



EFFECT OF FLIPPED INSTRUCTIONAL STRATEGY ON PERFORMANCE AND MOTIVATION IN WAVE CONCEPT AMONG LOW-ACHIEVING SECONDARY SCHOOL PHYSICS STUDENTS IN ZARIA, KADUNA STATE, NIGERIA

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Abstract

This study examined the Effect of Flipped-Instructional-Strategy on Motivation and Performance in Wave Concept among Low-Achieving Secondary School Physics Students in Zaria, Kaduna State, Nigeria. The study employed quasi-experimental involving pretest and posttest control group design. The population of the study comprises all public co-educational Senior Secondary School II (SS2) Physics Students in Zaria Education Zone of Kaduna State. In this study, available data revealed that there were 3357 SSII students (2184 males and 1173 females) offering Physics in the Zone. The sample of the study comprised 115 SS II Physics low achievers (76 males and 39 females) from two (2) randomly selected public co-educational senior secondary schools in Zaria Education Zone. The study was guided by two objectives with their corresponding research questions and null hypotheses. Two instruments; Wave concept Performance Test (WCPT) and Wave Concept Motivation Questionnaire (WCMQ) were used to collect data. The instruments were validated by experts and the reliability coefficient of WCPT and WCMQ were obtained to be 0.84 and 0.76 using Pearson Product Moment Correlation Coefficient (PPMCC) for WCPT and Cronbach Alpha statistical tool for WCMQ respectively. The data collected was subjected to analyses at two different levels via descriptive and inferential statistics. The descriptive statistics of mean, standard deviation, and sum of Rank were used to answer the research questions raised. While at the inferential level,



t-test, and Mann-Whitney U-test analyses were used to test the null hypotheses at the significance level of $\alpha \leq 0.05$. The inferential statistics level forms the basis to permit decision on whether to reject or retain the null hypotheses after being tested. Results of findings revealed that, there is significant differences between the performance means scores of low achieving students taught wave concept using Flipped Instructional Strategy and those taught using conventional method in favour of the experimental group ($p=0.000$). There was significant difference between the motivation level of students taught wave concept using FIS and those taught using conventional method in favour of the experimental group ($p=0.000$). Based on the findings of the study, it was recommended among others, that Physics teachers should be encouraged through training and retraining programmes by state Ministry of Education and professional bodies such as STAN on the use of FIS in teaching Physics concept like wave, as it enhanced students' motivation and academic performance

Keywords: Flipped Instructional Strategy, Motivation, Academic Performance, Wave concept

Introduction

Science is the foundation upon which the bulk of present day technological breakthrough is built. These days, developing nations all over the world including Nigeria are striving hard to develop scientifically and technologically since the world is becoming scientific and proper functioning of lives depend greatly on science. Its relevance as a requirement for technological development of a nation cannot be underrated. Bell (2015), viewed science as an integral part of human society. Its impact is felt in every way of human life so much that, it is intricately linked with a nation's development. Science as a field of study has done a lot for mankind. For instance, life has become easier for man as a result of the advancement in science. Through science, man has been able to understand his environment. For example, by drastically changing our means of communication, the way we work, our housing, clothes and food, our methods of transportation, and indeed even the length and quality of life itself, science has generated changes in the moral values and basic philosophies of mankind. It is for these reasons that science is taught in Nigeria's senior secondary schools as recognised by the West African Examinations Council (WAEC) and the National Examinations Council (NECO) in

their Chief Examiner's Reports as Biology, Chemistry and Physics.

Physics is one of the science subjects taught in Nigeria's senior secondary schools. It deals with the study of the behaviour of matter in relation to energy. According to Egoyan (2017), Physics is the most fundamental and all-inclusive of sciences and as science is considered a veritable tool widely recognized as being of great importance for the development of the economic well-being of any nation, therefore, the knowledge of Physics cannot be overemphasized. Moreover, the role of the knowledge of Physics in technological advancement such as in electronic and computer technologies made it an enviable and attention-seeking subject within the science domain. As far back as 1984, Wenham, Dorlin, Snell and Taylor (1984) asserted that, Physics is and will remain the fundamental science subject that has contributed significantly to the technological development of the world at large. Almost four decades after, this assertion according to Ballah and Ugwumba, (2015) has not changed.

