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Unlocking innovation through engineering student research: Challenges and Opportunities in Nigerian Higher Education Institutions

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Abstract

This study investigates the state of student-led research in Nigerian universities, focusing on engineering faculties across three institutions: Abubakar Tafawa Balewa University, Lagos State University of Science and Technology, and the University of Calabar. Conducted under the RAEng-HEPSSA initiative, the research employed a comprehensive survey of 216 undergraduate and postgraduate students to identify gaps in research engagement, training, mentorship, infrastructure, and institutional support. Findings reveal that students possess enthusiasm and moderate confidence in basic research skills, but their exposure to research practice is limit. Only 16.7% of respondents had prior research experience, and over 80% had not taken research-related courses. Additionally, significant proportions of students were unaware of available research resources and reported inadequate access to databases, labs, and mentorship. Financial barriers, poor faculty interaction, and lack of inclusive infrastructure further constrain their participation. Despite these limitations, the survey indicated a strong demand for formal mentorship programs, greater access to research training, and inclusive policies supporting female students and those with disabilities. The study contributes valuable empirical evidence on the institutional and systemic barriers hindering research excellence in Nigerian universities. Recommendations are provided for curriculum reforms, mentorship development, infrastructural investment, and policy alignment aimed at fostering a supportive and inclusive research environment. By addressing these gaps, universities can better prepare students for research-intensive careers and contribute meaningfully to Nigeria's broader developmental goals. The findings have implications not only for Nigerian institutions but for higher education systems in the African sub-region.

Keywords: Student-Led Research; Nigerian Universities; Research Barriers; Mentorship; Infrastructure; Curriculum Reform; Inclusivity

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1. Introduction

Academic institutions are vital for fostering innovation and national development. In this process, student research is crucial for cultivating a culture of inquiry and preparing students for the modern workforce [1,2,3]. Research and innovation form the bedrock of technological progress and sustainable development, particularly in Sub-Saharan Africa, where local solutions depend on high-quality research from universities [4,5,6].

However, the student research landscape in many developing economies, especially Nigeria, remains largely untapped [7,8,9]. Engineering education, a strategic sector for national growth, faces systemic obstacles that hinder active student engagement in meaningful research [10,11,12]. A persistent gap exists between academic learning and applied research at the undergraduate and early postgraduate levels [13,14,15]. This disconnect is worsened by inadequate infrastructure, a lack of formal mentorship, limited funding, and low awareness of support services, creating a research culture that is reactive and under-resourced [16,17,18, 19].

This study addresses this gap by providing a student-centered perspective on the barriers and opportunities for research within Nigerian university engineering faculties. While faculty-centered assessments are common, there is limited data on how students experience and perceive research opportunities. Understanding these dynamics is essential for designing effective, needs-based interventions.

In response to these challenges, the Royal Academy of Engineering's (RAEng-HEPSSA) project supported a collaborative needs assessment survey across three Nigerian universities: Abubakar Tafawa Balewa University, Lagos State University of Science and Technology, and the University of Calabar [19]. The study's primary objectives were threefold: to assess students' research experiences, skill levels, and access to training; to evaluate the availability of research support systems, including infrastructure and mentorship; and to propose strategic recommendations for universities and policymakers to create a more inclusive, student-centered, and development-aligned research environment.

The findings offer valuable insights for enhancing research productivity and national development.

2. Methodology

This study used a mixed-methods approach, primarily a quantitative survey, to evaluate the research engagement, experiences, and support systems of engineering students in Nigerian universities [19]. A structured online questionnaire, created with Google Forms, served as the primary data collection tool. It included both closed and open-ended questions covering demographics, research experience, skills, access to resources, mentorship, and funding. The survey utilized Likert scales, frequency scales, and multiple-choice questions to gather quantitative data, with open-ended questions providing detailed qualitative feedback.

The survey was distributed to undergraduate and postgraduate engineering students at three Nigerian universities—Abubakar Tafawa Balewa University (ATBU), Lagos State University of Science and Technology (LASUSTECH), and the University of Calabar (UNICAL)—which were chosen to represent different geographical and institutional contexts [19]. The survey was sent through mailing lists and social media, resulting in a total of 216 complete responses collected between November and December 2024.

For data analysis, the collected responses were cleaned in Microsoft Excel to remove incomplete or duplicate entries. Descriptive statistics, such as frequency distributions and percentages, were used to summarize the quantitative data. Qualitative responses from the open-ended questions were grouped into themes to supplement the quantitative findings. The study also triangulated data to compare self-reported skills with actual exposure to training, providing a more nuanced analysis [20,21]. Ethical approval was obtained from the participating institutions, and all participants provided electronic informed consent. To ensure confidentiality and voluntary participation, all data was anonymized.

3. Key Findings

The data collected from students at three Nigerian universities provides comprehensive insight into the current state of research support, student preparedness, and institutional barriers. The key findings are grouped into thematic areas reflecting the core dimensions of student research engagement: demographics, research experience, skills and confidence, training and infrastructure, faculty interaction, challenges, support services, and mentorship.

