Effect of Flip Classroom and Think-Pair-Share Instructional Strategies on Students' Retention in Biology in Enugu Education Zone

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Abstract
The study investigated the effect of flip classroom and think-pair-share instructional strategies on students' retention in biology. Three research questions and four null hypotheses guided the study. The design of the study was quasi-experimental. The population of the study comprised of 5,213 senior secondary year two biology students in Enugu Education Zone of Enugu state, out of which 144 students were involved in the study. The instrument used for data collection was Biology Retention Test (BAT) validated by experts from Nnamdi Azikiwe University, Awka with a reliability coefficient of 0.81. The research questions were answered using mean and standard deviation. The null hypotheses were tested at 0.05 level of significance using Analysis of Covariance. The findings of the study showed that students taught using flip classroom had significantly higher retention score than those taught using think-pair-share and conventional methods. It was recommended that teachers of biology should use FCIS to facilitate interaction between students and learning materials, among themselves and with the teacher through online collaborations.

Keyword: *retention, biology, flip classroom, think-pair-share, excretory*

Introduction

Science provides a body of knowledge for use in addressing various forms of human, material and environmental problems. It is composed of two major complementary modes; accumulation of knowledge through exploration and discovery efforts about the natural world, and the use of such knowledge for human and material development (Okoye, 2012). Science is studied and practiced in all parts of the world, including Nigeria. Nigeria, as a developing nation, has an increasing demand for science based skilled manpower which can start with the learning of science subjects such as integrated science, physics, chemistry and biology at the secondary school level. Biology is one of the science subjects which give students understanding into the matters of life and existence. According to FRN (2013) the objectives of the biology curriculum are to prepare students to acquire: adequate laboratory and field skill in biology, meaningful and relevant knowledge of biology, the ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture as well as reasonable and functional scientific attitude. To achieve the objectives, teaching and learning process must engage the students and make them take responsibility for their learning.

A good teacher according to Caine (2012) should organize classroom activities that focus on active role of the learners to construct their own knowledge and understanding through interacting with the environment around them. However, these activities should be interesting to learners and appropriate for their developmental level so that they can use their whole brain to participate in the activities, which will in turn improve their retention of

learning. However, due to time constraints and lack of pedagogical skills for innovative teaching methods, biology teacher often adopt conventional method of teaching leading to poor retention among students.

Retention is an individual's ability to remember and recall information, materials and experiences learned over time. This acquired materials in the mind need to be preserved in form of images for knowledge to develop. When a stimulating situation occurs, retained images are revived or reproduced (Douglass & Morris, 2014). This is why biology concepts need to be presented to the learners in a way or method that touches their sub consciousness, which can trigger quick recalling of the concept being taught or learnt. Okeke (2008) stated that teachers could improve retention of concepts and information by explicitly creating memorable events involving visual or auditory images with projects, plays, simulations and other forms of active learning, to boost student's retention.

According to Okoye (2012) retention is the process of maintaining the availability of new meanings or some part of them. It may be suggested that the amount of the original meaning that will be retained at any given point in time is a variable quantity. Forgetting represents a decrement in the availability of an acquired meaning that describes the loss in availability that occurs between the original establishment of the meaning and its later reproduction. Considering the two terms, retention is seen as a positive aspect of memory while forgetting is seen as the negative aspect. Frequent reviews and tests, elaborated feedback and active involvement of students in learning projects have been associated with longer retention (Okoye, 2012). Okoye further stated that active participation during instruction increases learning and retention. There is need therefore to empirical investigate the potentials of innovative instructional strategies like flipped classroom and think-pair-share for improving retention in biology.

