LANGUAGE OF INSTRUCTION AND PUPILS' ACHIEVEMENT IN SOME SELECTED SCIENCE CONCEPTS AT THE PRIMARY SCHOOL LEVEL

By
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Abstract

The study examined the effectiveness, of language of instruction on the achievement of pupils in some selected concepts at the primary school level. Two hundred and twenty four subjects were assigned to three experimental groups namely Yoruba, English and Bilingualism. The results indicated that Bilingual medium was the most facilitative for the attainment of the science concepts that have some elements of abstraction. Significant interaction existed between medium of instruction and pupils' parental educational background while gender and pupils' parental educational background did not interact significantly.

Introduction and Background

Several researchers and evaluation studies have been carried out on the use of mother tongue in the teaching of science as well as some other school subjects (Bajah, 1988, Fafunwa, 1990, Ogbeide 1999, Ibude 1991, Olanrewaju 1991, Odunsi 1991). One of such studies in Nigeria is the Ife six-year mother tongue primary school project.

The aims and objectives of the project include among other things the development of materials together with appropriate methodology for teaching primary education using Yoruba Language as the medium of instruction. The result of the evaluation showed that primary school pupils (classes one to six) who studied science and mathematics in Yoruba (mother tongue) performed better than their experimental counterparts who learned in English (Yoloye 1972, Fafunwa 1975, Dada 1989).

The policy (NPE 1981) on the use of mother tongue as a medium of instruction has generated considerable controversy among several highly respected intellectuals as well as the general public. When considered objectively one is bound to accept that there are some technical and pedagogical problems associated with the use of mother tongue as medium of instruction in Nigeria. There are sometimes conceptual problems resulting from differences in the mode of thought in English and the Nigerian languages. The important issue however is to what extent have efforts been made to overcome these problems". Production of textbooks in the languages of instruction is not proceeding quite as expected. The Nigerian Educational Research and Development Council (NERDC) has produced textbooks based on the new curricular for the three major languages namely Hausa, Igbo and Yoruba, but no textbooks for other school subjects in these languages. The pedagogic problem is usually overcome by the teachers by using the English words for the numbers Many

other conceptual and pedagogical problems were solved by the Ife six-years primary project.

Although evidence has shown that the children so taught in Yoruba language in the Ife six-year project made substantial affective gain in respect of adjustment to school and personality characteristics (Fafunwa 1990), further researches also indicated that in some cases bilingual media of instruction seem to improve performance (Zeep 1982, Collin 1988, Gold-Blatt 1989, Ande 1990, Raoch 1990). In the light of what has been discussed so far it would seem that there is clearly a linkage between learning science and other school subjects with language.

In summary the questions or issues raised so far are which particular medium of instruction will be most facilitative in enhancing pupils' performance in some identified primary science concepts? Will the educational background of the pupils' parent and gender influence their achievement in some identified primary school science concepts. In addition, the study also attempted to determine the extent, if any to which the gender of pupils and the educational background of their parents influence the achievement of the concepts.

Hypotheses

H_{o1} There will be no statistically significant differences in the post-test mean scores on primary science concept attainment test of pupils expose to each of the three instructional media groups.

H_{o2}: There will be no statistically significant interaction effect on attainment between media of instruction and pupils' parental educational background.

H_{o3}: There will be no statistically significant interaction effect on attainment between the media of instruction and gender of the pupils.

Methodology

The study adopted the quasi-experimental pre-test, post-test design. There were three experimental groups namely:

Experimental Group 1: Yoruba Language Group
Experimental Group 2: English Language Group
Experimental Group 3: Bilingual Media.

The research design is as shown below

Pretest	**Treatment**	**Post-test**	
0_1	X	0_2	E_1
0_1	X	0_2	E_2
0_1	X	0_2	E_3

A 3 x 2 x 2 factorial design was further adopted for data analysis.

Subjects for the Study

The sample for this study were drawn from thirty two co-educational primary schools in Ijebu-Ode Local Government Area of Ogun State. The Schools in the

Local Government were initially zoned into six based on geographical spread to ensure the study being concentrated in one area. One school was then randomly selected from each zone. In each school, one arm of primary three was randomly selected and allocated to each treatment group as intact classes. In all, two hundred and twenty four primary three pupils constituted the sample for this study. Primarily, seventy-six pupils' in Yoruba language were in experimental group, seventy-three in English language experimental group and seventy five in Bilingual experimental group.

Research Instrument

The instruments used in this study were:
The Concept Attainment Test (CAT) that tested pupils' competence in the selected science concepts.
The Concept Attainment Instructional Programme (CAIP) – describe the teaching procedure adopted in this study.
The Parental Educational Background Questionnaire (PEB) was used to assess the highest level of education of the pupils' parents.

