# THE EFFECT OF MODELLING AND DIRECT TEACHING STRATEGY ON ACHIEVEMENT OF PRIMARY SCHOOL PUPILS IN BASIC SCIENCES

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**Abstract**

This study is quasi-experimental involving the use of pretest, post-test control group design. The independent variable was instructional strategy which was stratified into three, while the dependent variable was achievement in basic science. The pretest was a modified form of the posttest. Three equivalent coeducational primary schools which were distant from one another were purposively drawn from one Local Government Area (LGA) of one state in Nigeria for this study. Three treatment conditions employed for the study were modeling, demonstration and direct teaching strategies. The three conditions were randomized among the three schools. The target class for the study was primary four and all the class four pupils in each school received the treatment. The study lasted six weeks before the posttest was administered and scored. The sample size was 60 consisting boys and girls in equal numbers from each of the schools. The pretest was used as a covariate of the posttest. The results of the study revealed that modeling instructional strategy was significantly better than both demonstration and direct teaching ($F_{(2, 59)} = 29.830$; $P < .05$). Pair-wise comparison of means scores showed that modeling (16.811) was significantly higher than Demonstration (12.409) and significantly higher than direct teaching (10.130); and Demonstration (12.409) was significantly higher than direct teaching (10.130). The results showed that there was a significant gender effect ($F_{(1,59)} = 4.605$; $p < .05$). The mean score of males (13.887) was significantly higher than that of females (12.346). Treatment *gender interaction was not significant. The implications of these results were discussed and it was recommended that teachers should use active learning strategies such as modeling to teach science for improved learner achievement.

**Key words**: Modeling, Demonstration, Direct teaching, gender, basic science

**Introduction:**

Science is one of the most important subjects in the school curriculum of most nations .Its' importance derives from its utilitarian value to scientists, engineers, researchers and other professionals who employ science and its products to solve both environmental and numerous human problems. That is why science teaching is a highly valued curriculum activity in western education. The high status accorded to science in such nations is evidenced by the adequacy of provision, of various learning materials, special teacher preparation and very secure, adequately furnished well ventilated rooms or laboratories, where teaching and learning of science take place. These special provisions made for science teaching in schools are strategic designs laid out to ensure that learners acquire significant amounts of content knowledge and unparalleled levels of procedural and practical skills. In the process, the learner acquires the skills of problem identification and problem solving. The acquisition of these skills is the ultimate aim of science teaching, a situation which according to Maloney (1994) and Iroegbu, (2002) produce for society, proficient problem solvers.

National, economic and political development of nations depend in the main on in-depth knowledge of the facts, concepts, and principles of science coupled with the appropriate application of technology which is a product of science (Bello and Famakinwa, 2014). There are evidences from literature that show that science has contributed immensely to the provision of better living conditions and longevity for man, animals and plants (Adeniyi, 2005; Bello, 2012). Shaw and Nagashima, 2009 has shown that the developed nations of the world have employed their knowledge in science and technology to promote their peoples' well being and accelerate their education and national development. Nations like the United States of America, Russia, France, Britain, Japan, to mention just a few, are nations that have used science and technology to improve their peoples' welfare while achieving spectacular socio-economic development.

Having realized the great potential of science and technology to promote the rapid attainment of high socio-economic and national development, the Federal Government of Nigeria introduced the study of Basic science and Technology into the curriculum of its primary schools (FGN, 2013). However, the teaching of basic science and technology at the primary school level has been bugged with many problems such as the use of poorly trained teachers in teaching science(Iroegbu, 2009); the use of inappropriate teaching strategies and rote learning by pupils (Ogunkola and Bilesanmi-Awoderu, 2000; Salami,2012). These special problems must be eliminated from science teaching and learning at the primary school level if the essential content knowledge and skills must be acquired by learners.

The practice of teaching science theoretically by adopting the narrative approach at the basic level has proved difficult to be stopped even when the outcome of the process had been found to be poor (Salami, 2012). The simple reason adduced by teachers is that pupils at the basic level have not acquired sufficient knowledge and experiences to enable them engage in abstract reasoning. The consequence of the learners' lack of adequate knowledge, usually lead them to rote memorization. The young learners involved need to acquire their initial knowledge from direct experience. Therefore, useful instructional strategies must be those that will expose the learner to learn first-hand, from practical activity.

