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Assuring Quality Teacher Education: Preparing Science Teachers for Blended Classrooms

Assurer la Qualité de l'Education des Enseignants : Préparer les Enseignants de Sciences pour les Salles de Classe Hybrides

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Abstract
The advent of Information and Communication Technology and the continued acceptance and advancement of online learning following the COVID-19 pandemic has placed demands for unique competencies and skills on teachers if they are to succeed in their career. This study investigated the extent to which science teacher preparation programmes in South-East Nigeria incorporate Blended Learning. Two hundred and ten (210) pre-service science teachers and Thirty-two (32) science teacher educators in three federal government-owned universities in South-East Nigeria made up the sample for the study. The instrument for data collection, which had different versions for teacher educators and pre-service science teachers, and Cronbach Alpha reliability coefficient of 0.86 and 0.81 respectively, was a 21-item researcher-developed instrument titled Blended Learning in Science Teacher Preparation Questionnaire (BLiSTPQ). Three research questions and two hypotheses guided the study. Results indicated that blended learning is not generally adopted in pre-service science teacher preparation in Federal Government-owned universities in South-East Nigeria. Based on the findings of the study, it was recommended, among others, that teacher education programmes should adopt learning management systems to provide hands-on learning and training opportunities on the use of blended learning to pre-service science teachers.

***Keywords*:** Quality Assurance, Blended Learning, Science Education, Teacher Education

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Résumé
L'avènement des technologies de l'information et de la communication ainsi que l'acceptation et le progrès continus de l'apprentissage en ligne après la pandémie de COVID-19 ont imposé aux enseignants des exigences de compétences et d'aptitudes uniques s'ils veulent réussir dans leur carrière. Cette étude a examiné dans quelle mesure les programmes de préparation des enseignants de sciences au sud-est du Nigeria intègrent l'apprentissage hybride. Deux cent dix (210) enseignants de sciences en formation et trente-deux (32) formateurs d'enseignants de sciences dans trois universités publiques fédérales de la region du sud-est du Nigéria constituaient l'échantillon de l'étude. L'instrument de collecte des données, dont les versions étaient différentes pour les formateurs d'enseignants et les enseignants de sciences en formation initiale, et dont le coefficient de fiabilité Cronbach Alpha était respectivement de 0,86 et 0,81, était un instrument de 21 questions élaboré par le chercheur et intitulé Blended Learning in Science Teacher Preparation Questionnaire (BLiSTPQ) (Questionnaire sur l'apprentissage mixte dans la préparation des enseignants de sciences). Trois questions de recherche et deux hypothèses ont guidé l'étude. Les résultats ont indiqué que l'apprentissage hybride n'est généralement pas adopté dans la formation initiale des enseignants de sciences dans les universités fédérales du sud-est du Nigeria. Sur la base des résultats de l'étude, il a été recommandé, entre autres, que les programmes de formation des enseignants adoptent des systèmes de gestion de l'apprentissage pour offrir aux enseignants de sciences en formation des opportunités d'apprentissage et de formation pratiques sur l'utilisation de l'apprentissage hybride.

Mots-clés **:** Assurance Qualité, Apprentissage Hybride, Enseignement Scientifique, Formation des Enseignants

Introduction

In September 2015, one hundred and ninety-three (193) United Nations member states unanimously adopted the seventeen (17) sustainable development goals (SDG), and their one hundred and sixty-nine (169) targets as a universal agenda to end all dimensions of poverty and inequality, as well as craft a just and secure world for people and the planet (FAO, undated; United Nations, 2017). The fourth sustainable development goal (SDG-4) is committed to ensuring inclusive and equitable quality education and promoting lifelong learning

opportunities for all. To help countries improve their capacity for monitoring their progress in SDG-4 attainment, the United Nations Educational, Scientific and Cultural Organisation's Institute for Statistics (2022) updated the list of targets and indicators for achieving quality education. These consist of ten specific and measurable targets. Seven of the targets are expected outcomes while three are means of achieving these outcomes. These means of achieving SDG-4 outcomes are:

(i) Build and upgrade education facilities that are child, disability, and gender-sensitive, and providing safe, non-violent, inclusive, and effective learning environments for all;
(ii) By 2020, substantially expand globally, the number of scholarships available to developing countries, in particular least developed countries, small island developing states, and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries;
(iii) By 2030, substantially increasing the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least-developed countries and small island developing States (UNESCO, 2022, p.3).