The Concept Attainment Test (CAT)

The test was based on a Concept Learning and Development (CLD) model developed by Klausmeier and Allen (1979). The model deals with five hierarchical levels, concrete level, identity level, classificatory level, formal level and use-of-concept in that order of increasing mental complexity.

In developing the test items for this study, a table of specification was first constructed. The table of specification had thirty cells. At concrete level one question was asked to assess pupil's competence to attend to visual features of an object. One question was also drafted at identity level to assess pupils' ability in identifying the basic features of an object. Three questions were drafted for each concept at the classificatory level. These questions were designed to assess pupils' ability to classify concepts and give relevant examples and to be able to place two examples as equivalent. Three questions asked for each of the concepts at the formal level were drafted to elicit information on the pupil ability to give defining attribute of the concepts. Two questions were also asked at the use of concept level in order to assess how pupil used the attained concepts in solving problems.

The test which was administered verbally to pupils were validated in terms of its content and construct validity. The reliability index of the test was carried out by administering the test items in its final form to a group of thirty pupils not used in the main study and at a distantly located school to avoid contamination were used. The reliability index was estimated by using the split half, odd-even plot reliability technique and applying the Pearson product moment correlation coefficient formular. It yielded a correlation coefficient of 0.61 for both halves of the CAT. The correlation coefficient was later subjected to Spearman Brown's formular in order to estimate the reliability of the entire instrument. This yielded a value of 0.75 as the

correlation coefficient for the entire instrument, suggesting a strong index of reliability of the Concept Attainment Test (CAT).

ii. The Concept Attainment Instructional Programme (CAIP)

The Core Curriculum for primary three science as well as science textbooks for primary level generally were thoroughly reviewed before embarking on the development of the Concept Attainment Instructional Programme (CAIP).
The CAIP provide the following specification:

(a) Topics (concepts) to be taught.
(b) Objectives to be achieved at the end of each topic.
(c) Content of study together with steps for the teaching of each lesson.
(d) Instructional materials and evaluation.

The teaching procedure which involved mainly classroom pupils' – centred activities was geared towards achieving the task of concept attainment at the five hierarchical levels. For examples, the concrete and identity levels focused on pupil activities involving the identification of the perceptual features of the concepts; Classificatory lessons dealt with activities involving placing examples into different classes and classifying equivalent examples. Formal level activities consisted of given accepted defining attributes of the concepts in questions, and the use-of-concept level comprised activities requiring pupil to use the concept to solve problems.

CAIP was given to four science education specialists for validation. They were required to comment on the adequacy, content and appropriateness of examples and non-examples for each of the topics at the different levels of attainment. The CAIP was translated into Yoruba Language using the language glossary on Nigerian mother-tongue science word equivalent produced by Nigerian Educational Research and Development Council (NERDC). This Yoruba version of the CAIP was further back-translated into English for cross-checking. The English and Yoruba versions were then passed to four language specialists (Yoruba language specialists and English Language specialists and the four of them after minor modifications certified the programme as linguistically correct for use in the study. The two versions were then given to three science education specialists and two primary school teachers. Based on their comment, the programme were slightly modified and later approved by them. The two versions were further validated through try-out in school during pilot study. The CAIP was used for the teaching and the assessment procedures of the primary science concepts in the three treatment (experimental) groups.

iii. The Parental Education Background Questionnaire (PEB)

The Parental Education Background (PEB) questionnaire is a modified version of parent's educational background questionnaire validated and standardized in Nigeria by Onwu, Mansaray, Uwakwe (1990) for the World Health Organisation (WHO) Global Programme on AIDS. The questionnaire consists of two sections. Section one dealt with obtaining information on the name of schools, class, sex, and

age of the pupils. Section two dealt with the educational achievement level of the pupils' parents. A short slip in which parents were to indicate the highest educational level attained was passed to them through the pupils. The slips were returned to school and were used for cross checking pupils' response of their parents' educational background.

Administration of Instruments

Parental Educational Background (PEB) questionnaire was first administered to collect information on the parent educational background and this was carried out before the commencement of the treatment. The Concept Attainment Test (CAT) was then administered as a pre-test in a one-to-one interview session by the researcher in a classroom setting before the beginning of the treatment. The result of the pre-test was not made known to the pupils. Treatment started after the pre-test in the experimental groups. The only instrument used for the treatment was the Concept Attainment Instructional Programme (CAIP). The teaching methods were mainly classroom activities/experiments on floating, sinking etc. and discussion as specified in the core-curriculum for primary three science. The administration of the PEB, the teaching and testing were carried by the researcher in order to ensure that the specified medium or media of instruction for each experimental groups were strictly adhered to.

Result of the Data Analysis

The data were analysed using the principle of mean, standard deviation and analyses of covariance. A summary of the descriptive statistics of means and standard deviation on CAT according to treatment groups is given in table 1.

