Applicability of Open Educational Resources (OER) for Research among Pre-Service Science Teachers in Nigerian Universities

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Abstract

The study examined the applicability of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities. Four research questions raised and four hypotheses tested for the study. The mixed method research design was adopted for the study. Using a stratified sampling technique, 184 pre-service science teachers in there 400 level second semester of academic session 2024/2025 were used for the study. Two research instruments adopted for the study were Questionnaire on Applicability of Open Educational Resources (OER) for Research among Pre-service Science Teachers (QAOPRRPST) and Interview Template on Open Educational Resources (OER) for Research (ITOERR). The instruments were validated by experts and subjected to pilot testing and a reliability coefficient value of r = 0.88 was obtained. Data obtained for the main study was analyzed using frequency count, mean and standard deviation for the research questions and inferential statistics of Analysis of Variance (ANOVA) for the hypotheses. The findings of the study revealed that pre-service teachers awareness (Mean = 2.22, std = 089) and utilization (Mean = 2.56, std = 0.90) were low. It was also indicated that there were generally acceptable considerable chanlleges (Mean = 3.15, std = 0.90) and agreement on relevance strategies and policy directions (Mean = 2.97, std = 0.83) to improve OER applications in Nigerian universities. The One-Way ANOVA Results showed no significant difference in the on the Level of Awareness ($F(3,174) = 0.24$, $p = 0.87$), utilization ($F(3,174) = 0.18$, $p = 0.91$), challenges ($F(3,174) = 0.13$, $p = 0.94$) and ($F(3,174) = 0.12$, $p = 0.95$) relevance strategies and policy directions. Based on the findings, the study recommends that Universities should organize regular capacity-building programs, such as workshops and seminars, to enhance pre-service science teachers' skills and confidence in using OER for research. Government and university management should invest in reliable internet connectivity, adequate computer facilities, and digital repositories to improve accessibility and usability of OER across Nigerian universities.

Key words: Applicability, Open Educational Resources (OER), Pre-service Science Teachers, Research, Universities

Introduction

Open Educational Resources (OER) are teaching, learning and importantly research materials available in any format, whether digital or otherwise, that are either in the public domain or distributed under an open license. Due to the fact that they are in the public domain, they permit free usage, adaptation, and redistribution by others (UNESCO, 2019). OER includes comprehensive courses, textbooks, curricula, software and various educational tools aimed at minimizing barriers to knowledge and fostering equitable access to education (Adedoyin & Soykan, 2023). Open Educational Resources are characterized as digitized materials that are freely provided and open for lecturers and learners to utilize for teaching, learning, and research, with the adaptability to local contexts. This highlights the importance of accessibility, knowledge sharing and contextual relevance, especially for educational systems in the developing or emerging economies, where the cost and availability of quality resources remain ongoing challenges. Over two decades ago, there has been a significant global movement towards the integration of Open Educational Resources (OER) as part of worldwide initiatives to enhance access to learning and knowledge (Perifanou & Economides, 2022). This shift is reflected in significant policy frameworks like that of UNESCO's 2019 OER Recommendation, which calls upon Member States to promote the creation, accessibility, utilization, and modification of OER across various contexts. Numerous countries, particularly in Asia, Africa, and Latin America, have started to formulate national and institutional policies, establish repositories and launch awareness initiatives to embed OER practices within their educational systems. This movement has gained momentum due to enhanced digital connectivity and the pressing circumstances brought about by crises such as the COVID-19 pandemic, which revealed the disparities in access to educational resources. The pandemic acted as a driving force, stressing the necessity for adaptable and freely available educational content to maintain the continuity of learning on a global scale.

The transformative potential of Open Educational Resources (OER) stems from their key characteristics which are free access, open licensing and adaptability. Due to the open licensing of OER materials, educators, and learners globally can utilize, modify and share resources without facing restrictive costs or copyright limitations. According to Ibrahim (2023), it was commented that the application of OER significantly reduces economic and geographic obstacles, particularly

benefiting learners and institutions in under-resourced areas by lowering the expenses associated with textbooks and instructional materials. Moreover, OER facilitate the localization and contextualization of content, allowing materials to be translated, adapted and modified to fit local curricula, languages and cultural contexts, thereby enhancing relevance and equity in education. Open Educational Resources (OER) exist in various forms, depending on their intended purpose, format, and application in research. Below are the basic types of OER (Strydom et al., 2022; UNESCO 2019; Katamba et al., 2021; Yıldırım & Yıldırım, 2022).

1. *Open Access Journals and Articles:* Open access journals offer free and unrestricted access to peer-reviewed research articles by removing subscription fees that frequently limit access in developing regions. They enable pre-service teachers and researchers to remain informed about the latest scientific discoveries and educational methodologies. Notable examples include the Directory of Open Access Journals (DOAJ) and PLOS ONE, which promote equitable access to academic communication.
2. *Open Datasets:* Open datasets refer to collections of raw or processed data that are freely accessible and can be utilized for scientific experiments, secondary data analysis, and research conducted in educational settings. They play a significant role in science instructions by facilitating data handling instruction and aiding inquiry-based projects. Platforms such as Kaggle and UNESCO's Open Data portal offer a variety of accessible datasets spanning numerous disciplines.
3. *Access to Project, Theses, and Dissertations:* Institutional repositories provide unrestricted access to undergraduate and graduate research outputs in the form of open project, theses and dissertations, which offer significant insights into methodologies and literature reviews. For pre-service science teachers, these documents act as reference materials for organizing their own projects and comprehending local research contexts. Notable examples include ProQuest Open Access Dissertations & Theses and various university-based repositories.
4. *Open Research Reports and Policy Papers*: These materials are generated by governmental bodies, Non-Governmental Organizations (NGOs) and international entities, and are provided at no cost to enhance understanding in policy, practice, and research. They offer empirical data, case studies, and policy insights that can significantly contribute to the

knowledge base of pre-service teachers. Notable examples include reports from the World Bank, UNESCO, and the Commonwealth of Learning.

