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EFFECT OF FLIPPED CLASSROOM STRATEGY ON UNDERGRADUATE CHEMISTRY STUDENTS' ENGAGEMENT IN OYO STATE

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Abstract
This study investigated the effect of the Flipped Classroom Strategy (FCS) on the engagement of undergraduate chemistry students in Oyo State, Nigeria, with emphasis on gender influence. A quasi-experimental design with pre-test, post-test, and control group was employed, involving 145 first-year chemistry students from Emmanuel Alayande University of Education, Oyo, and Lead City University, Ibadan. The experimental group (n = 130) received six weeks of CHM101 instruction via FCS through researcher-designed WhatsApp video lessons, while the control group (n = 15) was taught using conventional methods. Data were collected using a Chemistry Performance Test and an Engagement Questionnaire, both validated by experts (reliability coefficients: 0.865 and 0.712, respectively). Descriptive statistics and t-tests at a 0.05 significance level were used for analysis. Results showed high engagement levels among FCS students, with top-rated indicators including self-paced learning (M = 4.30), valuing subject matter (M = 4.18), and seeking additional information (M = 4.13). Gender had no significant effect on engagement (p = 0.652), indicating FCS benefits both male and female students equally. The study concludes that FCS fosters active learning, deep understanding, and equitable participation in chemistry education. It recommends among other that chemistry educators should use the Flipped Classroom Strategy (FCS) with digital literacy training and diverse online resources to improve students' comfort with virtual learning platforms, thereby maximizing self-directed learning benefits. Hence it was recommended for lecturers to use flipped classroom strategy

Keywords: Education, innovation, flipped Classroom, engagement, chemistry, university

Introduction

Over the years, the students are being taught with different teaching and learning strategy starting from conventional teaching method where by students are taught with Chalk and board in which the teacher takes the ownership of the whole process in the teaching and learning, and after some years technology, came on board to invert the conventional method in which the students are active in the teaching and learning with keen innovative strategies of which Flipped Classroom Strategy remain sterling as an alternatives to improve the teaching and learning pedagogy. Therefore, the flipped classroom strategy is a potential solution to erase the teacher-learner centered approach. if well adapted. It is an active learning technique that re-prioritizes focus from passive receipt of knowledge to active engagement with the subject. This approach is a learner centered approach that guarantees ownership of learning by students and allows peer-to-peer interaction to the extent of practical application of principles, thus improving academic success in chemistry education. The innovative strategy includes Concept mapping, Blended learning, Gamification, Flipped Classroom among others. Nugrahen and Surjono et al. (2022) described Flipped classroom (FC) as an alternative method of using creative problem-solving to provide courses outside the classroom, with homework and assignments completed before the teacher.It can be confidently said that one of the Innovative Strategies and instructional methodologies that make teaching and learning valued by students and parents who recognize the strategy's value as an educational tool to support their children's academic pursuits is the Flipped Classroom Package. The term "flipped classroom" refers to a mixed-learning approach in which students watch lectures on videotape to get a better understanding of the material before class. Meigen (2016), Quan (2015), and Bart (2014).

As an educational innovation in technology, the flipped learning approach has recently gained popularity, particularly when applied to higher education (Divjak et al., 2022). Using technology-enhanced teaching methods that go beyond traditional lectures is the most effective way to motivate students (Yıldız et al., 2022). Technology plays a vital role in boosting student engagement and happiness with the flipped classroom approach relying largely on technology (Tomas et al., 2019). Flipping a classroom implies turning the normal classroom on its side (Güler et al., 2023). Outside of class, students are expected to actively study new content by reading or watching recorded lectures. It requires that students recall the information provided in the class and evaluate it (Bachiller & Badía, 2020).

Makinde, (2017) clarifies the Flipped classroom as the only innovative strategy that can simplify the student's phobia in mathematics. Engagement lays a strong foundation for enhanced students' retention of core chemistry concepts, ensuring that students can effectively recall and apply their knowledge over time. Thus, the retention of learned concepts in the abstract nature of chemistry concepts is a critical factor in evaluating the effectiveness of any instructional strategy, and the flipped classroom model has been suggested to show promise in this regard. Incorporating pre-class preparation and active in-class engagement, the strategy reinforces students' understanding and helps solidify their grasp of chemistry concepts over time. The repetitive nature of reviewing materials before class and applying them during class activities creates multiple layers of reinforcement, which enhances long-term retention. Research has shown that flipped classroom students outperform their peers in retention assessments, particularly in content-heavy subjects like chemistry (Seery & McDonnell, 2017). Attention is always placed on how students are actively involved in performing all assigned activities in chemistry at both secondary and tertiary institutions because it is a prerequisite for all science and technology courses. So, Chemistry is an enabling science needed for numeracy and concept development and as a basis for other pure science disciplines. Agriculture, Engineering, Food Technology, Medicine, Nursing, and Pharmacy apply Chemistry (Olorundare 2014). Therefore, the present study seeks to investigate the effect of flipped classroom on chemistry student's engagement in Oyo State

