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INFLUENCE OF DIGITAL DIVIDE ON THE IMPLEMENTATION OF BLENDED LEARNING AMONG IN FEDERAL UNIVERSITY OF KASHERE GOMBE STATE, NIGERIA

[1]Abdullahi, Muhammad, [2]Tessy Ofoegbu, [3]Bello, Ahmed, & [4]Mohammed, Ibrahim Abba.

[1,3 &4] Department of Science Education, Federal University of Kashere, Gombe State
[2] Department of Arts Education, University of Nigeria Nsukka, Enugu State

Abstract

This study investigated students` perception of the impact of digital divide on effective implementation of blended and open learning at the Federal University of Kashere, Gombe State, Nigeria. The study specifically examined how disparities in access to digital devices, internet connectivity, digital competencies, and institutional technological support influence participation and instructional effectiveness within blended and open learning environments. A descriptive research design was employed. The study population comprised 4,307 undergraduate 300 level students, from which 366 (183 male and 183 female) respondents was drawn using a stratified random sampling technique across the six faculties to ensure representativeness. Data were collected using a structured instrument titled Perception of the Impact of Digital Divide on the Effective Implementation of Blended and Open Learning Questionnaire (PIDEIBOLQ). The instrument underwent expert validation by specialists in educational technology and educational measurement, and internal consistency reliability was established at 0.79 using Cronbach's alpha coefficient. Data were analysed using descriptive and inferential statistics at the 0.05 level of significance. The findings revealed that disparities in students' access to digital devices and reliable internet connectivity, inequalities in digital skills and ICT competence, the non-availability and usability of institutional e-learning infrastructure, as well as students' socio-economic conditions, significantly contribute to the digital divide and, to a large extent, hinder the successful implementation of blended learning among undergraduate students at the Federal University of Kashere. The study concludes that mitigating structural and skills-based dimensions of the digital divide is fundamental to optimizing blended and open learning delivery. It therefore recommends the formulation of inclusive institutional digital policies, strategic investment in ICT infrastructure, systematic capacity-building initiatives, and targeted interventions to support socio-economically disadvantaged learners in order to enhance equity, access, and educational quality within Nigerian higher education institutions.

Keywords: Digital divide, blended learning, open learning, Nigerian universities.

Introduction

Technology has provided different approaches to education where access is now easily found in different ways never seen before. This technological advancement has given rise to more quality education, improved performance, access and closure of gaps (Sobowale et al., 2024; Mohammed et al., 2025a). The rapid uptake of blended and open learning in higher education has been widely promoted as a strategy to expand access, improve learning flexibility, and enhance

quality — aims that are central to national and institutional education policies across developing countries (Falode& Mohammed 2023; Itasanmi et al., 2024). In Nigeria, the COVID-19 pandemic accelerated institutional adoption of remote, blended, and open modalities, exposing both the potential of digital-enabled instruction and the fragility of access for large segments of the student population and also revealed stark inequalities in students' ability to participate meaningfully (Azubuike, Adegboye, & Quadri, 2021). While many universities embraced blended approaches to maintain continuity, the uneven distribution of digital resources and skills produced stark differences in who could participate meaningfully in these models (Azubuike et al., 2021). These inequalities are commonly described under the rubric of the "digital divide," a multifaceted phenomenon that undermines the equitable implementation of technology-enabled learning and risks widening existing educational disparities.

Digital divide in the educational context is multi-dimensional conceptualized as more than device ownership: it encompasses at least four interrelated dimensions: (1) physical access to devices and reliable broadband (availability of reliable broadband, electricity, and devices); (2) affordability of connectivity and devices(costs of data and devices relative to household incomes); (3) digital literacy and the ability to use platforms effectively (the capability to use technologies effectively for learning); and (4) institutional readiness — including infrastructure, pedagogical design for blended delivery (platform availability, technical support, and pedagogical design), and academic support (Olanrewaju et al., 2021; Paradigm Initiative, 2021). In Nigeria, even though personnel involved in open and distance learning are aware and ready to use digital resources for instructional purpose (Mohammed et al., 2024; Mohammed et al., 2025b)**,** however**,** studies have repeatedly identified poor internet connectivity, erratic power supply, high cost of data, and limited digital skills as principal barriers to effective remote and blended learning, especially for students from low-income households and rural communities. These structural and socio-economic factors interact to shape students' actual participation in blended and open learning and translate into unequal learning engagement and risk exacerbating pre-existing educational inequalities.

