Effect of Deep Conceptual and Think Pair Share Strategies on Students Academic Performance in Basic Science

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Abstract

The study examined the effect of deep conceptual and think pair share strategies on students academic performance in Basic Science. The study adopted a quasi experimental design. Through stratified random sampling, a sample size of 128 junior secondary two (JS2) Basic Science students were selected. The students were grouped into experimental and control groups. Deep conceptual and think pair share were used to teach the experimental groups while the control group was tutored using the conventional instructional method.. Three research questions and three hypotheses guided the study. Mean was used to answer research questions while t-test was used to test hypotheses at 0.05 level of significance. Results obtained indicate that there was a significant difference between the experimental group and the control group. Performance of students in the experimental group was better than those in the control group. Therefore, recommendations were made.

Keywords: Deep Conceptual and Think Pair Share, Strategy, Achievement

Introduction

Science is seen as a body of knowledge, a way of investigation and thinking in pursuit of an understanding of nature. The way this science is being taught and learned in school is called science education (Ogunyebi, 2018). Science education plays a vital role in the lives of individuals and the development of a nation because it enhances nation's technological development. Obikezie (2022) averred that a well developed and implemented science and technology education programme of a country will not only produce knowledgeable and skilled manpower for the workforce but also usher in sustainable socio-economic growth

and political stability in that country. Science educations to which Physics, Chemistry and Basic Science form the bases focus not only on producing excellent scientists but also, to produce citizens who use their knowledge to advance the society (Obikezie & Abumchukwu 2021). As a result, students are being encouraged to take up science-related courses within the content of science education which Basic Science subject is one of them.

Basic Science has been identified as a very important subject and as a core subject taught at the senior secondary school in Nigeria. Basic Science is the study of living things which includes plants and animals (Michael, 2015). It deals with living organisms including their structure, function, evolution, distribution and inter-relationships. Basic Science curriculum is designed to continue students' investigation into natural phenomena, deepening students' understanding, achievement, interest and retention in biological science and to encourage students' ability to apply scientific knowledge to everyday life because of its importance to humanity. Furthermore, Obikezie et. al. (2022) asserted that importance of Basic Science to humanity includes it helps man understand the living world and the ways its many species function, evolve, and interact. But despite all these importance of Basic Science to humanity, the West Chief examiners' reported weaknesses in some concepts of Basic Science.

West African Examination Council Chief examiners' reports averred that from year 2011 to 2022, individually summarized that weaknesses of students in Basic Science subject includes (i) poor performance in questions.

That require application knowledge (ii) inability to identify the samples skeleton parts (iii) poor knowledge in cell structure and functions of the cell (iv) poor knowledge in forms in which living cell exist (v) Basic ecological concepts, Ecosystem: components and sizes, (vi)Local biotic communities or biomes: tropical rain forest, Northern guinea savanna, sahel, desert, (vii) Population studies by sampling method: population size, dominance, density, factors that affect population (viii) inability to identify concept in ecological factors: aquatic, terrestrial and factors common to all habitats (ix) transport system (Blood circulation) (x) respiration and (xi) respiratory mechanism in man. One could imagine while WAEC Chief Examiners' should be reporting these weaknesses in

Basic Science concepts every year from 2011 to 2022. The question now is what could be the causes of these under achievement and weaknesses among secondary school students in Biological concept of blood circulation also known as transport system for these twelve years?

Osuafor and Ogbaga (2016) opined that the major causes of weaknesses in secondary school Basic Science especially in the areas of blood circulation in senior secondary school examination is lack of use of innovative instructional strategy in teaching the students. The authors stated that innovative instructional strategies like deep conceptual and think-pair-share may help to improve the achievement of secondary school students in science related subject especially in teaching Biological concept of blood circulation.