It is a generally accepted maxim that no education system may rise above the quality of its teachers, as the quality of any educational system is directly linked to the quality of its teachers. Nigeria, as a nation, concedes to this principle in its national policy on education (Federal Republic of Nigeria, 2004, 2013), which accentuates the pivotal role of quality teachers in the provision of quality education.

For the United Nations, quality education is one that ensures inclusive and equitable education that promotes lifelong opportunities for all. It is one that "helps children acquire basic literacy, enjoy learning without fear, and feel valued and included, irrespective of where they come from" (United Nations Children's Fund, UNICEF, 2018). Quality education, according to the United Nations Educational, Scientific and Cultural Organisation, UNESCO (2022), "specifically entails issues such as appropriate skills development, gender parity, provision of

relevant school infrastructure, equipment, educational materials and resources, scholarships or teaching force". Thus, achieving and maintaining quality education is intrinsically related to what teachers do to foster student learning.

Before the Covid-19 pandemic, increasingly irreversible and almost unlimited advancements in interconnectivity, access to information on the internet, and improvements in information and communication technologies (ICT) had modified people's lifestyles as it allowed real-time interactions between people, territories, and organisations in diverse economic, cultural, political and educational domains (Li & Lalani, 2020; Barlow-Jones & Van Der Westhuizen, 2013; and Shopova, 2014). Thus, people seemed to rely more on digital devices for their day-to-day activities. This situation was further reinforced by the COVID-19 pandemic in the year 2020, which caused almost all nations of the world to impose lockdowns and social distancing as a means of curbing the spread of the disease. These measures "created the largest disruption of education systems in history" (United Nations, 2020; OECD, 2020a), and caused nations to resort to e-learning. E-learning is characterised by teaching and learning undertaken remotely, over the internet, and on digital platforms. E-learning kept students occupied in a bid to redeem the disrupted academic activities, as face-to-face classes were impossible to achieve amid the pandemic (United Nations, 2020; Li & Lalani, 2020; OECD, 2020a).

Although teachers across the globe had been saddled with the responsibility of implementing online learning using innovative technologies during the pandemic, most of them, especially secondary school teachers in sub-Saharan Africa, were largely unprepared to support continuity of learning as they lacked the most basic ICT skills (OECD, 2020a). This is because they had not received minimum training that included digital skills, were not sufficiently prepared to adapt to new teaching methodologies, and as such struggled with facilitating quality online learning during the Covid-19 pandemic (United Nations, 2020; International Task Force on Teachers for Education-2030, 2020). This assertion is echoed by OECD's (2021) report that 43% of upper secondary school teachers in countries which

took part in a 2018 Teaching and Learning International Survey carried out prior to the pandemic, felt unprepared to use ICT for teaching.

These challenges faced by teachers have highlighted the need for initial and in-service training of teachers on new methods of education implementation (UNESCO, 2021). To improve teachers' ICT preparedness and digital pedagogical competences, so as to meet emerging societal demands from formal education, teacher training should deliberately incorporate ICT usage and instruction (OECD, 2021). This has become imperative, and researchers such as Sharma (2021), Mishra, (2020), and OECD (2020a), have advocated for teaching and learning modes combining traditional and modern learning models that incorporate digital technologies. This is in response to the profound changes in the education sector prompted by the Covid-19 pandemic, as well as rapid advancements in ICT.