Despite the relevance of Physics in technological advancement and the steps taken by government of Nigeria to improve teaching and learning of the subject in



schools, students' performance in the subject as reported by Amusa, Ayanwale, Oladejo and Ayedun (2022), had perpetually been poor. In addition, the poor academic performance in SSCE Physics has become a trend in the WAEC results of Nigerian candidates. The WAEC Chief Examiner's Report (2019) revealed low achievement of students in Physics specifically in Wave concept. In a study conducted by Onyewuchi, Adewusi, Okebukola, Odekeye, Gbeleyi and Awaah (2021), Wave concept has been considered by students as abstract and difficult to understand which contributed to their poor performance. Moreover, a preliminary survey of students' terminal achievement records of coeducational schools in Zaria Education Zone for 2021/2022 SS II Physics students first and second terms results, revealed that out of 2941 SS II students who sat for the first term examination, only 1326 students representing 45.09% scored the pass mark of 50% and above, while 1615 students representing 54.91% failed with scores below 50%. Also, in the second term of the same session, 1175 students representing 39.95% scored 50% and above out of 2941 SS II Physics students who participated in the examinations, while 1766 students representing 60.05% failed to score up to the benchmark of 50%. In view of these statistical data reviewed, it is evident that students' achievement in Physics has not been encouraging. Regrettably, the percentage of students who achieved below average in their academic pursuit is on the increase. This trendy movement towards the direction of low achievement in Physics learning could likely suggest that tomorrow's Physics education practitioners may be bereft of techno-scientific competencies required for future development and the applications of Physics in achieving the goals of Physics education (FME, 2014). The achievement momentum of students in the classroom

teaching and learning of Physics varies according to certain factors such as; students' background, developmental level in terms of chronological and cognitive maturity. Such variations lead to "labeling" students as "talented" generalized as high-ability group and the under-achievers (limited learners), dropout, all being descriptions of weak and low ability group. Low achievement according to Mulanayi (2024), is due to inability of classroom instructional experience to stimulate the innate potentials of learners. Packiam, Selvi, and Fathima (2020) described low achievers as those students who scored an average less than 50 per cent marks consecutively over two years in their previous examinations. Magableh and Abdullah (2021) viewed low achievers as those students whose ability is not quite so limited but nevertheless who have more difficulty in learning than average students. The students' attainment is not in tune with their capability but below the expected level of achievement. Low achievers in this study are regarded as students who score below average in three consecutive Physics examinations. This low achievement in Physics students' performance according to Omebe and Akani (2015) could be attributed to many factors ranging from the attitude of students towards the subject, lack of motivation on the part of the students, lack of basic science background at the primary school and fundamentally, teachers' strategy which is considered as an important factor.

Nigeria secondary school students taught Physics by "chalk and talk" conventional method have repeatedly demonstrated poor motivation, low performance and retention in and from their Physics education programme. Conventional method has been described by Renau (2016), as oral presentation of information about a particular subject. It is often used to deliver a large amount of information to the



students in a short period. It is designed to deliver new information to a large group of students. It is also known to be effective in dealing with a large class. Regrettably, Ali and Akubue, (2015) asserted that, most science teachers in a bid to cover their syllabus adopt conventional method. Conventional method is mainly teachers centered and subject driven. It does not encourage initiatives, curiosity, and creativity in students and does not offer them opportunity to interact effectively with their peers and learning materials. This has resulted in students' low motivation, reduced participation and poor learning performance. Student-centred strategy supported by educational media could enhance effective teaching and learning. Among student-centred strategy is flipped instructional strategy.

