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Effect of Open Source on Students' Performance in Electronics and Lecturers' Readiness for Its Adoption in Institutions in Adamawa State, Nigeria

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Abstract

This study investigated the effect of an open-source instructional approach on students' academic performance in Digital Electronics and lecturers' readiness for its adoption in tertiary institutions in Adamawa State, Nigeria. Guided by three research questions and three hypotheses, the study employed a quasi-experimental pre-test–post-test control group design. The study population comprised 48 students and 30 lecturers in Electrical/Electronic Technology, and no sampling was undertaken because the population was manageable. Data were collected using the Digital Electronics Achievement Test (EAT), Electronics Skills Acquisition Test (ESAT), and Lecturers' Readiness for Adoption of Open Source in Instructional Delivery (LROSAID), all developed by the researcher. The validated EAT and ESAT demonstrated high internal consistency, with Cronbach's alpha coefficients of 0.92, 0.89, and 0.90, respectively. Data were analyzed using mean and standard deviation to answer the research questions, while ANCOVA and Scheffe's test were used to test the hypotheses at the 0.05 level of significance. The findings revealed a

significant difference in achievement test scores between the open-source instructional strategy and the lecture strategy, as well as a significant difference in skills acquisition in favour of the open-source instructional strategy over the demonstration strategy. However, the results also showed that lecturers were not ready to adopt open source for instructional delivery. The study concludes that the open-source instructional strategy enhanced students' academic achievement and skills acquisition in Electrical/Electronic Technology, while lecturers' low readiness for adoption remains a critical implementation challenge. These findings contribute empirical support for the instructional value of open-source approaches and imply the need for institutional efforts to strengthen lecturers' readiness and encourage the integration of open-source strategies in Electrical/Electronic lesson delivery in Colleges of Education.

Keywords: Open-Source Instruction; Digital Electronics; Academic Achievement; Skills Acquisition; Lecturers' Readiness

INTRODUCTION

Varieties of instructional strategies have been integrated since different courses, including Electrical/Electronic Technology, were introduced into educational institutions. The problem of instructional strategies employed in Electronics Technology–related subjects has continued to attract the attention of educational researchers seeking to enhance learning outcomes and reduce failure rates in the teaching–learning process. Instructional strategies commonly used at different levels of education include lecture, question-and-answer, project-based learning, textbook-based teaching, discussion, tutorial, audio-tutorial, demonstration, and problem-solving strategies (Darling-Hammond et al., 2020).

However, the teaching of Electronics Technology has largely been described as expository, with limited student participation in experimentation and practical activities. Several studies have identified shortcomings associated with conventional traditional instructional strategies. In traditional classroom settings, the teacher assumes the role of authority while students remain passive recipients of knowledge. This approach is typically characterized by teacher talk, note-taking by students, and minimal interaction. Consequently, it is teacher-centered, teacher-active, learner-passive, and content-oriented (Bokolo, 2021).

Recent studies have argued that lecturers who rely solely on conventional traditional instructional strategies demonstrate limited pedagogical adaptability to modern learning demands. Such strategies have been found to be ineffective in producing competent manpower required for emerging economies, thereby contributing to persistent challenges in educational productivity in Nigeria and similar contexts (Adebayo & Adigun, 2020; Yusuf & Balogun, 2022). As a result, there have been increased calls for innovative, learner-centered, and resource-based instructional approaches capable of improving academic achievement.

To overcome the limitations of traditional instructional strategies, contemporary researchers advocate the integration of digital technologies in instruction. Emerging evidence shows that educational technologies play a critical role in transforming teaching and learning processes by reducing rote memorization and enhancing active engagement (Kirkwood & Price, 2020). Studies further reveal that students' academic achievement improves significantly when computer-based instruction (CBI) and multimedia-supported learning environments are employed for instructional delivery (Sung et al., 2021).

In response to the need for improved instructional delivery and academic performance, curriculum reforms in Technical and Vocational Education now emphasize the integration of Information and Communication Technology (ICT) and Computer-Assisted Instruction (CAI). Across higher education institutions, computer-based learning materials and educational software have become increasingly prevalent as part of standard instructional practice (UNESCO, 2021).