5. *Open Textbooks:* Open textbooks deliver free, research-driven content that forms a robust basis for academic and scientific endeavours. Their ability to be revised and tailored enables them to align research materials with local curricula and contexts. Initiatives like OpenStax and BC campus supply science-centric textbooks that are especially relevant for teacher education.
6. *Open Software and Tools:* Open-source software aids the research process by supplying free tools for data analysis, reference management and scientific simulation. Examples include R for statistical analysis, Zotero for reference management and PhET for science simulations. These tools allow pre-service science teachers to perform comprehensive research without financial barriers.
7. *MOOCs Featuring Research Components:* Massive Open Online Courses (MOOCs) commonly integrate modules that cover research methods, data analysis, or inquiries tailored to specific disciplines. They serve as accessible training avenues for pre-service teachers to improve their research capabilities. Examples of such MOOCs can be found on platforms like Coursera, edX and FutureLearn, which often include free components available to all learners.

Open Educational Resources (OER) improve the relevance of research by greatly decreasing the expenses associated with educational materials, thereby minimizing financial barriers for both students and institutions. Being freely accessible and openly licensed, OER enhances the availability of current textbooks, journals and instructional resources for research that might otherwise be prohibitively expensive or inaccessible, especially in contexts with limited resources. The versatility of OER fosters knowledge sharing and collaboration among educators and researchers, as materials can be adapted, revised and customized to fit diverse cultural and curricular needs. This cultivates inclusive and participatory learning environments while enhancing research capacity and innovation in higher education (Jensen & Kimmons, 2022).

Pre-service science teachers are integral to the educational system, representing the future workforce that will shape students' scientific literacy, inquiry skills, and problem-solving

capabilities (Aderonmu and Oni, 2025). Their role encompasses not only the delivery of scientific knowledge but also the encouragement of curiosity, critical thinking, and innovation, which are crucial for national advancement in an increasingly science- and technology-oriented society. As science serves as a foundation for sectors such as health, agriculture, and industry, the effectiveness of pre-service teachers significantly impacts the quality of science education that learners receive at the primary and secondary levels. This affects the development of the nation's human capital. Quality preparation for pre-service science teachers is therefore imperative to ensure they obtain a strong foundation in subject-matter knowledge, pedagogical skills, and research proficiency. Effective training equips them to integrate modern instructional resources, including digital tools and open educational resources, into their teaching while also engaging in classroom-based research to enhance their practice. In situations such as Nigeria, where challenges like inadequate facilities, limited access to updated learning materials, and overcrowded classrooms exist, thorough training is essential to produce teachers who are adaptable, resourceful, and innovative in confronting these issues (Ojeogwu & Mumba, 2025).. Ultimately, investing in the high-quality preparation of pre-service science teachers ensures lasting improvements in science pedagogy and supports national objectives of educational equity and socio-economic development.

Research knowledge and skills are indispensable for pre-service teachers, as they provide a deeper understanding of pedagogy and the ability to make informed instructional decisions. Through research engagement, pre-service teachers can critically evaluate teaching methods, assess educational theories, and adjust instructional strategies to meet the needs of diverse classroom contexts. This reflective approach not only enhances their pedagogical proficiency but also encourages a mindset of continuous improvement, viewing teaching as an evidence-based practice rather than a standard delivery of content (Creswell & Guetterman, 2019). Research equips pre-service teachers with the tools to conduct classroom inquiries, enabling them to explore challenges in teaching and learning, test innovative approaches, and evaluate student outcomes. These inquiry skills prepare them to contribute to the larger body of educational knowledge by generating insights that can inform policy, curriculum development, and instructional innovation.

In countries such as Nigeria, where educational systems are challenged by resource limitations and diverse learner needs, the capability of pre-service teachers to engage in meaningful research is

particularly essential for promoting effective teaching practices and enhancing learning outcomes (Mertler, 2021). Open Educational Resources (OER) serve a critical function in advancing scientific research and innovation by providing pre-service science teachers with free and flexible access to high quality academic materials. By offering openly licensed textbooks, journals, datasets, and laboratory simulations, OER helps to mitigate the challenges of cost and the limited availability of current scientific resources, particularly in contexts where traditional research materials are not readily accessible. This accessibility empowers pre-service teachers to engage in evidence based inquiry, explore the latest scientific developments, and incorporate global knowledge into their academic work. Consequently, OER fosters a culture of independent research, critical thinking and creativity essential skills for promoting innovation in science pedagogy. In pre-service science teacher education, Open Educational Resources (OER) will significantly enhance collaborative learning and the co-creation of knowledge, which are fundamental to scientific innovation. Pre-service teachers can modify and adapt open materials, create experiments that are contextually relevant, and share their results with peers across various institutions and countries, thus contributing to the global scientific knowledge base. The openness of OER promotes pedagogical innovation, enabling teachers to design inquiry-based lessons, utilize digital simulations, and integrate research insights into their teaching practices (Aderonmu and Agbesor, 2025). This not only strengthens the preparation of teachers but also equips future teachers to exemplify innovative and resourceful approaches in their classrooms, ultimately improving science learning outcomes and contributing to national development goals (UNESCO, 2019).

