

EFFECTS OF ACTIVITY-BASED APPROACH AND EXPOSITORY METHOD ON STUDENTS' ACADEMIC ACHIEVEMENT IN BASIC SCIENCE.

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Abstract: The study investigated the effects of activity-based approach and expository method on students academic achievement in Basic Science. The specific objectives of the study were to determine the effect of activity-based approach and expository method on students' academic achievement in Basic Science. It also examined the influence of gender on students' academic achievement when taught using activity-based approach. The study adopted the pre-test-post-test, control group in quasi-experimental design. Eighty-seven (87) Junior Secondary School two (JSSII) Basic Science students in their intact classes from two purposively selected co-educational schools in Ondo West Local Government Area of Ondo State, Nigeria constituted the sample. The instrument used for collection of data was Achievement Test in Basic Science (ATBS). The co-efficient of reliability of ATBS was 0.76 using a test-re-test technique. The data collected were analysed using Analysis of Covariance (ANCOVA). The findings of the study showed that, significant difference existed between the achievement of students exposed to activity-based approach and those taught using the expository method. Learners in the activity-based approach group demonstrated better achievement than their counterparts in expository method group. The results also revealed that, gender had no significant effect on the achievement of students in Basic Science. Based on the findings, it is recommended among others that the government should ensure the provision of good functional laboratories that can serve as venues for the teaching and learning of science *concepts, from which activity-based approach can be utilized to improve students' academic achievement in Basic Science.*

Index Terms— students' academic achievement, activity based approach, basis science students

Introduction

The crucial role science plays in the development of any nation has long been recognized. Science is the bedrock of technological development. Ogunleye (2002) defined science as a dynamic human activity concerned with understanding the working of our world today. Countries all over the world are striving to improve their technological know-how and this can only be achieved through a solid foundation in science and technology studies. Having a solid foundation in sciences entails making students have keen interest in science (by extension Basic Science) right from their junior secondary school level of education. In Nigeria, the Science Teachers' Association of Nigeria (STAN) and Comparative Education Study and Adaptation Centre (CESAC) have contributed immensely to curricula innovations in science by the development of Nigerian Secondary Schools Science Project (NSSSP). Most of these innovations are based on inquiry-oriented programmes with emphasis on student-focused, active-learning, critical thinking and problem-solving approaches.

The history of science teaching in Nigeria dated back to 1867. It was introduced as nature study and hygiene. Later, it metamorphosed into biology, Chemistry and Physics. As a step towards presenting science to the child, reflecting the culture and tradition of Nigerians, the idea of the Nigeria Integrated Science Project (NISIP) was borne, which is an attempt to teach science as a unified whole. According to the Science Teachers' Association of Nigeria (1970), Nigerian Integrated Science should enable students to be able to:

- 1) observe carefully and thoroughly;
- 2) report completely and accurately;
- 3) organise information acquired;
- 4) generalize on the basis of acquired information;
- 5) predict as a result of the generalisations;
- 6) design experiments (including controls, where necessary, to check the predictions);
- 7) use models to explain phenomena, where appropriate; and
- 8) continue the process of inquiry when new data do not conform to predictions.

To achieve these objectives, it is suggested that, the teaching of Basic Science should involve the use of discovery teaching tactics, problem-solving activities and open-ended field or laboratory exercises. Results from previous researches on the teaching of Basic Science revealed that teachers lectured and give notes in Basic Science lessons (Olanrewaju, 1982, Jegede 1982; Mani, 1982; Odunbunmi, 1986, 1991). These have serious implications for cognitive achievement in Basic Science. Findings also indicated that a laboratory based method, where processes of science are used, could be effective in improving the achievement of students in science. For example, Comber and Reeves (1973) observed that, where students engaged in the processes of science in their schools, the level of achievement in science was higher. The processes of science provide students with unique opportunities to study abstract concepts and generalizations through the medium of 'real' materials. As students interact with learning materials, teachers and classmates, and practice what scientists do, they gradually developed skills needed for future work in sciences.

However, the Nigerian Integrated Science Project emphasizes the learning of the processes of science rather than mere acquisition of scientific knowledge. Therefore, one would expect a substantial part of the lesson to be devoted to investigative activities. In view of this, Basic Sciences is given great emphasis in the junior secondary school curriculum. The principal reasons why Nigerian Government started Basic Science teaching in Nigerian secondary schools are as follow:

1. it provides students at the junior secondary school level a sound basis for continuing science education either in single science subjects or further basic science;
2. it enhances the scientific literacy of the citizenry;
3. it allows students to understand their environment in its totality rather than in fragments;
4. it allows the students to have general view of the world of science; and
5. the processes of science serve as unifying factor for the various science subjects.