Flipped instructional strategy, is a new model for effective teaching. Leo and Puzio (2016) referred to it as the process by which students gain first hand exposure to learning content outside the class, usually via reading or lecture videos, and then use class time to do the harder work of assimilating that knowledge through problem solving, discussion, or debates. Flipped instructional strategy is a form of blended learning in which students learn content online by listening to audio lectures or watching video lectures, mostly at their various home, and assignment is done together in the class with teachers and students discussing and solving questions. Students can work together on a task, exchange their opinion, experiences, views, discuss and negotiate strategies, actions and results through flipped classroom (Ichinose & Clinkenbeard, 2016). These actions can provide students with opportunity to help, discuss, review teach, influence each other and thereby enhance a motivational situation for developing a learning community. Flipped classroom instructional practice is student-centered,

making students active participants of the learning task as well as motivate their learning curiosity.

Motivation is defined as a set of force that causes people to behave in certain ways. It is a set of force that changes behaviour and determine it form, direction and intensity. Motivation is that energizing force that induces or compels and maintain behaviour. There are two types of motivation in learning process. These are extrinsic and intrinsic motivation. Extrinsic motivation is directed at earning rewards that are external to a student, while intrinsic motivation is doing something because it is inherently interesting or enjoyable. The teaching approach a teacher adopts is a strong factor that may affect students' motivation toward learning, which in turn affects their performance. Motivation can be enhanced according to Galurisma, (2023) through teaching methods that actively involve students. Students are categorized as academically motivated when they are able to maintain high ability, and competence in their work. How the teachers view motivation will influence what they should do to establish a classroom environment that will enhance students' motivation (Kiliç & Durdağı, 2021). A teacher has the ability to influence the students' motivation to learn through a variety of teaching decisions and approaches (Zeid, Assadi & Murad 2017). A teaching method that would help students to find satisfaction in the subject matter and also make the subject matter relevant to the need of the student will be necessary to motivate them. Flipped instructional strategy is student-centered, making students active participants of the learning task and also enable them to retain learnt concepts.

Research Studies in subjects like English, Basic Science, Biology, Chemistry, Civic Education, Geography, Government and Mathematics had shown the effectiveness



of flipped instructional strategy on students' academic performance (Ihekoronye, Odawn & Ayotola, 2015; Gambari, Bello & Adeoye, 2016; Khadjieva & Khadjikhanova, 2019; Efinwere, 2019; Al-Zebidi, 2021; Ifeanyi and Ugwu (2022); Folade & Muhammad 2023). Besides, studies had also revealed that the conventional method of teaching commonly used in schools, is inadequate to several other methods in terms of its ability to enhance meaningful learning, performance and motivation in Physics and in science. Similarly, literature reviewed on motivation such as Khadjieva and Khadjikhanova (2019), Turhan (2020), Daher, Alfahel and Anabousy (2021), Naciri, El-Hajji, Radid and Chemsy (2022), Radulovic, Zupanev, Stojanovic and Budic (2022) revealed that students exposed to flipped instructional strategy recorded higher academic performance when compared with those taught using conventional method. Therefore, this study examined the effect Flipped Instructional Strategy on Performance and Motivation in Wave Concept among Low Achieving Secondary School Physics Students in Zaria Education Zone.

Statement of the Problem

There is growing concern about which instructional strategy or method of teaching would reverse the deteriorating trends in secondary schools Physics students' performance. Students' failure in senior secondary school West African Examination Council (WAEC) is becoming the order of the day in which only few candidates obtained the requirements for further studies into Nigeria higher institutions. The WAEC Chief Examiner's Report (2019) and Augustine (2018), observed that, teachers' use of ineffective teaching method is among the factors that has contributed to the deteriorating trends in secondary school Physics students' performance. This may account for the

current low students' performance, motivation and enrolment in the subject. Besides, a good number of studies such as Williams (2018) and Okeke (2019), had investigated the causes of the appalling state of Physics students' performance. These causes were identified to include low students' motivation to learn Physics, poor teaching strategies used by Physics teachers, poor learning environment, perceived difficulty of the subject and inadequate instructional materials among others. Students shun sciences particularly Physics when given an option and this applies to girls.