Several countries are taking advantage of Open Educational Resources (OER) to cultivate flexible, technology-driven learning environments that encourage collaboration, innovation, and the democratization of knowledge. This global initiative highlights the movement away from traditional, closed educational models toward more dynamic systems where educators and learners collaboratively create, share, and adapt knowledge to address changing educational needs (Jensen & Kimmons, 2022). In the case of Nigeria, this global shift corresponds with the urgent requirement for innovative teaching approaches to tackle persistent issues such as overcrowded classrooms, limited access to up-to-date resources, and underfunded educational infrastructure. By implementing OER, Nigerian universities can offer pre-service science teachers cost-effective and

adaptable resources that support contemporary pedagogical practices, including inquiry-based and technology-enhanced learning. This innovation not only prepares teachers to succeed in a 21st-century educational landscape but also ensures that learners develop the critical thinking and problem-solving skills essential for national advancement (Adedoyin & Soykan 2023). Therefore, aligning Nigeria's science teacher education with global OER practices signifies both a response to local challenges and a strategic step toward integrating the country into the knowledge-driven global economy.

Statement of Problem

Despite the global recognition of Open Educational Resources (OER) as crucial tools for democratizing access to knowledge and research, however, their adoption in Nigerian universities is still quite limited. While universities around the world are increasingly taking advantage of OER to cut costs, improve accessibility, and stimulate innovation, the Nigerian higher education system is not keeping pace in integrating these resources into pre-science teachers education programs. This underutilization results in a gap that prevents Nigerian universities from aligning with global best practices in promoting open knowledge for pre-service science teachers. Numerous challenges contribute to this issue, including low levels of awareness regarding OER among faculty and students, limited digital literacy, inadequate infrastructural support such as unreliable internet connectivity. Also, the absence of strong institutional or national policies that guide the use of OER. Without proper awareness and digital competence, many pre-service teachers find it difficult to explore, adapt, or create resources effectively using OER for their academic and research needs.

In addition, infrastructural limitations such as inconsistent power supply and inadequate ICT facilities further restrict access to openly licensed resources, thereby worsening the situation. These challenges greatly impact pre-service science teachers' ability to engage effectively in research, which is a critical component of their training. When students lack access to affordable and versatile research materials, they encounter barriers in conducting classroom-based inquiries, developing innovative teaching strategies, and contributing to scientific knowledge. As a result, the quality of teacher preparation is compromised, leading to a disconnect between the competencies Nigerian science teachers need in the 21st century and the opportunities their

training provides. Thus, addressing these gaps is crucial to ensure that pre-service science teachers can fully take advantage of OER for research and professional development in Nigerian universities.

Aim and Objectives of the study

The aim of this study is to examine the applicability of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities. Specifically the objectives of the study are to;

(i) assess the level of awareness of OER for academic research among pre-service science teachers in Nigerian universities.
(ii) examine the level of utilization of OER for academic research among pre-service science teachers in Nigerian universities.
(iii) identify the challenges (such as lack of awareness, digital literacy issues, infrastructural limitations, and policy gaps) hindering effective use of OER for research by pre-service science teachers in Nigerian universities.
(iv) suggest strategies and policy directions for improving the applicability of OER for research by pre-service science teachers in Nigerian universities.

Research Questions

The following research questions were raised for the study.

1. What is the level of awareness of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities?
2. What is the level of utilization of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities?
3. What challenges hinder the effective use of OER for research by pre-service science teachers in Nigerian universities?
4. What strategies and policy directions can improve the integration and applicability of OER for research in Nigerian universities?

Hypotheses

Ho_1: There is no significant difference in the mean value of the level of awareness of OER among Biology, Chemistry, Mathematics, and Physics pre-service science teachers.

Ho_2: There is no significant difference in the mean value of the level of utilization of OER among Biology, Chemistry, Mathematics, and Physics pre-service science teachers.

Ho_3: There is no significant difference in the overall mean perception of challenges hindering OER use among Biology, Chemistry, Mathematics, and Physics pre-service science teachers

Ho_4: There is no significant difference in the mean perception of strategies and policy directions for OER integration among Biology, Chemistry, Mathematics, and Physics pre-service science teachers.

Methodology

The research design adopted for the study is the mixed method research design which a combination of qualitative and quantitative study. According to Creswell & Plano-Clark (2018) mixed methods research in education is when quantitative and qualitative methodologies is employed in a single inquiry to secure a richer, more valid, more reliable set of findings. This allows exploration of diverse views and uncovering of relationships within multifaceted research questions. The study was conducted in universities in Ogun state, Nigeria, specifically universities having science teaching programmes.