A problem that must be over-come therefore is the use of poorly trained teachers, with poor science background to teach basic science and technology at the primary schools (Oludipe,

2006). This aspect of the problem is being tackled by the curriculum review for colleges of education. Experienced science teachers with adequate science training must be employed to lay the foundation for science for these basic science pupils. The teachers required for this group of learners must be so proficient that the learners will be confident to follow their patterns. Such teachers must use simple and familiar objects and materials to present their lessons meaningfully. The teachers must be those that have developed expertise in the use of models to help young learners comprehend the concepts that they learn. It is hoped that by adopting teaching strategies such as modeling, teachers will be able to reduce the tendency of young learners resorting to rote memorization in learning science (Iroegbu, 2012).

Ogunkola and Bilesanmi-Awoderu (2000) experimented with laboratory method and lecture method and obtained a result that favored the laboratory method for Biology; they also found that their strategy showed no gender effect. The problem with the study is that there are no science laboratories in Nigeria for studying basic science at the primary school level and there are no proposals for providing primary schools with science laboratories in the future. The laboratory method cannot therefore provide the rescue at this time for poor attitude to the study of science and the generally low level of science learning outcomes associated with their strategy (Shaibu and Mari, 1997).

Further, Iroegbu (1998) experimented with problem based learning model as a strategy for teaching physics at the senior secondary school level. The experiment produced improved achievements in physics, problem solving and line graphing skills for both boys and girls in the study. The benefits of problem based learning in promoting 'learning by doing' instead of 'by being told 'have been documented in literature (West, 1992). Based on these and other practical benefits, Nigerian Educational Research and Development Council (NERDC) in 2011, included the use of Problem- based learning as a strategy for teaching science and technology at the basic level of education in Nigeria. It may be noted that the Nigerian basic education covers nine years of schooling, starting from primary one through six and running through the third year of junior secondary education.

Most primary school teachers know little about problem based learning, and hardly apply it to their teaching. The prevailing strategy of instruction in most schools in Nigeria is expository strategy, whereby the teacher talks non-stop, whether the children are following the teaching or not. Agusiobo, (2012) opined that the Federal Government of Nigeria had a very serious view on the problem. There is therefore the need to investigate the use of other teaching strategies which have been found to be effective for teaching this level of pupils in other cultures.

**Objectives of the study**: Despite the introduction of new curricular for all levels of the Nigerian school system, and the writing and publication of school books for different levels of education by Nigerians, the study of science in Nigerian schools has declined in popularity in recent years. When compared with the situation in the last two decades ago, one may conclude that most Nigerians have lost interest in the study of science. Subjects such as computer science, law, social studies, economics and accounting have surpassed basic science in popularity among students. It was speculated that the use of interesting but meaningful activities which would engage learners in participatory science activities might possess the potential to improve both the

popularity of science among the learners as well as science achievement. This study was therefore designed to investigate the effect if any, of modeling, demonstration and direct teaching instructional strategies on achievement in science of boys and girls at the basic (primary) level of education.

**Statement of the problem:** At the level of the primary school in Nigeria, pupils are compelled to offer too many subjects in the curriculum, including science. The primary schools do not usually possess the trained science personnel and requisite equipment for teaching science practically. As a consequence, most children do not show sufficient interest in the study of science when compared with other subjects in the curriculum. The problem of this study therefore was to investigate the effect of modeling, demonstration and direct teaching strategies on pupils' achievement in basic science at the primary school level.

**Null hypotheses**: Two null hypotheses were generated for evaluating the performance of the pupils in the course of this study.

**Hypothesis 1:** There is no significant effect of strategy of instruction on the achievement of pupils in basic science.

**Hypothesis 2:** There is no significant effect of gender on primary schools pupils' achievement in basic science.

**Hypothesis 3**: There is no significant interaction of teaching strategy and gender in pupils' achievement in primary basic science.

**Significance of the study:** There is the need to restore the interest, love and improved achievement of young Nigerian school children in science. Nigeria had proposed in its 'Vision 20:2020' that the country hoped to be one top 20 economies in the world by the year 2020. The 'Development Plan' has objectives that include achieving for Nigerians, a high standard of living; a knowledge-based economy; efficient use of human and natural resources to achieve rapid economic growth, among others. The revitalizing of interest in the study of science is a condition that must prevail in Nigeria if the nation must make appreciable progress on its quest for accelerated economic and scientific development. It is hoped that teachers can achieve this feat through the use of teaching strategies that involve meaningful hands-on activities in the study of science at school.

**Methodology:** This study was a quasi-experiment, in which the pretest posttest, control group design was used in order to ascertain more clearly the effect if the independent variables and also the extent of interaction between the independent variables. A purposive sampling technique was used in selecting 60 pupils consisting of boys and girls in equal proportion from the three schools. Three coeducational public primary schools that have qualified National Certificate of Education (NCE) teachers charged with basic science teaching, were purposively selected for this study. The schools were distantly separated from one another in order to limit the possibility of exchange of research information. Primary 4 was selected as the class for this experiment because they had been receiving lessons in English language for at least four years and might not have developed the apathy to science that are noticeable in higher classes.