A flipped classroom instructional strategy is an instructional strategy and a type of blended learning that reverses the traditional learning environment by delivering instructional content, often online, outside of the classroom (Alvarez, 2011). It moves activities, including those that may have traditionally been considered homework, into the classroom. In a flipped classroom, students watch online lectures, collaborate in online discussions, or carry out research at home while engaging in concepts in the classroom with the guidance of a mentor. The flipped classroom intentionally shifts instruction to a learner-centered model in which class time explores topics in greater depth and creates meaningful learning opportunities, while educational technologies such as online videos are used to 'deliver content' outside of the classroom. In a flipped classroom, 'content delivery' may take a variety of forms. Often, video lessons prepared by the teacher or third parties are used to deliver content, although online collaborative discussions, digital research, and text readings may be used. A teacher's interaction with students in a flipped classroom according to Aşıksoy and Özdamlı (2016) can be more personalized and less didactic. Thus students are actively involved in knowledge acquisition and construction as they participate in and evaluate their learning (Strayer, 2012).

Think-pair-share instructional strategy (TPSIS) according to Abdurrahman (2015) is an instructional strategy designed to provide students to think on a given topic by enabling them to formulate individual ideas and share the ideas with another student. Think-pair-share instructional strategy engages the learner to think intuitively about the question, pair up with partners, and discuss their possible responses and answers (Othman & Othman, 2012). This strategy does not only mitigate the absentmindedness syndrome that is caused by teachers' excessive long explanations but it also allows students to process information and focus on verbal interaction (Anderson & Esquiredo, 2011). In the researcher's opinion, TPSIS helps students to apply the subject content to real life situations. Using TPSIS strategy leads to new meaningful ways of thinking about problems and solving them through collaborative sharing. Individual student's perspective may change as the student listens to his peer's opinions and

answers. The shy students are encouraged to share their views with less anxiety. Not only this, expression of ideas to and with a partner leads to better understanding of content which in turn improves retention irrespective of gender (Duraman, Shahrill & Morsidi, 2015).

Gender is a set of characteristics distinguishing between male and female, particularly in the cases of men and women which depending on the context, may vary from sex to social role to gender identity (Bland, 2013). According to Okeke (2014) gender is a social or cultural construct, characteristics, behaviour and role that varies from place to place or culture to culture. It is not like sex, which is biologically determined and universal too. Gender related issues in science education have continued to receive serious attention judging from the number of studies done to that effect. Babajide (2011) opined that science subjects, which include physics, biology and chemistry, are given masculine outlook by educational practitioners. In addition to this, studies show that retention in science subjects depends on gender. Some researchers are of the view that female students retain and perform better than males, others disagree with this view, arguing that retention is a factor dependent on several factors such as socio-economic background, and teaching method among others. In view of the above, the issue of gender particularly in relation to students' retention in biology has not yet been resolved. It is with this background that the study on effect of flipped classroom and think-pair-share instructional strategy on students' retention in biology was conceived.

Purpose of the Study

The purpose of this study was to investigate the effects of flipped classroom instruction and think-pair-share instructional strategy on students' retention in biology. Specifically, the study sought to determine the:

1. Difference between the mean retention scores of students taught biology using flipped classroom instruction (FCI), think-pair-share instructional strategy (TPSIS) and those taught using conventional method.
2. Difference between the mean retention score of male and female students taught biology using FCIS.
3. Difference between the mean retention score of male and female students taught biology using TPSIS.
4. Interaction effect of instructional strategies and gender on the retention of students in biology.

Research Questions

The following research questions guided the study:

1. What is the difference between the mean retention scores of students taught biology using flipped classroom instructional strategy (FCIS), think-pair-share instructional strategy (TPSIS) and those taught using conventional method?
2. What is the difference between the mean retention score of male and female students taught biology using FCIS?
3. What is the difference between the mean retention scores of male and female students taught biology using TPSIS?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the mean retention scores of students taught biology using flipped classroom instructional strategy (FCIS), think-pair-share instructional strategy (TPSIS) and those taught using conventional method.
2. There is no significant difference between the mean retention scores of male and female students taught biology using FCIS.

3. There is no significant difference between the mean retention scores of male and female students taught biology using TPSIS.
4. There is no interaction effect of instructional strategies and gender on the retention of students in biology.

