Effects of Scaffolding Instructional Strategy on Students' Academic Achievement in Basic Science by Gender and Birth Order in Yenagoa Metropolis of Bayelsa State

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Abstract
The study investigated the effects of scaffolding instructional strategy on junior secondary school students' achievement in Basic Science by gender and birth order. A pretest-posttest, control group, quasi-experimental design was adopted. One hundred and twenty-six (126) JS2 students in Yenagoa metropolis of Bayelsa State, Nigeria, was purposively selected for the study. Two schools were randomly assigned to experimental and control groups and the study lasted for six weeks. Three instruments were used for the study. They were two Instructional Guides and Basic Science Achievement Test (BSAT) with a reliability of 0.89 using Kuder-Richardson Formula 21(KR-21). Two research questions were answered and two null hypotheses were tested at 0.05 level of significance. Mean and standard deviation was used to analyze the research questions and Analysis of Covariance (ANCOVA) for the hypotheses. Treatment had no significant effect on students' achievement in Basic Science by gender and birth order. This shown by the 2-way interaction of instructional strategies on gender and birth order ($F_{1,121} = 0.175; p > 0.05$; partial eta squared = 0.001 which gives an effect size of 0.1 percent) and ($F_{1,121} = 0.471; p > 0.05$; partial eta squared = 0.004 which gives an effect size of 0.4 percent). The findings showed that scaffolding instructional strategy improved students' achievement in Basic Science equally despite differences in gender and birth order. It was recommended among others that, teachers should adopt scaffolding instructional strategy to improve students' achievement and to eliminate gender and birth order differences in Basic Science among secondary schools students.

Keywords: Scaffolding instructional strategy, Basic Science**,** birth order, gender

Introduction

Science is the deliberate, purposeful, systematic and organized study of the creation of God. This include the whole universe both living and non-living things. Abdulahi in Alake and Ogunsemi (2013) defined Science as the conscious and systematic search for an organized knowledge. The definition of Basic Science as is given by Omiko (2015) as science that express the fundamental unity of scientific thought and avoiding premature or undue stress on the distinction between various scientific fields. Basic science involves the study of elementary physics, chemistry and biology as a single science subject in the junior secondary school. Basic science studies also involve bringing together traditionally separate science topics so that students grasp a more authentic understanding of science.

The study of Basic Science is very important as it seeks to lay the foundation for the development of scientific knowledge, skills and attitudes that will make the learner capable of understanding and manipulating events and happenings in the environment (Alake & Ogunsemi, 2013). They further stated that, the subject also affords students the ability to learning about themselves. It also offers the basic training in basic skills required for human survival, sustainable development and societal transformation. It is expected that academic achievement of students should be good at all levels. However, this is not the case in most times. Okoro (2012) observes that achievement of students in science education is poor in Nigeria. The poor achievement of students is attributed to many factors. Okoro (2012) attributed the poor achievement of science to the way it is presented dogmatically in most schools by its teachers as a series of disjointed facts and concepts which students find difficult to relate with the real world. Studies have been carried out to investigate the possible cause of low achievement and how to increase students' learning of the subject. Other variables like inadequate time, improper teaching methods, teachers' competency and inadequate instructional materials are considered to contribute to low achievement in science (Danjuma, 2009).

Ebiye (2011) posited that in applying lecture strategy, the teacher does most of the talking during the lesson, giving new ideas, expressing an opinion, explaining various points, occasionally writing on the board and making use of instructional materials. It is a one-way traffic because the teacher gives ideas while the students receive them. Thus, one of the problems of this method is to grab the attention of students in the classroom. Another big problem is that, many students in the classroom cannot follow the theme of what the teacher is teaching (Umar, 2012).

However, there are recommended teaching strategies that may improve students' achievement in science such as scaffolding instructional strategy. Juce and Braz in Omiko (2015) stated that it is best to think of uses of instructional scaffolding in an effective learning environment as one would think of the importance of scaffolding in the support of the construction of a new bridge or building. Scaffolding represents the helpful interactions between a teacher and learners that enable the learners to learn something beyond their independent efforts (Omiko, 2015). Van de Pol, Volman & Beishuizen (2010) posited that scaffolding is a teaching method that can focus on the development of the child in its entire facet. Van de Pol *et-al* further state that if the student gains understanding, the teacher can fade over time. While fading the support, the teacher can also transfer the responsibility to the student so that the learner can take more and more control over his/her learning. Weinstein and Preiss (2017) found that scaffolding promote critical thinking and learner autonomy among pre-service education students. Aditi (2017) found that students taught using the scaffolding strategy performed better than those taught by the traditional methods in terms of their academic achievement in science. Aditi also found that students taught using the scaffolding strategy developed a positive attitude towards science.

