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Effects of Online Learning Instruction and Blended Instruction on Academic Performance and Digital Literacy of Pre-Service Teachers in an Educational Technology Course

Bede Blaise Chukwunyere Onwuagboke,
Christiana Onyejuru Nwakamma, Hope Chinyere Umune
Alvan Ikoku Federal University of Education Owerri, Nigeria
bbconwu@gmail.com; nwakamma.christiana@alvanikoku.edu.ng

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Abstract

This study examined the effects of fully online teaching and a blended teaching approach on the academic performance and digital literacy skills of student-teachers enrolled in an Educational Technology course at Alvan Ikoku Federal University of Education, Owerri. A quasi-experimental pre-test–post-test design was adopted, with a population of 589 level 200 pre-service teachers from the Faculty of Social and Management Sciences. The sample consisted of 92 student-teachers drawn from two intact groups in the Economics and Social Studies departments, taught during the second semester of the 2023/2024 academic year. Data were collected using two researcher-developed instruments: the *Educational Technology Achievement Test* (ETAT) and the *Digital Literacy Skills Scale* (DLSS), both validated by experts. Reliability testing yielded coefficients of 0.85 for ETAT (Kuder-Richardson 20) and 0.81 for DLSS (Cronbach's alpha). Descriptive statistics (mean and standard deviation) were used to address research questions, while analysis of covariance (ANCOVA) tested the hypotheses. Findings showed that both groups achieved substantial learning gains, with the blended learning group outperforming the online-only

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group in academic performance. Additionally, both groups demonstrated improved digital literacy skills. The study concludes that blended learning offers greater instructional benefits and recommends that educational technology lecturers incorporate online delivery into regular face-to-face teaching to optimize learning outcomes.

Keywords: Online Learning; Blended Learning; Face-to-Face Instruction; Academic Performance; Digital Literacy

INTRODUCTION

Since the days of Covid-19 using technology applications in the classroom has become very vital. Currently, technology is used more and more by teachers and students to develop their digital competencies and improve learning outcomes. Thus, education systems globally are undergoing digital transformation because the learning environment in the 21st Century has extended beyond the walls of the traditional classroom settings to the emergence of online classrooms. This makes learning to be accessible to all and flexible to students. Digital learning classroom and environments have different modes and all offer a wide range of benefits (Essien, & Udo, 2024). They stated that Google classroom is one of the most applied digital classroom platforms in recent times. The teaching of Educational Technology in a teacher education programme is significant because it makes it easier for teachers of today to incorporate new tools and technologies into their lessons. They can modernize and enhance their classrooms to make them more learner-centered. Furthermore, it gives educators the ability to involve their students in distinctive, creative, and fair ways. Educators can broaden their professional network and establish connections with colleagues both domestically and internationally (Loyola University, 2021) through the use of technology. With the use of educational technology, students can independently learn course materials, choose their own pace for work, go over content that is not sufficiently clear, receive results for tests right away, and monitor their progress (Stosic, 2015). The emergence of newer technologies for online teaching and learning at the turn of the 21st century has virtually rendered the traditional face-to-face instructional method obsolete. The Covid-19 pandemic has changed the mode of educational delivery making room for remote teaching with technologies like Google classroom, Moodle, Blackboard, Zoom etc. for online teaching and learning.

Online teaching and learning are two sides of one coin as both of them go hand in hand. According to Bates (2016) online learning refers to an educational process that is partly or entirely mediated by web-based tools, platforms, and devices. The platforms include Edmodo, Google Classroom, Zoom, Google meet, Microsoft Team, Moodle etc. For the purpose of this study, Google classroom platform was used. Google classroom is an online technology that has been widely used in teaching globally because of its flexibility and numerous features. Abidin and Saputro (2020) assert that Google Classroom's versatility and numerous features make it a valuable tool for enhancing teaching and learning activities. The app provides features as timetable management, online and offline chat, file sharing, assignment creation and management and effective feedback which encourage interaction and collaboration (Md Sari, et al. 2024). They also assert that educational material may be accessible on devices like laptops and smart phone by using the Google classroom app. This gives the students the benefit to access educational materials whenever and wherever they want. In that vein, Virgillo (2021) emphasize that using google application in higher education helps to improve students' communication and collaboration skills as well as students' perception and knowledge of technology use in the classroom.