Open-Source Software (OSS) represents a significant advancement in the development of computer-based instructional packages. Open-source educational tools provide free and flexible platforms that enable educators to design high-quality, interactive learning content, including simulations, quizzes, animations, assessments, and multimedia presentations. These tools support the development of learner-centered environments and enhance access to digital instructional resources (Weller et al., 2020). OSS-based learning systems allow students to interact with audio-visual materials and simulate real-world processes, thereby promoting deeper conceptual understanding and learner curiosity (Hilton, 2020).

One of the major advantages of computer-based instructional packages is their ability to visually represent abstract concepts, making learning more concrete and

meaningful compared to traditional instructional strategies. The use of digital technologies in education has been shown to improve learner motivation, engagement, and academic achievement by creating interactive and student-centered learning environments (Bond et al., 2021). Open-source multimedia applications, due to their flexibility and interactive capabilities, provide effective alternatives to traditional instructional strategies and enable the use of simulations and animations to simplify difficult technological concepts

Although technology has significant potential to enhance curriculum delivery and teaching effectiveness, many teachers lack the requisite skills and confidence to integrate digital tools effectively. Consequently, teacher education programs and accreditation bodies now emphasize the importance of technology integration competencies for effective classroom instruction (Tondeur et al., 2020). Teachers must develop new roles, professional attitudes, and pedagogical approaches that align with digital curricula and learner-centered instruction (Insteford & Munthe, 2020).

The successful implementation of digital technology in education largely depends on lecturers' readiness, willingness, and competence to adopt technological innovations. Studies indicate that when lecturers effectively integrate digital tools, instruction becomes more interactive, collaborative, and student-centered, thereby improving learning outcomes (Schindler et al., 2020). To meet contemporary educational demands, lecturers must possess not only subject-matter expertise but also the technical and pedagogical skills necessary for effective technology integration.

Statement of the problem

Tertiary Institutions are the institutions that are saddled with responsibility of producing the skilled Manpower needed for national development. Electronics Technology is very vital in a dispensation like this when the world is driven by technology. In spite of this immense responsibility vested on tertiary institutions, tertiary institutions are still battling with poor performance generally and specifically in Electronics Technology programme. The graduates that are turned out have not been able to meet up with their requirement of teaching and practicing Technology in the society. Researchers such as Oladebinu, Amos and Oyediran (2018) have also observed the inability of these graduates to effectively teach and practice Technology in society. This inability may be due to one or combination of several factors which can be grouped into: government-related, teacher-

related, student-related, curricula-related, Parent-related and or environmental-related factors.

However, the researcher wishes to concentrate on the teacher-related factor. This is because, of all educational inputs, the teacher is the medium that delivers all these to the students. The way and the manner in which this is done determine, to a large extent, the success or failure of the system. The focus is particularly on instructional strategies adopted by the lecturers in colleges of education. It is stipulated in the national policy on education article 96 that, Teacher education shall continue to take cognizance of changes in methodology and in the curriculum. Teachers shall be regularly exposed to innovations in their profession. However, the researcher had observed that the Electronics lecturers in tertiary institutions in Adamawa State are still hold on to Conventional Traditional Strategy which is mostly teacher-centered.

If nothing is done to avert the situation, this will result in failure of the laudable Technology objectives, the future of youths that pick-up admissions to study Electronics will be jeopardized and the Nigerian society will be left handicap and backward in terms Electronics technology technicians.

This is what informed the researcher's decision to study the 'effect of open source on students' performance in electronics and lecturers' readiness for integration in tertiary institutions in Adamawa state, Nigeria.

Purpose of the study

The main objective of this study is to determine effect of open source on students' performance in electronics and lecturers' readiness for integration in tertiary institutions in Adamawa state, Nigeria while the specific objectives are to:

1. Determine the difference in pre-test and post-test mean achievement scores of students in Electronics achievement test when taught using OSIS and CTIS.

2. Determine the difference in pre-test and post-test mean performance scores of students in Digital Electronics practical skills test when taught using OSIS and CTIS.

3. Determine lecturers' readiness to integrate open source in instructional delivery.

Research questions

The following research question has been formulated to guide the study:

1. What is the difference in pre-test and post-test mean achievement scores of students in Electronics performance test when taught using OSIS and CTIS.

