Effect of Flipped Classroom Strategy on the Performance and Cognitive Style of Senior Secondary School Biology Students in Ogun State, Nigeria

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Abstract

This research investigated the effects of flipped classrooms on the academic performance and Cognitive style of students in Biology. The study employed a pre-test and post-test quasi-experimental research design. The population of the study comprises all senior secondary in Ogun state and the participants for the study were 89 Senior Secondary School I (SSSI) students of two intact classes which were purposively selected from Odeda local government. The instruments used were a Biology performance test and a cognitive style test. Reliability of the Biology performance test was done using KR-20 and the coefficient was found to be 0.77. The reliability of the cognitive style test was done using Cronbach-Alpha and the coefficient was found to be 0.72. The hypotheses were tested using ANOVA inferential statistics at a 0.05 level of significance. The outcome is that there was a significant difference in the academic performance of students who were opened tothe flipped classroom strategy and lecture method. The study conclude that flipped classroomsare more useful in improving students' academic performance and cognitive style in biological concepts than traditional teaching methods.

Keywords: Flipped classroom, Performance, Cognitive style, Biology

Introduction

Education plays a colossal part in the ever-evolving technological world. To survive a competitive world, quality instruction is of extraordinary significance.Cutting-edge society is based on people who have high living standards and knowledge which allows them to find better

solutions to their problems. Science is a form of education that involves the systematicstudy of the structure and behaviour of the physical, social, and natural world through observation and experimentation. Science makes Innovation, global competitiveness, and human advancement possible. It is implanted into the standard of living and to take an interest as a citizen of a developing country, one must learn almost an assortment of logical issues (Leshner& Perkins-Bough, 2017).

Biology is regarded as a life science because it encompasses the study of living things. It teaches different forms of organic life and their relations with the environment and other sciences. Biology is relevant to our lives, through the knowledge of Biology, we know how the body functions and, the organs that are in the body, learn about life in our environment. It also helps us to know our genetic makeup and prevent some genetic disordersand diseases.Biology can also tell us about plants of major importance and their benefits to our body systems. Biology is one of the foundational subjects for many professional courses such as Medicine, Biochemistry, Pharmacy, Microbiology and Agriculture among others.

In spite of the significance of this subject to human survival, the recital of upper secondary students of Biology is not encouraging. The poor academic performance is indicated in the report of WAEC and the National Teacher Institute (2011). Many factors seems to be contributing to this poor performance among these include inadequate laboratories, inadequate teaching facilities, and overcrowded classrooms among others. Dinah (2013) stated that the inadequate availability of textbooks and the use of conventional methods of teaching have an immense impact on the performance of students in Biologyexaminations. Therefore, there is a need to look into a more learner-centered approach to teaching.

The flipped classroom is a leaner-centered educational approach were learning exercises are improved to be viable in giving teachers more face-to-face intuition with students and extending the adaptability of the learning plan to progress learning outcomes. Specifically, the concept of the flipped classroom is concerned with the practice where content is made available to the learners before the teaching and learning contacts, usually for pre-class study while the in-class activities are facilitated by the teacher to foster the comprehension of the content (Brewer & Movahedazarhouligh, 2018; O'Flaherty & Phillips, 2015). The emergence of technologies has influenced the potential of flipped classrooms in effective teaching and learning leading to

improved students' learning achievement and satisfaction (Missildine et al., 2013; O'Flaherty & Phillips, 2015).

In flipped classroom the conventional parts of the classroom are modified so that students begin their learning off, the conventional classroom and proceed, fortify, and complement it amid their standard school hours (Mengula-Andres et al 2020). In flipped learning, students learn through audiovisual and various multimedia learning materials prepared by the teacher before classroom instruction (Lin & Hwang, 2018; Sams & Bergmann, 2013). Duringclassroom instruction, the learners, under the guidance of the teachers or peers engage in learning activities capable of enhancing knowledge application. It is expected that learners' performances and higher-order thinking abilities can be fostered with adequate interactive opportunities with the teacher and among peers and with the ability to apply knowledge.