Despite the lofty advantages of online tools for learning in education, scholars have craved for a blending of online with the traditional face-to-face approach for greater effectiveness (Tabassum, et. al. 2024; Tong, et al. 2022; Nwoke et al. 2023). This statement reflects the growing recognition of the benefits of blended learning, which combines the advantages of online and face-to-face instruction. Blended learning also referred to as is Hybrid approach is a teaching approach that combines online and traditional face to face classroom teaching method. According to Handiyanto, et al. (2022) Blended learning is an expansion of both online and face to face learning methods in which instructors help students participate in activities that meet their learning goals and aspirations. Blended learning has become increasingly favoured in teacher training institutions. This learning approach has been identified as an effective method of providing opportunities for student-teachers to work in both online and face-to-face environments (Le & Pham, 2021). Many benefits of using blended learning approach include positively impacting on students' academic achievement (Tong, et al. 2022) as well as enhancing their digital literacy skills (Dewi & Fatkhiyani, 2021).

Educational technology as a field of study had been described in many ways as undergone several considerable change since 1968 (Azubuike & Nwachukwu, 2019). It is one of the courses in teacher education institutions that prepare student-teachers to be professional teachers. Admittedly, Educational Technology is defined as the study of and ethical practice of facilitating learning and improving performance by creating using and managing appropriate technological processes and resources (AECT 2008). The course is an area of study that adopts the step-by-step programmed learning approach for effective handling of educational problems, especially teaching and learning activities. Good performance in the course no doubt enhances the teaching efficacy of student-teachers and in the long run graduate teachers.

Moreover, academic performance being the extent to which a student, teacher or institution has attained their short or long-term educational goals commonly measured through examination or continuous assessment but there is no general agreement on how it is best evaluated or which aspect are most important. Academic performance can be defined as the knowledge gained by the student which is assessed by marks by a teacher and/or educational goals set by students and teachers to be achieved over a specific period of time (Kumar et al. 2021). It is the measuring of students' learning level attained and is seen as a crucial sign of how well educational institutions are working at any given time. It plays an important role in an individual placement either in the academic institutions or job placement. The quest for good academic performance is a global phenomenon. Every instructional input has its effect on student learning and subsequent impact on academic performance. This is determined by many factors most especially in method of teaching and learning attitude of the learner and learning environment.

Students' performance can be influenced by several factors; one of them is the use of online learning tools (Maesaroh & Marlena 2021). Sugihartinin (2017) examined the use of digital technology as a learning tool that can affect students' academic performance. The findings of this study suggest that the use of digital technology compared to conventional learning has a substantial impact on students' academic performance. In the same vein, Ali et al (2023) compared the impact of solely online and blended and blended learning approach on students' academic achievement and discovered that both strategies significantly enhanced students' performance with the blended learning strategy having a significantly higher learners' performance compared to solely online learning strategy. In a

related study, Ranjan, (2020) discovered that the mean achievement score of blended learning mode were higher than that of the online learning mode.

Digital literacy since the era of Covid-19 has become a very important skill required globally for the survival of every individual in the present day. Digital literacy is essential because it enables people to communicate effectively, access information, and engage in the digital age. All employers of labour globally require their employees to have a level of digital literacy to cope with offices that are highly getting digitalized. American Library Association cited in University of the Potomac (2022) defines digital literacy as the ability to use technologies to find, evaluate, create and communicate information. Additionally, they define a digitally literate person as one who:

- Has the technical and cognitive abilities to digest information in a variety of formats;
- Is proficient with a variety of technologies;
- Makes use of digital tools to work with others, engage in civic society, and enhance communities.