Empirical work within the Nigerian higher education context further shows heterogeneity in students' preferences and capacities for blended and online learning. Large surveys of university students indicate that blended learning is often preferred where students have sufficient technology self-efficacy and access, but preference and successful uptake vary systematically by socio-demographic factors (age, employment status), digital literacy, and programme type (Itasanmi et al., 2024). This means that policy or programmatic moves toward blended/open learning will not automatically produce equitable outcomes unless access and capacity gaps are addressed.

Rural–urban and socio-economic divides are particularly salient. Research focused on remote and rural schools and communities demonstrates that limited broadband, device scarcity, and lack of institutional ICT strategies leave rural learners disproportionately excluded from digital learning gains (Olanrewaju et al., 2021). Government and civil-society analyses also point to progress in national digital strategies (e.g., broadband and RITC initiatives), but stress that penetration statistics mask persistent affordability and infrastructure gaps that constrain meaningful educational use (Paradigm Initiative, 2021; Okocha &Edafewotu, 2022).

Blended learning on the other hand, refers to educational designs that intentionally combine face-to-face instruction with online learning activities and resources to achieve pedagogical goals that neither mode could accomplish alone (Haleem, 2022). In practice, blended

models vary in the proportion of online to in-person contact, but their promise (greater flexibility, richer learning resources, and opportunities for active learning) depends heavily on reliable student access to digital platforms and instructors' competence in online pedagogy. Open learning (or open and distance learning, ODL) extends these principles further by emphasizing broad access, flexible entry and progression, and the removal of geographic barriers through distance technologies; ODL therefore places still greater emphasis on network reach, content availability offline/online, and policies that promote equity(Mohammed et al., 2024).

At the institutional level, studies of blended-learning pilots in Nigerian tertiary colleges and universities report that while blended strategies can enrich pedagogy and increase access to learning resources, they consistently encounter challenges tied to inadequate technical support, poor network reliability, and limited faculty capacity for online pedagogies (Osita& Ugochukwu, 2023). These operational constraints reduce the effectiveness of blended and open learning initiatives and can deepen inequities if students from disadvantaged backgrounds are less able to surmount them.

Access in this study is defined as students' practical ability to reach and use the required educational technology environment; this includes physical access to devices and connectivity, economic access (affordability), and temporal access (sufficient uninterrupted time online). Inclusion refers to equitable participation and learning outcomes irrespective of socio-economic status, gender, or geographic location; inclusion demands targeted supports (financial, pedagogical, and technical) so that historically disadvantaged students are not left behind by digital innovations. Evidence from Nigeria shows that rural students and those from low-income households are disproportionately affected by limitations in these dimensions, producing disparate engagement and poorer learning experiences during remote/blended transitions.

Empirical studies conducted in Nigeria and comparable contexts report consistent patterns: where internet reliability, power supply, and device ownership are limited, blended and open learning become nominal rather than substantive options for many students (Azubuike et al., 2021; Olanrewaju et al., 2021). At the institutional level, weak ICT support, limited faculty training in online pedagogy, and lack of inclusive policy frameworks reduce the pedagogical effectiveness of blended designs and magnify inequalities (Osita& Ugochukwu, 2023). These operational constraints mean that simply offering blended or ODL courses does not guarantee equitable learning gains; instead, targeted interventions that address both structural (infrastructure, affordability) and capacity (skills, institutional support) gaps are required.