The population of the study consisted of all pre-service science teachers programmes in Olabisi Onabanjo University and Tai Solarin University of Education. Using a stratified sampling technique, 184 pre-service science teachers in there 400 level second semester of academic session 2024/2025 were used for the study.

Table 1: Sample Size Distribution of Pre-service Science Teachers by Programme

Programmes	Number	Percentage
Biology Education	62	34.83%
Chemistry Education	53	29.78%
Mathematics Education	29	16.29%
Physics Education	34	19.10%
Total	**178**	**100%**

Source: *Researchers' field work, 2025*

The data in Table 1 shows the distribution of pre-service science teachers across four education programmes, with a total sample size of 178 participants. Biology Education has the highest representation with 62 respondents (34.83%), followed by Chemistry Education with 53 respondents (29.78%). Physics Education accounts for 34 respondents (19.10%), while Mathematics Education has the lowest representation with 29 respondents (16.29%). This distribution indicates that Biology and Chemistry Education collectively make up more than 64% of the sample, reflecting a stronger enrolment or participation in biology and Chemistry education compared to Mathematics and Physics education.

Two research instruments adopted for the study were Questionnaire on Applicability of Open Educational Resources (OER) for Research among Pre-service Science Teachers (QAOPRRPST) and Interview Template on Open Educational Resources (OER) for Research (ITOERR). Questionnaire on Applicability of Open Educational Resources (OER) for Research among Pre-service Science Teachers consisted of five sections; Section I, II, III, IV and V. Section I was designed to obtain the demographic information of the respondents used for the study. The information was, Name of University, Option of Study (Biology, Chemistry, Mathematics, and Physics) and level of research completed (Not started, Midway and completed). Section II dealt with the issue of level of awareness of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities. 10 item statements were stated and a categorization Table was used to for decision on the level of awareness based on the aggregate mean value.

Table 2: Categorization table for decision on the level of awareness based on the aggregate mean value.

Mean Score Range	Category of Awareness	Interpretation
0.00 – 1.25	**Very Low Awareness**	Respondents have little or no knowledge of OER and their use in research.
1.26 – 2.50	**Low Awareness**	Respondents have limited knowledge of OER, with minimal exposure to their research applications.
2.51 – 3.75	**Moderate Awareness**	Respondents are somewhat aware of OER and their potential for research, but usage may still be inconsistent.
3.76 – 5.00	**High Awareness**	Respondents demonstrate strong knowledge of OER and recognize their value in research activities.

Section III was focused on the level of utilization of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities with 10 item statements stipulated to address the research question. The Table below shows the categorization of utilization based on the aggregate mean value.

Table 3: Categorization table for decision on the level of utilization based on the aggregate mean value.

Mean Score Range	Category of Utilization	Interpretation
0.00 – 1.25	**Very Low Utilization**	Respondents rarely or never use OER for research activities.
1.26 – 2.50	**Low Utilization**	Respondents use OER occasionally but not consistently in research.
2.51 – 3.75	**Moderate Utilization**	Respondents make regular use of OER in research, though not extensively.
3.76 – 5.00	**High Utilization**	Respondents frequently and consistently use OER as a core part of their research work.

Section III was designed to address challenges that hinder the effective use of OER for research by pre-service science teachers in Nigerian universities using a 10 item statement presented in a modified Likert scale format. Section IV, which involved strategies and policy directions that can improve the applicability of OER for research in Nigerian universities, was treated with 5 item statements. In all, 35 item statements formed the questionnaire in a modified 4 ponit Likert scale format.

Interview Template on Open Educational Resources (OER) for Research (ITOERR) is a five item statement template which was developed as a guide used by the researchers for the purpose interview session that required oral expression from the respondents used for the study. Each interview session lasted between 30 to 40 minutes and recorded with the permission of the respondents. The recorded expressions were further transcribed and coded using the thematic content analysis to establish similarities and patterns of responses across the data set which provided in-depth and more reliable answers to the research questions that was answered.

Both instruments were validated for face and content validity by experts. Questionnaire on Applicability of Open Educational Resources (OER) for Research among Pre-service Science Teachers (QAOPRRPST) was subjected to pilot study by administering it to using 20 pre-service science teachers that were not part of the main study. This was done using the test-retest method in an interval of one week. The combined data was statistically analyzed using the Pearson Product Moment Correlation formula and a correlation coefficient index of $r = 0.88$ was obtained making the instrument 88% reliable for the study. Data obtained for the main study was analyzed using frequency count, mean and standard deviation for the research questions and inferential statistics of Analysis of Variance (ANOVA) for the hypotheses.

Results

Research Question 1: What is the level of awareness of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities?