Teaching and learning modes that integrate the face to face (traditional) classroom instruction with modern digital learning platforms and tools, are generally referred to as blended learning. For Alammary, Sheard, and Carbone (2014), "blended learning courses are those that: (i) thoughtfully integrate different instructional methods such as: lecture, discussion group, self-paced activity, etc.; and (ii) contain both face-to-face and computer-mediated portions" (Alammary, Sheard, and Carbone, 2014, p. 443). Blended learning denotes hybrid learning modes that adopt complementary face-to-face classroom instruction and online learning which permits students to have control over when, where and the pace of their learning (Coccoli, Guerico, Maresca & Stanganelli, 2014; Koch, 2014). Blending face-to-face and online learning facilitates the combining of the benefits of both environments as it supports students' development of new knowledge and skills that are transferable to the workplace environment, by changing the role of the teacher/instructor to that of a facilitator, moving learning activities online, and transferring the responsibility for learning to the student (Hilliard, 2015; Koch, 2014). To successfully implement either online or blended learning, teachers need to be competent in integrating technologies, as well as accessing, and using pedagogies that incorporate digital technologies, online learning and a variety of educational materials and resources. Thus, teachers require new forms

of professional development methods which should include both online and face-to-face learning (Le & Pham, 2021; Bryka, 2017; Alonta, Obi and Okolocha, 2022).

In view of the profound changes in education, prompted by the society's response to the pandemic, and the rapidly evolving nature of ICT, teachers now require higher levels of digital literacy in addition to specialised pedagogical knowledge to successfully integrate ICT into teaching and learning. To prepare teachers in using ICT for teaching, it is imperative that ICT is consciously incorporated into teacher education programmes, thus providing opportunities for pre-service teachers to receive hands-on training in online pedagogy. Therefore, this study sought to investigate the extent to which science teacher preparation programmes in South-East Nigeria incorporate blended learning.

The purpose of this study is to investigate the extent to which science teacher preparation programmes in South-East Nigeria incorporate Blended Learning. Specifically, the study intends to:

1. identify the online learning platforms from which pre-service science teachers take courses in Universities in South-East Nigeria;
2. examine teacher educators' and pre-service science teachers' perceptions of constraints to the utilisation of blended learning in science teacher preparation in Universities in South-East Nigeria; and
3. investigate teacher educators' and pre-service science teachers' attitude towards the utilisation of blended learning in science teacher preparation in Universities in South-East Nigeria.

Research Questions

The following research questions were formulated to guide the study.

1. What are the online learning platforms from which pre-service science teachers take courses?
2. What are teacher educators' and pre-service science teachers' perceptions of constraints to the utilisation of blended learning in Science Teacher Preparation?

3. What are teacher educators' and pre-service science teachers' attitude towards the utilisation of blended learning in Science Teacher Preparation?

Hypotheses

The following null hypotheses, which will be tested at 0.05 level of significance, have been formulated to guide this study.

1. There is no significant difference between teacher educators' and preservice science teachers' perception of the constraints to implementation of blended learning in pre-service science teacher preparation in public universities in South-East states in Nigeria.
2. There is no significant difference in teacher educators' and preservice science teachers' attitudes towards the implementation of blended learning in pre-service science teacher preparation in public universities in South-East states in Nigeria.

Methodology

The study adopted a descriptive survey design to elicit information from pre-service science teachers and teacher educators, on the extent of implementation of blended learning in science teacher preparation in federal government-owned universities in South-East Nigeria. The sample for the study consisted of a total of 210 pre-service science teachers drawn in clusters from a population of 673 final year (400 Level) pre-service science teachers, and 32 teacher educators, drawn from a population of 92 science teacher educators in three federal government-owned universities (offering science education) in South-East Nigeria. Pre-service science teachers were chosen for the study because they will be saddled with the responsibility of educating Nigerians in the sciences. The instrument for data collection was a 21-item, researcher-developed, instrument titled "Blended Learning in Science Teacher Preparation Questionnaire (BLiSTPQ)". The instrument had two versions: one for teacher educators and the other for pre-service science teachers. Each version of the instrument had three sections. Section one elicited information on the use of explicit online and blended learning activities, platforms, and systems in teacher education. Section two elicited information on respondents'