The teaching of Physics in Nigeria has predominantly been through conventional method, which has been implicated by researchers to bring about poor academic performance and low motivation among students. The use of conventional method discourages initiatives, curiosity and creativity in students and does not offer them opportunity to interact effectively with their peers and learning materials. Al-Zoubi and Younes (2015), observed that conventional method of teaching does not take cognizance of low achievers due to its short comings but form part of the students that seat for examination in which the outcome is generally poor. The low achievers are not encouraged to participate actively in the teaching and learning process. This has resulted in larger number of students' poor academic performance and low motivation to learn.

In view of these, the study examined the effect of Flipped Instructional Strategy on performance and Motivation in Wave Concept among Senior Secondary School Physics Low Achievers in Zaria Education Zone, Kaduna State, Nigeria.

Objectives of the Study

The study has the following objectives. To:

- i. determine the effect of Flipped



- Instructional Strategy on academic performance of low achievers in wave concept among secondary school Physics students and
- ii. find out the effect of Flipped Instructional strategy on motivation of low achievers in wave concept among secondary school Physics students.

Research Questions

The following research questions are formulated and answered:

- i. What is the difference between the academic performance mean scores of low achievers taught wave concept using Flipped Instructional Strategy and those taught using conventional method?
- ii. What is the difference between level of motivation between low achievers taught wave concept using Flipped Instructional Strategy and those taught using conventional method?

Null Hypotheses

Based on the objectives and research questions stated, the following null hypotheses were formulated and tested at a ≤ 0.05 level of significance:

H₀₁: There is no significant difference between the academic performance mean scores of low achievers taught wave concept using Flipped Instructional Strategy and those taught using conventional method

H₀₂: There is no significant difference between level of motivation of low achievers taught wave concept using Flipped Instructional Strategy and those taught using conventional method.

Methodology

A pretest and posttest quasi- experimental control group research design was used for the study. Two groups of students

participated in the study; experimental group (EG) and control group (CG). The target population of this study comprises all public co-educational Senior Secondary School II (SS2) Physics Students in Zaria Education Zone of Kaduna State, Nigeria. In this study, available data revealed there are 3357 SSII students (2184 males and 1173 females) offering Physics in the zone. The sample for this study comprised 115 SS II Physics low achievers (76 males and 39 females) from two (2) randomly selected public co-educational senior secondary schools in Zaria Education Zone, Kaduna State, Nigeria. Simple random sampling was used to select four (4) schools from the twenty (20) co-educational senior secondary schools in the study area. Low achievers from these schools were identified based on their teachers' record of three consecutive exams in Physics subject. From the preliminary survey, students who consistently scored below 50 were considered as low achievers. To further ensure homogeneity in the students' ability level, pre-test was administered to the low achievers in each of the four schools randomly selected to determine their equivalence in terms of academic performance in wave concept. This was achieved by subjecting the results obtained from the pre-test to Analysis of Variance (ANOVA) and Scheffe's post-hoc test at $p \leq 0.05$. ANOVA was used to determine the existence of any significant difference in the four schools while the Scheffe's post-hoc test was used to separate the schools and figure out which schools were significantly or not significantly different. Two schools were statistically homogeneous and were therefore used for the study.

Two validated instruments namely; Wave concept Performance Test (WCPT) and Wave Concept Motivation Questionnaire (WCMQ) were used to collect data. Test-retest method was used to determine the



reliability coefficient of Wave Concept Performance Test (WCPT) and computed to be 0.84 using Pearson Product Moment Correlation Coefficient (PPMCC). While the Wave Concept Motivation Questionnaire (WCMQ) was administered once and the reliability coefficient was determined to be 0.76 using Cronbach Alpha statistical tool.

