Faculty of Natural and Applied Sciences Journal of Mathematics and Science Education
Print ISSN: 2814-0885 e-ISSN: 2814-0931
www.fnasjournals.com
Volume 7; Issue 2; December 2025; Page No. 54-61.
DOI: https://doi.org/10.63561/fnas-jmse.v7i2.1090

Correlation Between Undergraduates' Interest in Educational ICTs and their Academic Achievement in a Science Education Course Within a Flipped Learning Context

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Abstract
This study examined undergraduates' interest in educational ICTs as a correlate of their academic achievement in a science education course in a flipped learning context. This study adopted a correlation design. The study was guided by three research questions and one hypothesis: The study sample comprised 68 second-year students of Education and Biology, who were selected using purposive and census sampling methods. Two instruments were used for data collection: The Educational ICTs Interest Rating Scale (EIIRS) and the History and Philosophy of Biology Achievement Test (HPBAT). Cronbach's alpha and Kuder-Richardson 20 statistics were used to ascertain the reliability of the EIIRS and HPBAT, which yielded coefficients of 0.78 and 0.74, respectively. The research questions were answered using mean, standard deviation, line graph, and Pearson product-moment correlation coefficient, while the hypothesis was tested using simple linear regression. The researcher found that most undergraduates were highly interested in educational ICTs and performed well in the flipped learning context. However, there was a low positive and non-significant relationship between undergraduates' interest in educational ICTs and their achievement in a flipped learning setting, and the hypothesis revealed that interest in educational ICTs does not significantly predict the achievement of undergraduates in a flipped learning context. The researcher recommended that since undergraduates' interest in ICT was not a strong predictor of achievement in a flipped learning class, lecturers should explore other approaches, such as the use of games and alignment of lessons to individual students' career goals to boost students' achievement in a flipped learning context.

Keywords: Flipped Learning, Educational ICTs, Interest, Achievement, Science Education

Introduction

Flipped Learning, a fast-growing method of teaching and learning that changes the traditional classroom pattern of teaching and learning while possessing elements of take-home assignments, has attracted great attention in tertiary and secondary education, principally in the field of science (McLean et al., 2016). This instructional method is characterized by the delivery of lessons at home, occasionally through videos pre-recorded by the teachers, sourced from the Internet or texts, and the use of actual class periods for interactions and discussions of what was done at home by the students. Flipped Learning offers the potential to enhance learners' achievement in all domains of Learning and promote a more active and collaborative learning environment (Al Mulhim, 2021). The Flipped Learning model thrives on four major pillars: (i). flexible environment (here, educators provide instructional content in a space where students can learn at their pace and get help from one another, if needed); (ii). Student-centered learning culture (iii). intentional content determined by the teacher; and (iv). professional educators (Demirel, 2016). The Flipped Learning model has been increasingly adopted by teachers and students in higher institutions. Undergraduates in higher institutions are likely to have access to personal technological gadgets and tools that promote the Flipped Learning experience, which explains the thriving adoption of this model.

The advent of information, communication, and technologies (ICTs) has made the practice of Flipped Learning acceptable and easy. Various forms of ICTs play an important role in lesson delivery in a Flipped Learning context. Educational ICTs play a significant role in simplifying Flipped Learning environments. This is because

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they use the required tools and stages to convert traditional instructional methods into highly interactive and student-centered approaches to learning.

Some Educational ICTs used in flipped classrooms include video conferencing tools (Zoom, Google Meet) and learning management systems (Moodle, Google Classroom) (Cueva & Inga, 2022). Learning management systems are popular in higher institutions, particularly Moodle and Google Classroom. Moodle, a learning management system, supports various classroom activities, including hosting student forums, homework, quizzes, grading quizzes/assignments, and strong reporting features. However, Google Classroom is a less sophisticated platform than Moodle. Google Classroom enables teachers and lecturers to arrange and send course materials and assignments in the digital space. In addition, it provides teachers with opportunities to grade assignments and provide feedback to students. The role of ICTs in facilitating Flipped Learning cannot be overemphasized.