perceptions of the constraints to the utilisation of blended learning in science teacher preparation. Section three elicited respondents' attitudes toward blended learning. The instruments were validated by an expert in measurement and evaluation and a specialist in science education. To establish the reliability of the pre-service science teachers' instrument, it was administered once to 20 Science Education students drawn from one public-owned university in South-East Nigeria. These students are part of the target population but were carefully excluded when data for the study was collected. The instrument had a Cronbach Alpha reliability coefficient of 0.81. To establish the reliability of the Teacher Educators' instrument, it was administered once to seven Teacher Educators in a public-owned University in a South-South state of Nigeria. These teacher educators, though not part of the target population of teacher educators, are comparable to them in all ramifications. These teacher educators were excluded when the data for the study was collected. The teacher educators' version had a Cronbach Alpha reliability coefficient of 0.86. The instruments were administered online using google forms. Respondents were sent the link to the survey and were required to anonymously respond to the survey. Data collected by the instruments were used to answer the research questions.

The data collected by the instrument were analysed using Mean and Standard Deviation, while the independent sample t-test was used to test the hypotheses. Item response criterion mean of 2.50 and above was considered acceptable, while item means below 2.50 were considered not acceptable to answer the research questions.

Results

Research Question 1: What are the online learning platforms from which pre-service science teachers take courses?

Table 1: Online MOOC platforms from which pre-service science teachers take full certifying courses

Online Learning Platforms from Which Students Take Full Certifying Courses (MOOC – Massive Open Online Courses)	Pre-service Science Teachers' Responses (%)	Teacher Educators' Responses (%)
edX	51 (34.3)	02 (0.64)
Coursera	42 (20.0)	0 (0.00)
Udemy	29 (13.8)	0 (0.00)
HavardEx	7 (3.33)	0 (0.00)
LinkedIn Learning	16 (7.62)	0 (0.00)
Others (FutureLearn, Udacity, Skillshare, Alison, Codeacademy, Pluralsight)	81 (38.57)	0 (0.00)
None	42(35.83)	30 (93.75)

Table 2: Online learning platforms deployed in pre-service teacher preparation in South-East Nigeria

Learning Management Systems deployed in pre-service science teacher education in universities in South East Nigeria	Pre-service Science Teachers' Response (%)	Teacher Educators' Response (%)
Moodle	5(4,17)	01(3.13)
Blackboard	0(0.00)	0(0.00)
Schoology	0(0.00)	0(0.00)
Canvas	0(0.00)	0(0.00)
Google Classroom	21(17.50)	4(12.5)
Others	0(0.00)	3(9.38)

Table 1 shows that pre-service science teachers took certificate-awarding courses from some online learning platforms. This appears to be done independently, without formal instructions from their teacher educators. Data in Table 2 indicate that Moodle and Google Classroom are mainly used in pre-service science teacher preparation.

Research Question 2: What are teacher educators' and pre-service science teachers' perceptions of constraints to the utilisation of blended learning in Science Teacher Preparation

Table 3: Teacher educators' and pre-service science teachers' perceptions of the constraints to the utilisation of blended learning in science teacher preparation.

	Constraints to the utilisation of blended learning in pre-science teacher preparation	Teacher Educators' Perception N_1= 32		Preservice teachers' response N_1= 210		Remarks
		$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2	
1	Inadequate supply of ICT tools such as computers, Smart Boards, Laptops	3.44	0.95	3.01	1.08	Agree
2	Insufficient supply of internet services within the university	3.28	0.96	2.94	1.08	Agree
3	Teacher educators' inadequate knowledge and skills in integrating online learning to face-to-face learning	3.03	0.90	3.09	0.96	Agree
4	Teacher educators do not have adequate technological skills to teach part of their courses online	3.19	1.03	2.75	1.10	Agree
5	The fixed teacher education curriculum does not allow teacher educators to implement blended learning in teaching	2.84	0.77	2.54	0.86	Agree

	Constraints to the utilisation of blended learning in pre-science teacher preparation	Teacher Educators' Perception N_1= 32		Preservice teachers' response N_1= 210		Remarks
		$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2	
6	Lack of adequate Institutional support for integrating blended learning	3.22	0.83	2.53	0.94	Agree
7	The structure of the semester calendar and time-table does not permit use of blended learning approaches in teacher education	2.69	1.03	2.68	0.92	Agree
8	Teacher educators do not have access to internet-enabled devices	2.38	0.71	2.48	0.95	Disagree
9	Pre-service science teachers do not have access to internet-enabled devices	2.56	0.84	2.71	0.92	Agree
	Grand Mean	2.96	0.89	2.75	0.98	

