COMPARATIVE EFFECTS OF EXPLICIT AND SCAFFOLDING INSTRUCTIONAL STRATEGIES ON BASIC SCIENCE AND TECHNOLOGY PUPILS' ATTITUDE AND ACHIEVEMENT IN SOUTHERN SENATORIAL DISTRICT, KADUNA STATE, NIGERIA

[1]Agu, Peter Ashlame and [2]Samuel, Iwanger Ruth

Department of Science, Technology and Mathematics Education,
Faculty of Education, Nasarawa State University, Keffi, Nigeria

ABSTRACT

This study compared the Comparative Effects of Explicit and Scaffolding Instructional Strategies on Basic Science and Technology Pupils' Attitude and Achievement in Southern Senatorial District, Kaduna State, Nigeria. Two research questions and two null hypotheses guided the study. Quasi-experimental, non-equivalent pretest, post-test, post-post-test control group design was employed for the study. The population of the study comprised 8,796 Mid basic III Pupils in public coeducational schools in Kaduna South Senatorial District, Kaduna State, Nigeria. The sample of the study comprised 85 Mid basic III pupils from two intact classes randomly selected from public coeducational schools in Kaduna South Senatorial District, Kaduna State, Nigeria. Basic Science and Technology Achievement Test (BASTAT) and Basic Science and Technology Attitude Questionnaire (BASTAQ) were used as instruments for data collection. The reliability of BASTAQ was determined using Cronbach Alpha and the coefficient obtained was 0.79 while that of BASTAT was determined using Kuder-Richardson formula 20 (KR_{20}) and this yielded a reliability coefficient of 0.80. Mean and Standard Deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance. Findings of this revealed significant difference between the attitude and achievement of BST pupils exposed to explicit and scaffolding instructional strategies in favour of the explicit group. These results therefore show that explicit and scaffolding instructional strategies are workable teaching strategies for Basic Science and Technology. Based on the findings of this study, it was recommended that; Explicit and scaffolding instructional strategies should be used by teachers of BST in Basic schools to teach the subject.

Keywords: Achievement; Attitude; Basic Science and Technology; Explicit and Scaffolding Instructional Strategies

INTRODUCTION

Basic Science and Technology education has become one of the best avenues to meet the global challenges facing the Nigerian nation. Despite the benefits of Basic Science and Technology

in the country's quest for technological advancement, there has been seeming ineffectiveness in the teaching and learning of the subject which in turn is strongly affecting the attainment of the country's laudable objectives and goals of developing a scientific and technologically literate citizenry. Researchers such as Bukunola and Idowu (2012), Osokoya (2013), Alabi (2014), Oni (2014) Kabutu, Oloyede and Bandele (2015) and Samuel (2017) attested that that poor instructional strategies employed in the teaching of Basic Science and Technology by teachers contribute to students under achievement. Students find it difficult to understand the basic concepts taught, hence a child that is not well grounded in Science and Technology at the basic level, will not show interest in offering core science and technology subjects at the Senior Secondary level.

Despite the relevance of science and technology to national development, security, economy, manpower and government's efforts to improve Science and Technology instruction in schools, students' achievement in its subjects is below average. This has become a great concern for Science and Technology educators especially at the foundational level. Researchers such as Nwadinigu and Azuka-Obieke, (2012); Igoegwu and Okonkwo, (2012); Bukunola and Idowu, (2012); Amoo, (2013); Kola and Taiwo, (2013); Osokoya, (2013); Alabi, (2014); Oni, (2014); Kabutu, Oloyede and Bandele, (2015); Samuel, (2017); Agu and Samuel, (2018); Eriba and Samuel, (2018) and Agu and Samuel (2019), opined that underachievement in science, technology and mathematics among secondary school students could be attributed to several factors such as poor teaching, psychological factors, unpreparedness on the part of the students, poor learning environment, school location, gender stereotyping, dearth of qualified teachers among others. As a result of the decline in science, technology and mathematics students' achievement, stakeholders in the sector agree that the huge investment in science and technology education is not yielding the desired dividend. Agu and Samuel, (2018); Eriba and Samuel, (2018); Agu and Samuel (2019) observed that poor instructional strategies employed in the teaching of science subjects by teachers contribute to students under achievement. Students find it difficult to understand the concepts taught. In order to achieve the objectives of Science and Technology education, the student-activity-based mode of teaching strategies have been recommended by the Federal Republic of Nigeria (FRN, 2014).