Cognitive style is another condition that influences the depth the students have about a particular concept. Cognition concurring with Margret (2015) is by and large taken to incorporate such mental exercises as considering conceptualizing and bargaining with things like memory, mental symbolism, discernment and maintenance, thinking and choice-making and representation. The importance of cognitive style and its role in students' learning arose from the fact that students of different cognitive styles learn differently (Vandana, 2017). Other research studies posited that from extensive evidence accumulated over the years, cognitive style plays a significant role in problem-solving and thinking as well. Cognitive style according to Witkin (1972) as cited in Ogundeji (2022) could be a strong variable in students' scholarly choices and professional inclinations; in students' academic advancement through their school career; in the mode of learning by the students and how instructors give information; and in students-teachers classroom interaction. The necessity of the present study arose from the report of Ogundeji (2022) that cognitive style is a factor in academic evolution and achievement.

It is against this background that the study was embarked upon to find the effect of flipped instruction on student performance and cognitive style in Biology since the performance of students in Biology has been declining in recent years, this is evident in the result of the senior school certificate examination conducted by the West African Examination Council (Adeleye, 2019). Prominent among the factors that have been identified as contributing to the persistently low level of performance in Biology is the use of traditional teaching methods adopted by Biology teachers. It has therefore become apparent that the lecture method which is currently the

predominant teaching approach in Nigerian secondary schools is seen as inadequate and ineffective for achieving the objectives of the Biology education programme.

Given the apparent students' poor performance in Biology among secondary school students as indicated by the West Africa Examination Council WAEC) result, the researcher is wondering whether the teaching method employed by the teachers may affect secondary school student's performance in the subject or not. The content of the Biology curriculum indicates that innovation is required in the teaching process to promote efficient learning. There is a need for the use of teaching strategies that will not only provide a meaningful understanding of concepts in Biology but also provide students with the opportunity to play an active role in teaching and learning. It is on this basis this study finds out the effects of flipped classrooms on cognitive style and student performance in Biology in Ogun State.

Purpose of the Study

The purpose of the study is to evaluate the effects of flipped classroom strategy and Cognitive style of students on academic performance in Biology. Specifically, the study sought to:

i. Determine the difference between the mean score of students' performance taught with flipped classroom strategy and conventional teaching methods.
ii. Examine the effects of flipped classroom strategy on the cognitive style of students in Biology.

Research hypothesis

These null hypotheses tested at a 0.5 level were formulated to direct the study:

H_{01}: There was no significant difference in the pre-test mean score of academic performance of students opened to flipped classrooms and conventional methods.

H_{02}: There was no significant difference in the pre-test mean score of the cognitive style of students opened to flipped classrooms and conventional methods.

H_{03}: There was no significant difference in the post-test mean score of academic performance of students opened to flipped classrooms and conventional methods.

H_{04}: There was no significant difference in the post-test mean score of the cognitive style of students opened to flipped classrooms and conventional methods.

Methodology

The research design for this study is a pre-test post-test Quasi-experimental design in which a flipped classroom strategy was used as an experimental group andlecture method as control group. The research participants were two (2) intact classes consisting of 44 and 45 students respectively were purposively selected from Senior Secondary School Biology Students in Odeda Local Government, Ogun State, Nigeria. The instruments used were a Biology performance test and a cognitive style test. The Biology performance test question was developed by the researcher and is a multiple-choice question that had option A-D to choose from. The instrument consisted of thirty test questions which carried two marks each. The cognitive style test questions were essay questions that involved critical reasoning with three questions answered and based on the answer the cognitive style of students will be determined. Biology performance test questions and cognitive style test questions were subjected to face and content validity to remove the ambiguity. The reliability of the cognitive test question was done using Cronbach Alpha and a coefficient of 0.72 was obtained while the Biology performance test was done using KR-20 and a value of 0.8 was obtained.

