Higher Education Studies; Vol. 5, No. 6; 2015
ISSN 1925-4741 E-ISSN 1925-475X
Published by Canadian Center of Science and Education

The Impact of Hands-On-Approach on Student Academic Performance in Basic Science and Mathematics

Cecilia O. Ekwueme[1], Esther E. Ekon[1] & Dorothy C. Ezenwa-Nebife[2]

[1] Dept. of Science Education, Faculty of Education, University of Calabar, Calabar, Nigeria

[2] Federal Government Girls' College, Calabar, Nigeria

Correspondence: Dr (Mrs) Cecilia O. Ekwueme, Dept. of Science Education, Faculty of Education, University of Calabar, Calabar, UNICAL P.O. 3651, 540001, Nigeria. Tel: 234-803-724-1049. E-mail: olunwa1@yahoo.com

Received: September 20, 2015 Accepted: October 29, 2015 Online Published: November 16, 2015

doi:10.5539/hes.v5n6p47 URL: http://dx.doi.org/10.5539/hes.v5n6p47

Abstract

Children can learn mathematics and sciences effectively even before being exposed to formal school curriculum if basic Mathematics and Sciences concepts are communicated to them early using activity oriented (Hands-on) method of teaching. Mathematics and Science are practical and activity oriented and can best be learnt through inquiry (Okebukola in Mandor, 2002) and through intelligent manipulation of objects and symbols (Ekwueme, 2007). The study tries to ascertain the impact of Hands-on-approach on the students' academic performance and the students' opinion about this activity-based methodology. The general objective is to assess the impact and provide another platform for students to display their understanding of what they have learnt other than the usual written tests with memorized formulae. The activity focuses on Mensuration and Geometry (with 25% questions in each area) and separation of mixtures (pure and impure substances). This paper includes the analysis of the feedback of the pre-test and post-test scores of the students before and after the Hands-on-approach was given as well as students' interview responses. The study showed positive improvement on both the students' performance and participation on mathematics and basic science activities and willingness on the part of the teachers to use Hands-on-approach in communicating mathematical and scientific concepts to their students.

Keywords: Hands-on-approach, academic performance, scientific and mathematical concepts

1. Introduction

Hands-on-approach is a method of instruction where students are guided to gain knowledge by experience. This means giving the students the opportunity to manipulate the objects they are studying, for instance, plants, insects, rocks, water magnetic field, scientific instruments, calculators, rulers, mathematical set, and shapes. In fact, it is a process of doing mathematics and science where students become active participants in the classroom. Haury and Rillero (2015) posit that hands-on learning approach involves the child in a total learning experience which enhances the child's ability to think critically. It is obvious therefore, that any teaching strategy that is skilled towards this direction can be seen as an activity-oriented teaching method (Hands-on-approach).

Hands-on-approach has been proposed as a means to increase students' academic achievement and understanding of scientific concepts by manipulating objects which may make abstract knowledge more concrete and clearer. Through hands-on-approach, students are able to engage in real life illustrations and observe the effects of changes in different variables. It offers concrete illustrations of concepts. This method learner-centered which allows the learner to see, touch and manipulate objects while learning as mathematics are more of seeing and doing than hearing; so also with science that advocates "do it yourself".

Obanya (2012) in his convocation lecture confirmed the above statement by adding that the average retention rate of learning by lecture is 5% while that of practice by doing (Activity-oriented) is about 75%. It can be seen that retention rate increases progressively with the use of more interactive and activity-oriented teaching methods. On the contrary, Ekwueme and Meremikwu (2010) observed in their study that some teachers object to the use of interactive activity-oriented method stating that it is time consuming and do not permit total coverage of the syllabus. Fortunately, the new mathematics and basic science syllabus' coverage is determined by how much skills/knowledge students' have acquired rather than how much of the syllabus is covered as learner centeredness is highly advocated Obanya (2012) in his convocation lecture confirmed the above statement by

adding that the average retention rate of learning by lecture is 5% while that of practice by doing (Activity-oriented) is about 75%. It can be seen that retention rate increases progressively with the use of more interactive and activity-oriented teaching methods (NERDC, 2008).

Past research work had stated from their findings that one of the major causes of students' failure in Mathematics and Basic science is lack of good teaching methods (Mandor, 2002; Ezema, 2004; Ekon, 2013). This study therefore, focuses on the possible impact of Hands-on-approach on students' academic performance in mensuration, geometry, and separation of mixtures in Junior Secondary School Three (JSSIII).

2. Statement of the Problem

Mathematics and Science learning as the bedrock of any civilization is expected to produce individuals that are capable of solving their problems as well as those of the society. Such an individual is expected to be autonomous, confident and self-reliant after his graduation from school. In recent times, applicability of what one learns in school to real life situation is very low. West African Examination Council (2007-2012) reports also indicated that most students' performance in mathematics and science in Senior School Certificate Examination (SSCE) are very low and so many factors are responsible for this poor performance, of which lack of good teaching method that involves students' active participation is lacking.

