



Effect of Blended Learning Strategies on Undergraduate Students' Self-Efficacy and Achievement on Difficult Biology Topics in South Eastern Nigerian Federal Universities

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Abstract

The study explored the effect of blended learning strategies on undergraduate students' self-efficacy and achievement on difficult Biology topics. Quasi experimental research design was used. First-year Biology Education students of 2020/2021 academic session constituted the population of the study. 177 students consisting of 78 males and 99 females formed the sample. The instruments for data collection were Nervous Coordination Achievement Test (NCAT) and Nervous Coordination Self-Efficacy Rating Scale (NCSERS). Research questions were answered using mean and standard deviation while the hypothesis was tested using ANCOVA. The results revealed that students exposed to flipped classroom had higher self-efficacy and achievement scores than those exposed to Edmodo social learning strategy. "The influence of gender on self-efficacy and achievement" was significant in favour of male students. It was recommended that lecturers should blend traditional classroom with on-line teaching and learning especially using flipped classroom for concretizing abstract concepts/topics.

Keywords: Difficult topics in biology; Achievement; self-efficacy; Flipped classroom and Edmodo social learning network

Introduction

Lecture, demonstration and discussion tagged 'Conventional' are the dominant teaching and learning methods used in institutions of Higher learning in most countries of the world. Nigeria is inclusive irrespective of the proliferation in number of student's enrolment yearly especially in sciences. This is in spite of the current technological revolutions that have provided online methodologies that use Information Technologies (IT) that are efficient for student-centred learning. Teaching and learning that employs information technologies (IT) provides students opportunities to navigate many on-line materials and tackle concepts tagged as difficult due to their abstractness, as students can extend their learning beyond the classroom through the use of IT and at the same time probe into and find solutions to scientific issues which the existence of physical laboratories with their equipment cannot offer. This is particularly important for teaching Biology as a science discipline that deals with the study of life and living organisms, including their structures and functions.

Biology as a science subject is taught from senior secondary schools to the university level across various disciplines such as Science Education, Medicine and Surgery, Pharmacy, Food and Nutrition, Psychology, Anatomy, Zoology, Botany, Biochemistry, Microbiology, Physiology, among others. Ogenevwe (2012) buttressed that Biology forms the fundamental for Medical, Biological and Environmental Sciences and other

science courses. Despite its relevance, researches show that students' performances in Biology have been poor as a result of difficulty in learning some biological concepts due to their abstract nature (Fauzi & Mitalistian, 2018; Fauzi & Fariantika, 2018; Lieu et al., 2018). Examples of such include water transport in plants, protein synthesis, respiration, gaseous exchange, meiosis and mitosis, organs and physiological processes that go on in them, genetics and the nervous system (Hadiprayitno et. al., 2019; Tekkaya et al., 2001). These Biology concepts do not lend themselves to presential classroom lecture methods only but methods that permit visualization of physiological processes using technological aids (Ibe & Abamuche, 2019). One of the major reasons why students' performances on these concepts have persistently been reported poor at both secondary schools and institutions of higher learning is as a result of teaching methods used by teachers (Cimer, 2012; Etobro & Fabinu, 2017). Enhanced learning outcomes in the cognitive, psychomotor and affective dimensions can be achieved in the learner when teaching methods appeals to the five senses (sight, touch, taste, smell and audio). The cognitive are measured mainly by domain specific (e.g. Biology achievement). In sciences, there are studies that underpin gender disparity with respect to science courses (Udoh & Ndirika, 2020; Namaziandost & Cakmak, 2020). Chukwuemeka and Dorgu (2019) reveal that nervous coordination was perceived as the most difficult topic in Biology by both male and female senior

secondary school students. Mavrikaki et al., (2012) showed that gender does not seem to affect students' overall views about difficult topics in biology.

