Australian Journal of Basic and Applied Sciences, 7(4): 648-653, 2013
ISSN 1991-8178

An Investigation into the Influence of Using Puzzles in the Teaching of Physics on Senior Secondary School Students' Achievement in Selected Topics

Sunday A. Adeyemo (Ph.D), Veronica F.T Babajide (Ph.D), Jamiu O. Amusa & Olubukola Adeyemo

Dept of Science & Technology Education, University of Lagos, Lagos, Nigeria.

Abstract: This study is to find out the influence of using puzzle in the teaching of Physics on Senior Secondary School Students' achievement in selected topics. The sample consists of one hundred and twenty (120) Physics students, selected randomly from fur secondary schools in Mushin local government, Lagos State. The instrument used for collecting data were two achievement tests a pre test and a post test on puzzles on the topics simple machine, work, energy and power. Data collected were analyzed using frequency counts, simple percentage, pair t-test, t-test and Pearson's correlation co-efficient. Results showed that most students understand the scientific concepts more when taught with puzzle method and it also enhances students comprehension in scientific skills and attitudes. Recommendations were then made, based on the research outcomes of the study.

Key words:

INTRODUCTION

Research on cognitive development has provided science educators with useful information regarding students capacities for meeting the goals of science instruction available evidences strongly suggests that a substantial number of senior school teacher who enter for science courses are unable to function at high intellectual level.

Dissatisfaction with behaviorism focus on observable behavior led educational psychologist such as jean Piaget and William Perry to demand an approach to learning theory that paid more attention to what went on "inside the learner head".

They developed a cognitive approach that focused on mental processes rather than observable behavior. It is relative to their stage of cognitive development, understanding the learner's existing intellectual framework is central in understanding the learning process.

Cognitive constructivism teaching can be achieved using puzzle game. Effective learning takes place when science is taught through a medium of puzzle games. It is known that information's are easier to recall when it has been presented through puzzle games.

The exposure to such learning experiences has to be continuous in an attempt to master the skills regularly for carrying out similar activities.

It is reminiscent of the discovery approaches to learning that have been occurring since Dewey (1938) where by learner learn best what they discover or can be led to discover themselves in any precise epistemology; the discovery is not identical to the construction of new knowledge but the approaches are similar in terms of benefits claimed and challenges, The approaches share at least one central notion that learners should attempt to resemble scientist in non trivial ways engaging in independent theory formation and hypothesis testing.

Constructivist influence has extended beyond just the research and scholar commodity. It has had an impact on a number of national curricular document and national education reforms.

Most reforms supported by national professional groups are based on constructivism. For example, the National science teachers Association, The National Council for teachers of mathematics.

Constructivisms influence the recently relaxed US National science Education standard. It proceeds to state that science is a mental representation constructed by the individual.

Purpose of the Study:

The purpose of the study is to explore the use of puzzle game to enhance the pupils' participation and achievement in Physics science, to analyze the effectiveness of puzzle game in the teaching of physics, and to find out which approach is commonly used in the class in teaching physics.

Research Questions:

Specifically, the following research questions were addressed:

1. Will the use of puzzle games affect the participation and performance of students' in physics?
2. Which of the approach of science teaching is most commonly used by class teachers in teaching physics?
3. Would the students conception of science differ from the conventional method of teaching physics?

Corresponding Author: Sunday A. Adeyemo (Ph.D), Dept of Science & Technology Education, University of Lagos, Lagos, Nigeria.
E-mail: doc_adeyemo@yahoo.com

4. Is there any significant difference in the student gender performances?
5. Are there differences in the performances students among the selected schools?

Research Hypotheses:

H_{o1}: There is no significant relationship between the performance of students taught with puzzle method and those taught with the conventional method

H_{O2}: There is significant difference in the academic performance of student taught physics using puzzle method and those taught physics the conventional method.

Methodology:

This study was carried out in 4 selected schools in Mushin Local Government area such as Senior Secondary School II (SS 2) of Surulere Girls Senior Secondary School, S.T. A College, Ransome Kuti memorial grammar school and zumratul – Islammiyat High School.