3.1. Demographics and Institutional Representation

The majority of respondents were from Lagos State University of Science and Technology (66.5%), followed by the University of Calabar (19.3%) and Abubakar Tafawa Balewa University (14.15%). This indicates a concentration of responses from urban and coastal institutions, particularly in southwestern Nigeria. While this regional focus offers strong localized insight, it also presents a limitation in geographical diversity that must be considered when generalizing findings across all Nigerian universities.

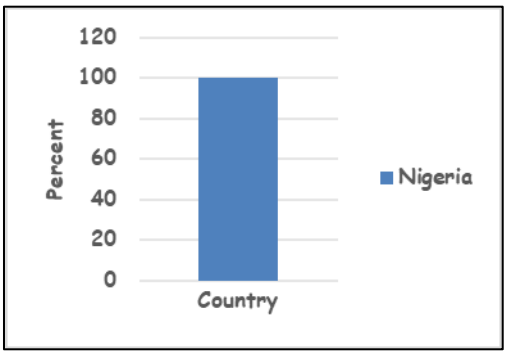

Figure 1 Country representation

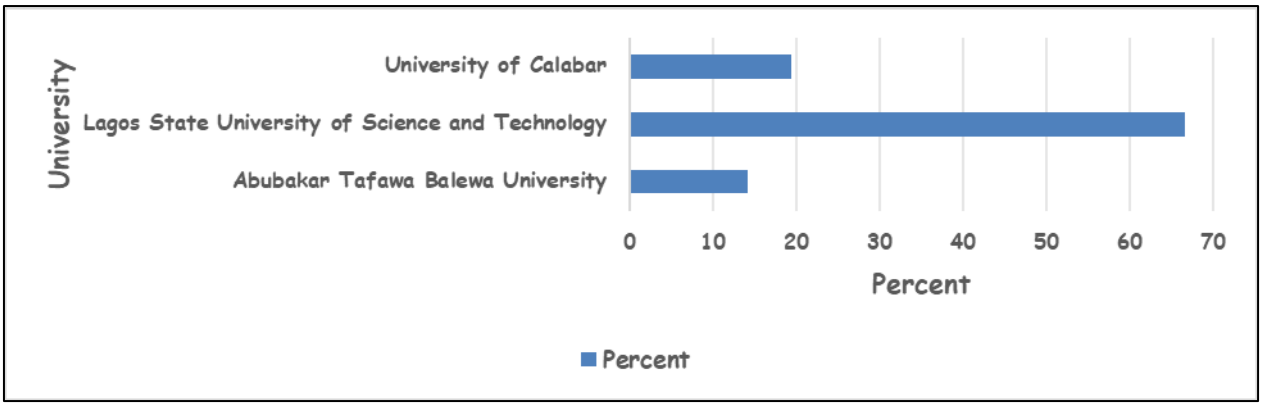

Figure 2 Nigerian Institutions under-survey

A striking demographic observation was the significant gender imbalance among respondents (refer to Figure 3). Approximately 85.2% of participants identified as male, reflecting the persistent underrepresentation of female students in engineering disciplines world over [22,23]. This gender gap suggests the need for more inclusive recruitment strategies, outreach, and targeted support for female researchers in science, technology, engineering, and mathematics (STEM) fields.

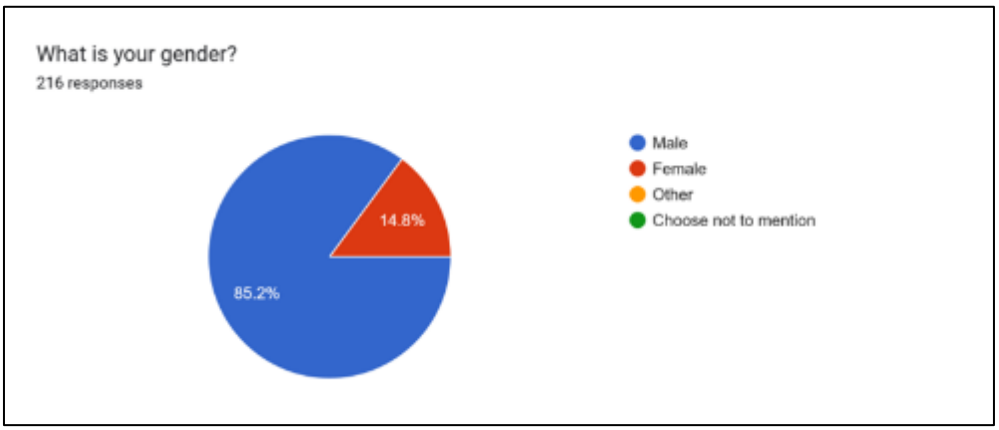

Figure 3 Gender Status

In terms of age distribution, most respondents were between 16–25 years old, a typical range for final-year undergraduates and early-stage postgraduate students (refer to Figure 4). This aligns with the academic phase where research projects are typically introduced and graded, underscoring the importance of targeted support at this critical stage of professional development.