Nervous coordination is a topic that cuts across both secondary school and tertiary Education curriculum. Mandel (2021) sees the nervous system as a complex network of nerves and cells that carry messages to and from the brain and spinal cord to various parts of the body. Over the years, reports show that nervous coordination is a difficult concept to teach by lecturers and difficult concept to learn by pre-service teachers; and challenging to both teachers and students at the secondary school level as well (Kvello & Gericke, 2021). Despite its importance as opined by the Society for Neuroscience (2018); that studying the nervous system advances understanding of our basic biology and body function. Biswas-Diener (2022) also posits that understanding nervous system is vital to understanding psychology in general. The abstract nature of the nervous system and coordination concepts namely: nerves transmission, brain interpretation of impulse, synaptic transmission and other electrochemical transmissions are indescribable and difficult to comprehend using the conventional teaching methods earlier mentioned, and in vogue in institutions of higher learning (Ibe, Aneke & Abamuche, 2021). The integrative nature of physiological processes embedded in the concept of nervous system (coordination) could challenge even the best teacher. Colthrope, Abe and Ainscough (2018) assert that to achieve effectively on physiological concepts, lecturers and students must choose appropriate learning methods to develop their understanding, as their choices may influence their academic achievement.

Although statistical report on students' achievement in nervous coordination is rare owing to the fact that students face it within courses offerings in institutions of Higher learning. Within the courses, students' responses to nervous coordination questions in examination prove that the concept is difficult. In Indonesia, report by Ningrum and Widjana (2018) reveals that students tagged the block of nervous system and special sense with a high degree of difficulty due to the complexity of the system. This was proven by the result of the block's final examination in 2016 with an average score of 41.98%. Also, a survey on Biology Education students' scripts on Basic physiology (ZEB 311) at Zoology and Environmental Biology Department University of Nigeria, Nsukka (Researcher, 2021) revealed that out of 41 students that sat for the examination, in 2018, only 46.3% answered question 6 which was on nervous coordination with an

average score 9.23%. While 53.7% of the students, did not attempt the question on nervous coordination. In 2019, a total of 99 students sat for the examination, 30.3% attempted question 4 which was on nervous coordination with an average score of 17.2%. While 69.7% did not answer the question at all. Several researchers have sought for appropriate teaching methods to combat this anomaly. Koseoglu Efendioglu (2015) reports that multimedia tools can enhance students learning outcomes in complex Biology concepts such as the nervous coordination. However, these researchers only reveal what the teacher can do without taking into consideration the students preferred learning styles. Kaginici and Sadi (2021) are of the view that activity enriched instruction enhances students' achievement on nervous system. But the study only focused on conceptualization of learning without looking at the ability of students to develop task performing oriented skill such as self-efficacy, in order to achieve positively.

Self-efficacy has strong relationship with academic achievement. Sapta and Maulana, (2017) found that students with low self-efficacy cannot be successful and thus are less likely to make concerted and extended efforts, and may consider challenging tasks as threats that are to be avoided. Sadi and Dağyar (2015) affirm that students with high self-efficacy tends to do something with a big and challenging effort, whereas individuals who have low self-efficacy will tend to avoid tasks and give up easily when problems arise resulting to poor achievement. Colthrope, Abe and Ainscough (2018) are of the view that the use of effective "self-regulatory learning" methods may be one mechanism by which students can tackle difficult concepts, as self-regulated learning includes personal factors that have been associated with academic resilience. This view was opposed by Ormrod (2012) who assert that only small number of students ever become great self-regulators and high academic achievers due to lack of instructional process that promote these two dependent variables of the study.

The "flipped classroom (FC)" is one of the pedagogical methods that take an active, learner-centred approach to teaching. Flipped classroom authenticates learning theories of Piaget (1970) and Vygotsky (1962) that learners are active participants of the learning process and create their own learning by solving problems with the least possible elementary aid from the instructor. (Lotter et al., 2011; Rusche & Jason 2011; Hashemifardnia et al. 2018). Positive outcomes in the flipped classrooms have been reported by those educators who have

integrated the flipped classroom in blended learning. Students were noted to be more involved in their own learning through collaborations with the teachers and their fellow students to solve difficult problems arising from teaching and learning processes. (Bergmann & Sams, 2012; Davies et al., 2013). Davies et al., (2013) assert that in the Flipped classroom, students take responsibility for their own learning and progress at their own speed. Students fulfil independent and active learning by accessing the learning environments presented through the Internet whenever and wherever they want. Hamdam et al. (2013) emphasized, that learners in a FCM “explore topics in greater depth and creating richer learning opportunities In FC students have an opportunity to gain their first exposure to content before the class time with instructor-provided content (Abeysekera & Dawson, 2015; Brame, 2013). Flipped classroom can therefore be defined as a blended strategy that gives learner the opportunity to facilitate learning before the teacher’s help is obtained. Since some researchers strongly affirm positive effect of integrating flipped classroom in blended strategy, this then necessitate this research.

