CONSTRUCTIVIST INSTRUCTIONAL STRATEGY AND PUPILS' ACHIEVEMENT AND ATTITUDE TOWARDS PRIMARY SCIENCE

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Abstract. The study investigated a constructivist instructional strategy and pupils' achievement in and attitude towards primary science. The population was 650 Basic-5 pupils in 21 public primary schools in Western Senatorial District of Rivers State, Nigeria. The sample of 180 pupils was drawn from four intact classes from four schools in the area. Primary Science Achievement Test (PAST) and Primary Science Attitude Scale (PSAS) were the instruments used for the study. Test-retest reliability coefficient and Cronbach alpha 21 reliability was 0.82 for PSAT and 0.85 for PSAS, respectively. Four research questions and four corresponding null hypotheses guided the study. Analysis of covariance (ANCOVA) and multiple classification analysis (MCA) were used in analyzing the data. Results showed that the constructivist strategy was more effective than expository strategy in facilitating pupils' achievement in and attitude towards primary science. Pupils' from urban

schools performed significantly better than pupils from rural schools under each of the two methods. The researchers advocated for the use of constructivist strategy by primary science teachers among their recommendations.

Keywords: constructivism, achievement, attitude, primary science

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Introduction

Science and technology have become a yard stick for measuring the rate of economic development and advancement of the countries. Scientific advancements are reflected in various aspects of their national cultures and practices, including political stability.

In trying to emulate the developed countries of the world, the developing nations, including Nigeria, have made vigorous attempts aimed at scientific and technological advancement. For instance, the objective of science education in Nigeria, as for back as the 1947 education policy, has been to introduce the child to the understanding of nature.[1)] In the era of regional government in Nigeria, science in terms of nature studies, agriculture and hygiene were emphasized. In the National Policy of Education, one of the cardinal goals of science education includes the development of scientific literacy among the citizens.

Presently, primary science is one of the two subjects in the primary school system which is taught by specialist teachers. The other is the English language. Indeed, the Nigerian government places so much emphasis on the inculcation of scientific literacy in the primary school pupils that the teaching of primary science features prominently in the annual workshops organized for primary school teachers in Nigeria. Such care and attention by government justify the assertion by (Ahiakwo, 2005) that the solution to scientific and technological take-off of Nigeria must start from the primary school since it is the foundation of our educational system on the whole. The Nigerian government, be it military or civilian, attaches much importance to science

and technology in the modernization process. This is evidence in government policy, for instance a special ministry of science and technology is erected. Moreover the federal government has yielded the ratio of 60:40 in favour of science for admission into all forms of tertiary institution in Nigeria.

The National Policy on Education FRN, 2004, emphasizes the importance of primary science by making one of the objectives of primary education to be the laying of a sound foundation for scientific and reflective thinking. The policy also speaks volumes on the appropriate use of instructional strategies in the teaching and leaning of primary science, which is meant to be practical, explanatory and experimental. Despite these efforts by government, students' achievement in primary science is not always commendable. Most often, the blame is leveled on the primary science teachers who are said to use wrong approaches in teaching Primary Science particularly the expository method. Achievement and better attitude towards science can only be achieved through a paradigm shift from the traditional method to such an approach that would enhance the development of science process, skills and scientific attitude. Such approach is the constructivism strategy.[2)] The strategy, according to Agulana & Nwachukwu (2004), focuses on meaning-making and knowledge construction and not mere memorization. In this approach the learner learns by personally and uniquely developing an understanding and making sense of information. The constructivist strategy is considered a veritable tool for shifting science teaching from the traditional chalk and talk method, which is teacher–centered, to the hand–on method, which is learner–centered. The constructivist strategy focuses on problem - solving, constructing and reconstructing ideas and methods.

The constructivist strategy fits into the model called 'experiential designs' (Etuk & Afangide, 2008). The instructional strategies subsumed under this model involve the learners as active participants in the learning process. Attention is shifted from the subject-matter content to the method used in im-

parting the knowledge. The emphasis in the use of the constructivist instructional strategy is on the development of learning skills, information search and retrieval and on learning how-to-learn (Etuk & Afangide, 2008). Cognitive skills are expectedly acquired in the course of interactions. The learning skills so acquired would remain life-long while the specific intellectual skills are likely to be forgotten with time (Bigge, 1971).