Method

The study adopted the quasi-experimental design. The study was carried out in Enugu Education Zone of Enugu state with a population of the study is 5,213 SS2 biology students out of which 144 students which was drawn using a multi-stage sampling procedure. The instrument for data collection is Biology Retention Test (BRT) administered three weeks after a posttest where it was used as an achievement test. The BAT is made of 20 objective questions drawn from past WAEC questions on the selected biology topics with each question having answer option lettered A-D. A table of specification was used to ensure that adequate number of questions were included from each content area taught. The instrument was validated by experts from Nnamdi Azikiwe University, Awka. The reliability of the BAT was established using Kudder-Richardson Formula 20 (KR-20) which yielded a reliability coefficient of 0.81.

The treatment was conducted in two phases. The first phase was the training of the research assistants. The second phase was the treatment for the experimental groups and control group. The experimental groups one and two received treatments using FCIS and TPSIS respectively. In experimental group one, the treatment using FCIS involved the students doing most of the learning outside the classroom with the teacher acting as a facilitator. In the flipped classroom, the teacher provided the students with study hints and guide on what they are expected to know at the end of their study. With the guide and content of learning, the teacher gave students the websites to visit to log in and study on the topic. Students were assigned to internet enabled laptops on which they are to surf internet and watch third party tutorials, videos, animations and text book explanations on the concept being studied. Students were required to write down the knowledge gained to be shared in the classroom during the normal classroom classes.

In the think-pair-share classroom, students were assigned numbers one to four. For each week, students were paired differently after the instruction. In week one, all students assigned one, paired with other students assigned one, same for students with numbers two through to four. In the second week, odd number students were paired together and even numbers too. In the third week, odd numbered students were paired with even numbered students. In the fourth week, students were allowed to choose their partners at random. The essence of the variation in pairing was to ensure that students interact with a good number of other students during their pair activity all through the treatment. In each lesson, the teacher introduced a concepts and what is to be learnt in the classroom, give a brief explanation and ask students to think and read the concept, after that, students were allowed to pair with others. The pairing exercise involved students discusses and sharing ideas only among the pair to further understand what their read and thought about. After the pairing, the students were called at random to explain what they learnt or given exercise to do which were marked by their pairs in the next lesson. The control group were taught using conventional method. Students in the control group were not introduced to the internet and were not involved in any group activities.

BAT was administered as pretest before the commencement of the treatment. This was done without any feedback or revisions. After the treatment, BAT was administered as posttest after the four weeks treatment and as post posttest after three weeks of posttest. The data from each test was collated for analysis. Data relating to the research questions were analyzed using mean and standard deviation. The hypotheses were tested using Analysis of

Covariance (ANCOVA) at 0.05 alpha level. The choice of ANCOVA was to eliminate initial group difference. The decision rule is that the null hypothesis was rejected when Pvalue is less than or equal (P≥0.05) but when Pvalue is greater than 0.05, the null hypothesis will not be rejected.

Results

Research Questions 1: What is the difference between the mean retention scores of students taught biology using flipped classroom instructional strategy (FCIS), think-pair-share instructional strategy (TPSIS) and those taught using conventional method?

Table 1: Mean Retention Scores of Students taught Biology using FCIS, TPSIS and those taught using Conventional Method

Method	N	Posttest Mean	Posttest SD	Retention Mean	Retention SD	Mean Loss
FCIS	50	72.46	6.581	68.96	4.53	-2.50
TPSIS	51	77.31	5.997	74.73	7.91	-2.58
Conventional	43	69.79	4.25	65.66	4.69	-4.13

Table 1 shows that the group taught biology using FCIS has mean loss in achievement score of -2.50, those taught using TPSIS has mean loss in achievement score of -2.58 while those taught using conventional method has mean loss in achievement score of -4.13. The spread of score was greatest in the retention scores of those taught using TPSIS (7.91), followed by those taught using conventional method (4.69) while those taught using FCIS having the least scores spread (4.53).

