sporting equipment was 9.97 and between shot-put and none sporting equipment was 6.05. This implies that javelin was the most effective in facilitating students' academic performance in the concept of projectile. This was seconded by discus, followed by shot-put while none sporting equipment was seen to be the least effective in facilitating students' academic performance in the concept of projectile.

Hypothesis Two

There is no significant difference in the academic performance of male and female Physics students in the concept of projectile when taught with javelin, discus, shot-put and those taught without sporting equipment.

The analysis is as shown in Table 4.

Table 4: 4 x 2 Factorial Analysis of Covariance (ANCOVA) of posttest scores of physics students as determined by sporting equipment and gender

Source of Variation	Sum of Squares	DF	Mean Square	F-cal.	F-critical	Discussion at P<.05
Covariates – pretest	1181.86	1	1181.86	72.66	3.90	*
Main effects	5337.22	4	1334.55	82.04	2.40	*
Gender	.25	1	.25	.02	3.90	NS
SP – EQ	5334.54	3	778.18	109.32	2.63	*
2-way Interaction						
Gender X SP – EQ	11.09	3	3.70	.23		NS
Explained	6531.17	8	816.40	50.19		*
Residual	2830.35	174	16.27			
Total	9361.52	182	51.44			

* = Significant at P<.05 alpha level

NS = Not Significant at P<.05 alpha level

SP – EQ = Sporting Equipment

As shown in Table 4, the gender main effect was not significant at P<.05 where the calculated F-value of .02 is less than the critical F-value of 3.90. Thus, the null hypothesis stating a non-significant difference in the academic performance of male and female Physics students in the concept of projectile when taught using javelin, discus, shot-put and those taught without sporting equipment was retained.

Hypothesis Three

There is no significant interaction effect of sporting equipment and gender on students' academic performance in the concept of projectile in Physics.

The analysis is as shown in Table 4.

As shown in Table 4, the interaction between the sporting equipment and gender was found not significant at $P < .05$ where the calculated F-value of .23 is less than the critical F-value of 2.63. Thus, the null hypothesis stating a non-significant interaction effect of sporting equipment and gender on students' academic performance in the concept of projectile in Physics was retained. This means that the facilitating influence of sporting equipment on students' academic performance in the concept of projectile in Physics is about the same at all levels of gender.

Discussion of Results

The results of hypothesis one indicated that there was a significant difference in the academic performance of students taught using sporting equipment (javelin, discus and shot-put) and those taught without sporting equipment in the concept of projectile. The results of the Multiple Classification Analysis showed that 70% of the total variance in the academic performance of students in the concept of projectile in Physics is attributed to the influence of sporting equipment used in teaching the students. The Scheffe post hoc analysis showed that javelin was the most effective in facilitating students' academic performance in the concept of projectile. This was seconded by discus, followed by shot-put while none sporting equipment was seen to be the least effective in facilitating students' academic performance in the concept of projectile. The above order of effectiveness of the sporting

equipment (javelin, discus and shot-put) might have been depended on the nature of the equipment. During the treatment period, it was observed that, the students manipulated javelin with ease compared to discus and discus was easily manipulated compared to shot-put. This implies that, shot-put was the most difficult for them to manipulate. This might be attributed to the heavy nature of the equipment. Also, sporting equipment as instructional materials arouse the learners' interest and help to sustain their attention in learning of the concept of projectile in Physics.

This study agrees with the findings of Uche and Umoren (1998) and Ahamadu (1999) that validly selected, properly organized and evaluated instructional materials and resources for classroom delivery generate focuses for effective teaching and learning and offer experiences that reflect real life situation. This study is also in line with the findings of Abdulahi (1982), Weston & Cranton (1986), Agboola (1986) and Wilkinson, Cranton and Weston (1988) that instructional material in science teaching helps not only to explain the lesson points clearly but also make it practical. They asserted that instructional materials enhance the experiences of the learners by enabling them to see and interact with objects and materials which would otherwise not have been seen.

The result of hypothesis two showed that there was no significant difference in the academic performance of male and female Physics students in the concept of projectile when taught using javelin, discus, shot-put and those taught without sporting equipment. This might be due to the enthusiasm exhibited by both male and female students who showed

equal zeal when they were taught with sporting equipment. Also, the interaction of both male and female students freely in groups might have led to increasing the depth of understanding, enhance motivation, develop positive attitude toward later use of material presented in the course, develop problem solving skills and generate greater involvement of the male and female students with the concept. This study is in agreement with the findings of Akpan (1987), Nsofor (2001) and Akibobola (2005) that boys and girls could perform equally well if exposed to the same conditions of learning. However this finding is inconsistent with the research of Plake and Melican (1983) that females are higher in verbal ability than males and that females performed lower in mathematical based subject. According to Plake and Melican (1983), males are superior to females on problem-solving tasks and specific abilities relating to problem-solving.

The result of hypothesis three showed that there was no significant interaction effect of sporting equipment and gender on students' academic performance in the concept of projectile in Physics. This implies that the facilitating influence of sporting equipment on students' academic performance in the concept of projectile in Physics is about the same at all levels of gender.

Conclusion

The study has examined the effect of sporting equipment on students academic performance in the concept of projectile in Nigerian senior secondary school Physics. The results of the study showed that sporting equipment facilitate meaningful learning and enhance students' academic performance in the concept of projectile in Physics. The result also indicated that javelin was the most effective in facilitating students' academic performance in the concept of projectile.

This was followed by discus, while shot-put was seen to be the least effective in facilitating students' academic performance in the concept of projectile in Physics. The results also showed an insignificant gender difference in the academic performance of Physics students taught with different sporting equipment. Also, the facilitating influence of sporting equipment on students' academic performance in the concept of projectile in Physics is about the same at all levels of gender.

Recommendations

In order to enhance students' academic performance in Nigerian Senior Secondary School Certificate Examination (SSCE) in Physics, the following recommendations are hereby proposed.

1. Physics teachers should explore the use of sporting equipment (javelin, discus and shot-put) in teaching the concept of projectile in secondary school Physics.
2. Seminars and workshops should be organized for Physics teachers to acquaint them with the use of sporting equipment in the teaching of the concept of projectile in Physics
3. A good teaching of Physics should be combined with the use of relevant and adequate instructional facilities that will ensure mastery of skills.
4. Governments (Federal, States and Local) should provide adequate instructional facilities and conducive classroom environment that will stimulate teaching and learning of Physics in our secondary schools.

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