Ayodele, Adebayo and Ayeni, (2014) studied the power of selected variables on students' academic achievement in basic science and found that, gender and birth order affect the academic achievement of the students. Gender refers to the social construction of the relations between male and female in terms of certain roles that are seen as exclusively for females and others for males (Imasuen & Omorogbe, 2016). It is a social connotation that has sound psychological background, used to refer to specific cultural patterns of behaviour that are attributable to human sexes as male and female (Akpochafo in Peter, 2014). It refers to social differentiation of humans as males and females and the assigning of certain responsibilities that may be unique on the basis of that differentiation.

Another factor that has been found to affect students' academic achievement is their birth order in the family. Birth order is the chronological order of siblings' birth in a family. It refers to the order a child is born in the family; first born and second born are examples. Birth Order is often believe to have profound and lasting effect on psychological development and academic achievement of students. Groose in Princewill (2016) noted that the position of a child in his family is a powerful predictor of academic achievement and it is a factor that parents and teachers need to consider as they look for ways to raise happy and well-adjusted children. However, Edwards and Thacker in Tshui and Cai (2011) found no association between birth order and grade point average. Hauser and Sewell in Tshui and Cai (2011) also reported no significant birth order effect on academic achievement. This research is based on constructivism. The constructivists' perspective posited that learning is not passively received from the world or from authoritative sources but constructed by individuals or groups making sense of their experiential world (Maclellan & Soden in Yilmaz, 2008).

Statement of the Problem

Basic science is very important as it lays the foundation to the study of other science subjects. The proper implementation of the basic science curriculum in such a way that it does not show any disparity in academic achievement among male and female students and on other learner variables like birth order is a concern to science educators. The lecture instructional strategy which is predominantly used by teachers, may have contributed to low academic achievement and disparity in learner variables in basic science. Therefore, this study examines the effect of scaffolding instructional strategy on students' achievement in basic science by gender and birth order.

Research Questions

The following research questions were used to guide the study:

1. What difference exists between male and female students' achievement in basic science when taught with scaffolding instructional strategy and those taught with modified lecture instructional strategy?

2 What difference exists between first-second born and later born students' achievement in basic science when taught with scaffolding instructional strategy and those taught with modified lecture instructional strategy?

Null Hypotheses

The following null hypothesis was used to guide the study:

$H0_1$. There is no statistically significant difference between male and female students' achievement in basic science when taught with scaffolding instructional strategy and those taught with modified lecture instructional strategy

$H0_2$. There is no statistically significant difference between first-second born and later born students' achievement in basic science when taught with scaffolding instructional strategy and those taught with modified lecture instructional strategy

Methodology

The study adopted a pretest-posttest, control group, quasi-experimental design. Two schools were purposively selected and randomly assigned to treatment and control groups. The selection of schools was based on the following three criteria:

1. The schools must be public schools.
2. The teachers must be specialist in basic science and have been teaching basic science for at least four (4) years.
3. The teachers must be willing to be involved in the experiment.

One intact class was randomly selected for treatment and control group from the two schools. A total of 126 students (males=55, females=71) were involved in the study. Three instruments were used in this study, namely:

1. Instructional Guide on Scaffolding Instructional Strategy (IGSIS)
2. Instructional Guide on Modified Lecture Instructional Strategy (IGMLIS)
3. Basic Science Achievement Test (BSAT)

IGSIS and IGLIS were used as teaching guides for the experimental and control groups respectively. The Basic Science Achievement Test (BSAT) had a reliability of 0.89 using Kuder-Richardson Formula 21 (KR-21). All the instruments were duly validated by expert review. The first two weeks were used for training the participating teachers in each of the schools by the researchers on the use of IGSIS and IGLIS. The third week was used for the administration of pre-test by the teachers and researchers on BSAT. The next two weeks (weeks 4-5) were used for the administration of treatment to experimental group; Scaffolding Instructional Strategy (SIS) and control group; Modified Lecture Instructional Strategy (MLIS) and week six was used for the administration of posttest on BSAT by the teachers and researchers. The data collected were analyzed using Analysis of Covariance (ANCOVA). This was adopted to test the hypotheses using pre-test scores as covariates. The research questions were analyzed using mean and standard deviation.

Results

Research Question 1: What difference exists between male and female students' achievement in basic science when taught with scaffolding instructional strategy and those taught with modified lecture instructional strategy?