Table 1: Summary of the Descriptive Statistics of means and Standard Deviation on CAT according to treatment groups.

Concept Attainment Level	YORUBA N = 76			ENGLISH N = 73			BILINGUAL N = 75		
Concrete X S.D	Pretest 4.0811 1.365	Post test 4.7952 1.266	Mean Diff. 0.7141 Sig.	Pretest 3.3467 1.878	Post test 3.9130 1.741	Mean Diff. 0.6263 Sig.	Pretest 4.0264 1.269	Post test 5.7695 0.720	Mean Diff. 1.7431 Sig.
Identify X S.D	4.2510 1.479	4.8152 1.264	0.5642 Sig.	2.5220 2.067	2.9154 1.899	0.3934 Sig.	4.3004 1.604	5.4444 0.768	1.1440 Sig.
Classification X S.D	3.1152 2.022	10.7189 2.723	7.6057 Sig	0.8501 1.267	4.8289 4.443	3.9788 Sig.	2.9177 2.351	13.0135 3.110	10.6818 Sig.
Formal X S.D	1.4257 1.294	9.8169 1.899	8.3912 Sig.	0.1501 0.392	3.4695 2.782	3.3194 Sig.	1.4002 0.919	12.0820 2.999	10.6818 Sig.
Use of ConceptX S.D	0.2611 0.500	4.994 1.515	4.7331 Sig.	0.1660 2.028	2.8642 2.125	2.6982 Sig.	0.2569 2.202	5.8920 2.402	5.6351 Sig.

Sig. = Significant $P < 0.05$

The mean and mean differences for the bilingual experimental group were generally higher as reflected in table 1 above at all the levels of concept attainment. The trend also indicates that there are differences in the performance of the three media groups. All results have significant difference. Table 2 below is the analyses of covariance on overall post-test scores for Treatment, Parental Educational Background (PEB) and Gender.

Table 2: Summary of the Analysis of Covariance (ANCOVA) on the Overall Post-Test Scores of Pupils According to Treatment, Parental Educational Background (PEB) and Gender

Source of Variation	SS	DF	MS	F	Sig. of F
Covariates	21389.982	1	21389.982	1215.466	0.000
Main Effects	11855.724	8	1481.966	84.211	0.000
Treatment	10562.264	2	5281.132	300.096*	0.000
Parental Education Background(PEB)	3478.158	5	695.632	39.529*	0.000
Gender	898.418	1	898.418	51.052	0.000
Explained	33245.706	9	3693.967	209.906	0.000 n.s
Residual	3766.008	214	17.598		
Total	**37011.714**	**223**	**165.972**		

Treatment has a significant main effect $F = 300.096$, $P < 0.05$ on the variation in the scores of the pupils in the concept attainment test. The null hypothesis is not accepted. Multiple Classification Analysis (MCA) was used to look at the performance of the pupils in the three experimental groups and at each of the last three levels of concept attainment. The result of the MCA indicate that:

i. Bilingual media group (Experimental 3) had the highest mean scores (table 1 and appendix 1) on concept 2 (Floating and sinking) and concept 3 (Measuring Time and Measuring Weight).

ii. Yoruba medium group (Experimental 1) had the highest mean scores on concept 1 (identifying Plants and Identifying Animals). Table 1 and Appendix 2.

Duncan Multiple range (Appendix 1 and 2) was used as a post-hoc analysis to confirm the observations made on the multiple classification analysis. From the post-hoc $P < 0.05$ level of significance, the following were drawn.

a. The groups differed significantly from each other (table 2 and appendix 1 and 2).

b. Bilingual media group was the most effective for the attainment of the concept of floating and sinking, measuring time and measuring weight while

Yoruba medium was the most facilitative for the attainment of the concept of identifying plants and identifying animals.

MCA and Post hoc analysis were also carried out on parental education background.

The result of the post-hoc using Duncan Multiple range test (appendix 3) at 0.05 showed that:

i. The parental educational groups differed significantly from one another (table 2 and appendix 3).
ii. The higher the parental educational background, the higher the pupils' performance.

Analysis of variance on the interaction effect between media of instruction and pupils' parental educational background was computed.

The result indicated that media of instruction interacted significantly with the pupil's parental educational background within and between groups. Post-hoc comparison using Duncan Multiple range at $P < 0.05$ significant level indicated that:

i. The means of the different pupils parental educational background differed significantly from one another in each treatment group and overall.
ii. Bilingual media was the most effective for pupils with higher parental educational background.
iii. Yoruba medium was the most facilitative for pupils with lower parental educational background.
iv. The higher the parental educational background of the pupils, the higher the pupils' performance across all the treatment groups.