There were three stages involved in the experiment which was carried out in 8weeks (one week was used for each pre-test and post-test, six weeks for the treatment stage): stage 1 involved visitation to the schools, permission from the administrative, heads of the participating schools, training of research assistants and administration of pre-test questions to the participant. In stage 2 the experimental group was taught using a flipped classroom instructional guide while the control was taught using a conventional teaching method instructional guide and a post-test was administered to the participant at the end of the lecture period which was stage three. The data was analyzed using ANOVA. All the hypotheses were tested at a 0.05 level of significance (P= 0.05).

Results

H_{01}: There is no significant difference in the pre-test mean score of academic performance of students opened to flipped classrooms and conventional methods.

Table 1: ANOVA of pre-test performance mean score of students in experimental and control groups

Sources of variation	SS	df	MS	F	P-value	F-critical
Between Groups	587.6	1	281.3	8.20	0.13	47.13
Within Groups	465.4	88	6.24			
Total	1104.9	89				

Table 1 shows an analysis of variance (ANOVA) on the mean difference in the pre-test mean score of academic performance of students opened to flipped classrooms and conventional methods. It was revealed that (0.13 > 0.05), and f-value (8.20) is less than F-critical (47.13). The null hypothesis is not rejected which implies that there was no significant difference in the pre-test mean scores performance of students in the two groups before the treatment. Therefore, the hypothesis is accepted. This demonstrates the homogeneity of the groups before the treatment was applied.

H_{02}: There is no significant difference in the pre-test mean score of the cognitive style of students opened to flipped classrooms and conventional methods.

Table 2: ANOVA of pre-test mean score of cognitive style of students in experimental and control groups

Sources of Variation	SS	df	MS	F	P-value	F-critical
Between Groups	7573.76	1	3727.54	3.16	0.32	40.77
Within Groups	8254.24	88	94.29			
Total	16587.21	89				

Table 2 shows an analysis of variance on the mean difference in the pre-test mean score of the cognitive style of students opened to flipped classrooms and conventional methods. It was revealed that (0.32 > 0.05), and f-value (3.16) is less than F-critical (40.77). There was no significant difference in the mean scores of cognitive styles of students in the various groups before the treatment and therefore we do not reject the null hypothesis. The hypothesis is therefore accepted. This shows the group's homogeneity before the treatment.

H_{03}: There is no significant difference in the post-test mean score of academic performance of students opened to flipped classrooms and conventional methods.

Table 3: ANOVA of post-test performance mean score of students in experimental and control groups

Sources of variation	SS	df	MS	F	P-value	F-critical
Between Groups	580.35	1	290.17	87.66	0.0014	3.10
Within Groups	287.96	88	3.30			
Total	868.32	89				

Table 3 showsthe analysis of variance on the mean difference in the post-test mean score of academic performance of students opened to flipped classrooms and conventional methods. It was revealed that (0.0014 < 0.05), and f-value (87.66) is greater than F-crit (3.10). The null hypothesis is rejected which implies that there was a significant difference in the mean scores performance of students in the various groups after the treatment. Therefore, the hypothesis is rejected. Table 4 is presented to show the magnitude of the mean scores of the group performanceas follows:

Table 4: Estimated Marginal Mean of the Treatment group on Students' performance in Biology

Treatment Groups	N	Mean	Std Error
Flipped Classroom Method	44	37.50	.108
Conventional Teaching Method	45	22.165	.139

Based on the estimated marginal mean, flipped classrooms had a higher post-test mean score (37.50) than the conventional teaching method (22.165). This implies that flipped classrooms performed better than conventional teaching methods.

H_{04}: There is no significant difference in the post-test mean of the cognitive style of students opened to flipped classrooms and conventional methods.