It is necessary for the learner to know these processes through integrated approach of learning science (Federal Ministry of Education, 2013).

In an attempt to improve the standard of science teaching and learning, a lot of research studies had been carried out. Studies in Basic Science education have reported that, many students at the junior secondary school level have developed negative attitudes towards the subject (Akpan, 1996). Many of the students at this level, because of their dismal performance in the subject, are not benefiting much from the Basic Science curriculum (Balogun, 1992; Afuwape, 2003; Afuwape and Olatoye, 2004; Odetoyinbo, 2004). This, according to Afuwape and Olatoye (2004), has prevented many of them from offering core science subjects or performing better in the core science subjects at the senior secondary school level.

The Nigerian government's efforts towards making sure that Nigerian students show interest in science and science-oriented programmes (e.g. 60:40 ratio admission policies in favour of the science-oriented programmes) cannot be said to have yielded much positive results. This is because many of the students at the junior secondary school level (J.S.S) are not showing interest in studying core science subjects (Physics, Chemistry, and Biology) at the senior secondary school level. This has affected them in choosing science-oriented programmes at the Nation's tertiary institutions level. The problem was attributed to the ineffective and unproductive strategies used by the Basic Science teachers at the J.S.S. level (Odetoyinbo, 2004).

Several studies had been carried out in order to popularize appropriate teaching strategy for teaching and learning Basic Science which include activity-based approach. The Basic Science curriculum is child-centered and emphasis is laid more on learning science as a process than as a body of knowledge (Olaewaju, 1994). Hence, teachers should actively involve students in the teaching and learning of Basic Science. Activity-based approach was specifically chosen because it allows more active involvement of students in the teaching and learning process than the traditional method which is in line with the design of Basic Science curriculum as stated earlier. While empirical evidence supports the use of activity-based approach with a variety of subject areas and age groups within and outside Nigeria, the extent to which this strategy is beneficial in Basic Science in Nigeria has not been extensively looked into.

In an activity-based approach, teachers often structure learning so that students work in cooperative learning groups (Gurganus et al, 1995). The use of such groups can encourage the establishment of scientific classroom communities where students work in groups to communicate about and experiment with solutions to scientific problems. Cooperatively structure learning let students formulate and pose questions, share ideas, clarify thoughts, experiment, brainstorm, and present solutions with their classmates. Students can see multiple perspectives and solutions to scientific problems. Unfortunately, research reports showed that, the teaching of science in Nigeria secondary schools falls short of the standard expected of it. It has been observed that the present methods used in teaching science in secondary schools do not augur well for the acquisition of science process skills by students (Mandor, 2002; Ibe, 2004; Madu, 2004). These methods are demonstration, drill, lecture, direct observation, fieldtrip, group work, laboratory activities, reading, recitation, seminar and programmed instruction.

Alli (1997) asserted that, there is no best method but effective science teaching should be laboratory-centred, activity-oriented rather than textbook or lecture-centred, which characterised the Nigerian schools. It is against this background that the effect of activity-based approach and expository method on students' academic achievement in junior secondary school Basic Science would be investigated.

Statement of the Problem

There has been much concern expressed about the continuous decline in the standard of science education at the secondary school level in Nigeria. The government has spent a lot of money to improve science teaching and learning. In spite of government huge investment in science education at the secondary school level, there have been not much positive results as students' performance in public examinations is not encouraging. Persistent poor performance in science subjects at School Certificate level (Achor, 2003; Umoren, and Ogong, 2007; Ogbeha, 2009) has given rise to an assumption that, most science teachers in secondary schools in Nigeria probably do not make use of varied forms of teaching strategies to be able to cope with some specific difficulties associated with the teaching of science. In view of the foregoing, this study investigated the effects of activity-based approach and expository method on students' academic achievement in junior secondary school Basic Science.

Purpose of the Study

The purpose of this study was to investigate the effect of activity-based approach and expository method on students' academic achievement in Junior secondary school Basic Science. Specifically, the study ought to:

1. determine the effect of activity-based approach and expository method on students' academic achievement in Basic Science.
2. determine the influence of gender on students' academic achievement when taught using activity-based approach.

Hypotheses

Two null hypotheses tested in the study were:

Ho₁: There is no significant difference in the academic achievement of students exposed to activity-based approach and those taught using expository method

Ho₂: There is no significant difference in the academic achievement of male and female students exposed to instructional approaches.

Research Method

The study adopted the pre-test, post-test, control group in quasi experimental design. In a schematic form, the design for the study is in the form;

| | | |
|-------|-------|-------|
| O_1 | X_1 | O_2 |
| O_3 | | O_4 |

Where;

O_1 and O_3 represent the pre-test while O_2 and O_4 represent the post-test for experimental and control groups. X_1 represents for the activity-based approach. The design was chosen to identify the subjects' entry behaviours before treatment and after treatment during the study. Quasi-experimental design was also adopted because the researcher made use of intact classes.