Collectively, these literature points to an urgent research need to assess empirically how the digital divide affects the effectiveness of blended and open learning in Nigerian universities not simply whether blended modalities are available. Such assessment must disaggregate access (devices, connectivity), digital competencies, institutional provision (platforms, support), and socio-economic variables to reveal pathways through which the divide shapes participation and learning outcomes. The Federal University of Kashere like many Nigerian universities located in less urbanized contexts (a university serving a largely semi-urban and rural catchment area) provides a pertinent case for this inquiry because campus-level infrastructure, student socio-demographic profiles, and institutional policy shape the lived experience of blended and open learning. By documenting these dynamics, empirical evidence from Kashere can inform targeted interventions (infrastructure, capacity building, financial support, and ODL-oriented policy) to bridge digital gaps and realize the inclusive promise of blended and open learning in Nigeria. Thus, inform actionable recommendations—such as investments in ICT infrastructure, subsidized

student data/device programs, faculty development for online pedagogy, and ODL-oriented institutional policies—to ensure that blended and open learning fulfil their promise of widening access and improving quality in Nigerian universities.

Objectives of the Study

This study investigated the undergraduate students` perception of the impact of digital divide on effective implementation of blended and open learning in Federal University of Kashere, Gombe State, Nigeria. Specifically, this study is set to:

1. find out the extent to which disparities in student`s access to digital devices and internet connectivity influence successful implementation of blended learning among undergraduate students in Federal University of Kashere, Gombe State, Nigeria.
2. find out the extent to which inequalities in students' digital skills and ICT competence influence successful implementation of blended learning among undergraduate students in Federal University of Kashere.
3. determine the extent to which availability and usability of institutional e-learning infrastructure influence successful implementation of blended learning among undergraduate students in Federal University of Kashere.
4. find out the extent to which students` socio-economic factors add to digital divide influence successful implementation of blended learning among undergraduate students in Federal University of Kashere.

Research Questions

The following research questions guided the study;

1. What is the extent to which disparities in student`s access to digital devices and internet connectivity influence successful implementation of blended learning among undergraduate students in Federal University of Kashere, Gombe State, Nigeria?
2. What is the extent to which inequalities in students' digital skills and ICT competence influence successful implementation of blended learning among undergraduate students in Federal University of Kashere?
3. What is the extent to which availability and usability of institutional e-learning infrastructure influence successful implementation of blended learning among undergraduate students in Federal University of Kashere?
4. What is the extent to which students` socio-economic factors add to digital divide influence successful implementation of blended learning among undergraduate students in Federal University of Kashere?

Methodology

The study adopted a descriptive survey research design. Descriptive survey research design was considered appropriate for this study as it seeks to find out the opinions of respondents on the impact of digital divide on effective implementation of blended and open distance learning among undergraduate students at the federal university of Kashere. The population for the study was made up of all 4,307 undergraduate 300 level students in Federal University of kashere, Gombe State. The sample size was drawn using Taro Yamane formula which constitutes 366 (183 males and 183 females) students who were randomly selected using stratified random sampling techniques from the six faculties (Agriculture, Education, Humanities, Management Sciences, Science and Social Sciences) of the university. In each faculty, 61 students were randomly

selected for the study and gender was considered at the selection in 1:1. The instrument titled students` Perception of the Impact of Digital Divide on the Effective Implementation of Blended and Open Learning Questionnaire (PIDEIBOLQ)was developed by the researchers and used for data collection. The questionnaire was patterned into four clusters with ten items each and four points Likert like scale as 4- Very High extent (VHE), 3- High extent (HE), 2- Low extent (LE) and 1- Very Low extent (VLE).

The instrument was validated by two experts from Educational Technology and an expert from Measurement and Evaluation. The Instrument was administered to 20 undergraduate students in Gombe State University and the result was computed using Cronbach alpha determined the internal consistency of the instrument as 0.79 which is acceptable for the study.
The data was analyzed using both descriptive and inferential statistics. Mean and standard deviation was used to answer the four research questions for the study. Therefore, any item with weight mean of 2.5 was considered high extent (accepted) and any item with mean weight less than 2.5 was considered low extent (rejected) as decision rule. The result was analyzed using SPSS version 26.

Results

Research Question one: What is the extent to which disparities in student`s access to digital devices and internet connectivity have an effect on successful implementation of blended learning among undergraduate students in Federal University of Kashere, Gombe State, Nigeria?