Three experimental conditions were randomized among the three schools as follows:

School A: Hands-on Modeling teaching strategy
School B: Teacher Demonstration teaching strategy
School C: Direct instruction teaching strategy

One teacher and one research assistant were trained by the researcher for each school. They were separately given micro teaching practice on the teaching strategy they were going to implement until there was intra-rater agreement on their teaching procedure, content sequencing and presentation as well as timing. The study lasted seven weeks. The first week was used for training the teachers, while six weeks were used for the actual study. A pretest was administered on the pupils during the first day of study in each of the schools. The research assistants kept a register of participation for the students and also assisted the classroom teacher in marking take-home assignments.

The instrument for this study was a 20 item researcher made primary school basic science achievement test (PBSAT) with test-retest reliability of 0.72. The items on the instrument were distributed as follows: Remembering, 6 items; understanding, 5 items; observational skills, 5 items and analysis, 4 items. The pretest was a modified objective test that was adapted from the PBSAT but required the pupils to complete the gaps left in statements. For both the pretest and the post test, each correct option was awarded one mark. Wrong answer attracted zero score.

A maximum of 20 marks were obtainable for each test. At the last day of the study, the post test was administered in each school. The scripts were collected and scored. The list of all pupils who attended all the lessons and completed all assignments and the tests was compiled for each school. Stratified purposive sampling technique was used in selecting the scripts of 60 participants for analysis, from the pool of those who attended all the lessons and completed the tests.

**Results:** The data collected from this study was analyzed using analysis of covariance ANCOVA, the results of the pretest being used as covariate of the post test. Levene's test of equality of error variances of PBSAT yielded ($F_{(5, 54)} = 1.106$), which was not significant at .05 level.

The test of between-subjects effects is presented in Table 1.

**Table 1: Analysis of covariance of Pupils' Post test Scores on PBSAT**

| Source | Type III sum of square | df. | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected model | 709.079[a] | 6 | 118.180 | 15.310 | .000 | .634 |
| Intercept | 983.267 | 1 | 983.267 | 127.382 | .000 | .706 |
| Pretest | 141.996 | 1 | 141.996 | 18.396 | .000 | .258 |
| Teaching strategy | 460.514 | 2 | 230.257 | 29.830 | .000 | .530 |
| Gender | 35.546 | 1 | 35.546 | 4.605 | .036 | .080 |
| Strategy * Gender | 27.983 | 2 | 13.992 | 1.813 | .173 | .064 |
| Error | 409.104 | 53 | 7.719 | | | |
| Total | 11441 | 60 | | | | |
| Corrected Total | 1118.183 | 59 | | | | |

Key: a. R Squared = .634 (Adjusted R squared = .593)
Null hypothesis 1 postulated that there is no significant effect of strategy of instruction on the achievement of pupils in basic science. The data in Table 1 shows that the effect of strategy of teaching is significant, ($F_{(2, 59)} = 29.830$, $P < .05$). Null hypothesis 1 was therefore rejected. The implication of this result is that there exist some fundamental differences in the various teaching strategies that could not have occurred by chance. In order to locate the treatment condition that differed significantly from others, pair wise comparison of post test mean scores are required for treatment conditions. The group means scores for the three experimental conditions is presented in Table 2.

Table 2: Post test mean scores for treatment groups, Grand mean=13.117

| Treatment condition | Mean | Std. Error | 95% confidence interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Modeling strategy | 16.811[a] | .622 | 15.564 | 18.059 |
| Demonstration strategy | 12.409[a] | .622 | 11.160 | 13.657 |
| Direct teaching strategy | 10.130[a] | .621 | 8.884 | 11.376 |

Key: a. Covariates appearing in the model are evaluated at the following values: Pupils' pretest score= 2.8333.

The data in Table 2 show that the group taught with modeling strategy obtained a group mean score of 16.811, which is above the Grand Mean of 13.117. The Demonstration strategy group obtained a group mean score of 12.409 and Direct teaching strategy group 10.130, both of which were below the Grand Mean score. The significance of these group scores were evaluated with the pair wise comparisons in Table 3.
Table 3: Pair wise comparison of Mean Science post test achievement scores for treatment groups

| (i)Strategy | (j)Strategy | Mean Difference (i-J) | Std. Error | Sig. |
|---|---|---|---|---|
| Modeling | Demonstration | 4.403* | .881 | .000 |
| | Direct teaching | 6.681* | .879 | .000 |
| Demonstration | Modeling | -4.403* | .881 | .000 |
| | Direct teaching | 2.278* | .880 | .012 |
| Direct teaching | Modeling | -6.681* | .789 | .000 |
| | Demonstration | -2.278* | .880 | .012 |