For the purpose of data collection, the following sequential steps were used. The Wave Concept Performance Test (WCPT) and Wave Concept Motivation Questionnaire (WCMQ) was administered to the students as pretest and posttest (at 6 weeks' interval) to determine their performance and motivation level. The data collected was subjected to analyses at two different levels, that is, descriptive and inferential levels. At the descriptive level, the descriptive statistics of mean, standard deviation, sum of rank and mean rank difference were used to answer the research

questions raised. While at the inferential level, independent sample t-test and Mann Whitney U-test were used to test the null hypotheses at $\alpha \leq 0.05$ level of significance. The inferential statistics level forms the basis to make decision on whether to reject or retain the null hypotheses.

Results

Results obtained from the data collected were analyzed as follows:

Research Question One: What is the difference between the academic performance mean scores of low achievers taught wave concept using Flipped Instructional Strategy and those taught using conventional method?

To answer research question one, post-test scores of experimental and control groups obtained using Wave Concept Performance Test (WCPT) were subjected to descriptive statistics. The mean scores and standard deviation of the statistics is presented in Table 1.

Table 1: Distribution of Mean and Standard Deviation of Posttest Scores of Low Achievers in Experimental and Control Groups

Groups	N	Mean	Std. Deviation	Mean Difference
Experimental	56	34.36	1.17	21.05
Control	59	13.31	3.50	
Total	115			

The result of Table 1 shows that the posttest mean scores of the experimental group is 34.36 with standard deviations of 1.17. The control group recorded mean scores of 13.31 with standard deviation of 3.50. The mean difference between the two is 21.05. This shows that Physics students taught Wave Concept using flipped instructional strategy achieved higher academically than conventional group counterpart. The mean difference recorded is 21.05. To determine whether the mean difference is significant or not, null hypothesis one was tested using t-test at $\alpha \leq 0.05$ as presented in Table 2.

Null Hypothesis One: There is no significant difference between the academic performance mean scores of SSII Physics low achievers taught wave concept using Flipped Instructional Strategy and those taught using conventional method

To test null hypothesis one, the post-test scores obtained from WCPT of the experimental and control groups were subjected to an independent sample t-test statistic at $\alpha \leq 0.05$. Summary of the analysis is presented in Table 2.



Table 2: Independent Sample t-test Analysis of Posttest Performance Scores between Experimental and Control Groups

Group	N	Mean	Std. Dev.	df	t	p	Decision
Experimental	56	34.36	1.17	113			
					42.80	0.000	Ho ₁ Rejected
Control	59	13.31	3.50				
Total	115						

Significant at $p < 0.05$ level

Table 2 revealed that significant difference exists between the performance mean scores of SS II Physics low achievers in the experimental and control groups, $t (42.80)$, $p = 0.000$, which is less than 0.05 level of significance. The experimental and control groups recorded mean scores of 34.36 and 13.31 respectively. Therefore, the null hypothesis which stated that there is no significant difference between the mean performance scores of SS II Physics low achievers taught wave concept using flipped instructional strategy and those taught using conventional method is hereby rejected. This implies that FIS is effective

in improving students' performance in wave concept than the lecture method.

Research Question Two: What is the difference between level of motivation between SSII Physics low achievers taught wave concept using Flipped Instructional Strategy and those taught using conventional method?

To answer research question two, descriptive statistics of mean ranks, sum of rank and mean rank differences were used to answer the research question. Summary of the analysis is presented in Table 3.

Table 3: Distribution of Mean and Sum of Ranks in Motivation between Experimental and Control Groups

Group	N	Mean Rank	Sum of Ranks	Mean Rank Diff.
Experimental	56	87.50	4900.00	
				57.50
Control	59	30.00	1770.00	
Total	115			

From Table 3, the mean rank value of 87.50 was obtained in the experimental group with a value of 4900.00 as the sum of rank; while in the control group, a mean rank value of 30.00 with a sum of rank of 1770.00 was also obtained. A high mean rank difference of 57.50 was computed and this shows that the experimental group developed a higher motivation than the

control group. As such, flipped instructional strategy has a positive impact on students' motivation. To determine whether the mean rank difference is significant or not, Hypothesis two was tested using Mann Whitney U-test at $\alpha \leq 0.05$ as presented in Table 4.