In a digitally inclusive learning environment, digital literacy is an essential skill for enabling different learners to perform basic tasks like emailing to more complex ones, it includes the ability to use, assess, and engage with technological tools effectively (Yazov, 2022). It has been reported by scholars that higher levels of digital literacy and self-directed learning lead to higher levels of engagement, resulting in better academic achievement (Hwang and Oh, 2021; Kara, 2022). Nantha et al (2024) has discovered that blended learning model enhanced computer and ICT literacy skills. Thus it is speculated that the digital literacy skills of the student-teachers taught using online and blended learning strategies will increase significantly by the end of the study. Some other variables can affect the impact of teaching approach on the academic performance of learners such as gender.

Gender is the range of physical, biological, mental and behavioural characteristics pertaining to and differentiating between the famine and masculine population. The importance of examining performance in relation to gender in based primarily on the socio-cultural difference between girls and boys (Essien & Udoh, 2024). Ugboaja & Achumonu (2022) discovered that there was no significant difference in the male and female mean achievement score in essay writing when taught using blended learning. Similarly, Ugwuoti et al. (2025) reported no significant influence of gender on students'

achievement in their study. In a related study, Nwandu et al. (2023) discovered that Blended learning is more effective in enhancing female students' academic achievement in electronic libraries than that of male students.

Despite the importance of a course in Educational Technology in teacher education programme, there seem to be a dearth of studies on the more effective teaching approach for enhance performance of student-teachers in course. Scholars have attributed poor performance in some subjects to a number of factors especially prevalence of traditional method of teaching (Izuagba, et al. 2016). If this poor performance goes unchecked, the competence of graduate teachers produced to integrate technology into teaching becomes questionable; they will become irrelevant in the emerging world of work. Based on the researchers' recent interaction with some students, it was observed that even with the introduction of digital classroom with learning in this 21st Century where interest has been shifted on integrating technology to purely online instruction, On the basis of the foregoing, the researchers were prompted to investigate the effects if online teaching using only Google Classroom and blended teaching approach using Google Classroom platform and face-to-face Strategy on the academic performance of student-teachers in Educational Technology and their digital literacy skills.

Research Questions

The following research questions were raised to guide the study

1. What is the mean achievement score of student-teachers taught Educational Technology with only online teaching approach and those taught blended teaching approach?
2. What is the mean achievement score of male and female pre-service teachers taught Educational Technology with only online teaching approach and those taught using blended teaching approach?
3. What is the mean digital literacy skill gain score of student-teachers in the two experimental groups?

Research Hypotheses

1. There is no significant difference in mean gain scores between student teachers taught Educational Technology using only online teaching strategy and those taught using blended teaching approach.

2. There is no significant difference in mean gain score between male and female student teachers taught Educational Technology using only online teaching approach and those taught using blended teaching approach.
3. There is no significant difference in mean scores in digital literacy skills between student-teachers taught educational technology using only online teaching strategy and those taught with blended teaching strategy?

The theory that underpinned this study is Connectivism. It is a learning theory developed by George Siemens and Stephen Downes, in 2005. This theory is particularly relevant for this study due to its emphasis on networks, nodes, and patterns. The theory posits that knowledge is distributed across networks of people and resources and that learning is a process of navigating and forming connections within these networks. This theoretical framework aligns well with the digital nature of Google Classroom platform and blended instruction, as they rely heavily on online networks and interactions.

METHODS

This study adopted quasi-experimental non-equivalent group pre-test treatment and post-test research design. One group was taught online on Google Classroom platform while the other group was taught with a blend of online Google Classroom and face-to-face teaching approach. Both groups were subjected to both pre-test to establish the baseline measurement of the dependent variable and to ensure group equivalence before treatment and post-test to ascertain their performance under the two different treatments. The population of the study was 586 second year degree students of AIFUE of the 2022/2023 academic session. The sample size of 92 students which was purposively drawn from the population. The Intact classes used were Economics Education students and Social Studies Education students from the Faculty of Social and Management Sciences. The two intact classes were randomly assigned to treatment one and treatment two.

A O_1 X_1 O_2

B O_1 X_2 O_2

O_1 – Pre-tests (Researchers made achievement test: ETAT and DLSS).
X_1 – Online Google Classroom Instruction Group.
X_2 – Online Google Classroom plus face-to-face Instruction Group.
O_2 – Post-tests (Researcher-made achievement Test ETAT and DLSS).

