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Effect Of Activity-Based Instruction On Secondary School Students' Achievement In Basic Science

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Abstract: ***The study examined the effect of activity-based instruction on students' achievement in Basic science. Two research questions guided the study and three hypotheses were tested. The quasi-experimental design was used, specifically the non-equivalent pretest posttest control group design. A sample of 58 Junior Secondary School year two (JSS 2) Basic science students from Aguata Education Zone was involved in the study. The instruments for data collection were Basic Science Achievement Test (BSAT) validated by three lecturers in science education and two experienced basic science teachers. The reliability of the instrument was established using Kudder-Richardson formula 20 which yielded a coefficient of internal consistency of 0.89. The data obtained were analyzed using mean to answer research questions, standard deviation to check how close the students' scores are to the mean and Analysis of Covariance (ANCOVA) to test the hypotheses at 0.05 level of significance. The results showed that there is significant difference between the mean achievement scores of students in the experimental and control groups, in favour of the experimental group. It was concluded that activity-based instruction positively enhances achievement. The researcher recommended that seminar, workshops and orientation exercise should be organized by the government to familiarize basic science teachers on how to design activities relating to basic science subject matter contents and how to engage the students actively in such exercises should be organized regularly.***

Keywords: Basic Science, activity-based instruction, crude oil, radiation,

I. INTRODUCTION

Education in the 21st century has witnessed a continuous advocacy for learner-centered methods of teaching especially for science and science related subjects. This is because learner-centered approaches to science teaching encourage and develop the spirit of inquiry in the learner as well as invoke in him/her awareness and the understanding of the ways scientists work (Akinyemi & Folashade, 2010). Obviously, competency in any field of science demands that learners in such field should possess some basic science knowledge that are indispensable for efficient application of science to daily life activities. Learners however, cannot properly assimilate the basic science concepts if their learning process did not afford them the opportunity to attempt or apply the knowledge in the process of learning.

Basic science forms the most basic or foundational level of science while expressing the unity of science. Basic science which was formerly known as Integrated Science attempts to integrate the disciplines of biology, chemistry, physics and mathematics into a unified whole. It teaches the students the general principles necessary for the study of science in its entirety. It is a necessary subject that must be undertaken before going to study any field of science discipline. Given this importance of basic science, the Science Teachers Association of Nigerian (STAN) from onset mapped out guidelines for teaching basic science to the junior secondary schools. Notwithstanding the effort by STAN and the publishing of basic science Project textbook, students' achievements have been poor (Mbaliki, Ngban & Ibu, 2009). Quality of performance in Basic science analysis obtained from Examination Development Centre (EDC), Awka, Anambra state revealed that from 2013 – 2016 except in 2014,

up to 50% of the students who sat for Basic science in Anambra state could not make a credit pass.

The students' poor achievement has been blamed on the teaching methods adopted by the teachers which de-emphasize activities or practical lessons (Olufemi & Ibukun, 2013). The common teaching methods used in secondary schools are often teacher centered. According to Olufemi and Ibukun, the teacher centered methods such as lecture method has been implicated in a number of studies as one of the major factors contributing to students' underachievement. Students may improve their achievement if opportunity is given to them to carry out certain activities that are related to the concepts being taught to them. There is need to examine whether activity-based instruction can improve students' achievement in Basic science and boost their acquisition of science process skills.

The concept of activity-based instruction is one that stresses teaching and learning by practical exercises. It accentuates the importance of learning by practice. In this method, the teacher explains the concept to be learnt while at the same time demonstrating with practical examples, the concept being taught and giving the students similar exercise to do in the course of the lesson. Activity-based instruction is an exercise-laden method of teaching. The students in activity-based instruction classroom must be involved in one exercise or the other which is related to the lesson of the day. These activities range from observations in and outside the classroom, taking note or recording of what is observed, making some calculations, hypothesizing, carrying out one or two experiments and reporting results. Activity-based instruction is similar to practical and laboratory teaching methods but encompass practical and laboratory approaches to learning, in that they can take place beyond the laboratory and classroom. It also incorporates other learning methods such as problem-solving, discovery learning and the different types of cooperative learning methods. Its principle derives from the behaviorist theory of learning by Edward Thorndike.