Table 1: Mean and Standard Deviation on Access to Digital Devices and Internet Connectivity

SN	Items	Mean	SD	Decision
1	Access to a personal digital device (such as a laptop, tablet, or smartphone) influences my participation in blended learning activities.	2.11	0.92	Rejected
2	Limited access to digital devices influences students' ability to participate fully in blended learning courses.	3.81	0.96	Accepted
3	Reliable internet connectivity influences my access to online learning materials.	2.41	1.41	Rejected
4	Poor internet connectivity influences my participation in online lectures and virtual classroom sessions.	3.81	1.21	Accepted
5	The cost of internet data influences my level of participation in blended learning activities.	3.51	0.97	Accepted
6	Ownership of personal laptops or computers influences students' academic performance in blended learning compared to relying on smartphones or shared devices.	3.77	1.16	Accepted
7	Unstable internet connectivity influences my ability to download course materials and submit assignments online.	3.42	1.45	Accepted
8	Inadequate access to digital devices influences students' level of participation in blended learning classes.	3.82	0.91	Accepted
9	Access to reliable internet connectivity influences my interaction with lecturers and classmates during blended learning sessions.	3.91	0.99	Accepted
10	Differences in students' access to digital devices and internet connectivity influence the successful implementation of blended learning in the university.	3.62	1.22	Accepted
	Average Mean	**3.42**	**1.12**	

Decision Mean = 2.5

The findings in Table 1 reveal that disparities in access to digital devices and internet connectivity significantly influence the effectiveness of blended learning among undergraduate students. The average mean of 3.42**,** which is higher than the decision mean of 2.5, indicates that respondents perceive the impact to be high. Specifically, the responses show that many students do not have consistent access to personal digital devices, as indicated by the rejection of the statement that students have regular access to devices necessary for blended learning (Mean = 2.11). This suggests that a considerable number of students rely on shared devices or smartphones, which may not adequately support academic tasks such as preparing assignments, attending virtual lectures, or accessing digital learning platforms. Similarly, the rejection of the item indicating reliable internet availability (Mean = 2.41) implies that stable internet connectivity is not consistently accessible to students. However, the acceptance of several related statements—such as the negative effect of poor internet connectivity (Mean = 3.81), the high cost of internet data (Mean = 3.51), and unstable internet networks disrupting learning activities (Mean = 3.42)—indicates that students strongly believe connectivity challenges hinder their participation in online learning components. Furthermore, respondents agreed that students who own personal laptops or computers tend to perform better in blended learning environments than those who depend solely on smartphones or shared devices (Mean = 3.77). They also acknowledged that lack of adequate digital devices leads to unequal participation in blended learning classes (Mean = 3.82). This suggests that device ownership contributes significantly to disparities in academic engagement.

The findings imply that inequalities in device ownership, internet accessibility, and data affordability create substantial barriers to the effective implementation of blended learning**.** These factors limit students' ability to interact with lecturers, access learning resources, and fully engage in digital academic activities, thereby widening the digital divide within the university learning environment.

Research Question two: What is the extent to which inequalities in students' digital skills and ICT competence have an effect on successful implementation of blended learning among undergraduate students in Federal University of Kashere?

Table 2: Mean and Standard Deviation of Students' Digital Skills and ICT Competence

SN	Items	Mean	SD	Decision
1	I possess the necessary digital skills required to effectively participate in blended learning activities.	2.22	0,14	Rejected
2	Differences in students' computer literacy levels affect their ability to benefit from blended learning.	3.37	0.91	Accepted
3	Students with higher ICT competence find it easier to navigate online learning platforms used in blended learning.	3.51	0.99	Accepted
4	Limited digital skills make it difficult for some students to access and use online learning resources.	3.81	0.23	Accepted
5	My ability to use learning management systems (LMS) helps me to participate actively in blended learning courses.	3.33	0.16	Accepted
6	Some students struggle to submit assignments or participate in online discussions due to limited ICT skills.	3.67	0.91	Accepted

7	Adequate training in digital skills improves students' participation in blended learning environments.	3.11	1.33	Accepted
8	Students who are proficient in ICT tools perform better in blended learning activities than those with limited ICT skills.	3.41	1.21	Accepted
9	Lack of confidence in using digital technologies discourages some students from engaging fully in blended learning.	3.81	0.17	Accepted
10	Inequalities in students' digital skills and ICT competence affect the overall success of blended learning implementation in the university.	3.11	0.99	Accepted
	Average Mean	**3.34**	**0.70**	