Research Question 2: What is the difference between the mean retention score of male and female students taught biology using FCIS?

Table 2: Mean Retention Scores of Male and Female Students taught Biology using FCIS

Gender	N	Posttest Mean	Posttest SD	Retention Mean	Retention SD	Mean loss
Male	23	73.09	5.00	69.30	4.15	-3.79
Female	27	71.93	7.80	68.67	8.76	-3.26

Table 2 shows that the male students taught biology using FCIS has mean loss in achievement score of -3.79 while the females has mean loss achievement score of -3.26. The spread of scores was greatest among the females in the posttest (8.76) than among the male (4.15).

Research Question 3: What is the difference between the mean retention scores of male and female students taught biology using TPSIS?

Table 3: Mean Retention Scores of Male and Female Students taught Biology using TPSIS

Gender	N	Posttest Mean	Posttest SD	Retention Mean	Retention SD	Mean loss
Male	28	77.07	4.75	73.43	4.68	-3.64
Female	23	77.61	5.73	76.30	7.80	-1.31

Table 3 shows that the male students taught biology using TPSIS has mean loss in achievement score of -3.64 while the females has mean loss achievement score of -1.31. The spread of scores was greatest among the females in the posttest (7.80) than among the male (4.68).

Hypothesis 1: There is no significant difference between the mean retention scores of students taught biology using flipped classroom instructional strategy (FCIS), think-pair-share instructional strategy (TPSIS) and those taught using conventional method.

Table 4: ANCOVA on Difference between the Mean Retention Scores of Students taught using FCIS, TPSIS, RTS and those taught using Conventional Method

Source of variation	SS	Df	MS	F	P-value	Decision
Corrected Model	2103.839[a]	3	701.280	195.125	.000	
Intercept	3.102	1	3.102	.863	.354	
Posttest	1134.032	1	1134.032	315.534	.000	
Method	229.791	2	114.896	31.969	.000	Sig
Error	503.161	140	3.594			
Total	733632.000	144				
Corrected Total	2607.000	143				

Table 4 shows that at 0.05 level of significance, 1df numerator and 143 df denominator, the calculated F is 31.969 with Pvalue of .000 which is less than 0.05. Thus, the null hypothesis was rejected. Therefore, there is a significant difference between the mean retention scores of students taught biology using FCIS, TPSIS and those taught using conventional method.

Table 5: Scheffe PostHocAnalysis on Significance of Mean Difference in Retention between Groups

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
FCIS	TPSIS	-1.647*	.587	.006	-2.807	-.487
	CLM	2.793*	.501	.000	1.803	3.783
TPSIS	FCIS	1.647*	.587	.006	.487	2.807
	CLM	4.440*	.595	.000	3.263	5.617
CLM	FCIS	-2.793*	.501	.000	-3.783	-1.803
	TPSIS	-4.440*	.595	.000	-5.617	-3.263

Table 5 reveals that significant difference exists between the mean retention scores of students taught using FCIS and TPSIS in favour of TPSIS. Table 5 also reveals that a significant difference exists between the mean retention scores of students taught using FCIS and conventional method in favour of FCIS. Table 5 further shows that there is significant difference between the mean retention scores of students taught using TPSIS and conventional method in favour of TPSIS. This shows that the direction of significance moves from TPSIS followed by FCIS.

Hypothesis 2: There is no significant difference between the mean retention scores of male and female students taught biology using FCIS.

Table 6: ANCOVA on Difference between the Mean Retention Scores of Male and Female Students taught using FCIS

Source of variation	SS	Df	MS	F	P-value	Decision
Corrected Model	11.809[a]	2	5.904	2.718	.076	

Intercept	51.547	1	51.547	23.726	.000	
Posttest	6.758	1	6.758	3.111	.084	
Gender	1.269	1	1.269	.584	.448	Not Sig.
Error	102.111	47	2.173			
Total	237888.000	50				
Corrected Total	113.920	49				

Table 6 shows that at 0.05 level of significance, 1df numerator and 49df denominator, the calculated F is 0.584 with Pvalue of .448 which is greater than 0.05. Thus, the null hypothesis was not rejected. Therefore, there is no significant difference between the mean retention scores of male and female students taught biology using FCI.