Advantage of the constructivist instructional strategies include enhancement of a child's natural curiosity, development of creative and manual skills, utilization of the child's environment for teaching and learning and holistic development of the child. These provide basic tools for educational advancement of the child for useful living in the society, within the limits of an individual's capacity. Brooks & Brooks (1993) identified the effectiveness of constructivist strategy in teaching science concepts in the United States of America. Holloway (1999) also researched on the constructivist strategy and noted its effectiveness in academic achievement in chemistry in Washington schools. In Nigeria, the works of Nworgu,[2)] Ochilangua (2001) and Awodeyi (2005) all emphasized the effectiveness of constructivist strategy in enhancing school achievement and development of positive attitude towards the study of science in secondary schools.

Most works done on the use of constructivist strategy was at the secondary school level. Hence, this study investigated the constructivist strategy and pupils' achievement in primary science and attitude towards science in Western Senatorial District of Rivers State of Nigeria.

Statement of problem

The Nigerian primary science programme lays much emphasis on the development of science process skills in the primary school pupils; the development of literacy and the scientific skills. Despite the emphasis by the educational policy as evidenced in the curriculum, most Primary Science teachers

still teach in the non-scientific fashion. They teach science without the necessary facilities, often times with chalk and talk. Poor teaching method by primary school teachers would likely generate untold negative multiplier effects, including poor performance and negative attitudes towards science in the later school lives. When such happens Nigeria would be deprived of possible successful science and technology experts and such an ugly situation would not engender the much needed technological development of Nigeria. Therefore the major concern of this study was to investigate the effect of constructivist instructional strategy on pupils' achievement in and attitude to primary science. To this end four null hypotheses were formulated to guide the study.

Research hypotheses

(1) There is no significant difference between pupils' achievement in primary science when taught using a constructivist against an expository instructional strategy; (2) There is no significant difference between pupils' attitudes towards primary science when taught using a constructivist as against an expository instructional strategy; (3) There is no significant difference between urban and rural pupils achievement in primary science when taught using a constructivist as against an expository instructional strategy; (4) There is no significant difference between urban and rural pupils' attitude towards primary science when taught using a constructivist as against an expository instructional strategy.

Research method

This study used the 2x2 pre-test control group designs. The population was 650 primary 5 pupils in 21 public primary schools in western Senatorial District in Rivers State of Nigeria. The sample was 180 pupils drawn using the criterion sampling technique. The instruments used for the study were Primary Science Achievement Test (PSAT) and Primary Science Attitude Scale

(PSAS). The PSAT had 20 items designed to test the pupils' attitude towards primary science and measured in a 4 point scale. A test re-test reliability coefficient of 0.82 was established for PSAT and Cronbach alpha reliability coefficient of 0.83 for the PSAS.

Pupils in the experimental group were taught using constructivist strategy while the control group was taught using expository strategy. Lesson packages were based on simple machines. Four intact classes of pupils' dawn from four selected schools were used. Two classes (the control group) were taught using expository strategy while the other two classes (the experimental group) were taught using constructivist strategy where by the pupils were given problems to solve, ideas to construct and to reconstruct. The two groups were administered a pre-test before and post-test after the treatment. A pre and post attitude questionnaire was also administered. Data were analyzed using analysis of covariance (ANCOVA) and multiple classification analysis (MCA).

Results

Table 1. One way analysis of covariance (ANCOVA) of post-test scores of pupils' achievement taught using a constructivist and an expository instructional strategy using pre-test scores as covariates

Source of variation	Sum of square	df	Mean square	F	Sig.
Covariate pretest	149.555	1	149.55	1.656	.200
Main effect instructional	2768.169	1	2762.169	30.587	.000
Strategy	2911.724	2	1455.862	16.121	.000
Model	5984.187	177	90.306		
Residual	8895.911	179	105.584		
Total					

significant at .05 level; critical F2, 177 = 3.06; N= 180

The entries in Table 1 indicate that instructional strategy main effect was significant at $p < .05$ alpha level. The calculated F-value of 16.121 is

greater than the critical F-value of 3.06 at .05 with 2 and 177 degrees of freedom. Thus, the null hypothesis which stated that there is no significant difference between pupils' achievement in primary science when taught using a constructivist as against an expository instructional strategy is rejected. This implies that there is a significant difference between the academic achievement of pupils taught using constructivist and those taught using expository instructional strategy.

Consequently upon the observed difference in the main effect, multiple classification analysis (MCA) was considered to determine the index of relationship and also determine the variance of the independent variable (achievement) in primary science that is attributable to the influence of the independent variable (instructional strategies) as shown in Table 2.