Table 3: Summary of the Analysis Of Variance on the Interaction between Media of Instruction and Pupils Gender

Source of Variation	SS	DF	MS	F	Sig. of F
Between group	1188.843	1	1188.843	7.3674	0.072
Within group	35822.871	222	161.364		
Total	**37011.714**	**223**			

The summary of the analysis of variance showed that there was no significant interaction between media of instruction and pupils' gender. The null hypothesis is therefore accepted.

Discussion

The result in table 1 showed that the Bilingual media group had the highest mean scores at all levels of concept attainment. Table 2 and MCA (appendix 1 and further indicated that the three treatment groups differed significantly on concept attainment. Post-hoc analysis confirmed that the bilingual media groups was the most facilitating in the learning of the defined concepts (floating and sinking,

measuring time and weight), while Yoruba language was the most facilitative for the learning of the concept of identifying plants and animals.

These results are rather interesting and might not be unconnected with the nature of the concepts being studied. Floating and sinking, measuring time and weight are concepts that describe attributes or properties and have some element of abstraction. For example the concept of floating is explained in these terms; 'When a body is floating in a liquid it is said to displace a weight of liquid equal to its own weight.

At the primary school level appropriate scientific terms are required to explain the various ideas or concepts contained in their definition. Examples of such scientific terms are density and volume of water displaced and some element of abstraction is contained in these as far as the primary schools pupils are concerned.

In Nigeria for example science may be regarded as a second culture (Onwu 1990) and there is some deficiency as far as scientific terms are concerned in the mother tongue as the literature reviewed indicated. Therefore, it is not unlikely that the opportunity of the bilingual experimental group to use both English and Yoruba to explain and interpret the meaning of the ideas contained in those definitions of floating and sinking provided the pupils with added conceptual advantage thus culminating in improved performance of this group over the other groups (Yoruba and English). The analysis in respect to identifying plants and animals external features form the basis of identification of these concepts which are example of concepts in the mother tongue from early stage, and Yoruba language was the most facilitative.

In all the analyses in respect of all the selected science concepts (identifying plants and animals, floating and sinking, measuring time and weight) examined English medium was found to be the least facilitating in the learning of these concepts. The relatively poor performance of the English experimental group might be attributed to the lack of adequate knowledge of the pupils in the language of instruction which was English and this provide some support for previous research works which found that instruction in English or foreign language is not as effective as instruction in the bilingual (English and Yoruba) (Ande 1990) or in the mother tongue (Fafunwa 1990, Ibude 1991).

The analysis of MCA and post-hoc with respect to parental education background indicates that the problem encountered in the use of technical and scientific terms that are common features of the concepts under study are overcome by pupils of higher parental educational background due to availability of language facility. With the higher parental educational background, it is likely that the socio-economic status may indeed increased than those parents with lower educational background.

In practice, parents of higher educational background are possibly in a position to provide their children with additional language facility in term of radio, television and other audio-visual or educational aided materials in their homes. Pupils from such higher parental educational background are likely to learn English related programmes particularly scientific or educational programmes and their parents are also probably capable because of their level of education of explaining some of these programmes to their children. There is also the probability that

English Language may also be used as a medium of communication at home. Pupils of higher parental educational background are therefore likely to be brought up in a bilingual home environment. They learn two languages simultaneously at a very early stage. Such pupils are exposed to greater language facility needed to deriving scientific meaning of the primary science concepts that have some amount of abstraction.

The analysis of variance in respect of gender and treatment shows that no significant interaction exist between gender and treatment. In summary, the following conclusions can be drawn. Treatment had significant main effect on the variations in the achievement scores of the pupils in the concept attainment test. The bilingual medium of instruction was the most facilitative in the primary science concepts that describe attributes or properties; floating and sinking, measuring time and weight at the higher levels of concept attainment. The Yoruba language medium was most effective in the attainment of the concept of identifying plants and animals at the primary school level at the higher levels of concept attainment.

The English Language medium of instruction appeared the least facilitative in the attainment of the selected science concept at the higher levels of concept attainment. Yoruba medium was the most facilitative for pupils of lower parental educational background in the learning of the concept of identifying plants and animals while bilingual medium was the most effective for pupils of higher parental educational background in the learning of the concepts of floating and sinking, measuring time and weight which demand some level of abstraction.

Gender of the pupils did not play any significant role in the performance of the pupils in the selected primary science concept with respect to the treatment given.

Going by the findings of the study, it is expected to be beneficial to the pupils in the learning of primary science, if teachers becomes aware that bilingualism (Yoruba and English) could be used as a medium of instruction for teaching those concepts that require various levels of abstraction at the basic level. The use of bilingualism for instruction in primary school will also possibly increase the scope of the child knowledge because the problem of many significant concepts today particularly in science that do not have words representing them in the Nigerian mother tongue will likely be eliminated using both language (English and Yoruba) at the basic level.

Finally, teachers curriculum planners and government should work towards improving the orthography in science in the Nigerian languages.

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