Hypothesis 3: There is no significant difference between the mean retention scores of male and female students taught biology using TPSIS.

Table 7: ANCOVA on Difference between the Mean Retention Scores of Male and Female Students taught using TPSIS

Source of variation	SS	Df	MS	F	P-value	Decision
Corrected Model	456.974[a]	2	228.487	9.092	.000	
Intercept	10355.040	1	10355.040	412.046	.000	
Pretest	.790	1	.790	.031	.860	
Gender	177.796	1	177.796	7.075	.010	Sig
Error	1357.061	54	25.131			
Total	425625.000	57				
Corrected Total	1814.035	56				

Table 7 shows that at 0.05 level of significance, 1df numerator and 56df denominator, the calculated F is 7.075 with Pvalue of .010 which is less than 0.05. Thus, the null hypothesis was rejected. Therefore, there is a significant difference between the mean retention scores of male and female students taught biology using TPSIS in favour of the females.

Hypothesis 4: There is no interaction effect of instructional strategies and gender on the retention of students in biology.

Table 8: ANCOVA for Testing of Interaction Effect of Teaching Strategies and Gender on Students' Biology Retention

Source	SS	df	Mean Square	F	Sig.	Decision
Corrected Model	2183.475[a]	6	363.912	117.717	.000	
Intercept	9.516	1	9.516	3.078	.082	
Posttest	600.963	1	600.963	194.397	.000	
Method	237.759	2	118.880	38.455	.000	
Gender	9.270	1	9.270	2.998	.086	
Method * Gender	49.305	2	24.652	7.974	.001	Sig
Error	423.525	137	3.091			
Total	733632.000	144				
Corrected Total	2607.000	143				

Table 8 shows that at 0.05 level of significance, 1df numerator and 143 df denominator, the calculated F is 7.974 with Pvalue of .001 which is less than 0.05. Thus, the null hypothesis

was rejected. Therefore, there is no interaction effect of instructional strategies and gender on the retention of students in biology.