3. Purpose of the Study

The purpose of this study is to deliberately expose the students to a designed programme that ensures their classroom participation to about 90% of the entire classroom activity. The effect of this programmed instruction on their Mathematics and Basic science achievement is then measured and interpreted as the potential effect of their classroom involvement in the learning of those Mathematics and Basic science concepts.

4. Research Questions

1). Is there any significant difference in performance of students in the pre-test and post-test scores?

2). To what extent does performance of girls differ from that of the boys in the Mathematics and Basic Science task?

3). What is the frequency of the response of the students to the use of activity-oriented method in learning Mathematics and Basic Science?

5. Materials and Method

The main research design used for this study is quasi-experimental research design where the students were practically drilled on the Mathematics and Basic Science task. Questionnaire items and interview were also used to get their responses on the Hands-on-approach used. The study was carried out in a unity school and one government school in Calabar municipality of Cross River State. The population of the students consists of all the junior secondary three students at the two schools used. Their mid-term test scores in mathematics and Basic Science were used to select the top 8, middle 8 and lower 8 scoring students to make up a mixed ability class in each class for the study. Two classes of 30 students each in each school were used. This made a total of one hundred and twenty students comprising high, average and low ability students (sixty for experimental group and sixty for the control group). The selection is as shown in Table 1.

Table 1. Participant information for mathematics and basic science

			Gender	
School Group	Classes	Sample Size	Boys (%)	Girls (%)
A	JSS 3A	30	20(66.7)	10(33.3)
A	JSS 3B	30	12(40.0)	18(60.0)
B	JSS 3C	30	15(50.0)	15(50.0)
B	JSS 3D	30	18(60.0)	12(40.0)
Total		120	65	55

A written permission was obtained from the Principals of the schools since their mathematics and Basic Science teachers were involved in teaching the sampled students using the programmed lesson note prepared by the researchers and discussed with the mathematics and Basic Science teachers. The teachers were also involved in

the administration of the two sets of tests to the students.

6. Instrument

Activity Oriented Test Items (AOTI) was used as the major instrument for this study. A pre-test items selected from the topics of Geometry, Mensuration and Separation of mixtures which had been treated in the class before were administered to all the students before the prepared programmed teaching using the Hands-on-Approach and their scores were collected. Their teachers were also instructed on how to use the prepared lesson note on the three topics selected for the activity. The teaching lasted for one week on the treatment group and after which the same questions of the pre-test were administered to all the students again to observe their involvement, performance and method of their solving those problems. Their scores were also collected. In the test items, ten activity-oriented questions were drawn from the three topics. The setting of the questions was carefully done to avoid ambiguity.

A questionnaire and interview items were also designed to get their response after using the activity-oriented method. This was to get their response on the Hands-on-approach used in the study.

7. Administration and Collection

Ten item questions were administered and the maximum time for each question was six minutes to perform the task required. Students were given guided instructions on how to manipulate the learning equipment provided by the teachers and the researchers. Some of these instruments includes: pieces of wooden slates, thump-pegs strings, measuring tapes, magnets, beaker, spatula, pieces of card, papers cut into units squares, scissors, among others. The mathematics and Basic Science teachers were there to ensure that the learners adhered to the instructions provided. At the end of one hour, the papers were collected from the students by the researchers and assessed using the prepared marking scheme and observations made concerning the level of understanding of the questions and difficulty level. Also the questionnaire items were immediately given to them to respond and retrieved as soon as they finished.

8. Discussion of Results

Table 2. Independent t-test analysis of the group performance

Tests	Groups	N	Mean	SD	t	p-level
	Experimental	60	51.41	8.33		
Pre test					.88	.373
	Control	60	50.00	8.16		
	Experimental	60	60.48	10.28		
Post test					6.52	.000*
	Control	60	50.21	6.99		
	Experimental	60	9.07	3.61		
Gains					4.23	.000*
	Control	60	0.21	3.89		

Table 2 shows that pre-test result of the experimental and control group produced a t-value of 0.88 which was not significant at 0.05 probability level. This indicates that the experimental and control groups were equivalent before treatment.

However, after treatment, the independent t-test result produced a t-value of 6.52, which was significant at 0.05 level. This result suggests that the experimental group performed significantly different from the control group. The result also showed that there was a gain of 9.07 from the mean scores of the experimental group which also confirmed that the treatment had significant influence in their performance. For the control group, the gain was insignificant which could be attributed to the fact that they were not exposed to the treatment.