Apart from the flipped classroom, social learning network is also an on-line tool that helps to close the gap between students with regard to their access to education, thus improving learning outcomes. Edmodo Social learning network is one of the new educational social learning networks that draws the attention of educational researchers. It is a free and secure learning platform for teachers, students, parents, schools, and districts. (Chada Kongcham, 2013). Pardede (2017) identified various advantages of employing Edmodo for blended learning such as its ability to facilitate intensive communication, its potential to assist for running various types of active learning (e.g. provision of assignments and related resources, peer discussion, online quizzes concerning the learning topic, digital content assignment submission, and easy connection with students or teachers from different schools or other countries). Edmodo also facilitates teachers to meet the varied students’ needs, supports a sense of community among students, making them feel respected and significant and offers three helpful criteria, i.e. usability, accessibility, and compatibility (Bayne, 2015). Some researchers have shown that integrating Edmodo in a blended class produced significant results (Enriquez 2014; Tripathi, 2016), this then necessitated the researcher to ascertain its effect on difficult biology concepts.

Research Questions

1. What is the mean self-efficacy scores of students taught nervous coordination using flipped classroom and those taught using Edmodo strategies?
2. What is the mean achievement scores of students taught nervous coordination using flipped classroom and those taught using Edmodo strategies?
3. What is the influence of gender on students’ self-efficacy on nervous coordination?
4. What is the influence of gender on students’ achievement on nervous coordination?

Hypotheses

The following null hypotheses were tested at 5% level of significance.

- H0₁:** There is no significant difference in the mean self-efficacy scores of students taught nervous coordination using flipped classroom and those taught using flipped classroom and those taught using Edmodo strategies
- H0₂:** There is no significant difference in the mean achievement scores of students taught using flipped classroom and those taught using Edmodo.
- H0₃:** There is no significant influence of gender on students’ self-efficacy on nervous coordination
- H0₄:** There is no significant influence of gender on achievement of students on nervous coordination
- H0₅:** There is no significant interaction effect of strategies and gender on students’ self-efficacy on nervous coordination
- H0₆:** There is no significant interaction effect of strategies and gender students’ achievement on nervous coordination

Methods

Quasi experimental research design was used. First-year Biology Education students of 2020/2021 academic session constituted the population of the study. 177 students consisting of 78 males and 99 females formed the sample. The instrument for data collection was Nervous Coordination Achievement Test (NCAT) and Nervous Coordination Self-Efficacy Rating Scale (NCSERS). The face validation of the instruments was done by three experts; two from Biology Education and one from Measurement and Evaluation, all from the Department of Science Education, University of Nigeria Nsukka. The reliability of the NCATN was estimated using KR-20 while for NCSERS, Cronbach alpha method was

used for its reliability estimate. The research questions were answered using mean and standard deviation while the hypothesis were tested using ANCOVA at 0.5% level of significance. Week 1 was for orientation of students on the experiment and administration of pre-test on Nervous Coordination Achievement Test (NCAT) and Nervous Coordination Self-Efficacy Rating Scale (NCSERS), in week 2, learning objectives, handouts that contains some activities that the students are expected to do with assignment as well as good on-line videos on the concept of neuron were made available to students for pre-reading and watching via students Email address ten days prior to the scheduled in-classroom knowledge application session for the flipped classroom group contact. These same digital materials were uploaded on Edmodo website created by the researcher for the purpose of the experiment which is a free learning management platform for a digital classroom. The students in the Edmodo platform were grouped by the instructor to help facilitate ideas. The instructor was also part of the platform to assist the students

where necessary to avoid digressing from the main focus of the objectives. Week 3 was intervention that is the in-class activities, the class session was dedicated to explain nervous coordination in depth (neuron, its structures how it transmits impulse), leading the discussions or group work involved in interactional patterns such as pair work or group work, students were allowed to review the lecture, ask leading questions to correlate digital material on nervous coordination and classroom activities. After the experiment, in week 4, post-test on Nervous Coordination Achievement Test (NCAT) and Nervous Coordination Self-Efficacy Rating Scale (NCSERS) was re-administered and instrument was collected for grading and analysis the NCAT will be rated over 20 with each correctly answered question attracting 1 mark. the pretest mean scores of students will be used to categorise their cognitive ability. students with pretest mean score less than 10 is classified as low ability from 10 to 15 moderate and from 15 up high ability. Data from NCSERS will be analysed using mean and standard deviation counts.