Explicit teaching involves directing students' attention toward specific learning in a highly structured environment. It is teaching that is focused on producing specific learning outcomes. Topics and contents are broken down into small parts and taught individually. It involves explanation, demonstration and practice at the same time. Children are provided with guidance and structured frameworks. Topics are taught in a logical order and directed by the teacher (Gauthier, Mellouki, Simard, Bissonnette & Richard, 2004). Another important characteristic of explicit teaching involves modeling skills and behaviors and modeling thinking. This involves the teacher thinking out loud when working through problems and demonstrating processes for students. The attention of students is important and listening and observation are key to success. Explicit teaching is useful for introducing topics and specific skills. It provides guided instruction in the basic understanding of required skills, which students can then build on through practice, collaboration, repetition, hands on activities and developmental play (Bissonnette, Richard, Gauthier & Bouchard, 2010).

According to Gauthier, Bissonnette and Richard (2013), explicit instruction can be divided into three sequential steps: **modeling, guided or directed practice**, and **independent practice**. The modeling step promotes the understanding of the learning objectives for students. Guided practice allows students to practice using the technique and to consolidate their understanding through group work. Independent practice provides students with learning opportunities to acquire and master the target skills. The steps are further described by the authors as follows:

i. Explicit instruction begins with modeling. This step consists of the teacher demonstrating a task to students and describing exactly what is being done as it is being done. The goal of the modeling step is for the teacher to explicitly state the *what, why, how, when* and *where* of what they are doing. The information is presented in small units, in a graduated sequence, usually ranging from simple to more complex, not only to meet the working memory limitations of students, but also to enhance the connections between new and prior knowledge. The teacher can then use examples of what to do and what not to do to more directly highlight the skills they are trying to teach to students, to facilitate their understanding of the learning objectives and thus improve the quality of modeling.
ii. After modeling, the next step of explicit instruction is guided practice, also referred to as directed practice, which allows students (with the proper supports) to succeed in achieving

the desired learning objectives. It also helps students to gain the confidence and motivation necessary to continue their learning. This step is conducive to group work activities, which gives the teacher the opportunity to circulate and confirm that all students have understood the lesson. It also allows students not only the opportunity to try the tasks that were modeled, but ensures that they receive feedback on their finished work. Guided practice helps students to "verify, adjust, consolidate and to deepen their understanding of the learning taking place, by connecting their new learning with that which is already present in their long term memories".

iii. Finally, independent practice allows students to put themselves in new learning situations where they can apply what they have understood from the modeling and guided practice steps. This final learning step provides students an opportunity to test out their understanding in order to obtain the highest level of mastery possible, with the goal of consolidating their learning. This step also identifies any students who may be in need of some additional support before they move on.

Scaffolding is the teaching strategy that emphasizes the teaching of new skills by engaging students collaboratively in tasks that would be too difficult for them to complete on their own. The teaching strategy emphasizes on the role of teachers and other more skillful persons in supporting the learner's development and providing support structures to get to that next stage or level (Nonye & Nwosu, 2011). The teaching strategy originated from Lev Vygotsky socio-culture theory and his concept of Zone of Proximal Development (ZPD). His socio-cultural theory spelt out that social interaction plays an important role in the development of cognition. In his view, the learner does not learn in isolation, rather learning is strongly influenced by social interactions, which take place in meaningful contexts. The Zone of Proximal Development (ZPD) is that area between what a learner can do independently (mastery level) and what can be accomplished with the assistance of a competent adult or peer (Instructional level). It is believed that any learner could be taught any concept effectively using scaffolding techniques by applying the scaffolding at the ZPD.