***Decision Mean** = 2.5*

The findings presented in Table 2 indicate that inequalities in students' digital skills and ICT competence significantly affect the successful implementation of blended learning. The average mean of 3.34**,** which exceeds the decision mean of 2.5, suggests that respondents perceive the effect to be to a high extent**.** The rejection of the statement that students possess adequate digital skills to participate effectively in blended learning (Mean = 2.22) suggests that many students lack the necessary technological competencies required for online learning environments**.** This indicates that a substantial proportion of students may struggle with navigating digital platforms, accessing online materials, or performing other essential digital learning tasks. However, respondents agreed that differences in computer literacy levels affect students' ability to benefit from blended learning (Mean = 3.37). They also agreed that students with higher ICT competence find it easier to navigate online learning platforms (Mean = 3.51), while limited digital skills create difficulties in accessing online learning resources (Mean = 3.81). These responses suggest that digital competence plays a critical role in determining how effectively students engage with blended learning systems.

The findings further show that students acknowledged that limited ICT skills hinder participation in online discussions and assignment submissions (Mean = 3.67). In addition, respondents indicated that adequate digital skills training could improve participation in blended learning environments (Mean = 3.11). This implies that targeted training programs could help bridge the skills gap among students. Moreover, the respondents agreed that students who are proficient in ICT tools tend to perform better in blended learning activities than those with limited digital skills (Mean = 3.41). Lack of confidence in using digital technologies was also identified as a factor discouraging students from engaging fully in blended learning (Mean = 3.81).

The findings indicate that digital literacy and ICT competence are critical determinants of students' ability to benefit from blended learning. Inequalities in these competencies contribute to the digital divide and limit the effectiveness of technology-driven instructional approaches in the university.

Research Question Three: What is the extent to which availability and usability of institutional e-learning infrastructure have an effect on successful implementation of blended learning among undergraduate students in Federal University of Kashere?

Table 3: Mean and Standard Deviation of Availability and Usability of Institutional E-Learning Infrastructure

SN	Items	Mean	SD	Decision
1	The university provides adequate e-learning infrastructure to support blended learning activities.	2.99	0.19	Rejected
2	The Learning Management System (LMS) provided by the university is easy for students to access and use.	2.11	0.92	Rejected
3	Availability of functional computer laboratories supports effective participation in blended learning.	3.99	0.14	Accepted
4	The university's internet facilities enable students to access online learning resources without major difficulties.	3.65	0.12	Accepted
5	Technical problems with the university's e-learning platforms often disrupt blended learning activities.	3.11	0.15	Accepted
6	The digital learning platforms provided by the university allow effective communication between students and lecturers.	2.99	0.98	Rejected
7	The availability of multimedia facilities (such as projectors, smart boards, and digital content) enhances blended learning.	3.81	0.91	Accepted
8	Lack of adequate institutional e-learning facilities affects students' participation in blended learning courses.	3.45	0.89	Accepted
9	Technical support services provided by the university help students to effectively use e-learning platforms.	3.11	0.13	Accepted
10	The availability and usability of the university's e-learning infrastructure contribute significantly to the successful implementation of blended learning.	3.89	0.21	Accepted
	Average Mean	**3.31**	**0.46**	

Decision Mean = 2.5

The findings in Table 3 show that the availability and usability of institutional e-learning infrastructure have a considerable influence on the success of blended learning implementation. The average mean of 3.31, which is above the decision mean of 2.5, indicates that students perceive institutional infrastructure as having a high level of influence on blended learning effectiveness.However, some responses suggest that the university's existing digital infrastructure may not be entirely adequate. For example, respondents rejected the statement that the university provides adequate e-learning infrastructure (Mean = 2.99) and also rejected the claim that the Learning Management System (LMS) is easy to access and use (Mean = 2.11). These responses suggest that students experience challenges in accessing or navigating the institutional digital learning platforms.Despite these concerns, respondents acknowledged that functional computer laboratories support effective participation in blended learning (Mean = 3.99) and that the university's internet facilities help students access online resources (Mean = 3.65). This indicates that certain aspects of the university's ICT infrastructure contribute positively to the blended learning environment.Students also agreed that technical problems sometimes disrupt blended learning activities (Mean = 3.11), highlighting operational challenges associated with digital platforms. Additionally, the availability of multimedia facilities such as projectors and digital learning materials was perceived to enhance blended learning experiences (Mean = 3.81).Furthermore, respondents agreed that lack of adequate institutional e-learning facilities negatively affects participation in blended learning courses (Mean = 3.45), and they recognized that technical support services assist students in using e-learning platforms effectively (Mean = 3.11).