Results

Table 1: Mean self-efficacy scores of students taught nervous coordination using blended learning strategies

Blended learning strategy						
	N	Pre-test X	Pre-test SD	Post-test X	Post-test SD	Mean diff.
Flipped classroom	111	32.16	8.28	56.51	9.35	24.35
Edmodo social learning	66	31.02	6.10	52.45	7.30	21.43

The result on Table 1 shows that students taught nervous coordination using flipped classroom had a post-test mean of 56.51 while the Edmodo group had a post-test mean of 52.45. The result shows that both flipped classroom and Edmodo social learning

strategies are potent in increasing students` self-efficacy. However, the result showed that Flipped classroom strategy increased students` self-efficacy more than Edmodo social learning

Table 2: Analysis of Covariance (ANCOVA) of the mean self- efficacy scores of students taught nervous system using blended strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3778.688 ^a	4	944.672	16.292	.000	.275
Intercept	17121.376	1	17121.376	295.276	.000	.632
Pre_Efficacy	858.761	1	858.761	14.810	.000	.079
Strategies	517.089	1	517.089	8.918	.003	.049
Gender	923.114	1	923.114	15.920	.000	.085
Strategies * Gender	142.864	1	142.864	2.464	.118	.014
Error	9973.312	172	57.984			
Total	549177.000	177				
Corrected Total	13752.000	176				

a. R Squared = .275 (Adjusted R Squared = .258)

The result on Table 2 shows that the F-ratio of 8.918 with associated probability value of 0.003 was obtained with respect to mean self-efficacy rating of

students taught using both Flipped classroom and Edmodo social learning strategies. Since the associated probability value of 0.003 when compared with 0.05 set as the level of significance



was found to be less, the null hypothesis was rejected. This shows that there is a significant difference in the mean self-efficacy rating of

students taught using flipped classroom blended strategy and those taught using Edmodo social learning blended strategy in nervous system.

Table 3: Mean achievement score of students taught nervous coordination using blended learning strategies

Blended learning strategy	Pre-test		Post-test		Mean difference
	N	X	SD	X	
Flipped classroom	111	26.86	7.85	58.55	31.69
Edmodo social learning	66	26.12	8.46	54.21	28.09

The data on Table 3 shows that students taught nervous coordination using flipped classroom had post-test mean of 58.55 while the Edmodo group had a post-test mean of 54.21. The result shows that

flipped classroom increased students' achievement in nervous coordination more than Edmodo social learning.

Table 4: Analysis of Covariance (ANCOVA) of students mean achievement scores in nervous coordination using flipped classroom and Edmodo social learning strategies

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6144.327 ^a	4	1536.082	22.152	.000	.340
Intercept	51545.190	1	51545.190	743.345	.000	.812
Pretest	133.037	1	133.037	1.919	.168	.011
Strategies	867.100	1	867.100	12.505	.001	.068
Gender	2498.393	1	2498.393	36.030	.000	.173
Strategies * Gender	1441.644	1	1441.644	20.790	.000	.108
Error	11926.859	172	69.342			
Total	591777.000	177				
Corrected Total	18071.186	176				

a. R Squared = .340 (Adjusted R Squared = .325)

Data on Table 4 show that an F-ratio of 12.505 with an exact probability value of 0.001 was obtained with respect to the significance difference in the mean achievement scores of students taught using flipped classroom blended learning strategy and Edmodo social learning blended strategy. Since the associated probability value of 0.001 when

compared with 0.05 set as the level of significance was found to be less, null hypothesis was rejected. There is therefore, a significant difference in the mean achievement scores of students taught nervous coordination using flipped classroom and those taught using Edmodo social learning strategy.

Table 5: Mean and standard deviation on influence of gender on students' self-efficacy on nervous coordination

Variables Gender	N	Pre-test		Post-test		Mean Difference
		X	SD	X	SD	
Male	78	34.04	8.27	58.88	9.32	24.84
Female	99	29.92	6.40	51.94	7.11	22.02

Data on Table 5 shows that the post-tests mean self-efficacy rating of students in nervous system for male was 58.88 while females had a post-test mean rating of 51.94. The result indicated that the male students had a higher self-efficacy post-test mean than the female students.