2. What is the difference in pre-test and post-test mean performance scores of students in Digital Electronics practical skills test when taught using OSIS and CTIS.

3. What is lecturers' readiness to integrate open source in instructional delivery

Hypotheses

The following research null hypotheses have been formulated to guide the study:

1. There is no significant difference between the mean scores of students' achievement when taught using open-source strategy and CTS.
2. There is no significant difference between the mean scores of students' performance when taught using open-source strategy and CTS
3. There is no significant difference in the mean response of lecturers' of Modibbo Adama University, Federal Polytechnic Mubi, Adamawa State College of Education Hong and Adamawa State Polytechnic Yola

METHODOLOGY

Research Design

The design was quasi-experimental design. quasi-experimental Pretest-Posttest nonrandomized non-equivalent control-group design was used.

The diagrammatic representation of the design is presented in the table below:

Table 1: Non-Randomized Control-Group Pretest-Posttest-Design

Group	Pre-Test	Treatment	Post-Test
E G 1	0_1	X_1	0_4
C G 1	0_1	-	0_5

Where:

E G =Experimental group to be taught using, Open Source

C G = Control group to be taught using CTS.

The geographical area of the study was Adamawa State, Nigeria. The population of the study comprised of 48 students of year II Electrical/Electronic and 30 lecturers of Electrical/Electronic. No sampling was applied as the entire population was manageable.

mean and standard deviation were used to answer the research questions while ANOVA, ANCOVA and Scheffe's post hoc were used to test the hypotheses at 0.05 level of significance.

RESULTS

Research Question 1

What is the difference in pre-test and post-test mean achievement scores of students in Electronics achievement test when taught using OSIS and CTIS.?

Table 2: Mean and Standard Deviation of Pre-tests and Post-tests Mean Scores of Students in Digital Electronics Achievement Tests when Taught Digital Electronics Using OSIS and CTIS

Teaching Strategy	Source	n	$\bar{X}$	σ	Mean Difference
OSIS	Pre-test	26	15.38	3.60	
	Post-test	26	57.58	11.90	42.20
CTIS	Pre-test	22	17.36	2.90	
	Post-test	22	43.00	12.97	25.64

N=Sample size, $\bar{X}$=Mean, σ =Standard Deviation

Table 2 shows pre-test mean scores of 15.38 and 57.58 for OSIS and CTIS respectively. This is an indication that the three groups had little entry behaviour of Digital Electronics before the treatment commenced. Also, standard deviation of the pre-test mean score was 3.60 for QSIS and 2.90 for CTIS. These showed that the differences of scores in the experimental groups and control group from the pre-test DEAT were very small. Thus, the groups fulfilled the condition of both homogeneity of variances and normal distribution. There was post-test mean scores of 57.58 and 43.00 for OSIS and CTIS respectively and standard deviations of 11.90 and 12.97 OSIS and CTIS respectively. These indicated that the treatments resulted in high and uniform students' achievement. It can also be seen from the post-tests means scores that students achieved higher when OSIS was used in delivering Digital Electronics lesson followed than when CTIS was used in delivering Digital Electronics lesson.

Research Question 2

What is the difference in pre-test and post-test mean performance scores of students in Digital Electronics practical skills test when taught using OSIS and CTIS.

Table 3: Mean and Standard Deviation of The Pre-Tests and Post-Tests Mean Scores of Students in Digital Electronics Skills Acquisition Tests When Digital Electronics Taught Digital Electronics Using OSIS and TIS.

Instructional Strategy	Source	n	$\overline{X}$	σ	Mean Difference
OSIS	Pre-test	26	16.39	3.45	
	Post-test	26	57.39	13.19	41.00
CTIS	Pre-test	22	15.73	2.23	
	Post-test	22	47.46	9.43	31.70

N=Sample size, $\overline{X}$=Mean, σ =Standard Deviation

Table 3 shows pre-test mean scores of 16.39 and 15.73 OSIS and CTIS respectively. This is an indication that that the three groups had little entry behaviour of Digital Electronics before the treatment commenced. Also, standard deviation of the pre-test mean score was 3.45 for OSIS, 2.23 for the CTIS. These showed that the differences of scores in the experimental groups and control group from the pre-test DESAT were very small. Thus, the groups fulfilled the condition of both homogeneity of variances and normal distribution. There was post-test mean scores of 57.39, and 47.46 for OSIS and CTIS respectively and standard deviations of 13.19 and 9.43 for OSIS and CTIS respectively. These indicated that the treatments resulted in high and uniform students' skills acquisition. It can also be seen from the post-tests means scores that students achieve higher when OSIS was used in delivering Digital Electronics lesson than when CTIS was used in delivering Digital Electronics lesson.