Null Hypothesis Two: There is no significant difference between level of



motivation of low achievers taught wave concept using Flipped Instructional Strategy and those taught using conventional method.

To test null hypothesis two, the pretest and post-test scores obtained from WCMQ (Table 4.3) of the experimental and control groups were subjected to Mann Whitney U-test statistics at $\alpha \leq 0.05$. Summary of the analysis is presented in Table 4.04.

Table 4: Mann-Whitney (U-test) Analysis of Low Achievers' Motivation between Experimental and Control Groups

Groups	N	Mean Rank	Sum of Ranks	U-cal	p-value	Decision
Experimental	56	87.50	4900.00			
Control	59	30.00	1770.00	.000	0.000	Ho ₂ Rejected
Total	115					

Significant at $p < 0.05$ level

Results in Table 4 shows that the mean rank of mean 87.50 was obtained by the experimental group and a sum of rank value of 4900.00. On the other hand, the mean rank value of the control group was computed to be 30.00 and the sum of rank was 1770. The Mann -Whitney U-value was .000. Since the p-value of 0.000 is less than 0.05 which indicates that there is significant difference between the motivation level of SSII Physics low achievers in the experimental and control groups in favour of the experimental group who were taught wave concept using flipped instructional strategy. Hence, the null hypothesis is rejected. This implies that FIS enhances students' motivation than the conventional method.

Discussion of results

The findings and results of the study are discussed as follows:

The results in Table 1 show that students in the experimental group had a higher mean academic performance score than those in the control group. The difference was significant as indicated by the independent

samples t-test analysis in Table 2. This signifies that student taught wave concepts using flipped instructional strategy had higher mean academic performance scores than those taught using conventional method. By implication, the FIS had significantly enhanced the academic performance of students than the conventional method. It may be argued that the significant difference may be attributed to the fact that students exposed to FIS had the opportunity to watch lecture videos prior to the classroom instruction which enabled them to construct meaning as well as create learning experiences of the concepts taught during the classroom instruction This finding is in support of the research findings in Physics by Asiksoy (2018), Cheng, Ritzhaupt and Antonenko (2019), Abolarinwa (2020), Ipem, Onyemanche and Onwudiwe (2021), Akanbi, Eben and Yusuf (2024), Ihekoronye and AL Akinyemi (2023) and Abolarinwa, Gambari and Olugbemi (2022) which indicated that FIS is significantly effective in enhancing students' academic performance than conventional method.



Similar findings by Khadjieva and Khadjikhanova (2019) in Mathematics and English, Al-Zebidi (2021) in Mathematics, Ifeanyi and Ugwu (2022) in Government, Osuafor and George (2023) in Chemistry, Folade and Mohammad (2023) and Egara and Mosimege (2024) in Mathematics also confirmed the results of this study with a broad, positive and significant effect of the FIS on academic achievement of students. On the contrary, Ugwuanyi, Nduji, Elejere and Omeke (2020) reported that students taught Physics using think pair share performed better than those using flipped instructional strategy.

Tables 3 and 4 compared the motivation level of students in the experimental and control groups. From the findings of these Tables, results revealed significant difference in the motivation level of the students exposed to FIS and conventional method. The significant difference is in favour of the experimental group as revealed in the mean rank, mean rank difference and U-value. This signifies that student taught wave concept using flipped instructional strategy had higher motivation scores than those taught the same concept using conventional method. By implication, the FIS had significantly improved the motivation level of students than the conventional method. The significant difference may be attributed to the fact that students exposed to FIS were allowed to watch pre-recorded lectures or instructional videos, providing opportunities to observe and learn from the instructor's demonstrations of the concepts taught prior to in-classroom instruction. This finding is in agreement with Khadjieva and Khadjikhanova (2019), Fallah, Hafezi, Makvandi, and Bavi, (2020), Naciri, El-Hajji, Radid, Kharbach and Chemsu (2022), Hsieh and Maritz (2023).