A multiple design was used for the study i.e descriptive survey and experimental design.

Descriptive Survey: Which demanded the pupils rank in the activity which they will enjoy most if used in teaching them physics.

Experimental: Where the comprehensive of both the experimental and the control group were tested using puzzles in scientific concepts.

The researcher visited the selected secondary schools to seek the permission and co-operation of the schools authorities. A suitable period was fixed for the exercise. With the cooperation of the physics teachers, the researcher met with the students for about one hour during the normal period of physics to teach them using both the conventional method and puzzle method and these lasted for one week.

Day One:

The researcher taught the students the topic, work, energy and power using conventional method.

Day Two:

The researcher divided the class into two, to make up two groups i.e experimental and control groups.

The control group was the conventional method and the experimental group was taught using the puzzle method. Then both groups were been tested using puzzles in scientific concepts.

Senior Secondary School 11 Students of Mushin local Government Area formed the population of the study.

The sample consisted of 30 SS 11 students divided into 2 groups (experimental and control) of 30 students each.

10 male and 5 female students were randomly selected from each stated school for the rest with the co-operation of physics teachers in each school. The topic chosen work, energy and power are normally taught in SS 1 level.

In all, 120 students formed the study's sample.

Instruments:

The tests instrument used in this study was made of two achievement test: a pre-test to rank the students according to their intellectual skills in the use of puzzles. The second test was a post test which is based on the comprehension test which demanded their understanding of puzzle on scientific concepts after the experimental group and the puzzle groups were taught and this post-test was the major instrument used in this study.

The test was administered personally by the researcher during physics lectures, to the respondents with the cooperation of the physics teacher's in each of the selected school. The instruments were filled and collected immediately by the researcher.

Data collected through the above mentioned research instrument was analyzed using frequency count, simple percentage, paired t-test, t-test and pearson's correlation co-efficient.

Data Analysis:

This deals with the presentation and analysis of data collected from the field of study. 120 puzzle tests were distributed by the researcher. The entire puzzle were filled and returned by the respondents. The presentation of data of the respondent was first presented and analyzed using percentage while the responses from the respondent based on the research question formulated to guide the study using t-test, correlation coefficient and paired t-test.

Tables are illustrated first followed by the comment in tables respectively.

Table 1: Gender distribution.

SEX	FREQUENCY	PERCENTAGE
MALE	70	58.3
FEMALE	50	41.7
TOTAL	120	100

The above table shows that 58.3% of the respondents were male and 41.7 female physics students were involved in the study.

Table 2: Distribution of respondents according to schools.

SCHOOL	FREQUENCY	CUMULATIVE PERCENTAGE
RAANSOME KUTI MEMORIAL BOYS GRAMMAR SCHOOL	30	25
ZUMRATUL-ISLAMIYYAT HIGH SCHOOL	30	25
SURULERE GIRLS SENIOR SECONDARY SCHOOL	30	25
S.T.A. COLLEGE	30	25
TOTAL	120	100

Table 2 shows that 25% are in school 1, 25% are school 2, 25% are school 3 and 25% are school 4. This implies that physics students from various schools in secondary school 2 were involved in the study.

Table 3: Group Distribution of respondents.

GROUPS	FREQUENCY	PERCENTAGE
EXPERIMENTAL	60	50
CONTROL	60	50
TOTAL	120	100

Analysis from the table above showed that 50% of the respondents were in the experimental group and 50% were the control group.

In order to carry out a comparison between the performance of the students among the schools used for the study, the scores of the students in each school was collated and the paired t-test was carried out, the result of the paired t-test is shown in the table below;

Table 4: Showing paired t-test between the schools: Comparison between the students' performance among the schools after the post-test.