Table 1: Summary of mean and standard deviation of pretest and posttest scores on the effect of instructional strategies on male and female students' achievement in Basic science**.**

Instructional strategies	Gender	N	Pretest scores $\bar{X}$ SD	Posttest scores $\bar{X}$ SD	Mean gain scores

Scaffolding Strategy	Male	28	24.43	9.20	63.29	15.48	38.86
	Female	41	24.29	7.45	62.93	13.77	38.64
	Total	69	24.35	8.14	63.07	14.38	38.72
Modified Lecture	Male	27	33.19	9.97	49.19	13.96	16.00
Strategy	Female	30	33.87	7.63	48.13	11.03	14.26
	Total	57	33.54	8.74	48.63	12.40	15.09
Total	Male	55	28.73	10.47	56.36	16.25	27.63
	Female	71	28.34	8.86	56.68	14.59	28.34
	Total	126	28.51	9.56	56.54	5.28	28.03

The data presented in Table 1 show that the post-test mean score of male students taught with scaffolding strategy ($\bar{X}$=63.29, SD=15.48) was greater than their female counterparts with ($\bar{X}$=62.93, SD=13.77). Also the post-test mean score of male students taught with modified lecture strategy ($\bar{X}$=49.19, SD=13.96) is greater than those of their female counterparts with ($\bar{X}$=48.13, SD=11.03). On the total, the post-test mean score of female students taught with scaffolding and modified lecture strategies is ($\bar{X}$=56.68, SD=14.59) is greater than their male colleagues with ($\bar{X}$=56.36, SD=16.25). The Table further indicates that, the mean gain score of female students taught with both instructional strategies 28.34 was greater than those of their male colleagues with 27.63.This simply implies that; the achievement of female students was slightly greater than those of their male colleagues when taught with both instructional strategies.

Research Question 2: What difference exists between first-second born and later born students' achievement in basic science when taught with scaffolding instructional strategy and those taught with modified lecture instructional strategy?

Table 2: Summary of mean and standard deviation of pretest and posttest scores on the effect of instructional strategies on first-second born and later-born students' achievement in Basic science**.**

Instructional strategy	**Birth order**	**N**	**Pretest scores** $\bar{X}$	**SD**	**Posttest scores** $\bar{X}$	**SD**	**Mean gain scores**
Scaffolding	First-second	30	25.73	8.38	66.40	14.04	40.67
strategy	born	39	23.28	7.89	60.51	14.28	37.23
	Later born	69	24.35	8.14	63.07	14.38	38.72
	Total						
Modified	First –second	27	31.70	8.37	47.11	13.04	15.41
lecture strategy	born	30	35.20	8.88	50.00	11.85	14.80
	Later born	57	33.54	8.74	48.63	12.40	15.09
	Total						
Total	First-second	57	28.56	8.83	57.26	16.59	28.70
	born	69	28.46	10.19	55.94	14.19	27.48
	Later born	126	28.51	9.56	56.54	15.28	28.03
	Total						

The data presented in Table 2 shows that the post-test mean score of first-second born students taught with scaffolding strategy ($\bar{X}$=66.40, SD= 14.04) was greater than their later born counterparts with ($\bar{X}$ =60.51, SD=14.28). Also the post-test mean score of first-second born students taught with modified lecture strategy ($\bar{X}$ =47.11, SD=13.04) is less than those of later born counterparts with ($\bar{X}$ =50.00, SD=11.85). On the total, the post-test mean score of first-second born students taught with scaffolding and modified lecture strategy is ($\bar{X}$ =57.26, SD=16.59) greater than their later born colleagues with ($\bar{X}$ =55.94, SD=14.19). The Table further indicates that, the mean gain score of first-second born students taught with both instructional strategies 28.70 was greater than those of their later born colleagues with 27.48.This simply implies that; the achievement of first-second born was slightly greater than those of their later born colleagues when taught with both instructional strategies.

Null Hypothesis 1: There is no statistically significant difference between male and female students' achievement in basic science when taught with scaffolding instructional strategy and those taught with modified lecture instructional strategy.

Table 3: 2 x 2 factorial analysis of covariance (ANCOVA) of post-test scores of male and female students' achievement in Basic science when taught with scaffolding and modified lecture instructional strategies.

Source of Variation	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Decision p < 0.05
Corrected Model	16339.3	4	4084.83	38.518	.000	.560	
Intercept	6168.80	1	6168.80	58.169	.000	.325	
Pretest Scores	9812.07	1	9812.07	92.524	.000	.433	
Instructional	13809.8	1	13809.81	130.221	.000 *	.518	
Strategies							
Gender	30.271	1	30.271	.285	.594	.002	
2Way-interactions Instructional Strategies * Gender	18.574	1	18.574	.175	.676	.001	NS
Error	12831.961	121	106.049				
Total	431960.000	126					
Corrected Total	29171.302	125					

*R Squared = .560 (Adjusted R Squared = .546) *= Significant at p < 0.05 alpha level*

The data in Table 3 shows that the interaction effect was not significant on male and female (gender) students' achievement in Basic science ($F_{1,121} = 0.175$; $p > 0.05$; partial eta squared = 0.001), which gives an effect size of 0.1 percent. Therefore, the null hypothesis which states that "there is no statistically significant difference between male and female students' achievement in Basic Science when taught with scaffolding strategy and those taught with modified lecture strategy" was upheld.