Scaffolding as a teaching strategy depends heavily on the ideas that learners come to any educational setting with a great deal of pre-existing knowledge, some of which may be incorrect. It is the process of building on what a learner already knows that makes scaffolding an effective instructional technique. According to Olson and Prath (2000) and Casem (2013), in instructional scaffolding, a more knowledgeable order provides scaffolds

to facilitate the learner's development. These can be in the form of support which may include resources, a compelling task, templates, and guides, guidance on the development of cognitive and social skills. The scaffolds facilitate a student ability to build on prior knowledge and internalize new information. The activities provided in scaffolding instruction are just beyond the level of what the learner can do alone. An important aspect of scaffolding is that the scaffolds are temporary. Ibritam, Udofia, and Onweh (2015) asserted that as the learners' abilities increases, the scaffolding provided by the more knowledgeable person is progressively withdrawn. Finally, the learner is able to complete the task or master the concept independently.

LITERATURE REVIEW

Researchers such as Ajila (2003); Olagunju and Babayemi (2014) and Agu and Samuel (2019) found that the use of Explicit Instructional strategy is effective in science classroom as it enhances achievement among Science students. Casem (2013) studied the effects of scaffolding strategy on students' performance in Mathematics. The study revealed that the students taught mathematics concepts through scaffolding performed better than those taught through lecture method. Equally, Olatubosun (2013) investigated the effects of using scaffolding strategy on the academic achievement of students in integrated science in Junior secondary school (JSS). Results showed that students exposed to scaffolding strategy performed significantly better than their counterparts who were exposed to the traditional method. Akani (2015) conducted research on the effects of instructional scaffolding on the achievement of senior secondary students in Chemistry. The result obtained revealed that there is a significant difference in the mean score of students exposed to scaffolding strategy and conventional method of instruction.

Ibritam, Udofia, and Onweh (2015) conducted a study to determine the difference in students' achievement in Block-laying and concreting using Scaffolding and Demonstration instructional methods in technical colleges. The result showed that there is no significant difference in the mean achievement scores of the students taught using scaffolding instructional strategy and those taught using instructional demonstration method. Uduafemhe (2015) undertook a study to determine the comparative effects of scaffolding and collaborative instructional approach on secondary school students' psychomotor achievement in Basic Electronics. Findings revealed that instructional scaffolding and

collaborative instructional approaches are effective in improving students' achievement in Basic Electronics. However, the collaborative instructional approach was more effective than instructional scaffolding strategy. Adamu (2017) studied the effects of Analogy and scaffolding instructional strategies on senior secondary school Physics students' academic achievement. The two experimental groups were taught using Analogy and Scaffolding instructional strategies while the control group was taught using the lecture method. The finding of the study showed that there is a significant effect of treatment on students' academic achievement.

Atsumbe, Owodunni, Raymond and Uduafemhe (2018) carried out a study to determine the effects of scaffolding and collaborative instructional approaches on students' achievement in Basic Electronics. Results revealed that a collaborative instructional approach is more effective in improving student achievement in Basic Electronics than a scaffolding instructional approach. Also, gender had no significant influence on students' achievement in Basic Electronics when taught using scaffolding and collaborative instructional approaches. It was concluded that the collaborative instructional approach is a viable teaching method for improving students' achievement in Basic Electronics. Joda (2019) carried out a study to determine the effect of instructional scaffolding strategy on senior secondary school Biology Students' academic achievement and retention of concepts. The findings show that the students taught with instructional scaffolding strategy have significantly higher academic achievement than those taught with lecture method.

Attitude as a concept is concerned with an individual's way of acting and behaving. It has very serious implications for the learner, the teacher, the immediate social group with which the individual learner relates and the school system. Attitudes are formed as a result of some kind of learner experiences. They may also be learned simply by following the examples, opinions of parents, teachers or friends. This is imitation which also has a part to play in the teaching and learning situation. In this respect, the learner draws on his teacher's deposition to form his own attitude which may likely affect his learning outcomes (Eriba, 2013). Negative attitude can lead to low expectations on students' academics. Also teaching strategies can influence the attitude of students positively or negatively. Reports have shown that improved instructional strategy affects the attitude of students. Gambari and Yusuf (2017), Fatokun and Samuel (2018) reported that

students taught using cooperative learning strategy had positive attitude towards studying science and technology.