ICTs, such as educational platforms and digital tools, help learners study at their own pace, thereby fostering the comprehension and retention of assimilated information (Pastor & López, 2018). Bucheli et al. (2019) revealed that 92% of students preferred flipped classrooms over traditional classroom setups when digital platforms such as Schoology and tools such as YouTube and Apple Clips were used to deliver the lessons. Cueva and Inga (2022) asserted that ICTs facilitate communication between learners and teachers. The Flipped Learning method of teaching, when supported by ICTs, turns teachers into knowledge facilitators who guide learners through the application of theoretical knowledge (Shanthi, 2025).

Flipped Learning supported by ICTs transforms students from passive recipients of information to actively engaged learners. ICTs allow students to access lessons outside traditional classroom settings and engage in physical classroom collaboration. Al-Jarrah et al. (2021) are of the view that applying multimedia tools in the flipped classroom space will help to raise students from a basic phase in academic achievement to an advanced level and also expand the application of e-learning to improve students' interest in the Flipped Learning model. Evidently, the incorporation of technology not only boosts the learning experience but also fosters a participatory educational environment.

The benefits of Flipped Learning are multifaceted, enhancing not only academic performance but also the critical skills necessary for the modern workforce. Students report higher levels of enthusiasm and participation in classroom activities, leading to a more dynamic learning environment (Resmayani & Wahyuningsih 2023). Various studies have shown that Flipped Learning significantly increases students' academic outcomes. Examples are the results of a meta-analysis by Aybirdi et al. (2023) which showed a substantial effect size (g=1.303) for L2 learners, implying an improvement in the performance of the students. In addition, in a primary school setting, Flipped Learning has been shown to positively impact students' outcomes in mathematics (Yarim & Ada, 2023). Flipped Learning positively influences academic achievement, as higher awareness of this method correlates with increased Learning satisfaction and motivation (In & Kim, 2024).

While the integration of ICTs in the Flipped Learning classroom presents numerous advantages, challenges such as digital literacy gaps, interest in digital tools, and inadequate infrastructure must be promptly addressed if Flipped Learning is to be implemented effectively. ICT infrastructural limitations in many Nigerian Universities have led some students to lose interest in using ICTs to support their learning experience. However, studies have shown that students' interest in educational ICTs translates into improved academic performance (Kirkiç & Uludag, 2021; Ferrer & Dela Cruz, 2017). Interest plays a core role in improving the academic achievement of learners regardless of the setting (McIntyre et al., 2024), and as such, interest in the use of ICTs is expected to increase learners' achievement in a Flipped Learning setting. Therefore, it is pertinent to note that undergraduates' interest in the use of Educational ICTs would go a long way in determining whether they would thrive in a Flipped Learning setting.

Although many studies have established relationships between Flipped Learning and positive academic outcomes, there seems to be a dearth of literature on the relationship between students' interest in educational ICTs and their performance within a Flipped Learning setting. This is a major gap in the literature that necessitates further research.

Aim and Objectives of the Study

The aim of the study was to examine the correlation between undergraduates' interest in educational ICTs and their academic achievement in a science education course within a flipped learning context. Thus, this study has three objectives.

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1. determine undergraduates' interest in using educational ICTs.
2. measure undergraduates' academic achievement in a science education course in a Flipped Learning setting.
3. determine the relationship between interest in using educational ICTs and academic achievement of undergraduates in a science education course

Research Questions
The following questions guided this study.

1. What is the level of undergraduates' interest in using Educational ICTs?
2. What is the mean achievement score and trend in undergraduates' achievement in a science education course taught in a Flipped Learning setting?
3. What is the coefficient of the relationship between undergraduates' interest in using educational ICTs and their academic achievement in a Flipped Learning setting?

Hypothesis
Undergraduates' interest in using Educational ICTs does not significantly predict their academic achievement in a science education course in a Flipped Learning setting.