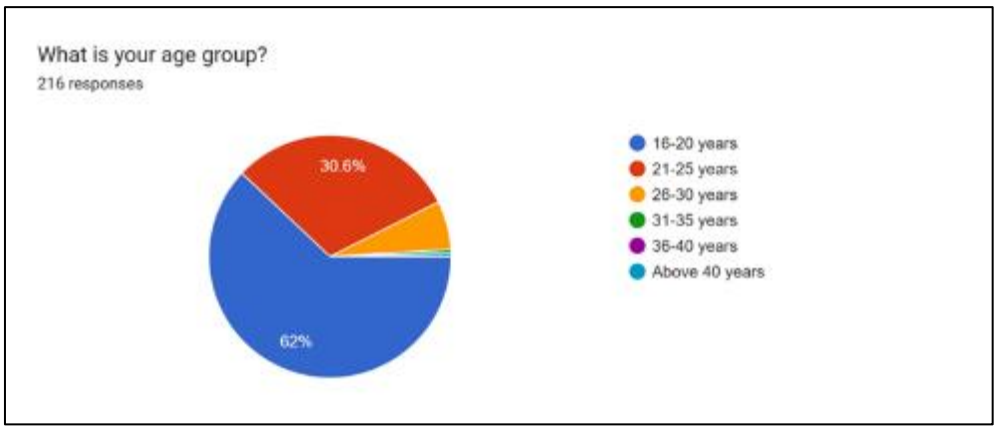

Figure 4 Responders Age Group

3.2. Research Experience and Exposure

The survey uncovered a significant lack of research exposure among students. About 83.3% of respondents had never participated in a research project, even though more than 33% were in their final year, a period when research is typically a graduation requirement (refer to Figure 5 and 6).

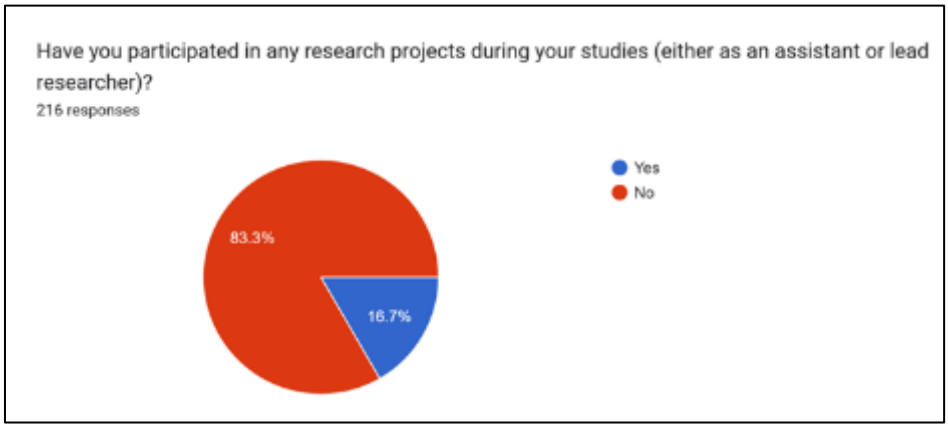

Figure 5 Evidence of research participation

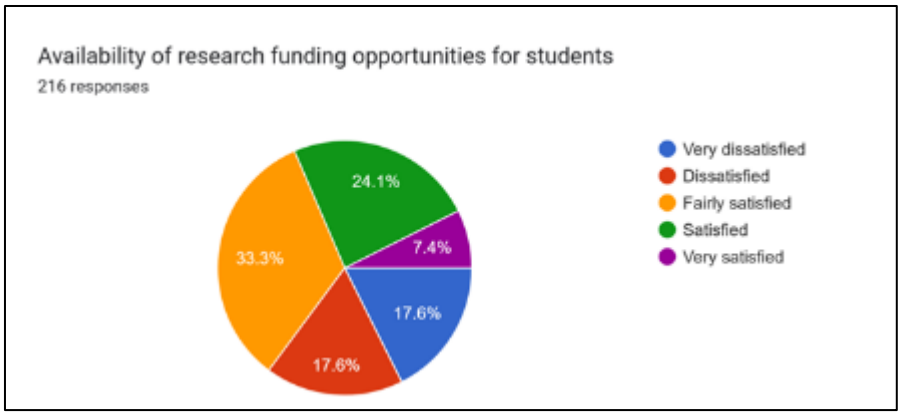

Figure 6 Research funding opportunities

Several factors contribute to this shortfall. First, research is often introduced late in the curriculum, which leaves little time for iterative learning or meaningful engagement. Second, a lack of accessible research opportunities before the final year limits student involvement. Third, institutional issues like limited supervision [**19**], funding, and infrastructure actively discourage students from participating.