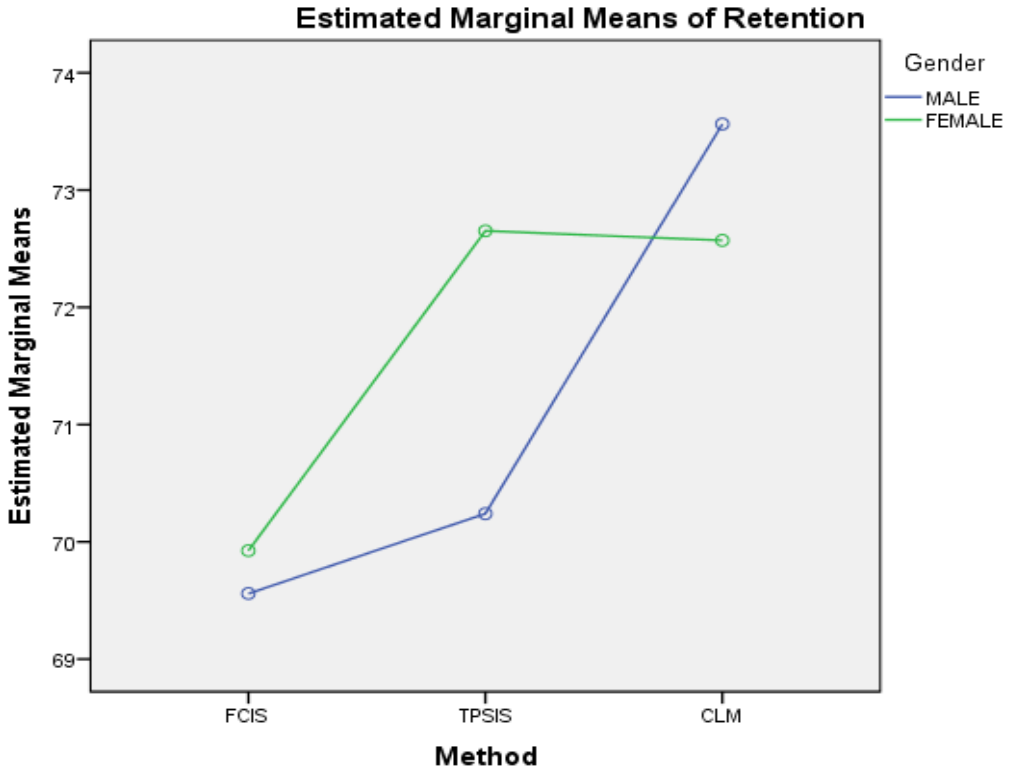

Figure 1: Plot of Interaction Effect of Teaching Strategies and Gender on Students' Biology Retention

The plot of the interaction effect between teaching strategies and gender on biology retention is significant and disordinal. This shows that the teaching strategies have different effects on biology retention of students on different conditions, for example, the effect of the teaching strategies on mathematic biology changed when gender was consideration.

Discussion

The finding of the study showed that students taught biology using think-pair-share instructional strategy had significantly higher retention than those taught using flipped classroom instructional strategy. The active and personal responsibility and participation in the study enabled them to repeat the learning materials over time. Repetition which is one of the factors that enhance learning retention enabled students in think-pair-share instructional strategy to retain the concept more.

The students in getting to share what they learnt and by teaching others consolidated their own understanding thereby moving the learning to the retentive memory meaningfully. Since the students sought to understand the learning materials and concepts taught properly, so as to be able to share with others, learning was more meaningful. The avoidance of rote learning and engagement in more meaningful learning in think-pair-share learning group enhanced their retention of learning.

The finding of the study is also showed that flipped classroom instruction significantly improved retention more than conventional instructional. Getting to continue the learning online afforded the students opportunity to explore learning in different formats. Some of the students stumbled into video and simulation materials on the learning concepts which made impressions in their memory that were not easily forgettable.

The finding of the study is in line with the finding of Gambari, Bello, Agboola and Adeoye (2016) that flipped classroom instruction has significant effects on students' retention. The finding of the study also lends credence to the findings of Makinde and Yusuf (2018) that was a significant difference in the retention of students which favoured the flipped classroom. The finding of the study is also in support of the finding of Didem and Selcuk (2018) that there was significant difference in the retention scores of students taught using flipped classroom and those taught using the conventional method.

There was no significant difference between the mean retention scores of male and female students taught using flipped classroom instruction but a significant difference was observed in their retention in favour of the females. The interaction effect of teaching strategies and gender was significant and disordinal. Thus, students' retention favoured both male and females at difference time across the instructional strategies.

The findings of Gambari, Bello, Agboola and Adeoye however contrast the findings of the present study since their results showed that gender differences with respect to the effects of flipped classroom instructional model on retention was not significant. The findings of the study also are supported by the findings of Makinde and Yusuf (2018) that no significant difference in the post-performance of both male and female students in flipped classroom was observed.

Conclusion

The study established that TPSIS was significantly more effective in improving students' retention of learnt biology concepts more than FCIS and conventional method. FCIS however significantly improved retention more than conventional method. The study concluded therefore, that TPSIS is most effect strategy for improving students' retention in learning biology than FCIP and conventional learning strategy.

Recommendations

Based on the finding and conclusion of the study, the following recommendations were made:

1. Teachers of biology should use FCIS to facilitate interaction between students and learning materials, among themselves and with the teacher through online collaborations.

2. School administrators should provide for the facilities needed by teachers who may wish to adopt the use of think-pair-share and flip classroom instructional strategies.

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