Table 4: Mean and Standard Deviation of Pre-Service Science Teachers' Awareness of Open Educational Resources (OER) for Research in Nigerian Universities

S/N	Item Statement	Mean	Stdv
1	I am aware of the concept of Open Educational Resources (OER).	1.95	0.81
2	I know that OER are freely accessible and openly licensed for teaching, learning, and research.	3.01	0.98
3	I am aware that OER can be used as alternative research resources in higher education.	2.61	0.88
4	I know that OER include open textbooks, journals, datasets, and learning objects.	2.36	0.85
5	I am aware of global platforms (e.g., OER Commons, OpenStax) that provide OER for research.	1.55	0.93
6	I am familiar with institutional repositories in Nigerian universities that host OER.	1.55	0.83
7	I know that OER can reduce research costs by providing free access to quality materials.	1.37	0.91
8	I am aware that OER promote collaboration and knowledge sharing in research.	2.85	0.87
9	I know that OER can be adapted and reused to suit specific research contexts.	2.37	0.86
10	I am aware of policy and advocacy efforts that encourage the adoption of OER in higher education.	2.56	0.95
	Aggregate Mean Value	**2.22**	**0.89**

Source: *Researchers' field work, 2025.*

The results in Table 4 show that the aggregate mean value of 2.22 with a standard deviation of 0.89 indicates that the overall level of awareness of Open Educational Resources (OER) among pre-service science teachers in Nigerian universities falls within the low awareness category**.** While some items, such as awareness that OER promote collaboration **(**Mean = 2.85**)** and their potential use as alternative research resources **(**Mean = 2.61**)** recorded relatively higher awareness, other critical areas such as knowledge of global OER platforms **(**Mean = 1.55**)** institutional repositories **(**Mean = 1.55**)** and their cost-reducing potential **(**Mean = 1.37**)** were notably low. The consistency in the responses, as reflected in the moderate standard deviation, suggests that limited exposure and inadequate institutional sensitization contribute to the generally low awareness levels. This implies a need for deliberate awareness campaigns and orientation programs to enhance pre-service teachers' understanding and application of OER in research.

Research Question 2: What is the level of utilization of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities?

Table 5: Mean and Standard Deviation of Pre-Service Science Teachers' Utilization of Open Educational Resources (OER) for Research in Nigerian Universities

S/N	Item Statement	Mean	Stdv
1	I frequently use OER such as open textbooks and journals to support my research activities.	1.95	0.91
2	I utilize open access datasets when conducting science-related investigations or projects.	2.15	0.87
3	I regularly access institutional repositories or global OER platforms for research purposes.	2.32	0.92
4	I make use of OER to develop literature reviews for my assignments or research work.	1.88	0.89
5	I integrate OER into classroom-based inquiries and science teaching simulations.	2.10	0.85
6	I rely on OER to complement or substitute paid resources in my research.	1.97	0.90
7	I use OER to gather up-to-date scientific information for academic projects.	2.22	0.93
8	I share OER-based research resources with peers or colleagues for collaborative learning.	1.85	0.86
9	I adapt and apply OER materials to suit the context of my science research tasks.	2.05	0.88
10	I consistently use OER as a major source of reference in my research writing.	1.92	0.90
	Aggregate Mean Value	**2.06**	0.90

Source: *Researchers' field work, 2025.*

The analysis of Table 5 shows that the aggregate mean value of 2.06 with a standard deviation of 0.90 indicates that the overall level of utilization of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities is low**.** Although some items, such as accessing institutional repositories **(**Mean = 2.32**)** and using OER for up-to-date scientific information **(**Mean = 2.22) show slightly higher utilization, most other activities including integrating OER into classroom inquiries **(**Mean = 2.10**)** and relying on OER as major research references **(**Mean = 1.92**)** remain consistently low. The relatively close standard deviation values suggest limited variability in responses, meaning that the majority of respondents underutilize OER for their research tasks. This underscores the need for increased awareness, training, and

infrastructural support to encourage pre-service teachers to adopt OER as a regular and integral part of their research practices.

Research Question 3: What challenges hinder the effective use of OER for research by pre-service science teachers in Nigerian universities?

Table 6: Mean and Standard Deviation of Challenges Hindering the Effective Use of Open Educational Resources (OER) for Research among Pre-Service Science Teachers in Nigerian Universities

S/N	Item Statement	Mean	Stdv
1	Lack of adequate awareness limits my ability to use OER for research.	3.10	0.89
2	I face difficulties in locating reliable OER platforms or repositories.	3.25	0.91
3	Limited digital literacy skills make it challenging to use OER effectively in research.	3.05	0.90
4	Poor internet connectivity hinders my access to OER resources for research.	3.40	0.92
5	Inadequate ICT facilities (computers, devices, software) restrict my use of OER.	3.20	0.88
6	Lack of training or orientation on OER reduces my confidence in using them for research.	2.95	0.90
7	Absence of clear institutional policies on OER discourages their use for research.	3.15	0.87
8	Concerns about the quality and credibility of OER materials limit my reliance on them.	3.05	0.89
9	Limited support from lecturers and supervisors reduces my motivation to use OER.	3.00	0.91
10	Irregular power supply and infrastructural challenges affect my ability to use OER consistently.	3.30	0.90
	Aggregate Mean Value	**3.15**	0.90

Source: *Researchers' field work, 2025.*

The findings from Table 6 revealed that the aggregate mean value of 3.15 with a standard deviation of 0.90 suggests that pre-service science teachers in Nigerian universities experience considerable challenges in the effective use of Open Educational Resources (OER) for research. The highest-rated barriers include poor internet connectivity **(**Mean = 3.40**)** irregular power supply and infrastructural issues **(**Mean = 3.30**)** and difficulties in locating reliable OER platforms **(**Mean = 3.25**)** all of which highlight persistent infrastructural and accessibility constraints. Other notable

challenges, such as inadequate ICT facilities **(**Mean = 3.20**)** and lack of clear institutional policies **(**Mean = 3.15**)** reinforce the systemic gaps that hinder OER adoption. Although some factors, like lack of training **(**Mean = 2.95**)** and limited support from lecturers **(**Mean = 3.00**)** are slightly lower, they still indicate significant obstacles. The consistency of responses across items, reflected by the moderate standard deviation, confirms that these challenges are widely shared among respondents. This emphasizes the urgent need for policy intervention, capacity building, and improved infrastructure to enhance the use of OER in research.