These findings suggest that while certain institutional resources exist, limitations in infrastructure quality, platform usability, and technical reliability hinder the full potential of blended learning implementation at the university.

Research Question four: What is the extent to which students` socio-economic factors add to digital divide have an effect on successful implementation of blended learning among undergraduate students in Federal University of Kashere?

Table 4: Mean and Standard Deviation of Socio-Economic Factors Contributing to the Digital Divide

SN	Items	Mean	SD	Decision
1	My financial situation affects my ability to purchase digital devices needed for blended learning.	3.89	0.19	Accepted
2	The cost of internet data limits my ability to participate fully in online components of blended learning.	3.91	0.98	Accepted
3	Students from financially stable families find it easier to participate in blended learning activities.	3.45	0.14	Accepted
4	Limited financial resources make it difficult for some students to acquire the necessary ICT tools for blended learning.	3.56	0.11	Accepted
5	My socio-economic background influences how often I access online learning materials.	3.21	0.92	Accepted
6	Students who can afford reliable internet services participate more actively in blended learning.	3.11	0.24	Accepted
7	Financial challenges sometimes prevent students from completing online assignments on time.	3.89	0.12	Accepted
8	Students from low-income backgrounds experience more difficulties in adapting to blended learning.	3.99	0.13	Accepted
9	Availability of financial support or subsidies for internet access would improve students' participation in blended learning.	3.11	0.98	Accepted
10	Students' socio-economic status affects the overall success of blended learning implementation in the university.	3.99	0.93	Accepted
	Average Mean	**3.61**	**0.47**	

***Decision Mean** = 2.5*

The results in Table 4 indicate that socio-economic factors significantly contribute to the digital divide and affect the successful implementation of blended learning. The average mean of 3.61, which is above the decision mean of 2.5, shows that students perceive the influence of socio-economic conditions to be very high**.** The findings reveal that students' financial situations strongly affect their ability to purchase digital devices required for blended learning (Mean = 3.89). Similarly, respondents agreed that the cost of internet data limits their participation in online learning activities (Mean = 3.91), indicating that economic constraints directly influence students' access to digital learning resources. Students also acknowledged that those from financially stable families find it easier to participate in blended learning (Mean = 3.45). Limited financial resources were reported to make it difficult for some students to acquire necessary ICT tools such as laptops and reliable internet services (Mean = 3.56). These findings suggest that economic inequality plays a critical role in shaping students' learning opportunities within digital environments**.** Furthermore, respondents agreed that their socio-economic background influences

how often they access online learning materials (Mean = 3.21). Students who can afford reliable internet services were perceived to participate more actively in blended learning activities (Mean = 3.11). Financial difficulties were also identified as factors that sometimes prevent students from completing online assignments on time (Mean = 3.89). Additionally, students from low-income backgrounds were reported to experience greater challenges adapting to blended learning systems (Mean = 3.99). Importantly, respondents strongly agreed that financial support or subsidies for internet access would improve students' participation in blended learning (Mean = 3.11), indicating that policy interventions could reduce the effects of the digital divide.

The findings demonstrate that socio-economic disparities significantly influence students' ability to participate in and benefit from blended learning environments, making economic support mechanisms an important component of equitable digital education implementation.