There has been the continuous poor attitude and academic achievement of students in science and technology subjects generally and especially at the elementary level. Researchers believe that the instructional strategies adopted by Basic Science and Technology teachers have generally contributed to students' poor attitude and academic achievement in BST. Therefore, there is the need to explore other ways of presenting BST concepts to the learners at the basic level to enhance meaningful learning. This calls for the use of learned-centered strategies such as Explicit and Scaffolding Instructional Strategies. This study is therefore, aimed at determining the effects of explicit and scaffolding strategies on BST Pupils' attitude and achievement in Southern Senatorial District of Kaduna State, Nigeria.

RESEARCH QUESTIONS

The following research questions were formulated to guide the investigation.

1. What are the mean attitude ratings of BST pupils' exposed to explicit and scaffolding instructional strategies?
2. What are the mean achievement scores of BST pupils' exposed to explicit and scaffolding instructional strategies?

HYPOTHESES

The following null hypotheses which were tested at an alpha level of 0.05 guided the study.

Ho_1: There is no significant difference in the mean attitude ratings of BST pupils' exposed to explicit and scaffolding instructional strategies.

Ho_2: There is no significant difference in the mean achievement scores of BST pupils' exposed to explicit and scaffolding instructional strategies.

METHODOLOGY

Quasi-experimental, non-equivalent pretest, post-test, post-post-test control group design was employed for the study. The population of the study comprised 8,796 Mid basic III Pupils in public coeducational schools in Kaduna South Senatorial District, Kaduna State, Nigeria. The sample of the study comprised 85 Mid basic III pupils from two intact classes randomly selected

from public coeducational basic schools in Kaduna South Senatorial District, Kaduna State, Nigeria. The experimental groups I (n=45) and II (n=40) were taught using Explicit and Scaffolding Instructional Strategies respectively. Basic Science and Technology Achievement Test (BASTAT) and Basic Science and Technology Attitude Questionnaire (BASTAQ) were used as instruments for data collection. BASTAT consisted of 30 multiple choice achievement test items with 4-options A-D designed to measure students' achievement. BASTAQ contained 20 items designed to determine students' attitude in Basic Science, it was rated using a four-point rating scale. The options were; Strongly agreed (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagreed (SD) = 1 point. The instruments were subjected to content and face validity by two experts in Science Education from Nasarawa State University, Keffi, Nasarawa State and Technology Education, Federal University of Technology, Minna, Niger State. The reliability of BASTAQ was determined using Cronbach Alpha and the coefficient obtained was 0.79 while Kuder-Richardson formula 20 (KR_{20}) was used to establish that of BASAT and this yielded a reliability coefficient of 0.80. Mean and Standard Deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance.

RESULT

RESEARCH QUESTION ONE

What are the mean attitude ratings of BST pupils' exposed to explicit and scaffolding instructional strategies?

Table 1

Mean Attitude Ratings of Treatment Groups Taught Basic Science and Technology with Explicit and Scaffolding Instructional Strategies Using BASTAQ

Groups	Number	Pre-test Mean	SD	Post-test Mean	SD	Attitude Gain
EIS (A)	45	12.95	0.54	31.46	0.84	18.51
SIS (B)	40	15.24	0.62	29.42	0.86	14.18

EIS = group with Explicit Instructional Strategy, SIA = group with Scaffolding Instructional Strategy.

Table 1 shows that the mean attitude gain of the Explicit Instructional Strategy group is 18.51 and that of the Scaffolding Instructional Strategy group is 14.18. Therefore, explicit

instructional strategy appears to be have improved the attitude of BST pupils more than scaffolding instructional strategy in Basic Science and Technology.

RESEARCH QUESTION TWO

What are the mean achievement scores of BST pupils' exposed to explicit and scaffolding instructional strategies?