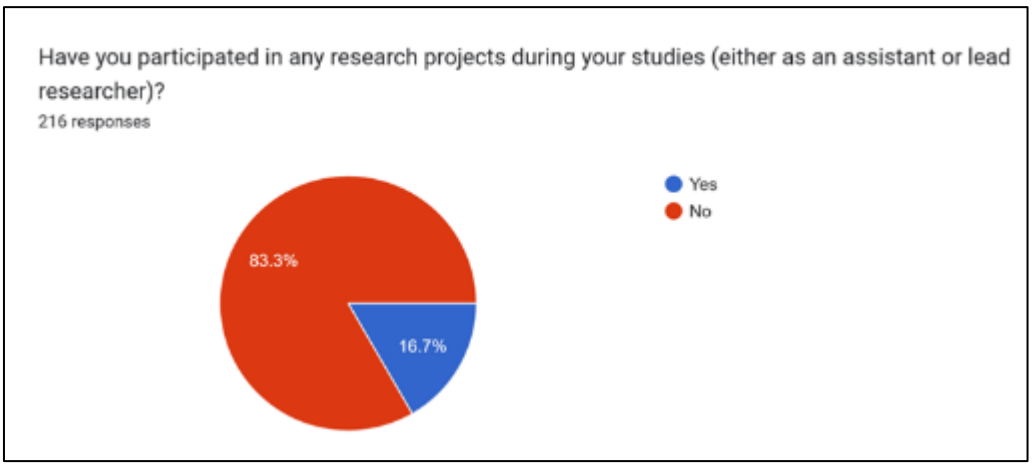

Figure 7 Evidence of research participation

For the minority (16.7%) who had engaged in research, their experiences spanned various disciplines, including renewable energy, robotics, and entrepreneurship (refer to Figure 7). These students reported diverse roles, such as data collection, analysis, and team leadership, which shows the potential for skill development when research opportunities are available.

3.3. Research Skills and Student Confidence

A significant number of students reported high confidence in their ability to formulate a research question, with 46.3% feeling 'Confident' and 8.3% feeling 'Very Confident' (refer to Figure 8). The results revealed that the students surveyed demonstrate a varied degree of confidence in the research process. While they feel comfortable with fundamental skills like writing reports (89.7%), their confidence diminishes when it comes to more technical areas (refer to Figure 9).

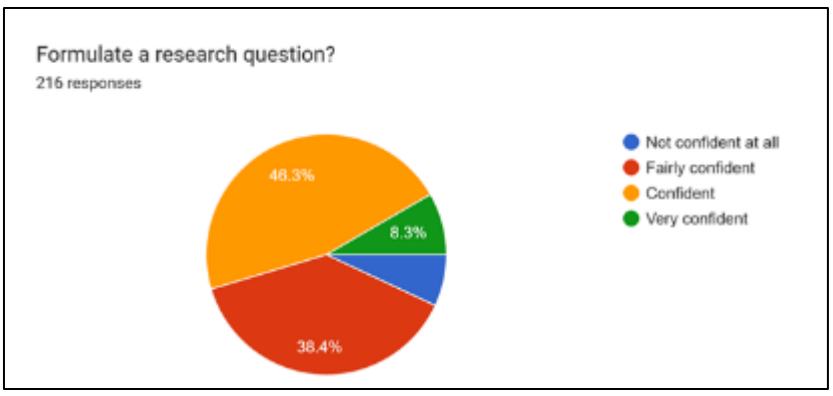

Figure 8 Research question formulation skills

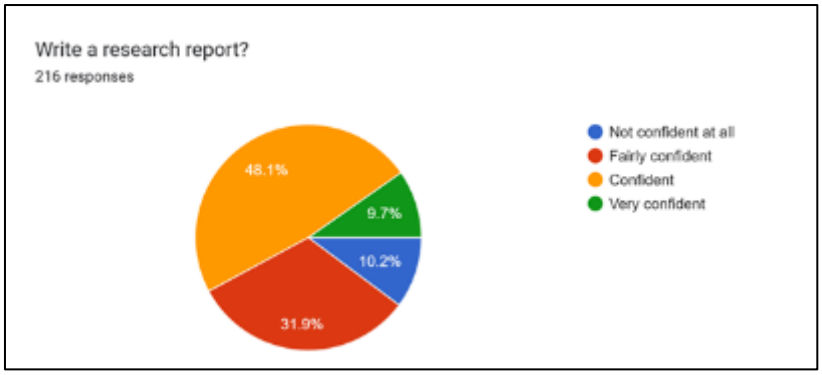

Figure 9 Report writing skill

Specifically, students reported lower confidence in conducting literature reviews (83.3%), designing research (87.5%), and analyzing data (90.8%) (refer to Figure 10, 11 and 12). The study notes that these self-assessments might seem optimistic; however, the absence of formal training suggests