Research Question 3

What is lecturers' readiness to integrate open source in instructional delivery

Table4: Analyses of the responses of lecturers on the readiness to integrate OSIS for instructional delivery.

S/N	ITEM	$\overline{X}$	σ	Remark
1	I am aware of the various OSIS available for instructional delivery.	3.60	1.13	Agree
2	I understand the potential benefits of using OSIS in my teaching.	3.50	0.78	Agree
3	I know where to find OSIS resources relevant to my subject area.	3.50	0.86	Agree
4	I have the necessary skills to effectively use OSIS for instructional purposes.	3.43	1.01	Agree
5	I am confident in troubleshooting common technical issues related to OSIS.	2.30	1.26	Disagree
6	I am comfortable installing and customizing OSIS if needed.	3.07	1.31	Agree
7	I am interested in exploring new instructional technologies, including OSIS.	3.13	1.28	Agree
8	I believe that using OSIS can improve the quality of my teaching.	3.10	1.30	Agree
9	. I am willing to invest time to learn and adapt to OSIS for instructional	2.77	1.19	Agree

	delivery.			
10	My institution provides adequate training on the use of OSIS for teaching.	1.83	0.38	Disagree
11	I have access to technical support when using OSIS for instruction.	2.03	1.27	Disagree
12	The institutional policies encourage or support the use of OSIS in teaching.	2.07	1.34	Disagree
13	I have reliable access to the necessary hardware and internet connectivity to use OSIS.	2.03	1.35	Disagree
14	The classrooms or teaching environments are equipped to support OSIS.	2.03	1.25	Disagree
15	I have access to a community or network of lecturers who use OSIS.	2.07	1.17	Disagree
16	Using OSIS reduces costs associated with instructional delivery.	2.20	1.24	Disagree
17	OSIS allow greater flexibility and customization for teaching needs	3.53	0.73	Agree
18	Students benefit from the use of OSIS in the learning process.	3.47	0.57	Agree
19	Security and privacy concerns discourage me from using OSIS.	2.20	0.52	Disagree
20	Lack of formal recognition or incentives reduces my motivation to adopt OSIS.	3.80	0.85	Agree
	GRANDMEAN	**2.79**	**0.69**	**DISAGREE**

Key: $\bar{X}$- mean response, σ - standard deviation,

Table 4 shows the analyses of staff responses on readiness to integrate OSIS for instructional delivery. It can be seen that item 1,2,3,4,6,7,8.9.17.18 and 20 have mean responses of 3 and above which indicates agree while item 5,10,11,12,13,14,15,16 and 19 have mean responses of below 3 which indicates Disagree. However, the grand mean of 2,79 shows that the overall mean responses is disagree. This means that lectures are not ready to integrate OSIS for instructional delivery.

Hypothesis 1

There is no significant difference between the mean scores of students' achievement when taught using OSIS and CTS.

Table 5: Result of ANCOVA of the Differences in Students' Mean Achievement Scores when Taught Digital Electronics Using OSIS and CTIS.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2792.701[a]	2	1396.350	8.419	.001
Intercept	1699.067	1	1699.067	10.245	.003
STRATEGY	2546.553	1	2546.553	15.355	.000
PRETEST	519.609	1	519.609	3.133	.083
Error	7463.216	45	165.849		
Total	136126.000	48			
Corrected Total	10255.917	47			

The results of the analysis in Table 5 shows that, F = 15.355 and P = 0.000 < 0.05.