Deep conceptual instructional strategy is an integrated understanding of important concept. Ogbaga (2022) reported that students who learn via deep conceptually are likely knowledgeable than those who only learn theoretical fact and procedures. Dehghan (2013) outlined the following rule in deep conceptual strategy as: withhold criticism within the session, Focus on the number of ideas generated by its group or individual members, documentation of ideas generated. Combine and improve ideas. These rules help use of deep conceptual strategy in classroom to be more effective. Deep conceptual strategy encourages learner to express their suggestion or ideas quickly and easily without much processed thought or reflection (Peter, 2016; Jacob et. al., 2016; Drits-Esser & Stark 2015). Most researchers believed that deep conceptual strategy is effective in enhancing students' achievement and interest in Basic Science, but had no significant effect on male and female students in the said subject (Hoffman & Turner 2015; Osuafor & Ogbaga 2016). Based on the findings, the researchers concluded that deep conceptual strategy is effective in improving students' achievement in Basic Science. Bilal-Adel (2012) observed that there are statistical significant differences at the level of ($\alpha = 0.05$) between the experimental group and the control group in the total score and the sub scores of the creative thinking in the favor of the experimental group indicating the effectiveness of using deep conceptual strategy in developing creative thinking skills. Owo et. al. (2016) observed that there is a statistical significant difference in both mean knowledge and mean academic achievement of students taught sciences with deep conceptual strategy and those

taught with conventional strategy in favour those taught in deep conceptual group and there is no statistical significant difference in the mean academic achievement of male and female students taught Basic Science using deep conceptual instructional strategy. Hidayanti et. al. (2018) reported that there is a statistical significant differences between experimental and control group in creative thinking skills test with the score of 0.70. The result is in favour of the experimental group, indicating there was effectiveness of deep conceptual strategy in developing students' creative thinking skills in learning nutrition just as when think pair share instructional strategy was used to teach the same concept (Hidayanti et. al. 2018).

Another concept under study is think-pairshare (TPS). Think-pair-share (TPS) strategy is one of the group discussion strategies and diverse method of learning collaboratively. This strategy was developed by Frank Lyman in 1981. Andrew and Alexandra, (2015) defined think-pair-share as a cooperative learning strategy that encourages students to work together to solve problems or answer questions on an assigned topic. TPS is used to keep all students actively involved in class discussion and provides an opportunity for everyone to share their idea and answer to every question posed by the teacher. Some researchers believed that think pair share effectively enhances students' achievement in science subjects (Drits-Esser & Stark 2015). Ogunyebi (2018) observed that there is a significant difference between the posttest means scores of students exposed to think-pair share and conventional strategies. The researcher revealed that there is no significant difference between the posttest means scores of male and female students exposed to think-pair and conventional strategies. Nwaubani et. al. (2016) averred that both Think-pair-share (TPS) and student teams-achievement (STAD) significantly improved students' achievement in economics. The researchers also revealed that female students achieved better than their male counterparts when both instructional strategies were used. The researchers concluded that both TPS and STAD could enhance students' achievement in economics with female students making more significant gain than their male counterparts. Bamiro (2015) observed that students taught with guided discovery and think-pair-share strategies obtained significantly higher posttest mean scores than those in the lecture strategy. The researcher concluded that the use of guided discovery and think-pair-share strategies had great potential for improving achievement in

Chemistry. Most of the study studies reviewed where done under other science subject areas that are not Biological concept of blood circulation. However, despite its importance and usefulness of Basic Science especially in the areas of blood circulation to humanity and other animals there is still weaknesses in the Basic Science concept of blood circulation as summarized by WAEC examiners' report from 2011-2022. One of the major contributing factors to this ugly state of learning as revealed by most studies and WAEC chief examiner's report is the teachers' instructional strategy of instruction. The conventional instructional strategies adopted by most Basic Science teachers fail to help students make connections between what is learnt and the real. The resultant effect is further decline in academic achievement after learning Basic Science. Deep conceptual and TPS instructional strategies have been found effective in improving students' achievement of learning materials in some subjects like Mathematics, Chemistry, Nutrition science, Computer science, Integrated Science and even in some Basic Science concepts but no such study known to the researchers has been carried out in basic science concept of blood circulation (Common Core State Standards Initiative, 2016). On this note the researchers investigated on the effect of deep conceptual and think-pair-share strategies on students' academic achievement in biological concept of blood circulation in Awka metropolis.

Research Questions

The following three research questions guided this study:

1. What is the difference in the mean achievement scores of three groups of students taught Biological concept of blood circulation using , think-pair-share (TPS) strategy, deep conceptual strategy and those taught using conventional strategy?
2. What is the difference in the mean achievement scores of male and female students taught basic science concept of blood circulation using TPS strategy?
3. What is the difference in the mean achievement scores of male and female students taught basic science concept of blood circulation using deep conceptual strategy?