Research Question 4: What strategies and policy directions can improve the integration and applicability of OER for research in Nigerian universities?

Table 7: Mean and Standard Deviation of Strategies and Policy Directions for Improving the Integration and Applicability of Open Educational Resources (OER) in Research among Pre-Service Science Teachers in Nigerian Universities

S/N	Item Statement	Mean	Stdv
1	Organizing regular training and workshops will improve pre-service teachers' capacity to use OER for research.	2.95	0.85
2	Providing adequate ICT infrastructure (internet access, devices, software) will enhance the integration of OER in research.	3.20	0.87
3	Increasing awareness campaigns will encourage greater adoption of OER for academic and research purposes.	2.85	0.84
4	Developing clear institutional and national policies will promote effective OER integration in Nigerian universities.	3.10	0.86
5	Encouraging collaboration between lecturers, students, and policymakers will strengthen the applicability of OER in research.	2.75	0.83
	Aggregate Mean Value	**2.97**	0.85

Source: *Researchers' field work, 2025.*

The results in Table 7 showed that the aggregate mean of 2.97 with a standard deviation of 0.85 indicates that respondents generally agree on the relevance of strategies and policy directions to improve OER integration for research in Nigerian universities. Though the emphasis varies across items. Providing adequate ICT infrastructure (Mean = 3.20) and developing clear institutional and national policies (Mean = 3.10) emerged as the most highly rated strategies, underscoring the importance of systemic and structural support for OER adoption. Organizing regular training and

workshops (Mean = 2.95) and increasing awareness campaigns (Mean = 2.85) also received strong support, reflecting the need to build capacity and promote a culture of OER use among pre-service science teachers. Encouraging collaboration between stakeholders (Mean = 2.75) was rated relatively lower, though still important, suggesting that respondents place greater priority on resources and policies over collaborative efforts. The relatively low spread of responses, as reflected by the standard deviation, suggests consensus among pre-service teachers on these strategies, pointing to the necessity of multi-faceted interventions that combine infrastructural, policy, and awareness-building measures.

Hypotheses

Ho_1: There is no significant difference in the mean value of the level of awareness of OER among Biology, Chemistry, Mathematics, and Physics pre-service science teachers.

Table 8: One-Way ANOVA Results on the Level of Awareness of Open Educational Resources (OER) among Biology, Chemistry, Mathematics, and Physics Pre-Service Science Teachers

Source	SS	Df	MS	F	Sig. (p)
Between Groups	0.58	3	0.19	0.24	0.87
Within Groups	134.2	174	0.77		
Total	134.78	177			

Source: *Researchers' field work, 2025.*

The ANOVA results in Table 8 ($F(3,174) = 0.24$, $p = 0.87$) indicated that there is no statistically significant difference in the mean level of awareness of OER among Biology, Chemistry, Mathematics, and Physics pre-service science teachers. Since $p > 0.05$, the null hypothesis is retained. This implies that awareness levels are relatively uniform across the four groups, reflecting a widespread need for OER sensitization across all pre-service science teachers programmes in Nigerian universities.

Ho_2: There is no significant difference in the mean value of the level of utilization of OER among Biology, Chemistry, Mathematics, and Physics pre-service science teachers.

Table 9: One-Way ANOVA Results on the Level of Utilization of Open Educational Resources (OER) among Biology, Chemistry, Mathematics, and Physics Pre-Service Science Teachers

Source	SS	df	MS	F	Sig. (p)
Between Groups	0.46	3	0.15	0.18	0.91
Within Groups	147.8	174	0.85		
Total	148.26	177			

Source: *Researchers' field work, 2025.*

The ANOVA results in Table 9 ($F(3,174) = 0.18$, $p = 0.91$) showed that there is no statistically significant difference in the mean level of utilization of OER among Biology, Chemistry, Mathematics, and Physics pre-service science teachers. Since $p > 0.05$, the null hypothesis is retained. This indicates that low utilization of OER is a common challenge across all respondents of pre-service teachers' programmes, highlighting the need for general capacity building, infrastructural support, and awareness campaigns rather than discipline-specific interventions.

Ho_3: There is no significant difference in the overall mean perception of challenges hindering OER use among Biology, Chemistry, Mathematics, and Physics pre-service science teachers.

Table 10: **One-Way ANOVA Results on Perceived Challenges Hindering the Use of Open Educational Resources (OER) among Biology, Chemistry, Mathematics, and Physics Pre-Service Science Teachers**

Source	SS	df	MS	F	Sig. (p)
Between Groups	0.32	3	0.11	0.13	0.94
Within Groups	145.6	174	0.84		
Total	145.92	177			

Source: *Researchers' field work, 2025.*

The ANOVA results Table 10 ($F(3,174) = 0.13$, $p = 0.94$) indicated that there is no statistically significant difference in the mean perception of challenges hindering OER use among Biology, Chemistry, Mathematics, and Physics pre-service science teachers. Since $p > 0.05$, the null hypothesis is retained. This suggests that the challenges such as poor internet access, lack of ICT

facilities, limited awareness, and weak institutional support are uniformly experienced across all programmes, pointing to systemic issues rather than discipline-specific problems.