Since the computed p-value (0.00) is less than 0.05 level of significant, this means that, there is significant difference in students' achievement when they are taught Digital Electronics using OSIS and CTIS. Therefore, the null hypothesis of no significant difference was rejected. Hence it is concluded that, there is significant difference in students' achievement when they are taught Digital Electronics using OSIS and CTIS. The difference was in fovour of OSIS.

Hypothesis 2

There is no significant difference between the mean scores of students' performance when taught using OSIS and CTIS

Table 6: Result of ANCOVA of the Difference in Students' Mean Skills Acquisition Test Scores when Taught Digital Electronics Using OSIS and CTIS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1816.697[a]	2	908.349	8.330	.001
Intercept	3717.243	1	3717.243	34.089	.000
STRATEGY	926.286	1	926.286	8.495	.006
PRETEST	291.100	1	291.100	2.670	.109
Error	4906.969	45	109.044		
Total	144540.000	48			
Corrected Total	6723.667	47			

The results of the analysis in Table 6 shows that, F = 8.495 and P = 0.006 < 0.05. Since the computed p-value (0.006) is less than 0.05 level of significant. This means that there is significant difference in students' skills acquisition when they are taught Digital Electronics using OSIS and CTIS. Therefore, reject the null hypothesis of no significant difference. Hence it is concluded that, there is significant difference in students' skills acquisition when they are taught Digital Electronics using OSIS and TIS. The difference is in fovour of OSIS.

Hypothesis 3

There is no significant difference in the mean response of lecturers' of Modibbo Adama University, Federal Polytechnic Mubi, Adamawa State College of Education Hong and Adamawa State Polytechnic Yola on their readiness to integrate OSIS for instructional delivery.

Table 7: Result of ANOVA of the Difference in the mean response of lecturers' of Modibbo Adama University, Federal Polytechnic Mubi, Adamawa State College of Education Hong and Adamawa State Polytechnic Yola on their readiness to integrate OSIS for instructional delivery.

Source			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		9.492	3	3.164	28.441	.000
	Linear Term	Unweighted	2.908	1	2.908	26.135	.000
		Weighted	3.485	1	3.485	31.326	.000
		Deviation	6.007	2	3.004	26.998	.000
Within Groups			2.893	26	.111		
Total			12.385	29			

The results of the analysis in Table 7 shows that, F =28.441 and P = 0.000< 0.05. Since the computed p-value (0.000) is less than 0.05 level of significant. This means that there is significant difference in institutions' readiness to integrate OSIS for instructional delivery. Therefore, reject the null hypothesis of no significant difference. Hence it is concluded that, significant difference in institutions' readiness to integrate OSIS for instructional delivery.

Table 8. Result of Scheffe's Post Hoc Test for Multiple Comparisons of institutional readiness to integrate OIs for instructional delivery.

					95% Confidence Interval	
(I) Institution	(J) Institution	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Lower Bound
MAU	FEDPOLY	1.40417*	.16207	.000	.9200	1.8884
	ADSCOEH	1.09167*	.17579	.000	.5665	1.6169
	SPY	1.01667*	.16809	.000	.5145	1.5188
FEDPOLY	MAU	-1.40417*	.16207	.000	-1.8884	-.9200
	ADSCOEH	-.31250	.18013	.407	-.8507	.2257
	SPY	-.38750	.17262	.196	-.9032	.1282
ADSCOEH	MAU	-1.09167*	.17579	.000	-1.6169	-.5665
	FEDPOLY	.31250	.18013	.407	-.2257	.8507
	SPY	-.07500	.18557	.983	-.6294	.4794
SPY	MAU	-1.01667*	.16809	.000	-1.5188	-.5145
	FEDPOLY	.38750	.17262	.196	-.1282	.9032
	ADSCOEH	.07500	.18557	.983	-.4794	.6294

As shown in Table 8, When MAU was compared to the three institutions (FEDPOLY, MAU and ADACOEH) the P-values were 0.000 < 0.05. It can be seen that, when all the institutions were compared among with each other, only MAU gives a P-value < 0.05. This means that FEDPOLY, ADSCOEH and SPY do not differ significantly in their mean responses. However, all the three differ significantly in their mean responses from MAU. This implies that only lecturers in Mau are saying that they are ready to integrate OSIS for instructional delivery.