The Online Google classroom group was assigned 48 participants and 44 participants were assigned to Google classroom blended with face-to-face instruction group. The instruments used for data collection in this study are the researchers' made Educational Technology achievement test (ETAT) and digital literacy skills scale (DLSS). The researchers created the two Google classroom platforms and shared the links to the participants assigned to the two groups. The researchers prepared two types of lesson plan one for the treatment group using only Google Classroom and treatment group two using a blend of Google Classroom with face-to-face strategy. The treatment lasted for 6 weeks. After the treatment, post-test was administered, the researchers reshuffled the questions and re-administered to the participants. Educational Technology achievement test (ETAT) which comprised of 50 item objective questions were constructed by the researchers using table of specification for data collection. The questions were drawn from two Educational Technology topics; Classroom Communication and Systems Approach to Instruction. The fifty (50) item questions were used for pretest and transposed post test of the students to determine the extent to which learning has taken place and results of the treatment received from the two groups. The digital literacy skills scale comprised of 30 items which required the student-teachers to select from very highly possessed, highly possessed, lowly possessed and very lowly possessed to indicate their level of possession of the skills. The instruments were subjected to trial test. It was administered to twenty (20) students who were not sampled for the study. The scores obtained from the trial testing were subjected to Kuder-Richardson (KR20) formular to determine the internal consistency of the ETAT instrument. The Kuder-Richardson was appropriate for determining the reliability of Educational Technology performance test because the instrument required only one correct answer in every case. The instrument (Educational Technology perform test used in collecting d ata was validated by three experts, two in Educational Technology and one from Measurement and Evaluation. The reliability of the instrument was determined using KR20 formula which gave a reliability coefficient of 0.85. On the other hand, the DLSS instrument yielded a reliability coefficient of .081 using the Cronbach's alpha model. Data collected were analysed using mean and standard deviation statistical tools to answer research question.

RESULTS

Research Question 1

What is the mean achievement score of student-teachers taught Educational Technology with only online teaching approach and those taught blended teaching approach?

Table 1. *Mean and standard deviation scores of student-teachers in the two experimental groups on Educational Technology Achievement Test 2.*

Instructional Strategy Group	N	Mean	SD	Mean Gain	Mean Difference
Online Learning Group	48	35.58	2.82	10.06	3.97
Blended Learning Group	44	38.50	2.28	14.03	

Data presented on table 1 indicate that students taught using online instructional strategy had a mean achievement score of mean score of 35.58 and a standard deviation of 2.82 in the post test with a gain score of 10.06. The data also show that students taught using the blended learning strategy had a mean score of 38.50 and a standard deviation of 2.28 in post-test, giving a gain score of 14.05. The findings reveal that students taught educational technology using blended learning instructional strategy had a higher mean gain score that those taught with only online Learning strategy with a mean difference of 3.97. This shows that the blended learning group had a higher achievement score than the online learning group.

Hypothesis 1

There is no significant difference in mean scores between student teachers taught Educational Technology using online instructional strategy and those taught using blended learning approach. The result of the test is presented in table 2.

Table 2. *Analysis of Covariance of the effects of online learning and blended learning strategies on student-teachers achievement in post-test Educational Technology achievement test*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	365.971[a]	2	182.985	38.231	.000	
Intercept	699.954	1	699.954	146.239	.000	
Etat1	170.681	1	170.681	35.660	.000	
Group	198.192	1	198.192	41.408	.000	Significant
Error	425.986	89	4.786			
Total	126592.000	92				
Corrected Total	791.957	91				

The result of the test presented in table 2 shows that there is significant difference in Educational Technology achievement test mean scores after post-test F = 41.41 (df 1, 91), P = 0.00. Since the computed p-value (0.00) is less than 0.05 level of significance. Consequently, the null hypothesis is rejected as it is concluded that significant difference existed between those taught using online learning strategy and those taught using blended learning strategy in favour of blended learning strategy.