The theory states that learning was incremental and that people learned through a trial-and-error approach. The behaviourist theories of learning did not consider that learning took place as a result of mental constructs. Instead, it described how mental connections are formed through positive responses to particular stimuli. For Thorndike, learning was based on an association between sense impressions and an impulse to action. Thorndike favoured students' active learning and sought to structure the environment to ensure certain stimuli that would 'produce' learning. The implication of this theory is that when students attempt to engage in activities during learning and for the sake of learning, they properly conceptualize what was taught through the trials and errors residents in their continuous practice. It builds on their motivation, such that they try to correct the mistake made in formal attempts in new and trial activities. Thus, students need to be engaged in activities that provide rich experiences and learning environments that can enhance their achievement.

Activity-based instruction owing to its complete involvement of the students during the lessons can boosts students' achievement and acquisition of science process skills (Chebii, Wachanga & Kiboss, 2012). Elvan, Ezgi and Mustafa (2010) noted that when problem-based activities were given to students, there were significant improvements in their achievements and in the acquisition of science process skills. This positive effect of activity-based instruction could be attributed to the fact that it helps students to have a logical thought of the concept taught, further acquire and develop skills and properly conceptualize what is taught by linking them to previous experiences (Feyzioğlu, 2009).

Although activity-based instruction may have beneficial effect on students' achievement and acquisition of science process skills, it proves difficult to use especially when there is limited time for the lesson. It also requires planning and use of activities that are based on the level of the learner. Students in the activity-based instruction classroom however, direct their own learning by asking questions or by requesting the teachers' help in the activities that prove difficult. Through the teachers' guidance, the students complete such tasks or activities and gain more insight on how to overcome such difficulty in the future. They acquire more science process skills and become competent in the use of such skills through continuous activities and also improve their achievement irrespective of their gender.

Gender issues in science education have remained a point of interest to researchers. While some of the researchers found significant difference in male and female students' achievement in science (Abungu, Okere & Wachanga, 2014), others found no difference in their achievement (Olufemi & Ibukun, 2009). Thus, findings on influence of gender on students' achievement and acquisition of science process skills are inconclusive.

PURPOSE OF THE STUDY

The purpose of the study was to investigate the effect of activity-based instructions on secondary school students' achievement and acquisition of science process skills in Basic science. Specifically, the study sought to determine the:

- ✓ Effects of activity-based instructions and lecture method on the achievement of students in basic science.
- ✓ Influence of gender on the achievement of students.
- ✓ Interaction effect of gender and teaching method on the achievement scores in basic science.

RESEARCH QUESTIONS

- ✓ What is the difference in the mean achievement scores of students taught basic science using activity-based instruction and that of those taught using the lecture method?
- ✓ What is the difference between the mean achievement scores of male and female students taught basic science using activity-based instruction?

HYPOTHESES

The following hypotheses were tested at 0.05 level of significance.

- ✓ There is no significant difference in the mean achievement scores of students taught basic science using activity-based instruction and that of those taught using the lecture method.

- ✓ There is no significant difference between the mean achievement scores of male and female students in basic science.
- ✓ There is no significant interaction effect of gender and teaching method on the mean achievement scores in Basic science.

II. METHOD

The design of the study is quasi-experimental. The pretest-posttest non-equivalent control group design was used. The design of the study is given in Figure 1.

Group	Pre-test	Treatment	Post-test
E	0_1	X	0_2
C	0_1	~X	0_2

Figure 1: Design of the Experiment

Where,

E_1 = Experimental Group

C = Control Group

0_1 = Pre-test

0_2 = Post-test

X = Experimental treatment – Activity-based instruction

~X = No experimental treatment – Lecture method

The study was carried out in Aguata Education Zone of Anambra State, Nigeria. The population of the study comprised 4352 junior secondary school year two (JSS II) students in 20 secondary schools in Aguata Education Zone (Source: Department of Planning, Research and Statistics, Post Primary School Service Commision, Awka, 2015). The sample size for the study was 58 (34 males and 24 females) junior secondary school year two (JSS 2) students obtained using multi-stage sampling.