Table 2. Multiple classification analysis (MCA) of the post-test scores of pupils taught using constructivist as against an expository instructional strategy

Grand mean = 74.02	N	Unadjusted		Adjusted for independent and covaiates
Variable + category		Dev'n	Eta	Dev'n Beta
Teaching strategies			0.38	0.38
Constructivist	93	3.78		3.79
Expository	87	-4.05		-4.05
Multiple R. = 0.393				
Multiple R. Squared = 0.154				

Table 2 indicates that instructional strategies (constructivist and expository) have an index relationship of 0.14 (Beta value of 0.38^2) with the academic achievement of pupils in primary science. Table 2 also indicates that the deviation of adjusted post-test score of pupils taught with the constructivist strategy from the grand mean of 74.02 is 3.79 while the deviation of the adjusted post-test scores of pupils taught using the expository strategy difference from the grand mean of 74.02 is -4.05. This implies that the pupils taught

using expository instructional strategy achieved significantly higher than pupils' taught with expository instructional strategy. The multiple regression index ® of 0.393 and multiple regression squared index (R^2) of 0.154 implies that 15.4% of the variance in the enhancement of pupils achievement in primary science was attributed to the influence of instructional strategies.

Table 3. One way analysis of covariance (ANCOVA) of attitude scores of pupils taught using a constructivist as against an expository instructional strategy with pre- test scores as covariate

Sources of variation	Sum of squares	df	Mean square	f-cal.	F-crit.	Decision p<.05
Pretest	382-16	1	382.16	30.31	3.89	*
Main effect	1948.32	1	1948	154.51	3.89	*
Explained	2352.74	2	1176.37	93.29	3.04	*
Residual	2231.63	177	12.61			
Total	4514.85	179	38.63			

*significant at p<.05 alpha level

As shown in Table 3, instructional strategies main effect was significant at p<.05 alpha level. The calculated F-ratio of 154.51 is greater than the critical F-ratio of 3.89. Thus the null hypothesis which stated that there is no significant difference between pupils' attitude to primary science when taught using a constructivist as against an expository instructional strategy was rejected and the alternate hypothesis upheld. This implies that there is a significant difference between the attitudes of pupils taught using a constructivist instructional strategy as against the expository instructional strategy. Consequent upon the observed difference in the main effect, multiple classification analysis (MCA) was considered to determine the index of relationship and also determine the variance of the dependent variable (attitude) to primary science that is attributable to the influence of the independent variable (teaching strategies) as shown in Table 4.

Table 4. Multiple classification analysis (MCA) of the attitude scores of pupils taught using a constructivist as against an expository instructional strategy

Grand mean	N	Unadjusted	Adjusted for independent and covaiates		
Variable + category		Dev'n	Eta	Dev'n	Beta
Teaching strategy			0.64		0.66
Constructivist	92	3.92		3.97	
Expository	88	-3.75		-3.77	
Multiple R. = 0.725					
Multiple R. squared = 0.526					

As shown in Table 4, the instructional strategies (constructivist and expository) have an index relationship of 0.64 (Beta value of o.66[2]) with the attitude of pupils to primary science. Table 4 also indicates that the deviation from the grand mean of 70.15 of the adjusted pos-test scores of pupils taught using the constructivist instructional strategy is 3.97 while the deviation of the adjusted post-test scores of pupils taught using expository instructional strategy is -3.77. This implies that pupils taught using the constructivist strategy have more positive attitude to primary science than pupils taught using the expository instructional strategy. The multiple regression index R of 0.725 and multiple regression squared index (R^2) of 0.526, imply that 52.6% of the variance in the attitude of pupils to primary science was attributable to the influence of instructional strategies (constructivist and expository instructional strategies).

Table 5. 2 x 2 factorial analysis of covariance (ANCOVA) of post-test scores of urban and rural pupils using pre-test as covariates and taught using a constructivist and an expository instructional strategies