Research Question 2

What is the mean achievement score of male and female student- teachers taught Educational Technology with only online teaching and those taught using blended teaching strategy?

Table 3. *Mean and standard deviation scores of male and female student-teachers taught Educational Technology using online learning strategy and blended learning strategy*.

Gender	N	Post-test Mean	SD	Mean Gain	Mean Difference
Male	32	37.00	2.83	12.77	.45
Female	60	36.97	2.04	12.32	

Result presented in table 3 shows that the post-test achievement means score of male 37.00 and female 36.79 slightly differs. The males had a gain score of 12.77 slightly higher than the females 36.97. This gives a mean difference of .45 in favour of the males.

The low range of standard deviation scores from 2.04 -.2.83 for males and females indicate that the students' scores did not deviate much from the mean score.

Hypothesis 2

There is no significant difference in mean score between male and female student-teachers taught Educational Technology using only online teaching strategy and those taught using blended teaching strategy.

Table 4. *Analysis of Covariance test Educational Technology Achievement Test Score 2 of male and female student-teachers in the two experimental groups*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	169.051[a]	2	84.525	12.077	.000	
Intercept	698.831	1	698.831	99.848	.000	
Etat1	169.028	1	169.028	24.150	.000	
Gender	1.272	1	1.272	.182	.671	Not Significant
Error	622.906	89	6.999			
Total	126592.000	92				
Corrected Total	791.957	91				

The result of the test presented in table 4 shows that there is no significant difference in Educational Technology achievement test mean scores after post-test F = .18 (df 1, 91), P = 0.67. Since the computed p-value (0.67) is greater than 0.05 level of significance. Consequently, the null hypothesis is not rejected. Thus it was concluded that there is no significance difference in achievement means scores as both male and female student-teachers equally benefited from both interventions.

Research Question 3

What is the mean digital literacy skill gain score of student-teachers in the two experimental groups?

Table 5. ***Mean and Standard deviation of Online learning group and blended learning group on post-test Digital Literacy Skill Score***

Group	Mean	Std. Deviation	N	Mean Diff
Online Learning group	79.44	8.29	48	2.97
Blended Learning group	82.41	8.39	44	

Data displayed on table 5 shows that online learning group achieved a mean score of 79.44 and a standard deviation of 8.29 while the blended learning group achieved a mean score of 82.41 and a standard deviation of 8.39. Thus the two instructional methods played a role in increasing digital literacy skill scores of the student-teachers who took part in the study with a mean difference of 2.97 in favour of the blended learning group.

Hypothesis 3

There is no significant difference in mean scores in digital literacy skills between student-teachers taught educational technology using online Instructional strategy and those taught with blended Instruction strategy?

Table 6. *Analysis of Covariance of the effects of online learning and blended learning strategies on student-teachers digital literacy skill post-test achievement score.*

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Decision**
Corrected Model	1693.054[a]	2	846.527	15.801	.000	
Intercept	8971.271	1	8971.271	167.455	.000	
DLSS1	1490.340	1	1490.340	27.818	.000	
Group	63.031	1	63.031	1.177	.281	Not Significant
Error	4768.109	89	53.574			
Total	607969.000	92				
Corrected Total	6461.163	91				

Data presented in table 6 shows that there is no significant difference in digital literacy skills after post-test F = 1.18 (df 1, 91), P = 0.28. Since the computed p-value (0.28) is greater than 0.05 level of significance. Therefore, the null hypothesis is not rejected. Hence it was concluded that there is no significance difference in digital literacy means

scores of participants in the study as student-teachers in the two intervention groups equally benefited and recorded increase in their digital literacy scores.

DISCUSSION

The findings of the study revealed that the two instructional strategies used in the study online learning strategy and blended learning strategy had effect on Educational Technology achievement test scores of the participants after the intervention. The blended learning method significantly improved ETAT achievement score than the online learning strategy. The result is in line with the findings of Ali et al (2023) and Ranjan (2020) who discovered that blended learning strategy has far more significant effect on achievement scores than solely online strategy. This result is also supported by Tong, et al (2022) who stated that using blended learning approach include positively impacting on students' academic achievement. This is further supported by Tang, and Chaw (2016) who maintained that blended learning strategy improved academic performance.