Discussion of Result

The findings of the study revealed that disparities in students' access to digital devices and reliable internet connectivity significantly affect the successful implementation of blended learning. This conclusion is supported by the high average mean of 3.42 obtained from the responses in Table 1. The results showed that many students do not have consistent access to personal digital devices and reliable internet connectivity, which are essential for participation in blended learning environments. The rejection of the statement that students have regular access to personal digital devices suggests that many students depend on smartphones or shared devices, which may not adequately support academic tasks such as accessing learning management systems, downloading learning materials, or participating in virtual classes.Furthermore, the findings revealed that poor internet connectivity, unstable networks, and the high cost of internet data significantly hinder students' participation in online learning activities. These challenges were strongly acknowledged by the respondents, indicating that connectivity constraints remain a major barrier to digital learning participation. The study also found that students who own personal laptops or computers tend to perform better in blended learning than those relying solely on smartphones. This suggests that device ownership plays a critical role in determining students' level of engagement and academic performance in blended learning environments.

These findings are consistent with the work of Azubuike, Adegboye, and Quadri (2021), who reported that unequal access to digital devices and internet connectivity significantly limited students' ability to participate in remote learning during the COVID-19 pandemic in Nigeria. Similarly, Olanrewaju et al. (2021) found that limited access to reliable internet services and digital devices contributed significantly to inequalities in students' participation in e-learning activities, particularly in rural and semi-urban areas. The findings also support the report by Paradigm Initiative (2021), which noted that high internet costs and poor broadband infrastructure continue to restrict meaningful participation in digital education across Nigeria. Consequently, the present study reinforces the argument that adequate digital infrastructure and affordable internet access are fundamental prerequisites for the successful implementation of blended learning in Nigerian universities.

The findings from Table 2 revealed that inequalities in students' digital skills and ICT competence significantly influence the effectiveness of blended learning implementation, as reflected in the average mean score of 3.34. The rejection of the statement indicating that students possess the necessary digital skills for blended learning suggests that a considerable proportion of students lack adequate digital literacy required to function effectively in technology-mediated

learning environments.The findings further showed that differences in computer literacy levels affect students' ability to benefit from blended learning. Students with higher ICT competence were perceived to navigate online learning platforms more easily and participate more actively in blended learning activities. Conversely, students with limited digital skills encounter difficulties in accessing online learning resources, submitting assignments, and participating in online discussions. Lack of confidence in using digital technologies was also identified as a factor discouraging some students from fully engaging in blended learning environments.

These findings corroborate the work of Itasanmi et al. (2024), who reported that students' technology self-efficacy and digital competence significantly influence their preference for and participation in blended and online learning environments in Nigerian universities. Similarly, Haleem (2022) emphasized that effective utilization of digital technologies in education requires not only access to devices but also adequate digital literacy skills that enable students to navigate learning platforms and engage with digital resources effectively.

In addition, Olanrewaju et al. (2021) observed that inadequate digital literacy among learners was one of the major barriers to effective e-learning implementation in Nigeria during the COVID-19 pandemic. The findings of the present study therefore highlight that digital competence represents a critical dimension of the digital divide, and addressing this skills gap through structured training programs and digital literacy initiatives could significantly enhance students' participation and success in blended learning environments.

The findings of the study also revealed that the availability and usability of institutional e-learning infrastructure significantly influence the successful implementation of blended learning, as indicated by the average mean score of 3.31 in Table 3. Although some institutional digital facilities were reported to support blended learning activities, several responses indicated that the university's e-learning infrastructure may not be entirely adequate.Specifically, the rejection of the statements indicating that the university provides adequate e-learning infrastructure and that the learning management system is easy to access suggests that students experience challenges in accessing institutional digital platforms. These challenges may limit their ability to interact effectively with lecturers and learning materials in online learning environments. However, the respondents acknowledged that the availability of functional computer laboratories, internet facilities, and multimedia equipment contributes positively to blended learning experiences.The findings also revealed that technical problems sometimes disrupt blended learning activities, indicating that operational and technical challenges remain an important concern in the implementation of digital learning systems.

These findings align with the study conducted by Osita and Ugochukwu (2023), which reported that although blended learning strategies have the potential to enhance teaching and learning in Nigerian higher education institutions, their effectiveness is often limited by inadequate ICT infrastructure and insufficient technical support services. Similarly, Okocha and Edafewotu (2022) emphasized that inadequate institutional digital infrastructure remains a major obstacle to the successful adoption of technology-based learning systems in Nigerian educational institutions.