Hypotheses

The following null hypotheses were tested in this study at 0.05 alpha level of significance. They are:

1. There is no significant difference in the mean achievement scores of three groups of students taught basic science concepts of blood circulation using think-pair-share (TPS) strategy, deep conceptual strategy and those taught using conventional strategy.
2. There is no significant difference in the mean achievement scores of male and female students taught basic science concept of blood circulation using TPS.
3. There is no significant difference in the mean achievement scores of male and female students taught basic science concepts of blood circulation using deep conceptual strategy.

Research Method

This study employed a quasi-experimental design which involved 3X2 factorial study. The 3 × 2 factorial indicates the three levels of treatment (deep conceptual, think-pair share and conventional strategies) and two levels of gender (male and female). The sample consists of 128 JS 2 Basic Science students selected from co-educational public school in Obio-Akpor Local government Area. Multi-stage sampling technique was used to draw three co-educational public secondary schools from the sixty co-educational public secondary schools in Obio-Akpor. First, the coeducational schools were listed out according to locations. Secondly, three co-educational schools were purposively selected. The purpose of selecting choice of school was based on coeducational to ensure a balanced representation of gender variable in study. Finally using three ballot papers representing each of the three schools, one of the schools was used as the first experimental group, second one was used as the second experimental group, while and the third was used as control group. First School was assigned as the deep conceptual strategy. Second was assigned as TPS and third was assigned as control group using flip of a coin. The study covered a period of five weeks. First week and first day of second week were used for familiarizing visit and training of the Basic Science teachers in the selected schools who act as research assistants and issuing of pre achievement test. Second day of the second week was used to teach the Basic Science concepts of transport system (Blood circulation) in three selected schools using deep conceptual instructional strategy, TPS instructional strategy and

control group using conventional strategy for three weeks using plan for each instructional strategy which was prepared by the researchers. At the end of the fifth week, both experimental groups and control group were post tested base on what they are taught. The data collected were used for analysis. The instrument for data collection was named Basic Science Achievement Test (BBAT) which was adopted from West Africa Examination Council (WAEC) past questions from (June 2011 -June 2022). The BAT was produced base on the Basic Science concept of transport system (Blood circulation) which consisted of twenty-five (25) objective test. To ensure the reliability of the instrument, the twenty-five (25) objective achievement questions were administered on a group of twenty-five students outside the place of study. The results were subjected to Kuder-Richardson 21 (KR-21). A mean coefficient of 0.71 was obtained indicating that the instrument was reliable. The date obtained from the pretest and posttest were analyzed using mean, standard deviation for research questions and Analysis of Covariance (ANCOVA) to test the hypotheses.

Research Question 1: What is the difference in the mean performance score of students taught basic science and technology with flipped classroom and those taught with group discussion?

Table 1: Mean and Standard Deviation of the Mean Achievement Scores among the Groups.

Teaching Method	N	Pretest		Posttest		Mean gain
		Mean	Std.dev	Mean	Std.dev	
Experiment 1	41	20.46	5.17	47.02	1.42	26.56
Experiment 2	45	19.40	5.48	41.20	1.17	19.30
Control	42	20.45	5.22	32.02	2.50	6.87

The result presented in Table 1 reveals the pretest and posttest mean achievement scores of students taught Biological concept of blood circulation using deep conceptual, think-pair share and conventional strategies. The pretests mean scores for the groups in the deep conceptual, think-pair share, and conventional

strategies are 20.46, 19.40, and 20.45 respectively. The posttest mean scores are 47.02, 41.20, and 32.02 respectively. The mean gain for the three groups are 26.56, 19.30, and 6.87 respectively, which depicts that JS2 students in the think-pair share strategy have the highest mean achievement score, followed by those in the deep conceptual strategy; while the students in the conventional method have the lowest mean achievement score

2. What is the difference in the mean achievement scores of male and female students taught Biological concept of blood circulation using TPS strategy?