The population of this study consisted of all junior secondary school two (JSS II) Basic Science students in Ondo West Local Government Area of Ondo State. Two (2) out of the thirty two (32) junior secondary schools in Ondo West Local Government Area of Ondo State were used for the study. Two co-educational schools were selected through purposive sampling technique. The criteria used for the selection of the two schools were:

- i. the schools should be at least ten years old;
- ii. the schools should have been approved by the government; and
- iii. the schools should have a standard and functional Basic Science laboratory.

The sample for the study was 87 subjects, made up of 35 male and 52 female students. The instrument used for collection of data was Achievement Test in Basic Science (ATBS). It was used to determine students' achievement in Basic Science. This consists of a 4-option multiple choice of 20 items. The instrument covered the contents of junior secondary school two (JSS II) Basic Science curriculum. The units of Basic Science covered included water pollution, physical and chemical changes, work, energy and power. The instrument was administered as pre-test and post – test.

The instrument was face and content validated by the two secondary school Basic Science teachers, and two experts in science education in the School of education, Adeyemi College of Education, Ondo. The experts were required to look at the appropriateness of the items in the instrument in measuring the expected knowledge and on the correctness of the questions. Based on their comments, the instruments were restructured and hence refined in order to meet the face and content validity requirements.

To ensure the reliability of the instrument, a test-retest technique was employed. A trial testing was carried out by administering the ATBS instrument at an interval of two weeks on thirty (30) non-participating junior secondary school two (JSS II) students from one of the schools outside the Local Government Area used for the study. The reliability coefficient of 0.76 was obtained which was considered appropriate for the study.

There were three phases of data collection. These were the pre-test for the first one week, treatment for the next six weeks and the post-test for the last one week. Three periods of 40 minutes were spent each week for the six weeks. There was no alteration on the time-table allocated for Basic Science by the school, that is, the periods were in line with the schools' time-table. During the lessons, the teacher presented a new topics, sub-topic, concepts and related concepts. At the implementation stage, students in the activity-based group were exposed to practical activities immediately after theoretical lesson. This enable the students have opportunity to test immediately the knowledge they have just learnt. In the control group, the regular teaching method which was predominantly expository method was used.

Achievement Test in Basic Science (ATBS) was scored one hundred percent (100%). The data collected from the administration of the instrument were analysed using Analysis of Covariance (ANCOVA). All the hypotheses were tested at $P < 0.05$ level of significance.

Testing the Hypotheses

Hypothesis One: There is no significant difference in the achievement of Basic Science students exposed to activity-based approach and expository method.

To test this hypothesis, the students’ post-test scores were subjected to Analysis of Covariance (ANCOVA) using their pre-test scores as the covariate and group as the fixed factor as presented in the Table 1.

Table 1: One way Analysis of Covariance (ANCOVA) of post-test scores of Basic Science Students exposed to activity-based approach and Expository Method using pre-test scores as covariate

| Source | Type III Sum of Squares | Df | Mean Square | F | P |
|-----------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 7733.063 ^a | 2 | 3866.532 | 137.506 | .000 |
| Intercept | 1388.228 | 1 | 1388.228 | 49.370 | .000 |
| PreTest | 6286.436 | 1 | 6286.436 | 223.566 | .000 |
| Group | 935.831 | 1 | 935.831 | 33.281 | .000 |
| Error | 2361.994 | 84 | 28.119 | | |
| Total | 243993.000 | 87 | | | |
| Corrected Total | 10095.057 | 86 | | | |

a. R Squared = .766 (Adjusted R Squared = .760)

Table 1 shows the test of significant main effect of activity-based approach on the achievement of the students. It can be seen from the Table 1 that, the F-value obtained in the test is 33.281 at p=0.000. Since the value of p is less than 0.05, it can be interpreted that the inclusion of practical activities in the teaching of Basic Science has a significant main effect on the students’ achievement. The table also shows a multiple regression squared index (R²) of .760. This implies that 76% of the total variance in the achievement of Basic Science students is attributable to the influence of instructional approaches.

Table 2: Descriptive analysis of students’ post-test scores

| Group | Mean | Std. Deviation | N |
|--------------------|---------|----------------|----|
| Experimental Group | 56.0714 | 9.50582 | 42 |
| Control Group | 47.9111 | 10.59979 | 45 |
| Total | 51.8506 | 10.83441 | 87 |

Table 2 shows an attempt to locate the trend of the differences in the post test scores of the students. It can be seen from the table that, the mean scores of Basic Science students exposed to activity-based approach were significantly better (Mean score = 56.07 with SD = 9.5) than those taught using expository method (Mean score = 47.91, SD = 10.60). It can be concluded that, Basic Science students achieved better when the subject is taught along with practical activities.