Statement of the problem

The persistent problems in chemistry education, especially in Nigerian universities, have been traceable to conventional teacher-centered pedagogical practices that fail to support critical thinking and holistic conceptual understanding. Even though there have been advancements in technology, there is still a remarkable gap in enhancing students' participation in chemistry education (Divjak et al., 2022; Yıldız et al., 2022). The fact remains that some Chemistry teachers still need a technological upgrade. The literature clearly illustrates that profound and meaningful gaps remain in the prevailing education approach. Although research works carried out by Makinde in 2017, Abolarinwa in 2020; Mahmood in 2023 have been vastly successful in terms of the application of flipped classroom method within the context of secondary school it is on this note, In Oyo State which is the locale of the study, based on the findings, there are no such study of this kind but Olasedidun and Ganiyu (2020) findings investigated that Colleges of Education students that are taught Educational Technology Concepts with the use of flipped classroom strategy perform excellently than those that are taught using conventional method of teaching in Oyo State and failed to Involved other students in other department like Chemistry and other variables that may have a great

influence in the use of flipped classroom to facilitate learning in quest to find out what other variables, the current study considered Undergraduate chemistry students Engagement.

Research Question

What is the difference in students' mean score of FCS engagement in chemistry?

Research Hypothesis

H_0: There is no significant difference in the gain scores of students taught with FCS and CC on engagement in chemistry class based on gender

Methodology

The study employed pre-test, posttest and control quasi-experimental design with 3x2 factorial matrix. The experimental groups were taught using Flipped Classroom Strategy while the control group was taught using Conventional method of teaching. The population of the study consisted of all first-year undergraduate students offering CHM101 from two universities in Southwest, Nigeria, particularly in Oyo State that is Emmanuel Alayande University of Education, Oyo and Lead City University Ibadan, Oyo State. The sample size of the study consisted of one hundred and forty-five (145). 100 level Chemistry Students were selected through simple random sampling techniques, for an experimental group, the respondent was 130 while the control was 15. The male students were 28 and female students were 102 totaling 130 in the experimental group while male were 5 and female were 10 totaling 15 in the control group. The treatment for the study was Teaching of CHM 101 (Inorganic Chemistry) for 100 level. The experimental group was taught this General Chemistry using FCS via Watching video on their whatsapp platform designed by the researcher for a period of six weeks. The students in the control group were taught the same course using the conventional method. The lesson plan designed for this purpose was strictly followed and lecture note given by the researcher. Chemistry Performance Test and Engagement Questionnaire served as instruments for data collection were face and content validated by experts in the field which was rated excellent. The reliability coefficients found to be 0.865 for FCS, 0.712 for Engagement Questionnaire. Mean and Standard deviation was used to answer the research, while the hypothesis was tested using t-test at 0.05 level of significant using statistical products and service solution (SPSS) version 20.00.

Results and Discussion of Findings

Table1:

Shows the engagement of students taught chemistry using a flipped classroom Strategy (FCS)

SN	Items	Always	Often	Sometimes	Rarely	Never	Mean	St.Dev.
1	I am Participating actively in small group or discussion forum in flipped classroom	59 (45.4%)	35 (26.9%)	25 (19.2%)	9 (6.9%)	2 (1.5%)	4.08	1.031
2	I often spend extra time trying to obtain more information about topic during flipped classroom	47 (36.2%)	56 (43.1%)	24 (18.5%)	3 (2.3%)	0 (0%)	4.13	.791
3	I am very comfortable doing online class using flipped classroom	28 (21.5%)	38 (29.2%)	42 (32.3%)	18 (13.8%)	4 (3.1%)	3.52	1.073
4	I do log into the webpage regularly for flipped classroom	32 (24.6%)	50 (38.5%)	28 (21.5%)	13 (10%)	7 (5.4%)	3.67	1.116
5	I am confident that I can understand complex topic in this subject through flipped classroom	57 (43.8%)	36 (27.7%)	29 (22.3%)	6 (4.6%)	2 (1.5%)	4.08	.993