Methods and Materials
This study adopted a correlational and survey design. The correlation design was adopted because the researcher sought to establish a relationship between two variables: Interest in Educational ICTs and Academic achievement in a Flipped Learning context. The study population comprised 272 students of Education and Biology in Imo State University Owerri. The purposive and census sampling techniques were used for the study. 200 level was purposively selected for the study being the class taking History and Philosophy of Biology. There were 68 undergraduate students in Education and Biology in 200 level, and as such, the entire number (68) Education and Biology students taking the course History and Philosophy of Biology was adopted as the sample size. The instruments used for data collection were as follows: i.) an Educational ICTs Interest Rating Scale (EIIRS) made up of 7 items measuring interest of undergraduates in the use of ICTs for supporting their learning experience and ii.) The History and Philosophy of Biology Achievement Test consisted of 30 multiple-choice questions. The rating scale was measured on a four-point Likert scale format of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). Each correct answer in the multiple-choice questions was given 1 mark, and the maximum score for each student in the achievement test was 30 points. For the achievement test, scores of 15 points and above were regarded as high achievement, while scores below 15 points were regarded as low achievement. The researcher structured the two instruments. The instruments were validated by two specialists, one in Education and Biology and the other in Educational Measurement and Evaluation. Cronbach's alpha statistic was used to test the reliability of the EIIRS, which yielded a coefficient of 0.78, while Kuder-Richardson 20 was used to ascertain the reliability of the History and Philosophy of Biology Achievement test, which yielded a reliability coefficient of 0.74. The EIIRS was distributed to the undergraduates before the beginning of the course (History and Philosophy of Biology), while the teaching of the participants using the flipped learning model lasted for four weeks using their main lecture periods for the course. After four weeks, they were given a week to prepare for the test. A Multiple-choice achievement test was administered to the students after one week of preparation. The test was administered in 40 minutes and returned to the researcher. The research questions were answered using mean, standard deviation, line graph, and Pearson product-moment correlation coefficient, while the hypothesis was tested using simple linear regression.

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Results

Table 1: Interest level of Undergraduates in using educational ICTs

S/N	Item statements	Mean	S.D	Remarks
1	Interested in watching instructional content on YouTube.	3.45	0.56	High
2	Interest in searching for more information using internet search engines.	3.38	0.55	High
3	Belief that the use of digital conferencing tools for learning provide rich information.	3.26	0.61	High
4	Preferring lecturers to use videos through Google Classroom.	3.23	0.69	High
5	Would readily create a meeting to collaborate with course mates on lessons.	3.64	0.54	High
6	Reference to online educational repositories to support learning experience.	2.91	0.79	High
7	Preference of a flipped learning experience.	3.23	0.69	High
	Grand mean	**3.30**		

The data in Table 1 show undergraduates' interest in using educational ICTs. The data further show that the mean responses of the undergraduates to the items in the rating scale are all above the criterion mean of 2.50 (cut-off mean for a four-point Likert scale). The grand mean was 3.30. A close look at the standard deviation scores shows that the scores are very low compared to the means of the responses, implying homogeneity of responses among the respondents. This result implies that most of the undergraduates who participated in this study had a high level of interest in using educational ICTs.

Table 2: Undergraduates' mean achievement score in a Flipped Learning setting

Learning context	N	Mean score	Standard deviation	Remark
Flipped Learning model	68	21.87	4.18	Passed

The data in Table 2 show the mean achievement scores of the undergraduates in a science education course in a Flipped Learning setting. The mean score of the students was 21.87, which is above the pass mark of 15. This implies that most of the undergraduates performed well in the Flipped Learning environment.