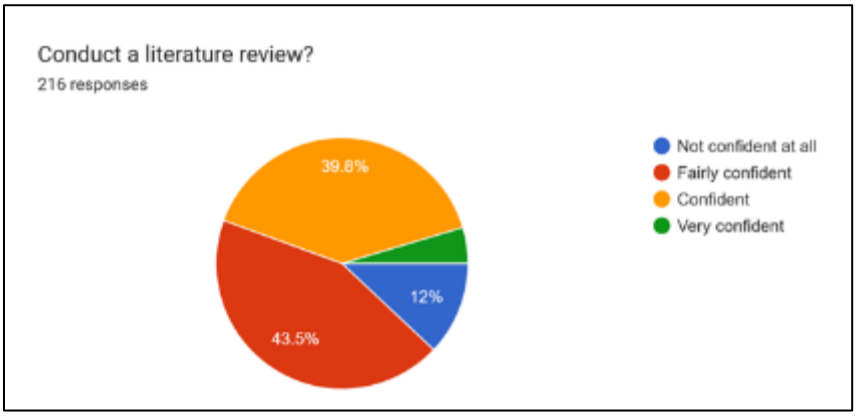

Figure 10 Literature review skills

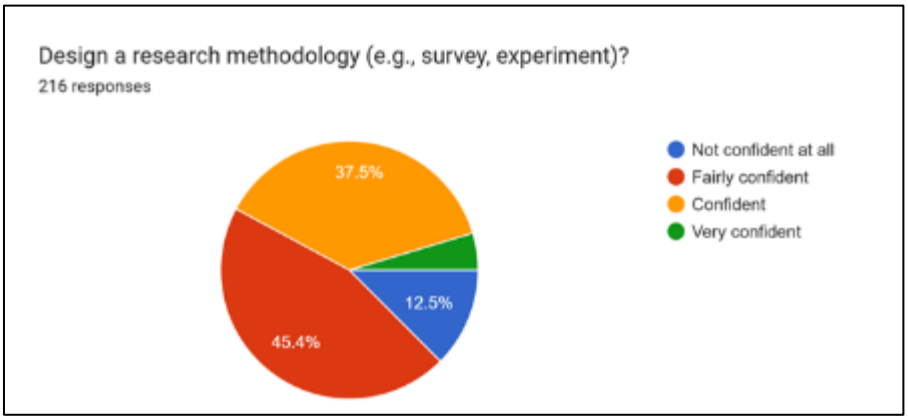

Figure 11 Research design skills

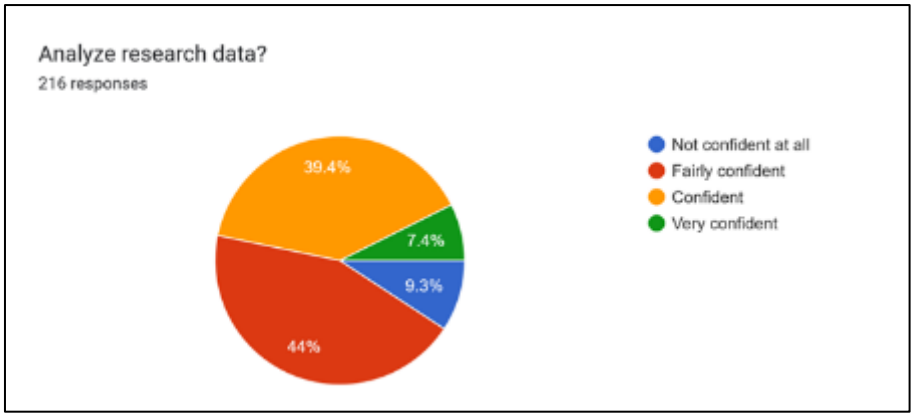

Figure 12 Research analysis skills

that this confidence may not align with actual competence. Inadequate guidance and poor research skills can erode student confidence, negatively affecting their willingness and ability to conduct high-quality research in Nigerian universities [24, 25, 26, 27, 28]. This discrepancy between perceived and actual skill levels is concerning, as it can lead to overconfidence, which masks the need for support, or under confidence, which discourages participation entirely in research activities. Nonetheless, a more detailed analysis revealed that roughly 7% to 12% of the respondent's lacked confidence in key research areas. This group is at a high risk of disengaging from research and should be a priority for targeted support, such as skills workshops and one-on-one mentorship.

3.4. Training and Infrastructure

A major finding of this study is the widespread lack of formal research training, with over 80% of respondents reporting they had not taken any research-related courses (refer to Figure 13). The 19.4% who had enrolled in such courses cited subjects like research methodology, final-year projects, qualitative and quantitative methods, and technical report writing (refer to Figure 14). This lack of structured training points to a significant gap in the curriculum. Inadequate infrastructure and poor training in Nigerian universities hinder scholarly activities for both students and staff due to a lack of resources and skills [29, 30, 31, 32, 33].