6	I frequently engage in teaching and learning because the content of the topic is interesting using flipped classroom	46 (35.4%)	47 (36.2%)	29 (22.3%)	6 (4.6%)	2 (1.5%)	3.99	.952
7	I drill myself on content of each topic until I understand them completely using flipped classroom	31 (23.8%)	56 (43.1%)	34 (26.2%)	9 (6.9%)	0 (0%)	3.84	.870
8	Even when course materials are uninteresting, I manage to keep working until I finish with the aid of flipped classroom	35 (26.9%)	52 (40%)	25 (19.2%)	10 (7.7%)	8 (6.2%)	3.74	1.124
9	Understanding the subject matter of this course is very important to me while I am on to flipped classroom	69 (53.1%)	28 (21.5%)	23 (17.7%)	7 (5.4%)	3 (2.3%)	4.18	1.053
10	I do well with flipped classroom in the tests and	70 (53.8%)	37 (28.5%)	18 (13.8%)	2 (1.5%)	3 (2.3%)	4.30	.929

	examination because I learn at my own pace

Source: Authors' survey, 2025

The results in Table 1 revealed that students taught chemistry through the Flipped Classroom Strategy (FCS) generally exhibited high levels of engagement, with mean scores ranging from 3.52 to 4.30 on a 5-point scale. The highest-rated items show that students believe learning at their own pace improves their performance (M = 4.30, SD = 0.929), that understanding the subject matter is very important to them (M = 4.18, SD = 1.053), and that they often spend extra time seeking more information about topics (M = 4.13, SD = 0.791). Active participation in discussions (M = 4.08) and confidence in understanding complex topics (M = 4.08) also emerged as strong engagement indicators, reflecting the method's capacity to foster self-directed learning and intrinsic motivation. However, moderate ratings on certain items indicate areas for improvement. The lowest mean score was recorded for comfort with online classes (M = 3.52, SD = 1.073), suggesting that not all students are fully at ease with digital learning environments. Similarly, persistence when course materials are uninteresting scored moderately (M = 3.74, SD = 1.124), pointing to the need for more engaging content design. Standard deviations ranging from 0.791 to 1.124 indicate moderate variability in responses, reflecting differences in students' digital skills, learning preferences, and adaptability to self-paced study.

Overall, the findings affirm that FCS is effective in promoting active, independent, and performance-oriented learning in chemistry, though targeted support in digital literacy and motivation strategies could further strengthen engagement. The findings of this study corroborated the study of Chadawodza et al. (2024) found that implementing a flipped classroom model in Grade 12 organic chemistry in South Africa led to significantly higher students' engagement during the COVID-19 pandemic. This study is in-line with the study of Naperi et al. (2025) evaluated media-based flipped classroom for chemistry education and reported moderate levels of behavioural (WM = 3.73), affective (WM = 3.29), and cognitive engagement (WM = 3.58), suggesting that while the strategy aids engagement across domains, further enhancements could bolster its effectiveness.

Table 2:
T-Test analysis of difference in the level of engagement of students taught Chemistry using a developed FCS between male and female

Gender	N	Mean	Std. Dev.	Df	t-value	Sig	Remark
Female	102	39.41	5.582	128	-.452	.652	Not Significant
Male	28	39.93	4.405				

Source: Authors' survey, 2025

The independent samples t-test results indicated that there is no statistically significant difference in the level of engagement between male (M = 39.93, SD = 4.405) and female (M = 39.41, SD = 5.582) students taught Chemistry using the developed Flipped Classroom Strategy (FCS), t (128) = -0.452, p = 0.652 > 0.05. This suggests that gender did not play a meaningful role in determining students' engagement levels in the FCS learning environment, implying that the instructional strategy was equally effective for both male and female learners. This study is in support of the study of Oladipo et al. (2025) reported that when instructional designs actively promote student-centered learning, gender differences in academic engagement tend to diminish, as both male and female students benefit equally from interactive, participatory approaches like the flipped classroom.

Conclusions

The findings of the study concluded that the study shows that the Flipped Classroom Strategy (FCS) significantly improves undergraduate chemistry student engagement in Oyo State, outperforming conventional methods. The learner-centered approach promotes deeper understanding, retention, and performance. However, moderate online learning comfort suggested that the need for targeted digital literacy interventions.

Recommendations

Based on the findings of this study, the study recommends the following:

i. The study suggested that chemistry educators should use the Flipped Classroom Strategy (FCS) with digital literacy training and diverse online resources to improve students' comfort with virtual learning platforms, thereby maximizing self-directed learning benefits.
ii. The Flipped Classroom Strategy (FCS) should be a gender-inclusive teaching approach in chemistry, ensuring interactive, participatory, and accessible learning activities for all students, promoting equal opportunities for engagement.

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