Hypothesis 3: Data on Table 2 also show that an F-ratio of 15.920 with an associated probability value

of 0.000 was obtained with respect to the influence of gender on mean self-efficacy scores of students taught nervous coordination. Since the associated probability value of 0.000 when compared with 0.05 set as the level of significance was less, the null hypothesis was rejected. There is therefore significant influence of gender on students' self-efficacy score on nervous coordination in favour of males.

Table 6: Mean and standard deviation of the influence of gender on students' achievement on nervous co-ordination

Gender	N	Pre-test		Post-test		Mean difference
		Mean	SD	Mean	SD	
Male	78	27.59	7.53	62.30	10.14	34.71
Female	99	25.79	8.42	52.69	7.90	26.90

The data on Table 6 show the pre-test and post-test scores on the influence of gender on students' achievement on nervous co-ordination. The result show that the post-test mean achievement score of males was 62.30, while the post-test mean achievement score of females was 52.69. However, the result shows that the male students had a higher post-test mean achievement than the female students on nervous coordination.

Hypothesis 4: Result in Table 4 show that an F-ratio of 36.030 with associated probability value of 0.000 was obtained with respect to the influence of gender on the achievement of students in nervous coordination. From the result, the associated probability value of 0.000 is less than 0.05 level of significance, hence, the null hypothesis is rejected. There is therefore a significant influence of gender on the mean achievement of students on nervous coordination, in favour of males.

Hypothesis 5: Data presented on Table 2 shows that an F-value of 2.464 has an associated exact probability value of 0.118 for the interaction effect of strategies and gender on the mean self-efficacy scores of students in nervous coordination. The result reveals that the exact probability value of 0.118 is greater than 0.05 level of significance. Hence, the null hypothesis is not rejected. Thus, there is no significant interaction effect of strategies and gender on the mean self-efficacy scores of students in nervous coordination. The result further showed the effect size of ($\eta^2_p = 0.014$), which indicates that only 1.4% variance of the increase in mean self-efficacy scores of students in nervous coordination was due to the influence of interaction effect of strategy and gender. This result is further explained and supported using the interaction graph in Figure 1. This is evidenced in the graph because the interaction lines of strategies against gender did not intercept as shown below.

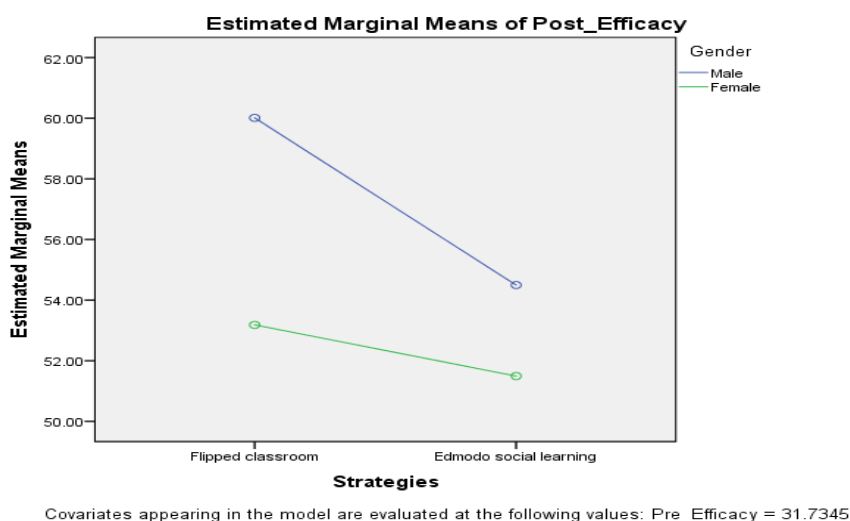
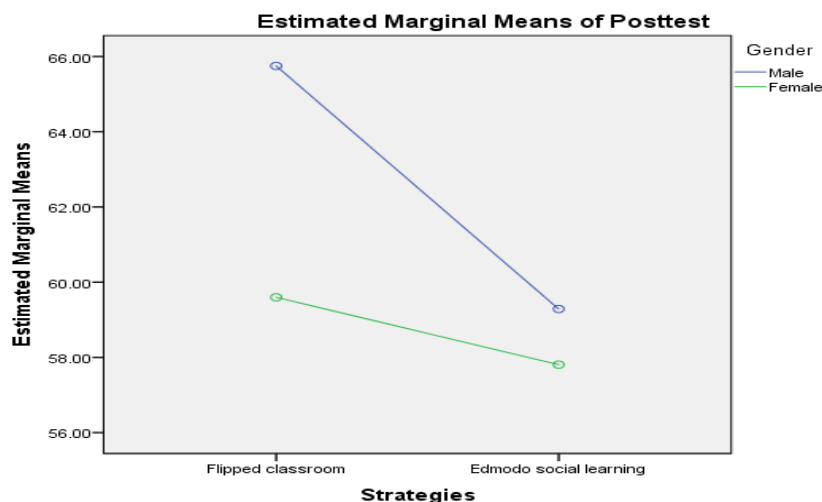