Table 2: Mean and Standard Deviation of the differences in the mean Achievement Scores of Students in the Deep Conceptual group based on Gender

Gender	N	Pretest		Posttest		Mean gain
		Mean	Std.dev	Mean	Std.dev	
Male	25	22.04	3.74	47.87	1.82	25.83
Female	16	18.00	6.19	47.95	1.28	29.95

Table 2 reveals the mean pretest and posttest scores of the male and female students taught Biological concept of blood circulation using deep conceptual instructional strategy. The pretest mean score for the male and female students in the group are 22.04 and 18.00 respectively. The posttest mean scores are 47.87 and 47.95 respectively. The mean gains for male and female JS 2 students are 25.83 and 29.95 respectively.

3. What is the difference in the mean achievement scores of male and female students taught Biological concept of blood circulation using deep conceptual strategy?

Table 3: Mean and Standard Deviation of the Mean Achievement Scores among the Groups.

Teaching Method	N	Pretest		Posttest		Mean gain
		Mean	Std.dev	Mean	Std.dev	
Male	27	20.33	4.87	41.33	1.27	21.00
Female	18	18.00	6.17	41.00	1.02	23.00

Table 3 reveals the mean pretest and posttest scores of the male and female students taught Biological concept of blood circulation using deep conceptual instructional strategy. The pretest mean score for the male and female students in the group are 20.33 and 18.00 respectively. The posttest mean scores are 41.33 and 41.00 respectively. The mean gains for male and female JS2 students are 25.83 and 29.95 respectively.

HO 1: There is no significant difference in the mean achievement scores of three groups of students taught Biological concepts of blood circulation using deep conceptual strategy, think-pair-share strategy and that of those taught using conventional strategy

Table 4: The ANCOVA Results of Achievement Scores among the Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	951.893[a]	3	317.298	200.001	.000
Intercept	15426.449	1	15426.449	9723.675	.000
Pretest	1.285	1	1.285	.810	.370
Group	951.752	2	475.876	299.956	.000
Error	196.724	124	1.586		
Total	238423.000	128			
Corrected Total	1148.617	127			

a. R Squared = .829 (Adjusted R Squared = .825)

Data shown in Table 4 reveals the ANCOVA results on the effect of think-pair share, deep conceptual and conventional strategies on students' academic achievement in Biological concept of blood circulation. The results show a significant difference F (2, 128) = 299.95, p = .000< .05. in pretest and posttest mean scores of students taught basic science concept of blood circulation with the three strategies. In all, the null hypothesis is rejected. The result shows that there is a

significant difference in the effect of the three strategies on the students' academic achievement in Biological concept of blood circulation.

HO2: There is no significant difference in the mean achievement scores of male and female students taught Biological concept of blood circulation using TPS.

Table 5: The ANCOVA Results of Mean Achievement Scores of Students in the Think-Pair Share Group based on Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.152[a]	2	.076	.044	.957
Intercept	4945.805	1	4945.805	2858.412	.000
TPS Pretest	.000	1	.000	.000	1.000
TPS Gender	.130	1	.130	.075	.786
Error	65.750	38	1.730		
Total	94338.000	41			
Corrected Total	65.902	40			

a. R Squared = .002 (Adjusted R Squared = -.050)

The data presented in Table 5 shows the ANCOVA results on the effect of think pair share instructional strategy between male and female students taught Biological concept of blood circulation. The results reveal no significant difference in the pretest and posttest mean scores of between the male and female students taught Biological concepts of blood circulation using brainstorming strategy $F(1, 38) = .075$, $p = .786 > .05$. Therefore, the null hypothesis is not rejected. Hence, the result shows that there is no significant difference in the pretest and posttest mean cores between male and female students taught biological concepts of blood circulation using TPS

HO3: There is no significant difference in the mean achievement scores of male and female students taught Biological concepts of blood circulation using deep conceptual.

Table 3 The ANCOVA Results of Mean Achievement Scores of Students in the Deep Conceptual Group based on Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10.932[a]	2	5.466	4.567	.016
Intercept	5859.385	1	5859.385	4895.665	.000
DC Pretest	9.732	1	9.732	8.132	.007
DC Gender	2.986	1	2.986	2.495	.122
Error	50.268	42	1.197		
Total	76446.000	45			
Corrected Total	61.200	44			

a. R Squared = .179 (Adjusted R Squared = .140)

The data presented in Table 6 shows the ANCOVA results on the effect of deep conceptual instructional strategy between male and female students taught Biological concept of blood circulation. The results reveal no significant difference in the pretest and posttest mean scores of between the male and female students taught Biological concepts of blood circulation using deep conceptual $F(1, 45) = .2.49$, $p = .12 > .05$. Therefore, the null hypothesis is not rejected. Hence, the result shows that there is no significant difference in the pretest and posttest mean cores between male and female students taught biological concepts of blood circulation using deep conceptual strategy.