Table 2

Mean Achievement Scores of Treatment Groups Taught Basic Science and Technology with Explicit and Scaffolding Instructional Strategies Using BASTAT

Groups	Number	Pre-test Mean	SD	Post-test Mean	SD	Mean Gain
EIS (A)	45	15.92	0.59	33.77	0.87	17.85
SIS (B)	40	13.41	0.58	29.98	0.87	16.57

EIS = group with Explicit Instructional Strategy, SIA = group with Scaffolding Instructional Strategy.

Table 2 shows that the mean achievement gain of the Explicit Instructional Strategy group is 17.85 and that of the Scaffolding Instructional Strategy group is 16.57. Hence, explicit instructional strategy appears to be more effective than scaffolding instructional strategy in Basic Science and Technology.

HYPOTHESIS ONE

There is no significant difference in the mean attitude ratings of BST pupils' exposed to explicit and scaffolding instructional strategies.

Table 3
ANCOVA Test of Significance on Students' Attitude in Basic Science Using BSAQ

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Square
Corrected model	2373.011	1	2373.011	542.109	.000*	.658
Intercept	3011.124	1	3011.124	365.511	.000*	.932
Pre-attitude	137.088	1	137.088	92.24	.000*	101
Group	4221.602	1	4221.602	641.181	.000*	523
Error	2170.315	81				
Total	26521.496	85				

Table 3 reveals that the calculated F-ratio of 641.181 was found to be greater than the critical F-ratio of 3.86. Therefore, the null hypothesis at 0.05 alpha level was rejected. This implies that there is a significant difference in the mean attitude ratings of BST pupils exposed to Explicit and Scaffolding Instructional Strategies.

HYPOTHESIS TWO

There is no significant difference in the mean achievement scores of BST pupils' exposed to explicit and scaffolding instructional strategies.

Table 4

ANCOVA Test of Significance of treatment on Basic Science and Technology Pupils' achievement.

Source of Variation	Sum of Square	Df	Mean Square	F	Sig. Level	Partial Eta Square
Corrected Model	2135.600	1	2135.600	325.344	.000*	.257
Intercept	2335.332	1	2335.332	54.698	.000*	.062
Pretest	247.378	1	247.378	989.473	.000*	.402
Groups	559.416	1				
Error	2314.325	81				
Total		85				

Table 4 reveals that the calculated F-ratio of 989.473 was found to be greater than the critical F-ratio of 3.86. Therefore, the null hypothesis at 0.05 alpha level was rejected. This implies that there is a significant difference in the mean achievement scores of BST pupils exposed to Explicit and Scaffolding Instructional Strategies.

DISCUSSION

The findings of this study revealed significant difference between the achievement and attitude of BST pupils exposed to explicit and scaffolding instructional strategies in favour of the explicit group. These findings are in agreement with the findings of Ajila (2003), Okilwa (2011), Agoro (2012), Agboola and Oloyede (2013), Olagunju and Babayemi (2014) and Agu and Samuel (2019) who in their different researches revealed that Explicit instructional strategies enhances students' achievement. The findings of this study are at variance with that of Casem (2013), Olatubosun (2013), Ibritam, Udofia, and Onweh (2015), Akani (2015),

Uduafemhe (2015), Adamu (2017) and Joda (2019) who asserted that instructional scaffolding strategy has a better effect on academic achievement. The increase in students' achievement and attitude scores could probably be because they were excited to have acted like teachers and given opportunities to teach and learn among their peer groups. Teaching, instructing, demonstrating and presenting instructions like their teachers promoted their attitude towards learning or studying Basic Science and Technology.

CONCLUSION

The findings of this study revealed significant difference between the achievement and attitude of BST pupils exposed to explicit and scaffolding instructional strategies in favour of the explicit group. These results therefore show that explicit and scaffolding instructional strategies are workable teaching strategies for Basic Science and Technology.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. Explicit and scaffolding instructional strategies are recommended for teachers of BST and other related trade subjects in secondary schools for use in the teaching of their subjects;
2. It is recommended that the Nigerian Educational Research and Development Council (NERDC) should consider incorporating explicit and scaffolding instructional strategies into the teaching of subjects like BST when next they are reviewing the curriculum.

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