The instruments used for data collection weas Basic science Achievement Test (BSAT) constructed by the researcher. The BSAT consisted of 20 items based on two topics in Basic science as contained in the junior secondary school two (JS2) Basic science curriculum. A table of specification was used to determine the lower and higher bloom taxonomy to be measured in the pool of 20 multiple choice objective test items in the instrument. Also, an instructional package designed with activity-based instruction was prepared by the researcher. This was used to teach the students in the experimental group and control group. The initial copies of the instruments along with the instructional plan were sent to three lecturers in Nnamdi Azikiwe University, Awka for validation. The corrections and suggestions by the validators were effected in the instruments in order to standardize them. The reliability of the instruments was established using Kuder-Richardon-20 Formula 20 for establishing internal consistency for both instruments. Consequently, the instruments were administered once to 40 students in Community Secondary School in Nnobi town and the reliability coefficients obtained was 0.89.

In the experimentation, the experimental group was exposed to the lesson contents using activity-based instruction. Before the treatment, the students were given a pre-test with BSAT. The teacher exposed the students to the concept of Crude Oil and Petrochemicals. Using simple explanations, questioning and examples the teacher familiarized the students with the concepts. The students were then engaged in the activity of identifying all the crude oil and petrochemical products in their classroom and outside their classroom. The students also made a list of the petrochemical products in their various homes as an assignment. The second concept taught was Radiation. The teachers explained to the students the theory behind the concept. The activity involved with the learning of the concept of radiation involved students coming out of their class to touch the pole bearing the school flag, their teachers' cars and correspondent attempt to differentiate the process of heat transfer of conduction and radiation going on with each object touched.

The teacher in another lesson divided the class into three groups with each group ready to carry out the experiments. Each group is given two meter rules and thermometers, one tin sheet, polish and dark surface sheets, pieces of candle wax, a stove. The teacher guided each group as they lit the stove, heat the candle wax on fire and have them stuck to the tin sheets at the same distance from the tip of the sheets. The students were required to measure the same distance and mark them off. The two sheets are placed at the same distance away from the stove. The students were to also measure the temperature changes in iron sheets, the time it took for the candles wax to melt and the distance it moves away from where it was on the iron sheets. The students were requested to record the observations, timing, and temperature changes and put forward their conclusions after discussing in group. The students were also asked to predict what would happen if the fire coming out of the stove were increased. The control group was exposed to the same lesson content using the lecture method of teaching. They were also given the pre-test and posttest before and after the lessons. The whole exercise lasted for six weeks.

The researcher controlled for such extraneous variables as teacher variable and test-knowledge. The lesson plans were prepared by the researcher who monitored the implementation of the lesson plan by the regular basic science classroom teacher. The study lasted for six weeks. The pretest was administered in the first week before the experimentation while the posttest was administered in the sixth weeks. The instruments were also reshuffled before they were also administered as posttest. Mean and standard deviation were used to analyze data related to the research questions. The hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The choice of ANCOVA is to eliminate any initial imbalances that existed among the groups. The decision rules are that when P-value is less than 0.05, reject the null hypotheses; otherwise we do not reject the null hypotheses.

III. RESULTS

RESEARCH QUESTION 1: What is the difference in the mean achievement scores of students taught basic science using activity-based instruction and those taught using the lecture method?

Analysis of data in relation to research question 1 is presented in Table 1.

Groups	N	Pretest Mean	Posttest Mean	Gain Mean	Pretest SD	Posttest SD
Experimental	27	24.26	57.78	33.52	8.85	4.87
Control	31	27.10	51.77	24.67	7.16	5.85

Table 1: Mean Achievement Scores of Students taught using Activity-based Instruction and those taught using Lecture Method

Table 1 show that the group taught using activity-based instruction had a gain mean achievement score of 33.52, while those taught using lecture method had a mean gain score of 24.67. The activity-based instruction group had a higher mean gain score than those in the lecture method group. In both groups, the standard deviations of their scores are lower in the posttest compared to their pretest. There was however, greater reduction in the spread of scores in the experimental group than in the control group.