On whether gender differences exist in achievement post-test scores, the result showed achievement gain scores for both male and female student-teachers with no significance difference in scores according to gender. This finding is in tandem with Ugboaja & Achumonu (2022) and Ugwuoti et al. (2025) discovered that there was no significant difference in the male and female mean achievement score in essay writing when taught using blended learning. However, this finding is at variance with Nwandu et al. (2023) discovered that Blended learning is more effective in enhancing female students' academic achievement in electronic libraries.

Furthermore, findings from the study revealed that online learning and blended learning strategies equally enhanced the digital literacy skills of the student-teachers who participated in the study. This result is supported by Nantha et al (2024) who reported that the use of blended learning model enhanced computer and ICT literacy as well as increase academic achievement. The result is also in tandem with Patmanthara and Nur Hidayat (2018) that discovered that digital literacy of students was enhanced by blended teaching model. On the other hand Chan and Sung (2025) reported that participants in their study considered their use of technology in the study facilitative of their development of digital literacy.

CONCLUSION

Based on the findings of the study therefore, it was concluded that blended learning approach to teaching improve students' performance in Educational Technology as compared to only online learning strategy. The online learning strategy equally led to high achievement of the learners with no difference in achievement between male and female student-teachers. It was also conclude that the use of both learning strategies did enhance the digital literacy skills of the student-teachers. This skill is required for learning in this 21st century that technology is taking the centre stage in instructional delivery.

Recommendation

Based on the findings and conclusions presented, the researchers made the following recommendations:

1. Teacher educators should endeavour to utilize both only online and blended learning strategies in their teaching in order to enhance performance of the learners as both effectively enhanced performances of both male and female student-teachers.
2. The University Management should organize workshops and seminars to update lecturers' digital literacy skills to enable them to effectively use technology in facilitating teaching and learning.
3. Regular trainings and orientation should be given to student-teachers on the effective use of only online and blended learning strategies to enable them enhance their digital literacy skills in order to integrate technology effectively in teaching.

REFERENCES

Abidin, Z. & Saputro, T. M. E. (2020). Google classroom as a mathematics learning space: potentials and challenges. *Journal of Physics Conference Series* doi:10.1088/1742-6596/1567/2/022094

Ali, A., Khan, R. M. I., & Alouraini, A. (2023). A Comparative Study on the Impact of Online and Blended Learning. *SAGE Open, 13*(1). https://doi.org/10.1177/21582440231154417

Anulobi, J. C., Ajuzie, N. E. & Amah, K. O. (2021). Concept, History and Scope of Educational Technology. In B. B. C. Onwuagboke, & P. C. Ifegbo, (eds) *Educational Technology: A systematic approach.* Divine Favour Digital Concepts.

Bates, T. (2016). Online learning for beginners: 1. What is online learning? Retrieved from https://www.tonybates.ca/2016/07/15/online-learning-for-beginners-1-what-is-online-learning/

Chan, A.Y.W., & Sung, C.C.M. (2025). Enhancing students' digital literacy skills through their technology use in a course-based research project: a Hong Kong case study. *Asia Pacific Educ. Rev.* https://doi.org/10.1007/s12564-025-10038-1

Dewi, R. A. K. & Fatkhiyani, K. 2021). Blended Learning: Can it be a Solution to Improve Digital Literacy and HOTS for PGSD Students in a Pandemic Situation? *International Journal of Elementary Education 5*(4) 601-611.

Essien, N. P. & Udo, U. A. (2024). Effects of google classroom on Computer Education students' Academic Achievement in Colleges of Education South, South Nigeria. *International Journal of contemporary Africa Researcher Netwwork* 1(1), 152-173. https//jouirnals.iapaar.com/index.php/ijcam/issue

Garzon, J. & Garzon, J. (2023). Teachers' Digital Literacy and Self-Efficacy in Blended Learning. International Journal of Multidisciplinary Educational Research and Innovation. 1(4), 162-174. https://doi.org/10.17613/cmjv-1386.