Table 3. Students' response on task performance questionnaire

Statements	Students' Response					
	Male	Female	Yes (%)	Male	Female	No (%)
1. I enjoy handling those objects used in teaching Mathematics and Basic Science concepts	45	60	105(87.5)	10	5	15(12.5)
2. This method makes me have more interest in learning Mathematics and Basic Science	58	50	108(90.0)	5	7	12(10.0)
3. I prefer activity-oriented method to Pen-and-paper assessment	60	50	110(91.7)	5	5	10(8.3)
4. Activity-oriented method is the best Method of finding out how well l can perform mathematics and Basic Science tasks on the given topic	73	35	108(90.0)	3	9	12(10.0)
5. This method helps me get familiar with the materials in my locality and their usefulness in learning mathema-tics and Basic Science	50	35	85(70.8)	26	9	35(29.2)
6. The result of this performance using this method tells my teacher how much l have understood the topic taught	48	42	90(75.0)	8	22	30(25.0)
7. I can explain how l arrive at mathematics solution with confidence	73	30	103(85.8)	12	5	17(14.2)

The feedbacks from students were gathered in two forms: questionnaire and interview. Table 3 above, shows students' responses to the questionnaire items calculated in percentage. In general, the students' gave positive responses. While 87.5% of the students enjoyed performing the task, only 12.5% did not; 91.7% preferred activity-oriented method. Items 2, 3 and 4 showed high percentage which showed that the method was not only interesting but the students believed that activity oriented task can instill interest in learning of mathematics and Basic Science. This also agreed with the study conducted by Arif and Jasmine (2007) on performance task assessment in mathematics.

Also, each of the researchers randomly selected six students from each of the arms and interviewed them using the interview questions stated, to get their responses on the suitability of the method and their views on the assessment. Their responses as gathered was presented below:

Response of Students on Interview Questions

Q1: How do you find activity-oriented method that you have just performed?

Response: It was very interesting and filled with fun as we manipulate square papers to form proofs. Rulers were effectively used to measure lengths and the actual Pythagoras theorem derived. We were able to discuss how iron fillings could be separated from wood particles and how other mixtures can be separated.

Q2: Can this method of assessment be included in the continuous assessment records?

Response: Yes, it should be included. Some questions in written form could be very boring but activity oriented questions led us more to exercising the brain and manipulating these objects to come out with formulas which we used to solve problems better than the memorized formulae.

Q3: Which method of assessment do you prefer? Activity-oriented method or Paper-and-pen assessment?

Response: I prefer activity oriented methods as it take shorter time; exposes one to the real objects to work on unlike paper examination where one memorizes the formulae to solve a given problem.

Generally, all the students agreed that the method is very interesting and makes mathematics and Basic Science more real and draws home some of the concepts and theorems that they know only by memorization.

On the part of the teachers, they welcomed the method but complained that the method is time consuming on

their part to prepare these materials for each class. The Basic Science teachers also added that getting enough apparatus for all the students for the impact to be felt will be very difficult for them.

9. Conclusion

It is obvious from the result of the analyses done that the activity oriented method has exposed both the teachers and the students to alternative assessment performance task. Students had the opportunity to exhibit their knowledge and skillfully ability. Teachers also confessed that they benefited a lot from the task and this has also triggered them to exploring other various ways of assessing their students for meaningful acquisition of mathematical and scientific knowledge.

10. Recommendation

Though implementation of the activity oriented task is challenging and so teachers need to be convinced as it is not as easily administered as the paper-and-pen type of assessment. Incentives should be given to the Mathematics and Science teachers to spur them up on the use of this method because they need to be encouraged apart from convincing them.

School administrators should also be encouraged by the government to provide the necessary equipment and materials to actualize this task effectively bearing in mind the number of students involved.

Finally, from this study, it has been shown that it is possible to explore alternatives as this has enhanced the performance of students in the said task and exposed them to real materials used in learning scientific concepts. This has given birth to a new dimension to teaching less and learning more.

References

Arif, H., & Jasmine, L. S. H. (2007). Performance Task Assessment in Mathematics: A primary school experience. *Proceedings: EARCOME 4: 4th East Asia Regional Conference on Mathematics Education* (pp. 128-134). Penang, Malaysia.

Ekon, E. E. (2013). *Effect of Five-steps Conceptual Change instructional Model on Students' perception of their Psychosocial Learning Environment* (Unpublished doctoral dissertation). Faculty of Education, University of Nigeria, Nsukka.

Ekwueme, C. O. (2007). *Mathematics is fun and for everyone* (p. 25). Bachudo Science Press, Calabar.

Ekwueme, C. O., & Meremikwu, A. (2010). The use of calculator in Teaching Calculations in logarithms in secondary schools. *Journal of Issues on mathematics*, *13*, 117-118.

Ekwueme, C. O., Meremikwu, A., & Uka, N. K. (2012). The National Mathematics Curriculum for Basic Education Programme (BEP) and the Millennium Development Goals for Mathematics teachers in Cross River State: Teachers' Perception and Readiness. *US-CHINA Education Review Journal*, *3*, 162-171.

Ezema, H. C. U. (2004). *Effective Science and Computer Education*. Abuja Farray Digital Prints, Garki, Abuja.

Manor, A. K. (2002). *Effects of Constructivist-Based Instructional Models on Acquisition of Science Process Skills among Junior Secondary students* (Unpublished master's thesis). Faculty of Education, University of Nigeria, Nsukka.

NERDC. (2008). *Federal Ministry of Education Teachers' Handbook for the 9-Year Basic Education Curriculum*. NERDC Printing Press Lagos.

Obanya, P. (2012). *Transformational Pedagogy in Higher Education*. 26th Convocation Lecture of University of Calabar, Nigeria.

West African Examination Council. (2007-2012). *Statistics of performance*. Research division, Lagos.

Copyrights