H_{O4}: There is no significant difference in the mean perception of strategies and policy directions for OER integration among Biology, Chemistry, Mathematics, and Physics pre-service science teachers.

Table 11: One-Way ANOVA Results on Perceived Strategies and Policy Directions for Integrating Open Educational Resources (OER) among Biology, Chemistry, Mathematics, and Physics Pre-Service Science Teachers

Source	SS	Df	MS	F	Sig. (p)
Between Groups	0.28	3	0.09	0.12	0.95
Within Groups	131.0	174	0.75		
Total	131.28	177			

Source: *Researchers' field work, 2025.*

The ANOVA results in Table 11 ($F(3,174) = 0.12$, $p = 0.95$) showed that there is no statistically significant difference in the mean perception of strategies and policy directions for OER integration among Biology, Chemistry, Mathematics, and Physics pre-service science teachers. Since $p > 0.05$, the null hypothesis is retained. This suggests that students across the four programmes share similar views on the importance of strategies such as training, ICT infrastructure, awareness campaigns, supportive policies, and collaboration for improving OER integration in Nigerian universities.

Discussions

The findings of this study revealed that the aggregate mean score of 2.22 with a standard deviation of 0.89 indicates that the overall level of awareness of Open Educational Resources (OER) among pre-service science teachers in Nigerian universities falls within the low awareness category. This outcome suggests that despite the global recognition and adoption of OER as a vital tool for enhancing teaching, learning, and research, Nigerian pre-service science teachers have yet to fully grasp its potential and opportunities. Excerpts from interview of a participant revealed that;

"I know that some materials online are free to use, but I didn't realize they are called OER. If they can actually reduce the cost of buying textbooks and journals, then I think they would be very useful." (R9)

Others expressed that;

"Honestly, I have heard the term OER once or twice, but I am not really sure what it means or how it applies to my research as a pre-service teacher." (R4)

"I have never used websites like OER Commons or OpenStax before. Most of the time, I just rely on Google search or what my lecturers recommend. I am not aware of any OER repositories in Nigerian universities." (R15)

Similar studies conducted in Nigeria have also reported low levels of OER awareness, particularly among undergraduates, thereby highlighting the need for targeted sensitization and training programs (Fabunmi & Umar, 2023; Itasanmi, 2020). In line the above, one respondent noted that;

"I think if the university can organize workshops to train students on how to use OER, it would help a lot. Right now, there is little or no information about OER in our curriculum." (R22)

This low awareness may be attributed to the absence of strong institutional policies, insufficient advocacy, and the lack of integration of OER concepts into teacher education curricula. The low awareness identified in this study also aligns with international findings that emphasize the persistent challenges of OER adoption across higher education contexts. Menzli et al., (2022) argue that while OER offers numerous benefits such as cost reduction, accessibility, and

knowledge sharing, its full potential is often constrained by limited awareness and weak institutional support structures. Excerpt from another respondent asserted that;

"From what I understand, OER could support collaboration and make research easier, but nobody has really introduced us to how to access or use them in our program." (R13)

Similarly, Peneder and Walcher (2020) observed that the lack of adequate orientation and digital culture hampers the sustainability of OER initiatives, particularly in developing countries. This finding underlines the urgent need for Nigerian universities to develop strategic awareness campaigns, integrate OER training into pre-service teacher preparation, and promote collaborative platforms that encourage knowledge sharing. By addressing these gaps, the Nigerian higher education system can align more closely with global educational trends that leverage OER to foster innovation and equitable access to research resources.

The results of this study revealed that the aggregate mean score of 2.06 with a standard deviation of 0.90 indicates a low level of utilization of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities. This finding suggests that although OER materials exist and are freely accessible, they are not being adequately integrated into research practices by pre-service science teachers.

Excerpts from a respondent interviewed revealed that;

"Even though I have heard about OER, I don't really use them because nobody has taught us how to access or apply them for research. Most of the time, I just depend on lecture notes or textbooks recommended by lecturers."(R7)

A possible explanation for this low utilization could be the limited awareness of OER platforms, inadequate digital skills, and infrastructural challenges such as poor internet access and unreliable power supply. Prior research in Nigeria similarly reported low engagement with OER among teacher education students, linking it to a lack of training and institutional support mechanisms (Fabunmi & Umar, 2023; Itasanmi, 2020). Menzli, Karadeniz, and Kocdar (2022) emphasize that access alone does not guarantee effective use; rather, meaningful utilization requires awareness, institutional policies, and pedagogical integration. Similarly, Cronin and MacLaren (2020) argue

that without embedding OER into curricula and research culture, their use tends to remain inconsistent and superficial. Another responded interviewed highlighted that;

"Sometimes I try to use online materials, but poor internet and lack of devices make it difficult. I don't use OER regularly because it is not part of our normal academic culture here, and most of my colleagues also don't rely on them." (R 12)

For Nigeria, this implies that universities must move beyond policy rhetoric by embedding OER use into teacher education programs, providing structured training in OER-based research, and encouraging collaborative practices that make OER more relevant to students' research needs. Addressing these gaps would not only improve pre-service teachers' research capacity but also align Nigerian higher education with international best practices in open education.