Table 5: ANOVA of post-test mean score of the cognitive style of students in experimental and control groups

Sources of variation	SS	df	MS	F	P-value	F-critical
Between Groups	1531.67	1	7675.83	30.09	0.0011	3.10
Within Groups	22188.33	88	255.03			
Total	37540	89				

Table 5 shows an analysis of variance (ANOVA) on the mean difference in the post-test mean score of the cognitive style of students opened tothe flipped classroom strategy and conventional method. It was revealed that (0.0011 < 0.05), and f-value (30.09) is greater than F-crit (3.10). The null hypothesis is rejected which implies that there was a significant difference in the mean scores performance of students in the groups after the treatment. Therefore, the hypothesis is not accepted. To find out the magnitude of the mean scores of the group performance, Table 6 is presented as follows:

Table 6: Estimated Marginal Mean of the Treatment group on Students' cognitive style in Biology

Treatment Groups	N	Mean	Std Error
Flipped Classroom Method	44	75.00	.120
Conventional Teaching Method	45	44.33	.140

Based on the estimated marginal mean, the flipped classroom had a higher post-test mean score (75.0) than the conventional teaching method (44.33). This implies thatflipped classrooms improved students' cognitive style better than conventional teaching methods.

Discussion of findings

The finding of the study indicates that there was no significant difference in the pre-test mean score of academic performance of students opened to flipped classrooms and conventional methods. The groups were homogeneous which implies thatthe students' baseline knowledge was the samebefore the treatment was applied. The result also indicates that there was no significant difference in the pre-test mean score of the cognitive style of students opened tothe flipped classroom method and conventional method which implies that all the students were at the same cognitive style level before the treatment was applied.

In addition, this study shows that there was a significant difference in the post-test mean score of academic performance of students opened tothe flipped classroom method and conventional method. As a result of allowing students to watch a lecture video outside of class and then use class time to complete more difficult tasks like problem-solving, debates, and discussion, the flipped classroom group outperformed the traditional method in terms of student performance. This agreed with the findings of (Ogundeji 2021; Leo &Puzio, 2016; Sun & Wu, 2016; Talley & Scherer, 2013; Wiginton, 2013; Zengin, 2017; Zhonggen & Wang, 2016) who argued that flipped classroom method enhances student's academic performance. The flipped classroom method is linked to a more productive teacher-student relationship (McCarthy 2016) encouraging students not only to learn at their own pace (Molnar, 2017) but also to take responsibility for their learning (Kim et al., 2017). It motivates students to share his/ their ideas with others through cooperation skills and enhanced self-esteem. This in turn enhances the learning experience of the learner and self-confidence level which influences positive attitude. The post-test achievement mean scores indicate that students who were open to the traditional way performed poorly, which may have something to do with the teacher-centred nature of the typical strategy. The students appear to be passive consumers of knowledge in this instance. It appears that there isn't any chance for the kids to participate actively in their education. The term "teacher-centered" refers to the method that the teacher uses on his own. The proverbial Chinese proverb, "What I hear, I forget; what I see, I remember; what I do, I understand," runs counter to this approach. This suggests that rather than focusing solely on hearing, the teaching-learning process should place more emphasis on "doing," or the active participation and engagement of students in the process. Therefore, to improve students' academic performance, there should be more of students' active engagement in the teaching-learning process (Agboghoroma and Oyovwi 2015; James, 2014; Lebata, 2014; Ngesu et al. 2014; Taylor and Parsons 2011).

Furthermore, the result shows that there was a significant difference in the post-test mean score of the cognitive style of students opened tothe flipped classroom method and the conventional method. Through forum discussions, it encourages student collaboration to investigate new concepts and information about the topic being studied (Jwair 2018; Sedraz et al., 2018; Sun et al., 2017). In addition, it encourages students to participate in active learning by giving them the chance to consider hypothetical scenarios.

Conclusion

The study shows that flipped classrooms aremore useful in improving students' academic performance in biological concepts than traditional teaching methods. The reason for this was that the flipped instructional strategy improved the progress of the cognitive style of students because it permitted them to be keenly involved in learning activities and form a positive environment for effective interaction which improved academic performance.

Recommendations

The following recommendations were made based on the findings:

1. Biology teachers should adopt flipped classrooms for teaching Biology to secondary school students.
2. Workshops and seminars should be organized for in-service teachers in the use of various activities-based strategies for teaching.

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