Conclusion

Based on the findings of this study, the following conclusions were made:

1. Academic performance in wave concept can be enhanced significantly by employing flipped mastery learning model during classroom instruction.
2. Flipped instructional strategy promotes meaningful learning which strengthens the motivation level of low achievers in wave concept among SSII Physics students.

Recommendations

On the basis of the findings obtained from this study, the following recommendations are made:

1. Physics teachers should frequently employ FIS in teaching difficult concepts like wave as it enhanced academic performance of low achieving students.
2. Professional bodies like STAN in collaboration with the Federal and State Ministries of Education should embark on nationwide training and retraining of Physics teachers how to design and implement classroom instructions based on the FIS through regular national, state and local seminars, workshops and conferences.

References

- Abolarinwa, I. F. (2020). Effects of three modes of flipped classroom collaborative strategies on learning outcomes of secondary school physics students in Minna, Nigeria (Doctoral Dissertation).
- Al-Zebidi, A. A. (2021). The Impact of Flipped Classroom Strategy of Teaching Mathematics on Students' Achievements at Umm Al-qura



- University. *Journal of Education*, 2(81), 49-67.
- Al-Zoubi, S. M., & Younes, M. A. B. (2015). Low academic achievement: Causes and results. *Theory and Practice in Language Studies*, 5(11), 2262.
- Amusa, J. O., Ayanwale, M. A., Oladejo, A. I., & Ayedun, F. (2022). Undergraduate Physics Test Dimensionality and Conditional Independence: Perspective from Latent Traits Model Package of R Language. *The International Journal of Assessment and Evaluation*, 29(2), 47.
- Augustine, O. (2018). Enhancing and Assessing the Conceptual Understanding of Nigerian Senior Secondary School Physics Students in Waves Using Concept Mapping Technique. *The International Journal of Humanities & Social Studies*. 95(3), 604-616
- Ballah, A. G., & Ugwumba, A. O. (2015). Attitudes and Academic Performance of Senior Secondary School Students in Physics in Nigeria. Paper Presented at the Proceedings of SOCOINTER15 – 2nd International Conference on Education, Social Sciences and Humanities 499 – 508
- Bell, D. (2015). Design and Technology; Educational Fallacy or Principal Exponent of School Based STEM Activity? Paper presented at the Annual Conference for Research in Education; Controversies in Education: Problems, Debates, Solutions, Edge Hill University.
- Cheng, L., Ritzhaupt, A. D., & Antonenko, P. (2019). Effects of the Flipped Classroom Instructional Strategy on Students' Learning Outcomes: A Meta-Analysis. *Educational Technology Research and Development*, 67(2), 793-824.
- Efinwere, R. A. (2019). Effects of Flipped Classroom Model on Interest among Senior Secondary School Mathematics Students II in Enugu and Anambra State, Nigeria. *Education and Information Technologies*.
- Egara, F. O., & Mosimege, M. (2024). Effect of Flipped Classroom Learning Approach on Mathematics Achievement and Interest among Secondary School Students. *Education and Information Technologies*, 29(7), 8131-8150.
- Egoyan, A. (2017). The Role of Physics in Science Integration. *The General Science Journal* 7(7), 831-840
- Folade, O.C. & Mohammad, I. B. (2023). Compared the Effectiveness of Computer Simulation and Animation Instructional Packages in Flipped Classroom settings on Secondary School Students' Performance and Retention in Geography. *Journal of Digital Educational Technology* 3(2)
- Galurisma, P. (2023). *Students' Motivational Startegies in Online Learning* (Doctoral Dissertation).
- Gambari, A.I., Bello, R.M., Agboola, A.K. & Adeoye, I.O. (2016). Impact of Flipped Classroom Instructional Model on Students' Achievement and Retention of Mammalian Skeletal System in Minna, Niger