Findings of the Study

1. There were differences in post-test mean score of students' achievement taught digital Electronics using OSIS and CTIS. However, those taught using OSIS achieved better than those Taught using CTIS.
2. There were differences in post-test mean score of students' performance taught digital Electronics using OSIS and CTIS. However, those taught using OSIS performed better than those Taught using CTIS.
3. Lecturers were not ready to integrate OSIS in instructional delivery.
4. There was significant difference between students' achievement when they were taught using OSIS than those taught using CTIS.
5. There was significant difference between students' performance when they were taught using OSIS than those taught using CTIS.
6. There was significant difference in the mean responses of MAU, FEDPOLY, ADSCOEH and SPY lecturers in their readiness in integrating OSIS in instructional delivery. The difference was in the direction of MAU.

DISCUSSION

The findings of this research were discussed based on the results, related literature and previous studies in order of the research questions and hypotheses respectively.

There were differences in post-test mean score and pre-test mean scores of students' achievement taught digital Electronics using OSIS and CTIS. However, those taught using OSIS achieved better than those Taught using CTIS. This was further deepened by the hypothesis that There was significant difference between students' achievement when they were taught using OSIS than those taught using CTIS. This finding

agreed with Efuwape, and Omofonmwan (2015), Effect of Free Open-Source Software Based Learning Package on Academic Achievement of Junior School Students in Basic Technology in Nigeria. a statistically significant difference was revealed between the two modes of instructions. No significant difference was found between male and female students' achievement on the effect of FOSS learning package in enhancing achievement in basic technology. Similarly, this finding is in line with Amosa, Akawo, Eli and Queen (2014) studied examined the effects of video-based multimedia instruction on secondary school students' achievement and retention in biology. The result showed that, students under multimedia instruction performed better than their colleagues in the conventional teaching method. However, students in conventional teaching method had better retention than other groups.

Conversely, this finding is at variance with Megan (2021) who examines the impact of free and open educational resource (OER) adoption on end-of-semester grades and withdrawal rates of community college students. Results found no significant difference on end-of-semester grades between students in OER courses and those in courses using a traditional textbook. This finding also contradicts. The finding also contradicts Owidi and Calvince (2018) who studied impact of moodle as an open-source e-learning platform on students' performance: a case study of Jomo Kenyatta university of science and technology. the finding revealed no significant difference in the achievement of the experimental and control group.

The available literature captured Junior secondary, Senior secondary as well as Undergraduate learners. The only exception is Primary school. It is also evident that most of the researchers found positive and significant impact of the OSIS on students' achievement in instructional delivery. Only few reported no significant difference.

There were differences in post-test mean score and pretest mean scores of students' performance taught digital Electronics using OSIS and CTIS. However, those taught using OSIS performed better than those Taught using CTIS. This was further cut deeper by the hypothesis that, there was significant difference between students' achievement when they were taught using OSIS than those taught using CTIS.

There was significant difference between students' performance when they were taught using OSIS than those taught using CTIS. This finding resonates with Ogunlowo (2021) who examined the effect of open-source simulation on teaching and learning acid-

base titration among Senior Secondary School II in Ogbomoso, Oyo State. The result of the study showed that the use of modified open-source simulation on teaching acid-base titration has greater positive effects on the academic performance of the experimental group compared to control group. It was also found that there was significant difference among students that used open-source simulation on content mastery and colour recognition in acid-base titration. Similarly, this finding agrees with Atefe (2023), who considered the impact of open educational resource on improving learning performance of students. tests show that the OER platform was a significant factor in improving average overall and project grades It is expected that OER is effective in helping students to learn building information modeling more effectively. Moreover, this finding is in line with Soladoye and Ojo (2021), who studied the impact of e-learning on secondary school students in Nigeria during COVID-19 Lockdown. The finding revealed that adoption of E-Learning really helped the students during the covid-19 Lockdown as it kept them busy and able to make good use of the long break and exposed them to the use of digital devices for Learning, while most students are ready to attend online classes if the need arises. This finding also supports Egoigwe, Nweke, Mamah, Isiaku, Ali and Madu (2020), who examined the impact of e-learning on academic performance of postgraduate students in higher institutions in Nigeria. The findings of the study revealed that e-learning has positive impact on academic performance of postgraduate students in higher institutions. In the same vein, this finding concurs with Nahid, Itedal and Rashida (2019), who studied the impact of E-learning on the students' academic performance. The findings of the present study show a significant difference in learning outcomes.