RESEARCH QUESTION 2: What is the difference between the mean achievement scores of male and female students taught basic science using activity-based instruction?

Gender	N	Pretest Mean	posttest Mean	Gain Mean	Pretest SD	Posttest SD
Male	34	26.62	55.15	28.53	8.23	6.21
Female	24	24.58	53.75	29.17	7.79	6.12

Table 2: Mean Achievement Scores of Male and Female Students taught using Activity-based Instruction

Table 2 shows that the female students had gain mean achievement score of 29.17 and the male with mean gain score of 28.53. The standard deviation of the scores for male and female students decreased in the posttest compared to the pretest.

HYPOTHESIS 1: There is no significant difference in the mean achievement scores of students taught basic science using activity-based instruction and those taught using the lecture method.

Source of variation	SS	Df	MS	F	Sig.	Decision
Corrected Model	778.467[a]	4	194.617	7.443	.000	
Intercept	11101.790	1	11101.790	424.602	.000	
Pretest	232.620	1	232.620	8.897	.004	
Gender	7.787	1	7.787	.298	.588	NS
Method	620.103	1	620.103	23.717	.000	S
Method*Gender	2.280	1	2.280	.087	.769	NS
Error	1385.757	53	26.146			
Total	174875.000	58				
Corrected Total	2164.224	57				

Table 3: ANCOVA on Significant Difference in the Mean Achievement Scores of Students taught Basic science using Activity-based Instruction and those taught using the Lecture Method

Table 3 shows that there was a significant main effect of the treatment which accounted for 36 percent of the variance in the achievement scores of the students, F (1, 57) = 23.717, P (.000) <0.05. Thus, the null hypothesis one was rejected. Therefore, there is significant difference in the mean achievement scores of students taught basic science using activity-based instruction and those taught using the lecture method in favour of acitivity-based instruction.

HYPOTHESIS 2: There is no significant difference between the mean achievement scores of male and female students in basic science.

Analysis of data in relation to hypothesis 2 is presented in Table 5.

Table 3 shows that there was no significant main effect of the treatment on the achievement scores of the male and female students, F (1, 57) = 0.298, P (0.588) >0.05. Thus, the null hypothesis two was not rejected. Therefore, there is no significant difference between the mean achievement scores of male and female students in basic science.

HYPOTHESIS 3: There is no significant interaction effect of gender and teaching method on the mean achievement scores in Basic science.

From Table 3, it can be seen that there was no significant interaction between gender and teaching methods on students' achievement scores, F (1, 57) = 0.087, P (0.769)> 0.05. Therefore, the null hypothesis five was not rejected. Thus, there is no significant interaction effect of gender and teaching method on the achievement of students in basic science.

IV. DISCUSSION

The study revealed that the activity-based instruction group had a higher mean gain score than those in the lecture method group. The use of activity-based instruction also reduced the score variation among the students in the experimental group than lecture method did for those in the control group. Thus, significant difference existed between Basic science students' achievement scores taught using activity-based instruction and those taught using lecture method in favour of those in the activity based instruction group. The treatment accounted for 35 percent variance of scores. The students in the activity-based instruction group had a mean gain of score 26.11 greater than those in the lecture method group. The beneficial effect of activity-based instruction can be attributed to the fact that it not only engaged the students actively but afforded them the opportunity to apply the knowledge of what they learnt in solving practical problems. Activity-based instruction as opined by Badri and Shri (2013) enable students to learn science very well leading to cognitive, content, process, historical, environmental and ethical validity of a science curriculum. Students therefore ask questions and improve on their achievement (Tutwiler, Lin & Chang, 2012).