Figure 13 Training on research methods

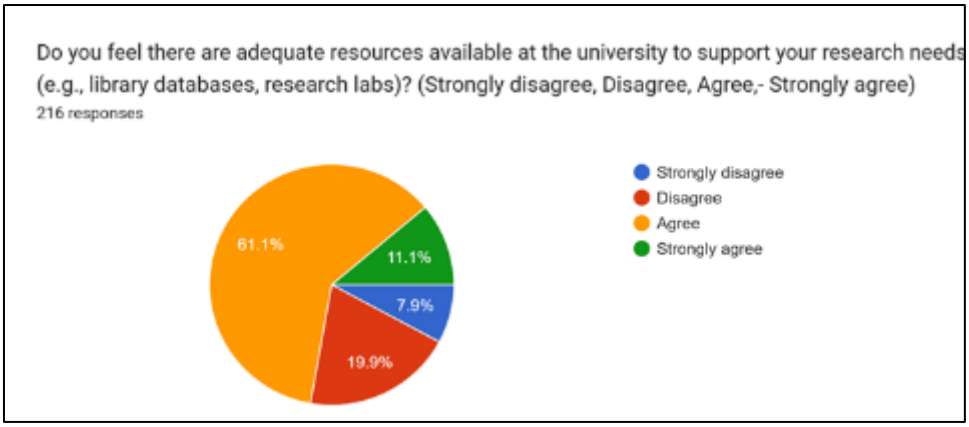

Figure 14 Adequacy of research resources

In an academic environment where students must complete research projects to graduate, this absence of foundational coursework is a significant obstacle. Without proper instruction in methodology, data analysis, and ethics, student projects may be superficial, poorly executed, or fail to meet academic standards. The problem is further compounded by a lack of access to adequate research infrastructure. While 61.1% of respondents considered research resources somewhat adequate, a substantial number disagreed, citing issues with libraries, labs, and online databases (refer to Figure 15). A similar trend was observed with research facilities; only 43.5% expressed satisfaction, while others noted insufficient or outdated research facilities.

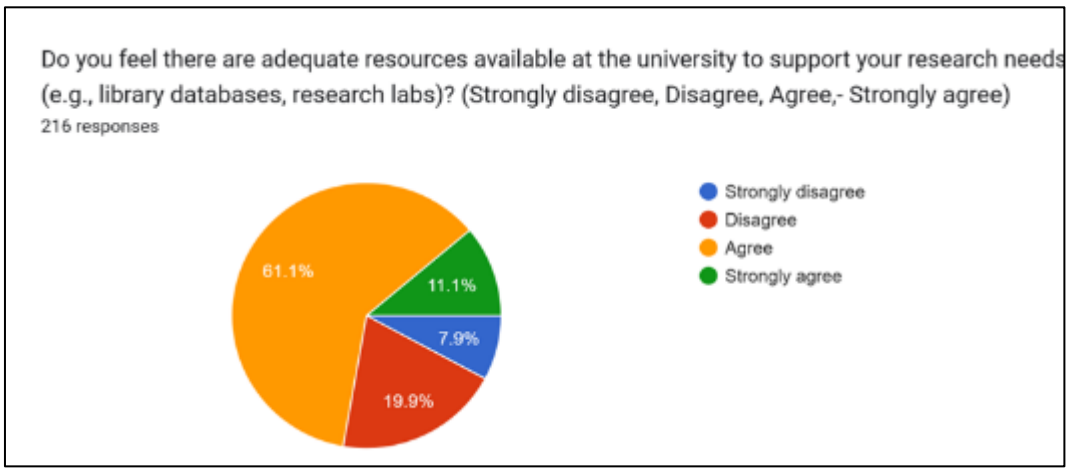

Figure 15 Adequacy of research resources

3.5. Faculty Interaction and Mentorship

Effective research is dependent on mentorship, yet student-faculty engagement in Nigerian universities appears to be limited. A significant 36.6% of students reported never discussing their research with faculty (refer to Figure 16), while only a small minority (1.3%) claimed to have regular engagement. This suggests a fundamental gap in academic guidance, especially since students in this environment often rely heavily on supervisors for project direction. Although 78.2% of respondents

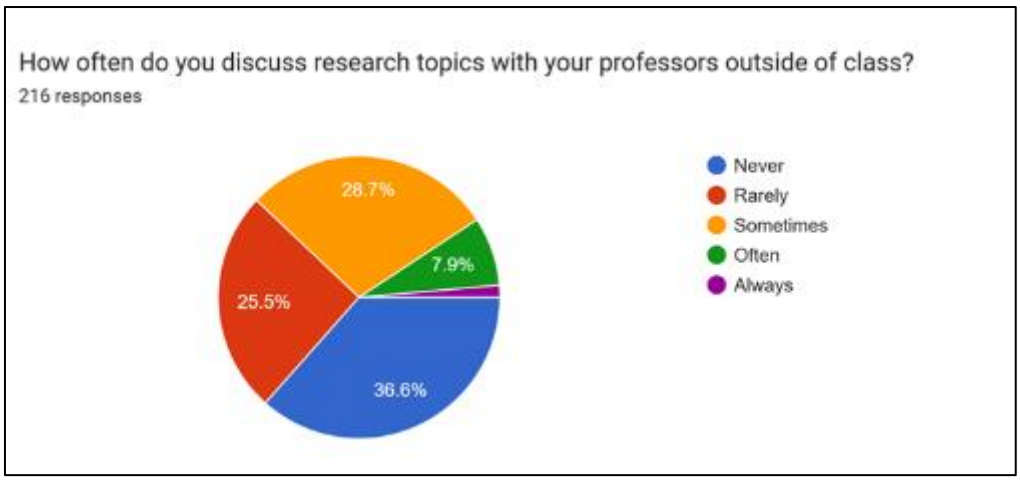

Figure 16 Student-professor interaction

acknowledged receiving some form of faculty support, the qualitative data showed that this support was often minimal or inconsistent (refer to Figure 17). Major barriers identified were heavy faculty workloads, a lack of receptivity, and unclear expectations. Without sustained and structured interaction, students are left to navigate research projects on their own, leading to frustration, poor-quality work, and disengagement.