	Paired Differences					
	Mean	Std. Deviation	95% Confidence Interval of the Difference		t-cal	t-tab
Pair1 Single sex school (M) -Mixed sex school (public).	-2.133	7.18107	-4.81479	.54812	-1.627	2.045
Pair2 Single sex school (M) – Single sex school (F)	-16.00000	13.32873	-11.02297	-20.97703	-6.575	2.045
Pair3 Single sex school (M) – Mixed sex school (private).	-16.13333	11.90692	-20.57945	-11.68722	-7.421	2.045
Pair4 Mixed sex school (public) – Single sex school (F).	-18.13333	12.14775	-13.59729	-22.66938	-8.176	2.045
Pair5 Mixed sex school (public) – Mixed sex school (private).	-14.00000	11.44703	-18.27439	-9.72561	-6.699	2.045
Pair6 Single sex school (F) – Mixed sex school (private).	-32.13333	16.72441	-38.37833	-25.88834	-10.524	2.045

From the above table, it can be seen that there is significant difference between single sex school (M) & single sex school (F), single sex school (M) & mixed sex school (private), mixed sex school (public) & single sex school (F), mixed sex school (public) & mixed sex school (private), single sex school (F) & mixed sex school (private) and there is no significant difference between single sex school (M) & mixed sex school (public).

To ascertain whether there is significant difference between the scores of the students in each of the schools during a pre-test on periodic table puzzle, their scores were rated into three groups, i.e. students with High

Intelligence Quotient, Medium Intelligence Quotient and Low Intelligence Quotient. The paired t-test was also carried out in order to measure whether the difference in the groups differ significantly or not. The result of the paired t-test is summarized in the table below;

Table 6: Showing the descriptive statistics of male and female student.

Gender	N	Mean	Std. Deviation
Male	70	62.0571	12.79027
Female	50	61.0400	22.56687

From the above table, it can be seen that the average score of the 70 male students is 62.06 while the average of the female student is put at 61.04 to verify whether there is significant difference between the male and female student, the t-test was used, the result of the analysis is presented in the table below;

Table 7: Showing t-test according to Gender.

Variable	Mean	Sd	Df	t-cal	t-tab	Remark
Male	62.0571	12.79027	118	0.387	0.678	Not Significant
Female	61.0400	22.56687				

From the above table, it can be seen that the value of t-cal (0.387) is less than the value of t-tab (0.678) which implies that there is no significant difference between the male and female students.

There is no significant relationship between the performance of students taught with puzzle method and those taught with the conventional method.

Table 8: Mean and standard deviation for groups.

	Mean	Std. Deviation	N
Experimental Group	79.2500	14.08043	60
Control group	45.9500	10.92567	60

Table 9: Correlation coefficient table.

Variable	Mean	Sd	Df	r-cal	r-tab	Remark
Experimental Group	79.2500	14.08043	118	0.213	0.678	Not Significant
Control Group	45.9500	10.92567				

From the table above, the calculated value of r was found to be less than the table value. In view of this, the null hypothesis which states that there is no significant relationship between the performance of students taught with puzzle and those taught using the conventional method is not significant. Therefore, there are no significant relationships between the performance of students taught with puzzle and those taught using the conventional method

There is no significant difference in the academic performance of students taught physics using puzzle method and those taught physics using the conventional method.

Table 10: t-test table.

Variable	Mean	sd	df	t-cal	t-tab	Remark
Experimental Group	79.2500	14.08043	118	1.034	0.459	Significant
Control Group	45.9500	10.92567				

From the table above, the calculated value of t-cal was found to be greater than the table value. In view of this, the null hypothesis which states that there is no significant difference in the academic performance of students taught physics using puzzle method and those taught physics using the conventional method is rejected. Therefore, there is significant difference in the performances of students taught physics puzzle method and those taught using conventional method.

Discussion and Conclusion:

From the result obtained from the testing of hypothesis 1, it shows that the correlation between the experimental group and control group for the hypothesis 1 (r-cal) is 0.213 and the degree of freedom is 118, it can be seen that there are no significant relationships between the academic performance of students taught with puzzle and those taught using the conventional method meaning that the methods are independent of each other when used in teaching the physics students and it was also found out from the hypothesis that these students

performed better when the puzzle method were used. This was supported by Hmielski (2003), he opined that students learning styles through the use of puzzle method impact on their performance, and that students learn effectively. Due to these individual differences their performance will be based on what they have learnt in one way or the other. This is supported by the work of Geary 1995, that if want someday to know something you teach it to them… If you want somebody to know something and retain it for along period if time, then you have them practice it. Moreover it may well be seen that a series of physics concepts, skills and attitude can be taught using this strategies of puzzles as the backbone of the science curricula throughout all levels of senior secondary school education. In line with this, it can be seen that if students are taught physics using the puzzle methods enhances students' comprehension in the learning of physics while the conventional method, the teaching method used does not make the students perform well in their academics.