Table 3 shows that all items (except item 8) had mean scores above 2.50, and standard deviations ranging from 0.71 to 1.03 for teacher educators, and 0.86 to 1.10 for pre-service science teachers. This result indicates that both teacher educators and pre-service science teachers perceived that the various factors identified constrained the utilisation of blended learning in teacher preparation in universities in south-eastern states in Nigeria. They also did not agree that teacher educators do not have access to internet-enabled devices. The small standard deviation values indicate that the respondents' responses did not vary widely from the mean for each of the items.

Research Question 3: What are teacher educators' and pre-service science teachers' attitude towards the utilisation of blended learning in Science Teacher Preparation?

Table 4: Teacher educators' and pre-service science teachers' attitude towards the utilisation of blended learning in science teacher preparation

	Pre-service science teachers' attitude towards Blended Learning	**Teacher Educators' attitude N_1= 32**		**Pre-service science teachers' attitude N_1= 210**		**Remarks**
		$\bar{x}_1$	**SD_1**	$\bar{x}_2$	**SD_2**	
1	The teacher education curriculum is overloaded, it is cumbersome to make pre-service science teachers take online courses that are not part of the already prescribed curriculum	2.31	0.82	2.87	0.98	Disagree
2	Allowing students to take full courses from online learning management platforms such as Coursera, EdX, and others, may distract them	2.06	0.44	2.19	1.13	Disagree
3	Having students study part of any given course online may enhance their class participation	3.47	0.51	2.99	1.00	Agree
4	Taking courses online does not improve a student's learning	1.92	0.78	1.63	1.00	Disagree
5	Fulltime students should not take any of their courses online	1.66	0.48	1.53	0.69	Disagree

	Pre-service science teachers' attitude towards Blended Learning	Teacher Educators' attitude N_1= 32		Pre-service science teachers' attitude N_1= 210		Remarks
		$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2	
6	When students access their course materials online, it may decrease their participation in class	2.25	0.98	1.73	0.97	Disagree
7	Accessing course materials online may enhance pre-service science teachers' interest in any given course	2.56	0.914	2.36	1.06	Disagree
	Grand Mean	2.34	0.70	2.19	0.98	

Data in Table 4 indicate that the grand mean of both teacher educators' and pre-service science teachers' attitudes towards the utilisation of blended learning in science teacher preparation was below 2.50.

Hypothesis 1: There is no significant difference between teacher educators' and preservice science teachers' perception of the constraints to implementation of blended learning in pre-service science teacher preparation in public universities in South-East states in Nigeria.

Table 5: t-test analysis of the difference between teacher educators' and preservice science teachers' perception of the constraints to implementation of blended learning.

Groups	N	Mean	Standard Deviation	t- cal	t -tab	Df	Sig.	Decision
Teacher Educators	32	2.96	0.89	0.933	1.960	240	0.352	Not Significant
Pre-service Science Teachers	210	2.75	0.98					

Table 5 shows that the calculated t-test value of 0.933 is less than the critical t-test value of 1.96 at degree of freedom of 240, and 0.05 level of significance. Since the calculated t-value is less than the tabulated t-value, the null hypothesis that there is no significant difference between teacher educators' and preservice science teachers' perception of the constraints to implementation of blended learning in pre-service science teachers' preparation in federal government-owned universities in South-East Nigeria is not rejected.

Hypothesis 2: There is no significant difference in teacher educators' and preservice science teachers' attitudes towards the implementation of blended learning in pre-service science teacher preparation in public universities in South-East states in Nigeria.