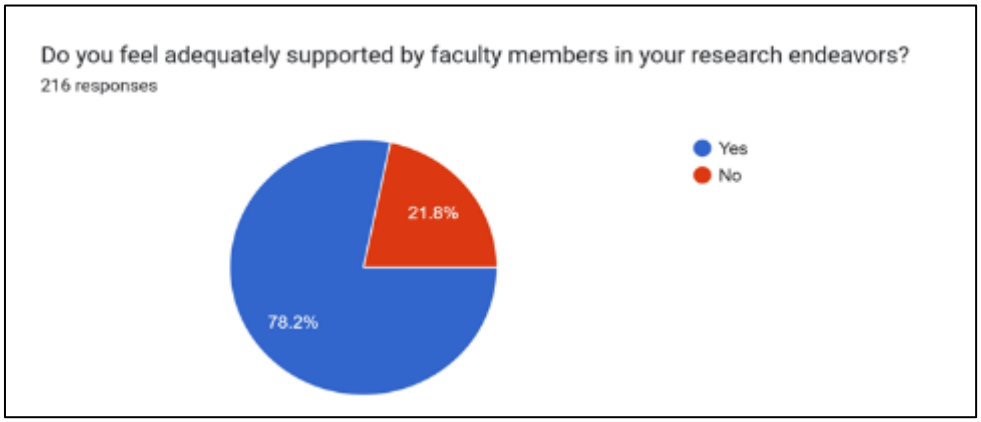

Figure 17 Support from faculty members

The mentorship gap is even more pronounced, with 82.9% of respondents stating they had never had a mentor (refer to Figure 18). A massive 96.3% expressed interest in formal mentorship programs, highlighting a significant demand for such support and a critical opportunity for intervention (refer to Figure 19). Positive mentorship is directly linked to better research outcomes, higher confidence,

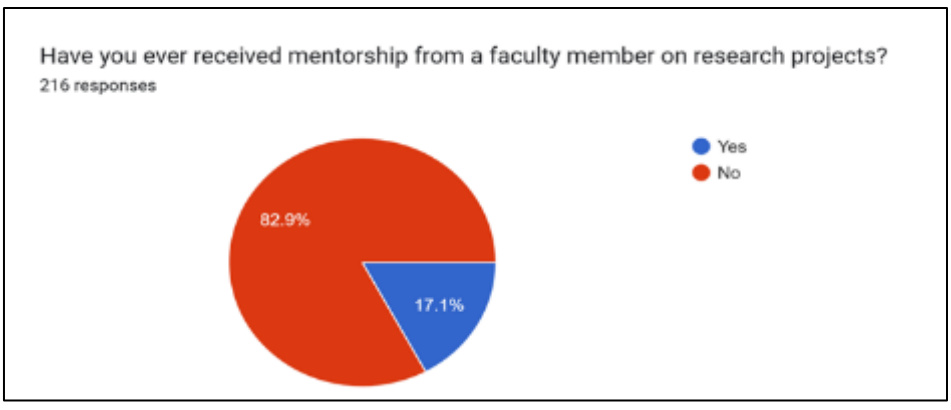

Figure 18 Mentorship support from faculty members

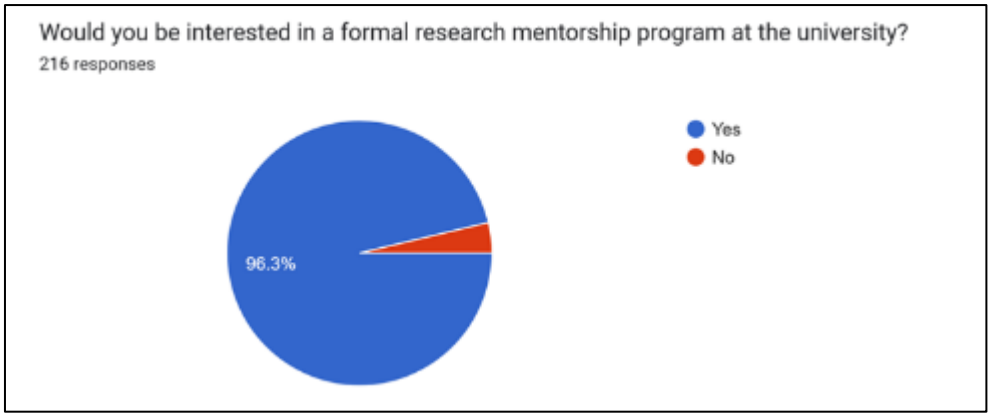

Figure 19 Interest in mentorship programs

and stronger academic engagement, making it a cornerstone of an effective research ecosystem. Weak faculty interaction and a lack of mentorship are significant challenges in Nigerian universities, hindering the research skills, confidence, and productivity of both academics and students [34, 35, 36, 37].