Key: * = The mean difference is significant at .05 levels

The data in Table 3 show that the groups mean achievement score of 16.811 for modeling instruction strategy is significantly higher than the mean of 12.409 obtained by the Demonstration strategy group, and also significantly higher than the group mean score of 10.130 obtained by the direct teaching strategy group. Similarly, the mean achievement score of 12.409 obtained by the Demonstration strategy group is significantly higher than the groups mean achievement score of 10.130 obtained by the direct teaching strategy group. The order of

increasing effect is Direct teaching < Demonstration strategy < Modeling strategy. Thus modeling instruction strategy is the most facilitating instructional strategy among the three teaching strategies tried in this experiment.

Null hypothesis 2 stated that there is no significant effect of gender on primary schools pupils' achievement in basic science. The result for testing this null hypothesis is contained in Table 1. The data in Table 1 reveal that there is a significant gender effect ($F_{(1, 59)} = 4.605$, $p < .05$). The null hypothesis was therefore rejected. In this study, the post test achievement mean score for the males was 13.887, while the one for females was 12.346. The Grand Mean score for the post test was 13.177. The pair wise comparison for male and female data is contained in Table 4.

Table 4: Pair wise comparison for male and female post-test mean achievement scores

| (i) gender of pupil | (j) gender of pupil | Mean difference(I – j) | Std. Error | Sig. |
|---|---|---|---|---|
| Male | Female | 1.541* | .718 | .036 |
| Female | Male | -1.541* | .718 | .036 |

Key: * = Significant at the .05 level

The data in Table 4 show than the male were significantly higher achievers in primary basic science than the females of this study. This experiment was therefore more favorable to males than females.

Null hypothesis 3 stated that there is no significant interaction of teaching strategy and gender in pupils' achievement in primary basic science. The data analysis contained in Table 1 reveals that the interaction of teaching strategy and gender of pupil did not reach significant level ($F_{(2, 59)} = 1.813$, $P > .05$). Null hypothesis 3 was not therefore rejected. This result therefore implies that whatever interaction that might have existed in the data of this study could have occurred by chance and chance alone and its presence in this result is of no consequence.

**Discussion**: The result of this experiment has revealed that the strategy of instruction is significant in determining the outcome of the experiment. Teaching strategy accounted for 53% of the variance due to the experiment. This is particularly worthy of note. Three variants of the instructional strategy employed were modeling, demonstration and direct teaching. Modeling strategy produced a significantly higher achievement level than either demonstration or direct teaching. Also demonstration was significantly better than direct teaching in enhancing learner achievement. It should be noted that both modeling and demonstration strategies involve learners in more meaningful physical and mental activities than teacher talk alone can afford. This factor may provide a little insight to the cause of the result of this experiment. These results and observation support the findings of Opara (2004) and Iroegbu (2009).

The effect of gender in this study was found to be significant and accounted for 8% of the variance in this experiment. Further analysis revealed that the males were significantly higher achievers than the females. This result seem to support the view of most student that physics is a difficult subject good only for the ablest males (STAN 19 ).This perception of numerous students has often failed to gain support in the face of properly designed studies(Shaibu and Mari, 1997). Many girls at the basic level of education do not perceive

science as being important for their career. This wrong perception of girls in the main, accounts for their poorer performance in situations such as in this study. Teachers and parents should try to re-educate the girl child on the importance of science to them as future mothers, and even for their future careers.

On interaction of teaching strategy and gender, the result in Table 1 shows the interaction was not significant. This implies that the level of interaction that existed between strategy of instruction and gender might have occurred by chance.

Conclusion: This study had the objective of investigating the effect of strategy of instruction on the achievement of primary school pupils in basic science. The results of the study have shown that modeling instructional strategy group achieved higher mean science score than either the demonstration strategy group or the direct instructional strategy group. This result demonstrates that the use of modeling strategy, which is a hands-on teaching, could be adopted to improve science achievement of primary school children. In this study, demonstration strategy produced a higher mean achievement science score than direct teaching. These results of this experiment lead to the conclusion that teaching strategies which involve meaningful learner participation yield improved learner achievement.

These results also imply that even without the use of traditional science laboratories for teaching basic science at the primary school level, improved science achievement scores could be obtained by adopting meaningful and active learner-centered teaching strategies in the classroom.

Recommendation: Based on these results, it is recommended that more teachers should embrace the use of modeling or other active learner based teaching strategies for teaching basic science at the primary school level.

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