However, this finding does not agree with Othman, Kadar, Umar, and Ahmad (2021), who study examined the effectiveness of Open Distance Learning (ODL) as a new pedagogical method in teaching and learning the pandemic The data analysis shows that an ODL methods has no significance on students' performance.

The available literature captured Junior secondary, Senior secondary as well as Undergraduate learners. The only exception is Primary school. It is also evident that most of the researchers found positive and significant impact of the OSIS on students' performance in instructional delivery. Only one reported no significant difference.

Lecturers were not ready to integrate OSIS in instructional delivery. And the supporting hypothesis shows that, there was significant difference in the mean responses of

MAU, FEDPOLY, ADSCOEH and SPY lecturers in their readiness in integrating OSIS in instructional delivery. The difference was in the direction of MAU. This agrees with the finding of (Egoigwe, Nweke, Mamah, Isiaku, Ali & Madu, 2020: Nafiu, Umar & Abdullahi, 2025: Opateye & Inegbedion, 2017: Ajadi & Adebakin, 2022: Yusuf, Akintola & Odutayo, 2020.) who examined lecturers' awareness and readiness to integrate open educational resources for instructional delivery. The findings of the studies revealed that there are challenges militating against the use of open educational resources to enhance academic performance of students in higher institutions in Nigeria. Based on the findings, the study recommends among others that government should ensure a maximum standard set for institutions to get computer and internet facilities to enhance effective e-learning process in the higher institutions in Nigeria.

CONCLUSION

This study concludes that the open-source instructional strategy is more effective than conventional teaching approaches in improving students' achievement and skills acquisition in Digital Electronics in tertiary institutions in Adamawa State, Nigeria. The findings confirm that open-source instruction has strong pedagogical value for Electrical/Electronic Technology education. Nevertheless, lecturers' low readiness to adopt this approach remains a critical challenge to its effective implementation. The study therefore emphasizes that the successful integration of open-source instruction requires not only recognition of its educational benefits but also sustained institutional support through lecturer training, improved ICT infrastructure, and enabling policies.

REFERENCES

Adebayo, F. A., & Adigun, O. T. (2020). Teaching methods and students' academic performance in technical education programmes in Nigeria. *Journal of Technical Education and Training, 12*(2), 45–56.

Ajadi, O. T., & Adebakin, A. B. (2022). Lecturers' readiness for virtual teaching in southwestern Nigerian universities. *UNESWA Journal of Education, 5*(1), 68–82. https://ojs.uneswa.ac.sz/index.php/ujoe/article/view/504

Anthony, B., Jr., Kamaludin, A., Romli, A., Raffei, A. F. M., Phon, D. N. A. L. E., Abdullah, A., & Ming, G. L. (2022). Blended learning adoption and implementation in higher education: A theoretical and systematic review. *Technology, Knowledge and Learning, 27*, 531–578. https://doi.org/10.1007/s10758-020-09477-z

Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2021). Emergency remote teaching in higher education: Mapping the first global online semester. *International Journal of Educational Technology in Higher Education, 18*, Article 50. https://doi.org/10.1186/s41239-021-00282-x

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science, 24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791

Dempsey, M. (2021). The impact of free and open educational resource adoption on community college student achievement and course withdrawal rates. *International Journal of Open Educational Resources, 4*(1), 45–57. https://doi.org/10.18278/ijoer.4.1.546

Efuwape, B. M., & Omofonmwan, G. O. (2015). Effect of free open-source software based learning package on academic achievement of junior school students in basic technology in Nigeria. *Journal of Educational and Social Research, 5*(2), 215–222. https://doi.org/10.5901/jesr.2015.v5n2p215

Egoigwe, S. V., Nweke, P. O., Mamah, N. V., Isiaku, W. B., Ali, A. A., & Madu, C. V. (2020). Impact of e-learning on academic performance of postgraduate students in higher institutions in Nigeria. *Journal of Engineering and Applied Sciences, 15*(14), 2863–2868. https://makhillpublications.co/public/view-article/1816-949x/jeasci.2020.2863.2868