The result obtained from the testing of hypothesis 2, the differences between the experimental group and control group for the hypothesis 2 (t-cal) is 1.034 and the degree of freedom is 118, it can be seen that there is a significant difference in the academic performance of students taught with puzzle and those taught using the conventional method from this findings, the puzzle method and conventional method should be used hand in hand the teaching of physics and this should also be noted by the curriculum developers.

It was also found out from the hypothesis that these students performed better when the puzzle methods were used. These was supported by Tyler (1949), he observed that the falling standard in secondary school physics student was due to the poor teaching strategies or principles employed by the physics teacher in teaching the students which resulted in their low performances.

Gardener (1986), who supports this notion noted that the performance of students in all the three domains that is cognitive affective, psychomotor domain of learning, is dependent on the use of the puzzle method and the conventional method, therefore this in teaching physics helps students to develop more confidence and had greater freedom in discussion physics concepts. This freedom in discussing can be achieved through the use of puzzles in teaching physics in senior secondary schools because it will serve as a mediator of the teacher – student relationship and a medium of communication, which was lacking among students' taught physics using the conventional method.

In line with this, it can be seen that if students are taught physics using the puzzle method there would be high performances in physics because puzzle method enhances students' comprehension in the learning of physics while the conventional method, the teaching method used does not make the students perform well in their academics.

Teachers should develop ability in using constructivism approaches that students enjoyed in learning physics

Science teacher education program should be restructured to allow for integrative learning activities that could reinforce science lifelong skills.

Since the government cannot directly address problem of students' access to science, there is need for resources support and capacity building of teachers by the teaching service commission, non governmental agencies and other corporate bodies.

Secondary school science curriculum developers should introduce the use by teachers.

Educational researchers need to execute further researchers to determine the practicability of the above construction approaches

To Government, Ministries of education should mount training workshops form time to time on modern techniques f teaching. The teacher could be trained on how to structure constructivism teaching strategies form textbooks, computers, should also be made available.

Teachers have to be well paid; their reward should start at from this world. If the teachers are well paid. They would be more dedicated in their job more than ever before without any monitoring whatever. Their effort should be acknowledged and commended.

The government should as a matter of urgency provide equipped laboratories, infrastructural amenities such as buildings, desks for secondary schools etc. More qualified teachers should e employed to reduce the work lead of the existing or already employed teachers and enhance the efficiency and effectiveness in teaching.

Laboratory attendants should be employed in all schools to maintain laboratories. Running grants in aid should be provided to schools to procure chemicals and maintenance of existing infrastructures.

Government should try to employ guidance and counselors who will carry the responsibilities of students in the choice of careers as this will eliminate the problems of choosing wrong subjects not relevant to choice of careers.

This research has established the need for the use of puzzles in teaching physics in senior secondary schools. This is because students' performance in the learning of physics has significant effect on their academic achievement in senior secondary physics. In the course of this investigation, it was discovered that puzzle method enhances the students' performance and retains academic achievements in learning physics concepts particularly in public schools.

It therefore implies that the use of puzzles should be introduced in the teaching of physics in schools by the curriculum developers and also helps the students to develop an awareness of their own view.

The results of this study finally confirmed that constructivism teaching strategies using puzzles on the topic: work, energy and power facilitate retention of subject matter particularly on what was taught.

Also the study reveals that cognitive constructivism teaching strategies through the use of puzzles promotes problem solving and leads to transfer of similar and new situation. Since, the students who were taught the topic on work, energy and power crossword performed much better in these tasks than those taught using the conventional method in problem solving. This implies that the use of puzzles enhanced the students' comprehension in the learning of physics. It also allows them to demonstrate and narrate the principles as well as the impact of the concepts from their observation in the real world.

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