Furthermore, Paradigm Initiative (2021) highlighted that although digital policies and infrastructure initiatives exist in Nigeria, significant gaps remain in institutional ICT readiness and access to reliable digital learning platforms. The findings of this study therefore suggest that improving institutional ICT infrastructure, ensuring user-friendly learning management systems,

and strengthening technical support services are essential for optimizing blended learning implementation.

The findings from Table 4 indicated that students' socio-economic conditions significantly contribute to the digital divide and strongly affect the implementation of blended learning, with an average mean score of 3.61, the highest among the variables examined in this study. The results revealed that students' financial situations greatly influence their ability to purchase digital devices and afford internet data required for participation in online learning activities.The findings also showed that students from financially stable families find it easier to participate in blended learning because they can afford digital devices, reliable internet services, and other necessary technological resources. In contrast, students from low-income backgrounds experience greater difficulties adapting to blended learning environments and sometimes struggle to complete online assignments due to financial constraints.

These findings are consistent with Azubuike et al. (2021), who found that students from low-income households in Nigeria were significantly more likely to be excluded from remote learning opportunities during the COVID-19 pandemic due to limited access to digital resources. Similarly, Olanrewaju et al. (2021) reported that socio-economic inequalities significantly affected students' ability to participate in digital learning activities in rural and disadvantaged communities.The findings also support the observations of Okocha and Edafewotu (2022), who emphasized that economic inequality remains a major factor contributing to the digital divide in Nigeria. The authors argued that students from disadvantaged socio-economic backgrounds often lack the financial resources needed to access digital learning technologies.

Importantly, respondents in the present study agreed that financial support or internet subsidies could improve students' participation in blended learning. This finding aligns with Adie (2022), who suggested that targeted interventions such as subsidized internet access, provision of digital devices, and the development of offline digital learning solutions could help reduce digital inequalities and improve access to digital education in developing countries.

Conclusion

This study investigated undergraduate students' perceptions of the impact of the digital divide on the effective implementation of blended and open learning at the Federal University of Kashere, Gombe State, Nigeria. The study concluded that the digital divide remains a significant barrier to the successful implementation of blended learning within the institution. Specifically, disparities in access to digital devices and reliable internet connectivity were found to limit students' ability to participate fully in online learning activities, thereby affecting their engagement with digital learning resources and virtual classroom interactions.

The study further established that inequalities in students' digital skills and ICT competence significantly influence their ability to navigate learning management systems, access online materials, and actively participate in blended learning environments. Students with higher levels of digital competence were better positioned to benefit from blended learning opportunities, while those with limited technological skills experienced difficulties engaging with online components of instruction.

In addition, the findings indicated that the availability and usability of institutional e-learning infrastructure play a crucial role in supporting blended learning implementation. Although certain facilities such as computer laboratories and multimedia resources were reported to enhance learning experiences, challenges related to platform accessibility, infrastructure

adequacy, and occasional technical disruptions continue to hinder the full effectiveness of blended learning delivery.

The study concluded that socio-economic factors constitute a major dimension of the digital divide affecting students' participation in blended learning. Financial constraints, particularly the cost of digital devices and internet data, significantly influence students' access to digital learning resources and their ability to engage consistently with online academic activities. The study concludes that bridging the digital divide through improved digital access, strengthened institutional infrastructure, enhanced digital literacy, and targeted financial support for students is essential for ensuring equitable participation and maximizing the effectiveness of blended and open learning in Nigerian universities.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. University management should develop initiatives that facilitate students' access to affordable digital devices such as laptops and tablets. This may include device loan schemes, instalment purchase programs, or partnerships with technology companies to provide subsidized devices for students.
2. The university should strengthen campus internet infrastructure to ensure reliable and high-speed connectivity for students. In addition, partnerships with telecommunication companies could be established to provide subsidized educational data packages that enable students to participate effectively in online learning activities.
3. The university should organize regular digital literacy training workshops and ICT competence development programs for students. These programs should focus on enhancing students' ability to use learning management systems, access online learning resources, and participate effectively in digital academic activities.
4. Government agencies, educational policymakers, and development partners should increase investments in digital infrastructure across Nigerian higher education institutions, particularly those located in semi-urban and rural areas. Strengthening national digital infrastructure will significantly improve the effectiveness of blended and open learning across the higher education system.

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