Source of variation	Sum of squares	df	Mean square	F	Sig.
Covariate pre-test	149.555	1	149.555	1.934	.266
Main effect	4895.916	2	2447.958	31.657	.000
Teaching strategy	2762.169	1	2762.169	35.720	.000
School location	2133.747	1	2133.747	27.593	.000
2-way interactions teaching strategy school location	318.038	1	318.038	4.113	.044
Model	5363.509	4	1340.877	17.340	.000
Residual	3532.403	175	77.328		
Total	18895.911	179	105.564		

significant at .05 level; critical F4, 175 – 2, 43, N = 180

Table 5 shows that the calculated F-value of 17.340 is greater than the critical F-value of 2.43 at .05 alpha levels. Thus, the null hypothesis which stated that there is no significant difference between urban and rural pupils achievement in primary science when taught using a constructivist as against an expository instructional strategies is rejected. This implies that school location had an influence on the academic achievement of pupils in primary science when taught using a constructivist instructional strategy as against an expository instructional strategy. Since the difference in the main effect was significant, multiple classification analysis (MCA) was considered to determine the index of relationship and also determine the variance of the dependent variable (achievement) in primary science that is attributable to the influence of the independent variable (school location) as shown in Table 6.

Table 6. Multiple classification analysis (MCA) of the post-test scores of pupils from urban and rural schools taught using a constructivist strategy as against an expository instructional strategy

Grand mean = 74.02	N	Unadjusted		Adjusted for independent and covariates	
Variables + category		Dev'n	Eta	Dev'n	Beta
School location			0.38		0.34
Urban	101	3.40		3.08	
Rural	79	-4.35		-3.93	
Multiple R. = 0.517					
Multiple R. Squared = 0.267					

Table 6, reveals that school location (urban and rural) has an index of relationship of 0.12 (beta value of 0.34^2) with the academic achievement of pupils in primary science. Table 6 also shows that the deviation of the adjusted post-test scores of urban school pupils' from the grand mean of 74.02 is 3.08 while the deviation of the adjusted post-tests scores of pupils' from rural schools from the grand mean of 74.02 is -3.93. This implies that pupils from urban schools achieved significantly higher than pupils from rural schools with a multiple regression index R of 0.517 and multiple regression squared index R^2 of 0.267. It implies that 26.7% of the variance in the enhancement of pupils' achievement in primary science was attributable to the influence of school location, when taught with a constructivist and an expository instructional strategy.

Table 7. 2 x 2 factorial analysis of covariance (ANCOVA) of attitude scores of pupils from urban and rural schools taught using a constructivist strategy as against an expository instructional strategy

Sources of variation	Sum of squares	df	Mean squares	F-cal	F-crit	Decision at p<.05
Pretest	382.16	1	382.16	24.25	3.89	*
Main effect	1949.43	2	974.72	61.85	3.04	*
SCH-LCT	1886-49	1	1886.49	119.70	3.89	*
TEA-STR	2135.08	1	2135.08	135.47	3.89	*
2-way interaction						
SCH-LCT * TEA-STR	20.74	1	20.74	1.32	3.89	NS
STR	2863.82	4	715.96	45.43	2.41	*

Explained	2957.61	175	15.76
Residual	5621.43	179	31.40
Total			

*= significant at p<.05 alpha level; NS = not significant at p<.05 alpha level SCH-LCT = school location; TEA-STR = teaching strategy

Table 7 shows that the calculated F-ratio of 61.85 is greater than the critical F-ratio of 3.89. Therefore, the null hypothesis stating a non-significant difference between the attitudes of pupils towards primary science when taught using a constructivist strategy as against an expository instructional strategy is rejected. This implies that school location has influence on the attitude of pupils to primary science when taught using a constructivist and expository instructional strategies. Consequently upon the significant difference the school location main effect, multiple classification analysis (MCA) was considered to determine the index of relationship and also determine the variance of the independent variable (attitude) towards primary science that is attributable to the influence of the independent variable (school location) as shown in Table 8.

Table 8. Multiple classification analysis (MCA) of the attitude scores of pupils from urban and rural schools taught using a constructivist strategy as against an expository instructional strategy

Grand mean = 70.15	N	Unadjusted		Adjusted for independent and covariates	
Variables + category		Dev'n	Eta	Dev'n	Beta
School location			0.66		0.57
Urban	95	2.96		2.72	
Rural	85	-4.38		-3.61	
Multiple R. = 0.632					
Multiple R. Squared = 0.399					

As shown in Table 8, school location (urban and rural) has an index of relationship of 0.66 (beta value of 0.57^2) with attitude towards primary sci-

ence scores of pupils. Table 8 also shows that the deviation of the adjusted attitude scores of pupils from the urban and from the grand mean of 70.15 was 2.72 while the deviation of the adjusted attitude scores of pupils from rural schools from the grand mean of 70.15 was -3.61. This implies that pupils from urban schools have more positive attitude towards primary science than pupils from rural schools. With a multiple regression index (R) of 0.632 and multiple regression squared index (R^2) of 0.399, it implies that 39.9% of the variance in the attitude of pupils towards primary science is attributable to the influence of school location.