- state Nigeria. *International Journal of Applied Biological Research*, 7(2), 193-207.
- Hsieh, H. M., & Maritz, A. (2023). Effects of Flipped Teaching on Entrepreneurship Professional Student Learning Motivation, Self-Directed Learning, and Learning Outcome. *Contemporary Educational Technology*, 15(4).
- Ichinose, C., & Clinkenbeard, J. (2016). Flipping College Algebra: Effects on Student Engagement and Achievement. *Learning Assistance Review*, 21(1), 115-129.
- Ifeanyi, C. I., & Ugwu, K. (2022). Effects of Flipped Classroom Approach on Students Achievement in Government in Nsukka Education Zone. *Journal of Educational Change*, 18(2), 17-28.
- Khadjieva, I., & Khadjikhanova, S. (2019). Flipped Classroom Strategy Effects on Students' Achievements and Motivation: Evidence from Cpfs Level 2 Students at Tashkent. *European Journal of Research and Reflection in Educational Sciences* 7(12).
- Kiliç, M. E., & Durdağı, A. K. (2021). Motivation in the classroom. *Participatory Educational Research*, 8(2), 31-56.
- Leo, J. & Puzio, K. (2016). Flipped Instruction in a High School Science Classroom. *Journal of Science Education and Technology*. 25. 10.1007/s10956-016-9634-4.
- Naciri, A., Hajji, M. E., Radid, M., Kharbach, A., & Chemsı, G. (2022). Exploring Student Motivation and Performance in the Flipped Classroom: A Case Study of Nursing Students. *Electronic Journal of General Medicine*, 19(3).
- Okeke, U. K. (2019). Students' Achievement and Low Enrolment in Physics: The Place of Physics Teachers and Other Necessary Resources. Unpublished dissertation), University of Ibadan, Ibadan.
- Omebe & Akani (2015) Attitudes of students towards Science and Science Education in Nigeria, focusing on the case of selected secondary schools in the Obioakpor Local Government Area of Rivers State. *International Journal of Humanities, Social Science and Education*,
- Onyewuchi, F. A., Adewusi, M. A., Okebukola, P., Tokunbo O. O., Gbeleyi, O. & Awaah, F. (2021): Breaking the Backbone of Difficult Concepts in the New Secondary School Physics Curriculum in Africa. Proceedings of the 28th iSTEAMS Inter-Tertiary Multidisciplinary Conference. *American International University West Africa, The Gambia. Series 28, Vol 3 October 2021. Pp 67-94* www.isteam.net/gambia2021. DOI [https://doi.org/ 10.22624/](https://doi.org/10.22624/)
- Packiam, D., Selvi, P., & Fathima, M. P. (2020). Improving Arithmetic Skills of Low Achieving Children through Appropriate Cognitive Strategies. *International Journal of Research and Analytical Reviews (IJRAR)*, 7(1), 769-773.
- Renau, M. (2016). A review of the traditional and current language teaching methods. *International Journal of Innovation and Research*



- in Educational Sciences*, 3(2), 82-88.
- Turhan, N.S., (2020) Gender Differences in Academic Motivation: A Meta-Analysis, *International Journal of Psychology and Educational Studies*, 7(2), 211-224
- Ugwuanyi, C. S., Nduji, C. C., Elejere, U. C., & Omeke, N. E. (2020). Effect of Flipped Classroom and Think Pair Share Strategy on Achievement and Retention among Senior Secondary School Physics Students. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, 52(2), 136-148.
- Wenham, E.J., Dorlin, G.W., Snell, J.A.N., & Taylor, B. (1984). *Physics: Concepts and Models* (2nd ed). Addison Wesley.
- Williams, M. (2018). The missing curriculum in physics problem-solving education. *Science & Education*, 27(3), 299-319.