Elfaki, N. K., Abdulraheem, I., & Abdulrahim, R. (2019). Impact of e-learning vs traditional learning on students' performance and attitude. *International Journal of Medical Research & Health Sciences, 8*(10), 76–82. https://www.ijmrhs.com/medical-research/impact-of-elearning-vs-traditional-learning-on-students-performance-and-attitude.pdf

Gambari, A. I., Yaki, A. A., Gana, E. S., & Ughovwa, Q. E. (2014). Improving secondary school students' achievement and retention in biology through video-based multimedia instruction. *InSight: A Journal of Scholarly Teaching, 9*, 78–91.

Instefjord, E. J., & Munthe, E. (2017). Educating digitally competent teachers: A study of integration of professional digital competence in teacher education. *Teaching and Teacher Education, 67*, 37–45. https://doi.org/10.1016/j.tate.2017.05.016

Nafiu, A., Umar, B., & Abdullahi, I. A. (2025). Lecturers' awareness and readiness to the adoption of open educational resources (OERs) for teaching in public tertiary institutions in Sokoto State, Nigeria. *Internal Academic Journal of Educational Research, 12*(3), 19–32.

Ogunlowo, S. A. (2021). *Effect of modified open-source simulation on students' achievement in acid-base titration in Ogbomoso metropolis.*

Oladebinu, T. O., Amos, A. A., & Oyediran, W. O. (2018). Factors affecting students' academic performance in colleges of education in Southwest, Nigeria. *British Journal of Education, 6*(10), 43–56.

Opateye, J. A., & Inegbedion, J. O. (2017). Assessment of lecturers' knowledge and readiness for open education resources in Nigerian open and distance learning universities. *West African Journal of Open and Flexible Learning, 5*(2), 157–177. https://wajofel.org/index.php/wajofel/article/view/205

Othman, J., Kadar, R., Umar, N., & Ahmad, N. (2021). The effect of students performance at higher education institution with open and distance learning (ODL) methods through formative and summative assessments aggregation during Movement Control Order (MCO), COVID-19. *International Journal of Academic Research in Progressive Education and Development, 10*(2), 556–569. https://doi.org/10.6007/IJARPED/v10-i2/10137

Owidi, S. O., & Otieno, C. (2018). Impact of Moodle as an open-source e-learning platform on students' performance: A case study of Jomo Kenyatta University of Agriculture and Technology (JKUAT). *International Journal of Recent Research in Social Sciences and Humanities, 5*(4), 265–284.

Schindler, L. A., List, A., Williams, B., & Stephens, J. (2020). Exploring the impact of learning management systems on student learning. *International Journal of Educational Technology in Higher Education, 17*(1), 1–17.

Soladoye, A. A., & Ojo, A. O. (2021). Impact of e-learning on secondary school students in Nigeria during COVID-19 lockdown. *International Journal of Scientific Research in Computer Science and Engineering, 9*(6), 94–104. https://ijsrcse.isroset.org/index.php/j/article/view/467

Sung, Y.-T., Chang, K.-E., & Liu, T.-C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education, 94*, 252–275. https://doi.org/10.1016/j.compedu.2015.11.008

Tondeur, J., Aesaert, K., Pynoo, B., Van Braak, J., Fraeyman, N., & Erstad, O. (2017). Developing a validated instrument to measure preservice teachers' ICT competencies: Meeting the demands of the 21st century. *British Journal of Educational Technology, 48*(2), 462–472. https://doi.org/10.1111/bjet.12380

UNESCO. (2021). *Reimagining our futures together: A new social contract for education*. https://unesdoc.unesco.org/ark:/48223/pf0000379707

Weller, M., Jordan, K., DeVries, I., & Rolfe, V. (2018). Mapping the open education landscape: Citation network analysis of historical open and distance education research. *Open Praxis, 10*(2), 109–126. https://doi.org/10.5944/openpraxis.10.2.822

Yusuf, M. O., & Balogun, M. R. (2022). Pedagogical practices and technology integration in Nigerian higher education. *African Journal of Educational Studies, 15*(1), 78–92.