The findings revealed an aggregate mean score of 3.15 with a standard deviation of 0.90, indicating that pre-service science teachers face considerable challenges in effectively using OER for research. The most prominent barriers identified were poor internet connectivity, inadequate ICT facilities, irregular power supply, and limited awareness of reliable OER platforms. These results reflect the persistent infrastructural and systemic challenges within Nigerian higher education, which hinder the ability of pre-service teachers to take full advantage of OER.

"Most times, I want to download or access OER materials, but the internet is too slow or unstable. Even when I manage to connect, power outages make it difficult to continue my research effectively." (R2)

Similar studies in Nigeria and other African contexts have shown that technological constraints, coupled with low digital literacy levels, continue to obstruct the integration of open resources in teacher education programs (Adeleke & Afolabi, 2021; Edewor, 2022). This suggests that while OER holds great potential for advancing research and reducing costs, its impact remains constrained by contextual realities. These challenges are consistent with international literature that highlights how infrastructural gaps and policy limitations affect OER adoption in developing countries.

We don't have enough functional computers in the faculty, and many students rely on their phones. This makes it hard to access or download large OER resources, especially research datasets and textbooks." (R9)

For Nigeria, the findings underscore the need for deliberate government and institutional interventions such as improving digital infrastructure, implementing targeted training programs, and establishing clear OER policies to mitigate these challenges. Such actions would create a supportive environment that enables pre-service science teachers to harness OER effectively for research and professional development.

The results showed an aggregate mean score of 2.97 with a standard deviation of 0.85, suggesting a moderate agreement among pre-service science teachers on strategies and policy directions that can enhance OER integration in Nigerian universities. Key strategies identified include organizing regular training and workshops, providing adequate ICT infrastructure, implementing awareness campaigns, and formulating clear institutional and national OER policies. This finding highlights that pre-service teachers recognize both capacity building and policy support as central to improving OER adoption. Previous research in Nigeria has also recommended similar strategies, emphasizing the role of structured sensitization, institutional commitment, and collaboration between stakeholders in driving OER uptake (Okonkwo & Chukwu, 2021; Fabunmi & Umar, 2023).

Excerpts from respondents interviewed explained that;

"Most undergraduates don't even know what OER are, so awareness campaigns are very important. Also, if universities and government bodies can set clear policies to support OER, more people will take it seriously."

"It will be more effective if our lecturers, students, and even policymakers work together to promote OER. When our lecturers recommend OER and guide us on how to use them, we are more likely to adopt them."

These findings align with global best practices, where structured policy frameworks and institutional investments have significantly improved OER adoption. Cronin and MacLaren (2020) stress that those universities that embed OER into strategic plans and provide staff and student

training record higher levels of utilization. Likewise, UNESCO (2020) advocated for policy-driven approaches that promote collaboration and sustainability in OER initiatives. For Nigeria, implementing these strategies would not only enhance research productivity among pre-service teachers but also align the nation's higher education system with international trends in open education. By addressing infrastructural deficits, strengthening institutional support, and encouraging collaboration, Nigerian universities can transform OER into a powerful tool for innovation and research capacity building.

Conclusion

This study explored the relevance of Open Educational Resources (OER) for research among pre-service science teachers in Nigerian universities, with a focus on awareness, usage, challenges, and strategies for enhancement. The findings showed that both awareness and usage levels of OER are low among pre-service science teachers, despite the global acknowledgment of OER as a means to democratize access to educational and research materials. The results pointed out significant barriers such as poor internet connectivity, inadequate ICT infrastructure, inconsistent power supply, limited training, and the lack of clear institutional policies. These challenges collectively limit the ability of pre-service teachers to fully integrate OER into their research and academic practices, thereby widening the gap between Nigerian universities and global trends in open education.

Conversely, the study also indicated that pre-service teachers are aware of the importance of strategies and policy directions that can support the adoption of Open Educational Resources (OER). Initiatives such as regular training workshops, awareness campaigns, improved digital infrastructure, and strong institutional policies were identified as crucial enablers for OER integration. This implies that with targeted interventions, Nigerian universities can substantially enhance the research capacity of pre-service science teachers, stimulate innovation, and align with global best practices in open education. Thus, this study concludes that while OER has great potential to transform teacher education and research in Nigeria, its effective application is dependent on deliberate institutional and policy-driven actions that address infrastructural and pedagogical barriers.

Recommendations

The following recommendations were highlighted for the study.

1. Universities should organize regular capacity-building programs, such as workshops and seminars, to enhance pre-service science teachers' skills and confidence in using OER for research.
2. Government and university management should invest in reliable internet connectivity, adequate computer facilities, and digital repositories to improve accessibility and usability of OER across Nigerian universities.
3. Clear institutional and national policies should be developed to support OER adoption, quality assurance, and sustainability, ensuring that OER use becomes a structured part of academic practice.
4. Lecturers, students, and policymakers should actively collaborate to promote awareness, credibility, and effective integration of OER into research in pre-science teachers' programms.

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