Null Hypothesis 2: There is no statistically significant difference between first-second born and later born students' achievement in basic science when taught with scaffolding instructional strategy and those taught with modified lecture instructional strategy

Table 4: Two-way analysis of covariance (ANCOVA) of post-test scores of first-second born and later born students' achievement in Basic Science when taught with scaffolding and modified lecture instructional strategies.

Source of Variation	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**	**Decision p < 0.05**
Corrected Model	16488.85	4	4122.21	39.32	.000	.565	
Intercept	6209.61	1	6209.61	59.24	.000	.329	
Pretest Scores	9273.16	1	9273.16	88.47	.000	.422	
Instructional Strategies	14075.73	1	14075.73	134.293	.000*	.526	
Birth Order	129.155	1	129.15	1.232	.269	.010	
2Way-interactions Instructional Strategies * Birth Order	49.354	1	49.354	.471	.494	.004	NS
Error	12682.44	121	104.814				
Total	431960.00	126					
Corrected Total	29171.302	125					

*R Squared = .565 (Adjusted R Squared = .551) *= Significant at p < 0.05 alpha level*

The data in Table 4 shows that the interaction effect was not significant on first-second born and later born (birth order) students' achievement in Basic science ($F_{1,121} = 0.471$; $p > 0.05$; partial eta squared = 0.004), which gives an effect size of 0.4 percent. Therefore, the null hypothesis, which states that "there is no statistically significant difference between first-second born and later born students' achievement in Basic Science when taught with scaffolding and modified lecture instructional strategies", was retained.

Discussion of Findings

The findings of the study revealed that there is no significant difference in the achievement of male and female students taught using scaffolding instructional strategy. This finding agrees with those of Alao and Abubakar (2010), that there was no significant difference between male and female students' academic achievement in physics. Also, Oludipe (2012) found that there was no significant difference between male and female students' academic achievement in basic science. The study also agrees with the findings of Godspower-Echie (2017), that there was no significant difference in the academic achievement of male and female students in integrated science. However, this finding disagrees with those of Omiko (2015) that male students performed better than female students in chemistry. Also, Akala (2010) found that boys performed better than girls in chemistry. The study further show that, boys performed better than girls in mathematics-related chemistry while girls performed better than boys in descriptive chemistry. Nnamani and Oyibe (2016) found that female students performed better than male students in social studies.Also, the findings of the study revealed that there was no significant difference in the achievement of first-second born and later born students in basic science taught using scaffolding instructional strategy. This finding agrees with those of Tshui and Cai (2011) that there is no association between students' birth order and academic achievement. Nutall, Polit and Hunter in Tshui and Cai (2011) reported that first born girls had better academic attainment than the last born girls. Princewill (2016) found that last born child performed better than middle born.

These findings point out to the fact that using scaffolding instructional strategy in basic science lessons has a great possibility of enhancing students' understanding and achievement in Basic Science. However, the findings disagrees with the finding of Ha and Tam (2011) that first born performed better than later born in terms of academic achievement. Also, Groose in Princewill (2016) noted that the position of a child in a family is a powerful predictor of personality and academic achievement and it is a factor that parents and teachers need to consider as they look for ways to raise happy and well-adjusted children.

Conclusion

Scaffolding instructional strategy is suitable for both male and female students for it shows no significant difference in the achievement of boys and girls in basic science. The same is true of birth order differences in academic achievement of students in basic science. So, it is a good strategy that can be used in teaching basic science to eliminate gender and birth order differences of students' achievement in basic science. These findings point out to the fact that using scaffolding strategy has a great positive effect on students' achievement and a powerful and effective instructional innovation that promises great academic benefits for students.

Recommendations

Based on the findings of the study, the following recommendations are made.

1. Basic Science teachers and educators should adopt scaffolding instructional strategy in the classroom teaching to enhance students' achievement and to eliminate gender and birth order differences in Basic Science among secondary school students.
2. The Federal and State government and other educational bodies should organize workshops and in-service training programmes as well as seminars on regular basis for secondary school Basic Science teachers on the use of innovative strategies, like the use of scaffolding instructional strategy for the implementing the Basic Science curriculum.

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