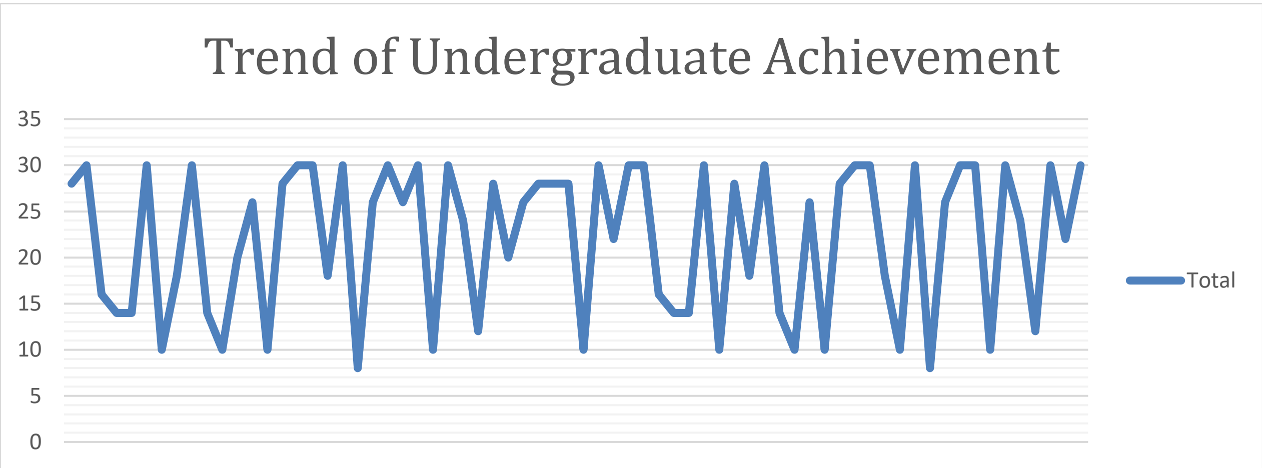

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Figure 1: Trend of undergraduates' achievement in a flipped learning environment

Figure 1 shows the trend of students' scores in the science education course achievement test after exposure to a flipped learning environment. The line graph shows that 20 students out of 68 students had scores below 30 in the achievement test. This is explained by the dipping points at the various levels of the line graph. Alternatively, this means that 48 students performed above average in the test with 22 students making the 30 points scoreline.

Table 3: Relationship between undergraduates' interest scores and their achievement scores in a flipped learning environment

Correlations

		Interest score	Test score
Interest score	Pearson Correlation	1	.157
	Sig. (2-tailed)		.376
	N	68	68

Table 3 shows the relationship between undergraduates' interest in educational ICTs and their achievement scores in a flipped learning context. The correlation coefficient between these two variables was 0.157. This correlation was weakly positive. The positive nature of the relationship implies that an increase in interest in ICTs leads to a commensurate level of increase in academic achievement, although this level of increase is low (as depicted by the low correlation coefficient). The p-value was .376, which was not statistically significant. In other words, there was no strong linear association between undergraduates' interest in educational ICTs and their achievement in a science education course in a Flipped Learning environment. Therefore, the null hypothesis was not rejected.

Table 4: Simple Linear Regression analysis of interest in use of educational ICTs as predictors of undergraduates' achievement in a science education course

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.157[a]	.025	-.006	4.076

a. Predictors: (Constant), Interest score

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	13.395	1	13.395	.806	.376[b]
	Residual	531.575	67	16.612		
	Total	544.971	68			

a. Dependent Variable: Test score

b. Predictors: (Constant), Interest score

Table 4 shows the results of the simple linear regression between the interest and achievement scores of the undergraduates. The R-squared value is 0.025, implying that only 2.5% of the variance in undergraduates' achievement can be accounted for by their interest in educational ICTs. The corresponding ANOVA output yielded a non-significant p-value (p=.376) with a low F value (.806). This implies that the achievement of undergraduates in a science education course in a flipped learning context cannot be significantly predicted by their interest in educational ICTs. Therefore, the null hypothesis was not rejected.

Discussion

The findings of the first objective, as shown in Table 1, show that most of the undergraduates have high levels of interest in using educational ICTs. This invariably means that there are great prospects for the use of ICT in undergraduate learning. This finding may not be farfetched given that educational ICTs have the potential to transform students' learning experience for good and promote engaging activities. In addition, the use of ICTs

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elevates students from being ordinary recipients of knowledge from their lecturers to knowledge creators. Similarly, ICT use fosters independent learning and research skills among students. This finding is corroborated by Gubbels et al. (2020), who recorded a high level of interest in ICT usage among 15 year old Dutch students. In addition, Aidoo et al. (2022) recorded a high interest of not just students but also science educators in using educational ICTs and implementing the flipped learning model in the teaching of chemistry. This finding underscores the need for higher institutions to invest in the necessary infrastructure for incorporating educational ICTs into students' curricula, as undergraduates have noted a high interest in using them.