The findings of this study lend credence to the findings of Abungu, Okere and Wachanga (2014) who reported significant differences in the achievement of students when activity-based instruction is used. According to Abungu et al., activity-based instruction provides opportunity for students to interact very well with both teacher and resources. The findings of the study also support the findings of Olufemi and Ibukun (2013) who reported significant differences in the achievement of students taught using practical assisted instructional strategy and lecture method. The findings of the study are also in line with the findings of Elvan et al. (2010) who reported significant differences in the achievement of students taught using problem solving activity-based instruction and lecture method.

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The findings of the study revealed that male taught using activity-based instruction had higher mean gain achievement score (35.46) than the female with mean gain score of 32.19. There were no significant differences in the mean achievement and science process skill acquisition scores of students taught using activity-based in relation to gender. There was no significant interaction effect of gender and teaching method on the mean achievement scores of the students. These observations from the results of the study indicate that the use of activity-based instruction is not gender biased. Thus, when activity-based instruction is used, all students irrespective of their gender is carried along resulting in better performance for all individuals. In the study, it was observed that both the male and female students equally participated in the entire lesson. The groups were mixed up of male and female students and each student engaged actively in his or her group resulting in a uniform achievement.

The finding of the study is in support of the findings of Abungu et al. who reported that there was no significant difference in the achievement of boys and girls when science process skill teaching strategy was used. The finding of Olufemi and Ibukun (2013) supported the findings of the study when they reported no significant difference in the mean achievement of male and female students.

The implication of the study is that basic science requires an activity oriented approach of instruction for improve achievement. The following recommendations are made in the light of the findings of the study:

- ✓ Seminar, workshops and orientation exercise to familiarize Basic science teachers on how to design activities relating to Basic science subject matter contents and how to engage the students actively in such exercises should be organized regularly by the government.
- ✓ The government should provide Basic science laboratory for junior secondary school students where basic experimental activities relating to Basic science concepts can be conducted; to afford the students opportunity to acquire the science process skills needed to study sciences in the future.

REFERENCES

[1] Abungu, H. E.O., Okere, M. I.O., & Wachanga, S. W. (2014). Effect of science process skills teaching strategy on boys and girls' achievement in Chemistry in Nyando District, Kenya. Journal of Education and Practice, 5(15), 42-49.

[2] Akinyemi, O. A., & Folashade, A. (2010). Analysis of science process skills in west african senior secondary school certificate physics practical examinations in Nigeria. American-Eurasian Journal of Scientific Research, 5(4), 234-240.

[3] Badri, Y., & Shri, K. M. (2013). A study of the impact of laboratory approach on achievement and process skills in science among IS standard students. International Journal of Scientific and Research Publications, 3(1), 1-6.

[4] Chebii, R., Wachanga, S., & Kiboss, J. (2012). Effects of science process skills mastery learning approach on students' acquisition of selected chemistry practical skills in school. Creative Education Journal, 3(8), 1291-1296.

[5] Elvan, G.A., Ezgi, G., & Mustafa, A. (2010). Effect of problem solving method on science process skills and academic achievement. Journal of Turkish Science Education, 7(4), 13-26.

[6] Feyzioğlu, B. (2009). An investigation of the relationship between science process skills with efficient laboratory use and science achievement in chemistry education. Journal of Turkish Science Education, 6(3), 114-132.

[7] Mbaliki, A.E., Ngban, A.N., & Ibu, J.E (2009). Analysis of students' performance in Junior secondary school mathematics examination in Bayelsa state of Nigeria. Stud Community Science, 3(2), 131-134

[8] Olufemi, A.A., & Ibukun, V. O. (2013). Effect of Practical Assisted Instructional Strategy on Students' Achievement in Biology. Journal of Resourcefulness and Distinction, 6(1), 1-15.

[9] Tutwiler, M. S., Lin, M. C., & Chang, C. Y. (2012). Determining virtual environment ''fit'': the relationship between navigation style in a virtual field trip, student self-reported desire to visit the field trip site in the real world, and the purposes of science education. Journal of Science, Education and Technology. doi: 10.1007/s10956-012-9398-4.