Hypothesis 2: There is no significant in the achievement of male and female Basic Science students exposed to activity-based approach.

To test this hypothesis, the students' post test scores were subjected to Analysis of Co-Variance (ANCOVA) using the pre-test as the covariates and group and gender as the fixed factors.

Table 2: One way Analysis of Covariance (ANCOVA) of post-test scores of Basic Science students.

| Source | Type III Sum of Squares | Df | Mean Square | F | P |
|-----------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 7794.299 ^a | 4 | 1948.575 | 69.448 | .000 |
| Intercept | 1368.161 | 1 | 1368.161 | 48.762 | .000 |
| Group | 948.390 | 1 | 948.390 | 33.801 | .000 |
| Gender | 38.937 | 1 | 38.937 | 1.388 | .242 |
| PreTest | 6239.301 | 1 | 6239.301 | 222.371 | .000 |
| Group * Gender | 20.042 | 1 | 20.042 | .714 | .400 |
| Error | 2300.758 | 82 | 28.058 | | |
| Total | 243993.000 | 87 | | | |
| Corrected Total | 10095.057 | 86 | | | |

a. R Squared = .772 (Adjusted R Squared = .761)

The total number of students in activity based approach only cannot be 87 since the sample size for both exptal and control groups were 87.

The Table 2 shows the interaction of including practical activities and gender on the achievement of the students. From Table 2, it can be seen that the F-value obtained in the test is 1.388 at p=0.242. Since the value of p is greater than 0.05, it can be concluded that there is no significant difference between the achievement of male and female Basic Science students exposed to instructional approaches.

Discussion of findings

The findings of this study indicated that, significant difference existed between the achievement of students exposed to activity-based approach and those taught using the expository method. Also, learners in the activity based approach group demonstrated better achievement than those in the expository method group. This means that, the experimental group had higher score than the control group; the null hypothesis is therefore rejected. The result is in line with the findings of Turpin and Cage (2004) who found that, activity-based methods had some effects on students' academic achievement. The improvement in achievement could be due to the fact that the subjects were actively involved in the teaching and learning process. Furthermore, this result is in agreement with the findings of Anderson (2002) who stated that, employing inquiry based science teaching in science education has some positive effects on cognitive achievement. Other researchers Butts et al., (1997), Walter and Soyibo (2001), Hofstein and Lunetta (2004), Bilgil, (2006), Ergul et al (2011) and Ndirika (2012) corroborated the results of this study.

The results of this study showed that, gender had no significant effect on the achievement of subjects in Basic Science. This implies that male and female students exposed to activity-based approach do not differ significantly in their academic achievement. This could be explained by the fact that, each gender had equal opportunity to participate effectively during teaching and learning process. The implication of this is that, activity-based approach is gender friendly. This finding is in support Arigbabu and Nji (2004), Ming and Esther (2004), and Bilesanmi-Awoderu, (2006) who reported that there are no longer distinguishing differences in the cognitive, affective and psychomotor skill achievement of students in respect of gender. This report however is in disagreement with Harding and Whiteleg, (1997), Usman (2000) and Aigboman (2002) who found that, boys performed significantly better than girls in science.

Conclusion

The results of this study showed that, students exposed to activity-based approach achieved better than the counterparts taught with expository method. Therefore, science teachers should learn to employ activity based approach in the teaching and learning of Basic Science. Basic Science being a practical-oriented subject will be better taught and learnt if teachers and students are exposed to laboratory activities as practical classes can help the students to relate with concrete objects and principles rather than depends on theoretical abstractions.

Recommendations

1. School management should ensure that, every student has the prescribed textbook (Basic Science textbook) alongside the work book.
2. School management should also assist teachers who wish to improvise instructional materials by way of supplementing the cost, if not sponsoring it.
3. Teachers should try and improvise instructional materials where the standard ones are not available.
4. At the in-service level, seminars and workshops should be organized by ministry, officials, zonal educational authority, and local educational authority in order to educate practicing teachers on how to implement activity based approach in the teaching and learning of Basic Science.
5. Authors of science method books should illustrate carefully in their books how to make use of activity-based approach to science teachers.
6. The government should also ensure the provision of good functional laboratories that can serve as venues for further teaching and learning of science concepts, from which activity-based approach can be utilized to improve students' academic achievement in Basic Science.
7. Science teachers should learn and use activity-based instructional strategy as a means of improving students' achievement in mixed gender and ability classes.

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