The findings from the second objective of the study (Table 2) revealed that the performance of undergraduates in the flipped learning setting was high (mean= 21.87, cutoff mean =15.00). The trend also showed that more than 50% of the undergraduates had scores above the pass mark. This finding indicates that the flipped learning setting strongly contributes to positive academic outcomes in a science education course. Flipped learning shifts students' learning experiences from traditional classroom activities to personalized learning. This consequently boosts concentration, and the result is seen in the performance of students. This finding validates the prominent belief that ICTs in learning promote positive teaching and learning outcomes. This finding gives credence to the findings of Bredow et al. (2021), who conducted a meta-analysis of 317 studies and reported that flipped learning interventions produced significantly better outcomes than lecture-based instruction, with effect sizes ranging from 0.20 to 0.53. Birgili et al. (2021) also showed an increase in students' performance and soft skills after exposure to teaching in a flipped learning environment. This finding implies that the adoption of the flipped learning model for science education courses in universities would promote optimum cognitive performance among students.

Furthermore, the findings on the relationship between undergraduates' interest in educational ICTs and their achievement in a flipped learning2 setting showed that respondents' interest in ICTs had a weak relationship with their achievement. The corresponding regression analysis revealed that only 2.5% of the variance in achievement in a flipped learning context could be predicted by undergraduates' interest in educational ICTs. This means that although interest in educational ICTs plays a role in students' achievement, as shown in the low positive relationship, it is not the primary factor accounting for students' academic success. A student may be highly interested in the use of computer applications and hardware, the Internet for study, digital study tools, etc., but this does not necessarily translate to improved critical thinking and comprehension, which are required for high achievement. Moreover, successful outcomes in the flipped learning class entail much more than technological enthusiasm. Flipped learning requires adequate self-regulation, intrinsic motivation, and time management on the part of students. Consequently, interest alone is not enough to build the skills required for high achievement. There are likely other factors that strongly influence students' academic achievement in a flipped learning context, such as students' prior knowledge, peer/team collaboration, and access to ICT resources. This implies that interest does not significantly translate to improved achievement. This suggests the need for educators to identify other determinants or predictors of high academic achievement and to strengthen students. This finding is in consonance with the findings of Van-Sickle (2016), who in a similar study recorded that the performances of undergraduates in an Algebra course improved significantly using flipped learning despite recording a remarkable decrease in their interest in the course. However, Fayda-Kinik and Cetin (2024) recorded weak but statistically significant relationships between students' attitude/interest towards the use of ICTs and their academic performance in mathematics. In addition, Gubbels et al. (2020) recorded a negative and statistically significant relationship between interest in ICTs and the academic performance of Dutch students.

Conclusion

Flipped learning is a learning model that holds the promise of outstanding performance and active engagement for students. The study reveals a fascinating irony in terms of the relationship between undergraduates' interest in Educational ICTs and their achievement within a flipped learning space. Although the findings showed that undergraduates have a high interest in educational ICTs, this interest unfortunately does not significantly predict their academic achievement in a science education course taught using the flipped learning approach. This finding implicitly implies that while undergraduates may be passionate about technological tools for learning, some other seen or unseen variables may play more significant roles in their outcomes in a flipped learning space. These results expose the intricate nature of the learning process and stress the necessity for a multifaceted method to address undergraduate achievement using flipped learning. Further research could be conducted to explore the influence of other variables, such as the quality of in-class activities and self-regulation skills, on students' achievement in a flipped learning class. Finally, these findings strongly show that interest in ICTs is not enough to determine students' outcomes in a flipped learning setting, but a wholesome look at a wider array of factors is needed to enhance educational results.

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Recommendations

The researcher recommends the following:

1. University administrations should make educational ICTs available to undergraduates, as there is an evident record of high interest in ICT use among undergraduates.
2. Flipped learning classrooms should be adopted by lecturers, since undergraduates taught in the flipped learning space performed optimally.
3. Since undergraduates' interest in ICT was not a strong predictor of achievement in a flipped learning class, lecturers should explore other approaches such as use of games, alignment of lessons to individual students' career goals etc to boost students' achievement in a flipped learning context.

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