Discussion of Findings

The finding has shown that Basic Science students taught blood circulation using deep conceptual and think-pair-share strategies achieved significantly better in Basic Science Achievement Test (BAT) than those taught with conventional method. The finding is in consonance with Peter (2016), Jacob et. al. (2016) and Bilal-Adel (2012) whom in their different studies observed that deep conceptual and think-pair-share strategies as a lateral thinking process by which students develop ideas or thoughts on solution to problems based on layout criteria. It may also be as a result of new useful ideas and creative thinking that the techniques bring to problems. The result from the conventional strategy suggested the need

to also adopt other teaching strategies in addition that would likely develop adequate content understanding in Basic Science in the secondary schools. This implies that the students in the treatment groups have significant higher gain in their content understanding than those in the control group. Also, the ANCOVA analysis indicated that there is a significant difference between the treatment groups and control group. The findings of this study is not surprising because deep conceptual and think-pair-share encourages students to move from one level of understanding to another as they think out the solution to their problem. More so, the difference may be as a result of the fact that both deep conceptual and TPS provides an opportunity for students to take active role in building their own knowledge. Hence, one would be in a position to say that the students taught using deep conceptual and think-pair-share strategies shifted in their level of understanding as they construct their own knowledge of Biological concepts of blood circulation.

The result of this research shows that there is no significant difference in academic achievement of male and female students taught Biological concept of blood circulation using deep conceptual method. The finding is in line with some researchers' assertion who observed that there was no significant effect on male and female students when taught with deep conceptual instructional strategy (Hidayanti et. al., 2018; Drits-Esser & Stark 2015; Osuafor & Ogbaga 2016; Hoffman & Turner 2015). While the mean gain score of males taught with deep conceptual in this study is presenting a slight mean difference of 1.29 in favour of male student, the slight difference may be as a result level of interaction between the male while learning. But then, deep conceptual strategy has reduced the male domination to the barest minimum by encouraging equal participation.

The result of this research shows that there is no significant difference in the achievement of male and female students taught Biological concept of blood circulation using Think-pair-share. The finding is in consonance with Ogunyebi (2018) observation who revealed that there was no significant difference between the posttest means scores of male and female students exposed to think-pair and conventional strategies. Also the finding of the study is in line with that of Nwaubani et. al. (2016) who revealed that both the Think-pair-share (TPS) and student teams-achievement (STAD) significantly improved students' achievement

in some subjects. While the mean gain score of males taught with TPS in the study is presenting a slight mean difference of 2.81 in favour of female students, the slight difference may be as a result level of interaction between the male while learning. But then, think-pair-share has reduced the male domination to the barest minimum by encouraging equal participation.

Conclusion

The findings of the study revealed that deep conceptual and think-pair-share strategies significantly improved academic achievement of Basic Science students in blood circulation irrespective of gender. The conclusion is that both deep conceptual and think-pair-share strategies are effective strategies for the teaching and learning of Basic Science concepts. It can also be concluded that when Basic Science teachers adopt any or both strategies, student to student interaction increases thereby making students to take responsibility for their learning.

Recommendations

The researcher formulated the following recommendations based on the findings and conclusions made from the study.

1. Teachers should be encouraged by curriculum planners to employ deep conceptual and think-pair-share more often in teaching and learning situation.
2. Higher Institutions involved in teacher education should help to propagate these instructional strategies so as to promote deep conceptual and think-pair-share among the student-teachers of science
3. Curriculum planners and developers in science should include deep conceptual and think-pair-share strategies in restructuring Basic Science curriculum in the secondary schools in order to help students to be creative and retentive in learning.
4. Ministry of education should help teachers through seminars, conferences, support supervision and journal publication to improve their competencies in the use of deep conceptual and think-pair-share strategies for effective teaching of Basic Science. 5. Teachers should direct the presentation of Basic Science lessons away from the traditional methods to a more students-centered approach like deep conceptual and think-pair-share strategies.

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