Fig 1: Interaction Plot of Strategies and Gender on Mean Self-efficacy Scores of Students

Hypothesis 6: The result of analysis presented in Table 4 shows that an F-value of 3.519 has an associated exact probability value of 0.062 for the interaction effect of strategies and gender on the mean achievement scores of students in nervous coordination. The result reveals that the exact probability value of 0.062 is greater than 0.05 level of significance. Hence, the null hypothesis is not rejected. Inference drawn is, there is no significant interaction effect of strategies and gender on the

mean achievement scores of students on nervous coordination. The result further showed the effect size of ($\eta^2_p = 0.020$), which indicates that only 2.0% variance of the increase in mean achievement scores of students on nervous coordination was due to the influence of interaction effect of strategy and gender. This result is further explained and supported using the interaction graph in Figure 2. This is evidenced in the graph because the interaction lines of

strategies against gender did not intercept as shown below.



Covariates appearing in the model are evaluated at the following values: Pretest = 27.4350

Figure 2: Interaction Plot of Strategies and Gender on Mean Achievement Scores

Discussion:

The findings from the study revealed that students taught nervous coordination using flipped classroom blended strategy had higher self-efficacy than those exposed to Edmodo social learning blended strategy. Findings also reveal that students exposed to flipped classroom blended strategy achieved higher than those exposed to Edmodo social learning blended strategy. This may be as a result that learners in a FCM “explore topics in greater depth and create richer learning opportunities. This is in tandem with the findings of (Sapta & Maulana, 2017; Sadi & Dağyar, 2015) that students with low self-efficacy cannot be successful and thus are less likely to make a concerted, extended effort and may consider challenging tasks as threats that are to be avoided. Both authors affirmed that students with high self-efficacy tends to do something with a big and challenging effort, whereas individuals who have low self-efficacy will tend to avoid tasks and give up easily when problems arise thereby resulting to poor achievement. The high achievement and self-efficacy of FC over Edmodo found in this study may be due to the students’ constant exposure to online materials, viewing and learning at their own pace before the in-class activities as it were in flipped classroom blended strategy.

There is a significant difference in the mean achievement scores of male and female students taught nervous in favour of males. This is in tandem with the findings of Udoh and Ndirik, (2020) and refute the findings of Namaziandost and Cakmak (2020). This is in contrast with the findings of Chukwuemeka & Dorgu (2019) that nervous coordination was perceived as the most difficult topic in Biology by both the male and female Senior

School students. The finding also refutes Mavrikakiet et al., (2012) who suggested in their study that gender does not seem to affect pupils’ overall views about difficult topics in biology. This contradictions of findings of earlier study and the present may be as a result of the information technologies students were exposed to irrespective of their gender, which earlier researcher have found males to outperform females on IT utilization (Udoh & Ndirik, (2020)

Conclusion

The current study examined the relative effect of two strategies of blended learning on undergraduate students’ self-efficacy and achievement on difficult Biology topics. flipped classroom blended strategy was proven to be more effective on improving students’ self-efficacy and achievement. When gender was examined, male students had higher self-efficacy and achieved higher than the female.

Recommendation

Since flipped classroom blended strategy has proven to be more effective as an online educational tool in teaching and learning of nervous system, it’s then become imperative towards its adoptability in science Education teaching and learning especially on those concepts in Biology that is too difficult to teach, learn, and requires students’ in-depth knowledge of some of the physiological processes before comprehension is attained. It therefore becomes paramount that teachers should blend traditional teaching strategy especially using flipped classroom in teaching and learning of abstract science Education courses (biology) that require students to have in-depth knowledge of

physiological processes that goes on in the body for visualisation and concretization via technological aids. The visualising of such abstract topics improves teachers' teaching, makes teaching less struggle and much easier. And on the other hand, it will increase students' engagement, responsibility, and autonomy during the teaching and learning process. These engender sustainable science education and successful living in a world dominated by scientific and technological culture.

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