Hadiyanto, H., Sulistiyo, U., Mukminin, A., Haryanto, E., & Syaiful, S. (2022). The effect of Blended Learning on EFL Students' Performance in Research Methodology and Practice of 21st Century Skills. *Journal of Educators Online19* (3), 224-238.

Hwang, Y., & Oh, J. (2021). The relationship between self-directed learning and problem-solving ability: the mediating role of academic self-efficacy and self-regulated learning among nursing students. *International Journal of Environmental Research and Public Health 18*(4) 1738.

Jimoh, M. A., Kareem, M. A., Ekunke, U. A. R., Ambode, A. B., Jimoh, F. O. & Rufal, K. O. (2020). Effect of zoom application and Google hangout on achievement and retention of mathematics students in private schools. *Minna Nigeria Journal of Economics ,Social and Educational Issues, 2*(2),59-68.

Kara, M. (2022). Revisiting online learner engagement: exploring the role of learner characteristics in an emergency period. *Journal of Research on Technology in Education 54*(sup1) S236–S252.

Kumar, S., Agarwal, M. & Agarwal, N. (2021). Defining and Measuring Academic Performance of Hei StudentsA Critical Review. *Turkish Journal of Computer and Mathematics Education 12*(6), 3091-3105.

Kusuma, J. W. & Hamidah, (2020). Platform whatsapp group dan webinar zoom dalam pembelajaran jarakjaub padamasa pendemicovid-19. *Journal Imah Pendidkan Makematida. 5*(1), 97-106.

Le, P. T. & Pham, H. T. T. (2021). Using Blended Learning in Teacher Training Programs: Perspectives of Pre-service Teachers. *Journal of Educational and Social Research 11*(2) 115-127.

Loyola University Maryland (2021). What is Educational Technology and Why is it Important? https://www.loyola.edu/school-education/blog/2021/what-is-educational-technology.html

Maesaroh, S. A. & Marlena, I. (2021). Zoom vs Google classroom: Which is likely more effectively for supporting students' learning in mathematics? *Journal Tadris Matematika, 14*(2), 142-153.

Md Sari, Koo, Y. Y. & Zakariya, Z. (2024). The Effect of Google Classroom-Assisted Learning on the Academic Achievement of Students. *International Journal of Academic Research in Business and Social Sciences, 14*(4), 354-369.

Mulungye, S., Ngaruiya, B., Kinyua, G. & Njagi (2022). Effect of teaching on zoom virtual on secondary school students performance in history and government during Covid-19. *Journal of Pedagogy, Andragogy and Heutagogy in Academic Practice (JPANAP).3*(3).

Nantha, C., Siripongdee, K., Siripongdee, S., Pimdee, P., Kantathanawat, T., & Boonsomchuae, K. (2024). Enhancing ICT Literacy and Achievement: A TPACK-Based Blended Learning Model for Thai Business Administration Students. *Education Sciences*, *14*(5), 455. https://doi.org/10.3390/educsci14050455

Nwandu, A. I., Onwudinjo, O. T., & Ezejiofo, V. (2023). Blended and non-blended learning strategies on students' academic achievement in Internet and electronic libraries in Anambra State, Nigeria. *Journal of ICT Development, Applications and Research, 5*(1), 58 – 67.

Nwoke, B. I.. Uzoma, P. O., & Nwaneri, O. M. (2023). Impact of Hybrid Learning Mode on Students' Achievement in Mathematics in Secondary Schools in Owerri Municipal Council. *African Journal of Science, Technology and Mathematics Education (AJSTME) 9*(5) 392-399.

Okoro, E. P. (2024). Application of Zoom E-learning Management System in Business Education in Universities Nigeria. *International Journal of Religion*, *5*(5) 317-326.

Patmanthara, S., & Nur Hidayat, W. (2018). Improving Vocational High School Students Digital Literacy Skill through Blended Learning Model. *Journal of Physics Conference Series 1028*(1) 012076.