Table 6: t-test analysis of the difference between teacher educators' and preservice science teachers' attitudes toward the implementation of blended learning

Groups	N	Mean	Standard Deviation	t cal	t-tab	Df	Sig.	Decision
Teacher Educators	32	2.32	0.70	0.171	1.960	240	0.864	Not Significant
Pre-service Science Teachers	210	2.19	0.98					

Table 6 shows that the calculated t-test value of 0.171 is less than the critical t-test value of 1.96 at 240 degrees of freedom, and 0.05 level of significance. Since the calculated t-value is less than the tabulated t-value, the null hypothesis that there is no significant difference between teacher educators' and preservice science teachers' attitudes towards the implementation of blended learning in pre-service science teacher preparation in federal government-owned universities in South-East Nigeria is not rejected.

Discussion of Findings

The findings from research question 1 indicate that no form of blended learning is incorporated in pre-service science teacher preparation programmes in federal government-owned universities in South-East

Nigeria. This finding corroborates OECD's (2020a) assertion that most secondary school teachers in sub-Saharan Africa had not received basic training that included digital skills, and as such were not sufficiently prepared to facilitate quality online learning. This finding is at variance with Sharma's (2021) and OECD's (2021) opinion that teacher training should deliberately incorporate ICT usage and instruction in order to improve teachers' digital pedagogical competencies.
The responsibility of training quality teachers with the right competencies needed to excel in their chosen careers falls within the purview of universities.

The findings from research question 2 and hypothesis 1 indicate that teacher educators and pre-service science teachers unanimously perceive that the inadequate supply of ICT tools, internet-enabled devices, and internet services within the university are the constraints to the implementation of blended learning in teacher preparation in federal government-owned universities. This finding supports Alonta, Obi and Okolocha's (2022) submission that the utilisation of blended learning depends greatly on access to and availability of technological devices and internet services. These factors translate to the dearth of institutional support for integrating blended learning and buttress Okonjo-Iweala's (2012), opinion that several Nigerian universities are producing graduates that lack the right skills needed to perform tasks required in their chosen fields. To successfully use pedagogies that incorporate digital technologies in their classrooms, pre-service science teacher education should incorporate online learning activities as well as face-to-face learning in a blended approach. The t-test analysis of the difference between teacher educators' and pre-service science teachers' perception of the constraints to implementation of blended learning in pre-service teacher preparation was non-significant. The study did not detect any differences between the teacher educators' and pre-service science teachers' perceptions of the constraints to blended learning implementation in pre-service science teacher preparation.

The findings of the study from research question 3 suggest that both teacher educators and pre-service science teachers (with 2.34 and 2.19 grand mean respectively) had unfavourable attitudes towards the

utilisation of blended learning in science teacher preparation. T-test analysis of the group means also indicated that there were no significant differences in teacher educators' and pre-service science teachers' attitudes towards the utilisation of blended learning in science teacher preparation. This finding is at variance with Le and Pham's (2021) finding that pre-service teachers favoured the use of blended learning in their training programmes. Le and Pham suggested that positive perception of blended learning tended to increase with students' greater exposure to, and familiarity with blended learning. This divergent finding thus necessitates that blended learning be adopted in pre-service science teacher preparation programmes, in order to improve their attitude towards blended learning, so as to achieve quality teacher education.

Conclusion

In conclusion, this study has found that online learning platforms such as Moodle, Blackboard, Canvas and others are generally not used by Science Teacher Educators in the preparation of Pre-service science teachers. Also, the inadequate supply of Information and Communication Technology tools to institutions for the training of preservice science teachers is a serious constraint to the implementation of Blended learning in Science Teacher Education programmes in Universities in South-East Nigeria.

Recommendations

Based on the findings from this study, the following recommendations have been made:

1. Science Educators in the various training institutions should be encouraged to undertake training and retraining programmes on new technologies to enable them to embrace the use of online learning platforms.
2. Universities should consider the adoption of Learning Management Systems for their institutions for more engaging teaching and learning, hands-on training of pre-service science teachers, and to enable easier access to learning materials, assessment and feedback for students and teachers.

3. Universities should be adequately funded for the supply of Information and Communication Technology tools such as laptops, computers and internet facilities to enable the utilisation of Blended Learning in Science Teacher Education programmes.

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