Discussion

A significant difference was established in the science achievement of pupils taught using the constructivist and the expository strategy. The pupils taught using the constructivist achieved significantly better than those taught using expository instructional strategy. This agrees with earlier findings by Marshall (1992) and Ormrod (2004) to the effect that the constructivist strategy makes for greater achievement by pupils. A possible explanation for this is that the constructivist strategy involves the pupils more in the instructional process, both individually and in groups. The pupils would remember better what they participated in, in doing because they involved more sense organ than just the ear. They made use of their hands and eyes in the least.

A significant difference existed between the attitudes of pupils towards primary science when taught using the two strategies. The pupils taught using the constructivist instructional strategy developed a more positive attitude towards primary science than pupils taught using the expository strategy. This findings agrees with the findings of Kizito (2005) and Okoli (2006) who all attested to the superiority of the constructivist instructional strategy over the expository strategy, both in enhancing pupils achievement and in the development of more positive attitude towards the study of science. A possible ex-

planation to this is that when learners participate effectively in the teaching/learning process and so achieve higher, they tend to have a sense of satisfaction, growth and advancement and so develop stronger positive attitude towards the learning tasks. Pupils from urban schools achieved significantly more than pupils from rural schools. However, this finding contradicts to the statements of Okebukola (1993, 2002) and Oraifo (1997) as if no significant difference between the achievement of pupils in urban and rural schools.

A possible explanation for the better performance of pupils in urban schools is found in the facilities which are better because state government use primary schools in urban areas to show-case their performances. Moreover, schools in urban areas are staffed with more qualified teachers mostly wives of government officials who are made to stay permanently in the cities close to where their husbands work in order not to separate families. The assertion and findings by Okebukola (1993, 2002) and Oraifo (1997) that no significant difference existed between a primary science performance of pupils in rural and urban areas raises some doubts, knowing the degree of deprivation of pupils in rural areas, in terms of failure to master the language of instruction; in terms of lack of home support for academics and in terms of lack of well qualified teachers. If pupils in rural areas measure up in school achievement to pupils in the urban areas, the teachers of the earlier group might be more dedicated to their work.

Pupils from the urban schools had more positive attitudes than pupils from the rural schools. This finding is at variance with findings by Okebukola (1993, 2002) and Oraifo (1997) that no significant difference existed in pupils' attitudes towards science be it rural or urban. A possible explanation for this variation is that in the present civilian government in Nigeria, the government has done a great deal in lifting the image of primary schools. Roofs of buildings have been replaced and new structures have been set up and boreholes sunk in primary schools. These are done because of the Universal Basic

Education (UBE) scheme. Hither to, primary schools were left for the local government to manage. The structures were dilapidated and teachers most often did not receive their monthly salaries on time. The story is different in the UBE era when the federal government has stepped into the scene with parity funding of primary schools. Schools in the urban communities seem to be more favoured in the amenities because they are located in the seats of governments.

Conclusion

The study investigated pupils' achievement in and attitude towards primary science using two instructional strategies, the expository and the constructivist strategies. The constructivist strategy is not a single strategy but a collection instructional strategy which make for experiential learning by pupils. The strategy used in this study was the problem-solving strategy. The superiority of other constructivist strategies like the project method, the open classroom and the inquiry method over the expository instructional strategy need to be investigated.

Recommendations

Based on the findings, it was recommended that: (1)The constructivists instructional strategy should be emphasized in teacher education curriculum at all levels to enable teachers have good background of the strategy; (2) Textbooks authors should expose the readers more to the use of the constructivist strategy by writing about it in their books; (3) Teachers should as much as possible use the constructivist strategy in teaching topics in Primary Science; (4) Employees of teachers should organize seminars, workshops and conferences at periodic intervals for primary science teachers on the use of the constructivist strategy in teaching primary science; (5) Government should make teaching in the rural area more attractive by providing special incentives for

teachers in rural schools; (6) Primary school head teachers' should work hand in hand with the Science Teachers Association of Nigeria (STAN) to establish science clubs in order to nourish pupils' interests and attitudes towards science.

Limitation

The pupils in the study were not taught by the same teacher. Although all the teachers who participated in the project were trained by the researchers, variations due to individual differences in the teachers are not ruled out.

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