3.6. Challenges to Research Participation

When students were asked about the primary obstacles to research, they overwhelmingly pointed to poor funding (60.2%), limited access to resources (59.3%), and lack of time (57.4%) (refer to Figure 20). These barriers are interconnected; insufficient funding impacts access to necessary materials, while time constraints are a result of overloaded curricula and limited institutional support. Other significant challenges cited were lack of effective supervision (43.1%), inadequate infrastructure (41.7%), non-inclusive physical environments (32.4%), and insufficient support for students with disabilities (19.9%). These findings indicate that while the most urgent issues revolve around funding

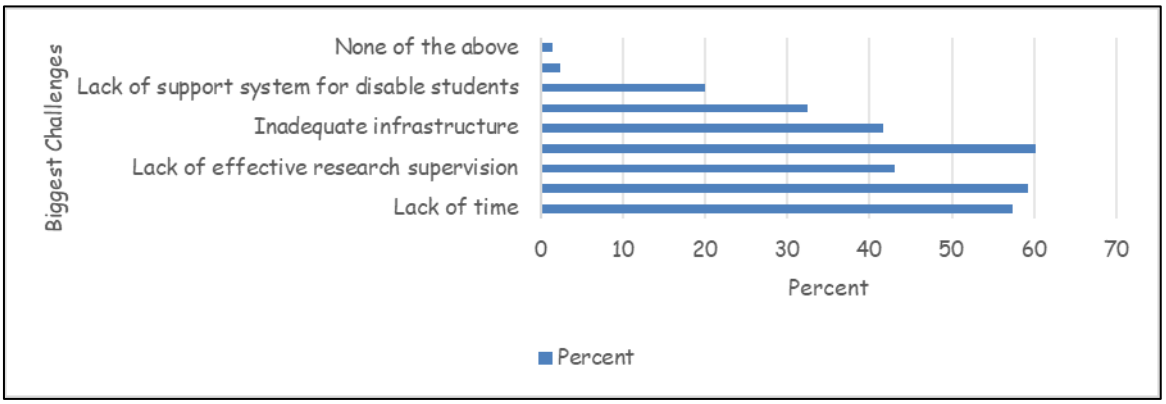

Figure 20 Challenges confronting student research participation

and resources, a significant number of students also encounter systemic barriers related to inclusion, supervision quality, and physical accessibility. Limited funding, poor infrastructure, and a lack of institutional support and mentorship are key challenges that hinder research participation and productivity in Nigerian universities [38, 39, 40]. These issues disproportionately affect marginalized groups, leading to disparities in research participation and outcomes.

3.7. Awareness and Utilization of Research Support Services

One of the most troubling findings is the almost complete lack of awareness regarding existing research support services. A staggering 92.6% of respondents were unaware of any institutional research support offerings, which include directorates, electronic databases, and resource centers (refer to Figure 21). Even among the 7.4% who were aware of these

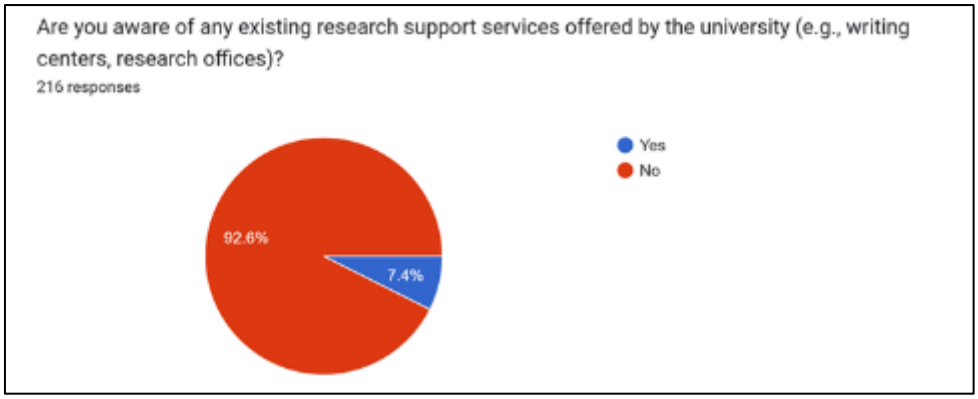

Figure 21 Availability of Research Support Services

services, satisfaction was low. Students' comments, such as "not helpful at all" and "of limited usefulness," point to a serious gap between the services offered and what students actually need. This disconnect undermines engagement and leaves students without the resources they require.

The lack of awareness is a symptom of several issues: weak institutional communication, unclear service delivery frameworks, and a top-down approach to support that often excludes student input. Bridging this gap will require proactive outreach, targeted orientation, and inclusive consultation with students. The combined evidence from these studies paints a clear picture [41, 42, 43, 44, 45, 46, 47]: while some research support services do exist, they are widely underutilized due to a combination of low awareness, poor digital literacy, and significant infrastructural challenges throughout Nigerian universities.

3.8. Disability and Inclusion

Although 98.6% of respondents reported having no physical disabilities, the few who did share concerning experiences (refer to Figure 22). Among students with disabilities, 81.3% indicated they received insufficient support, and 65.2% reported that university facilities were not compatible with their needs (refer to Figure 23). This highlights a crucial, yet often overlooked, aspect of equity in research: physical accessibility and inclusive infrastructure.

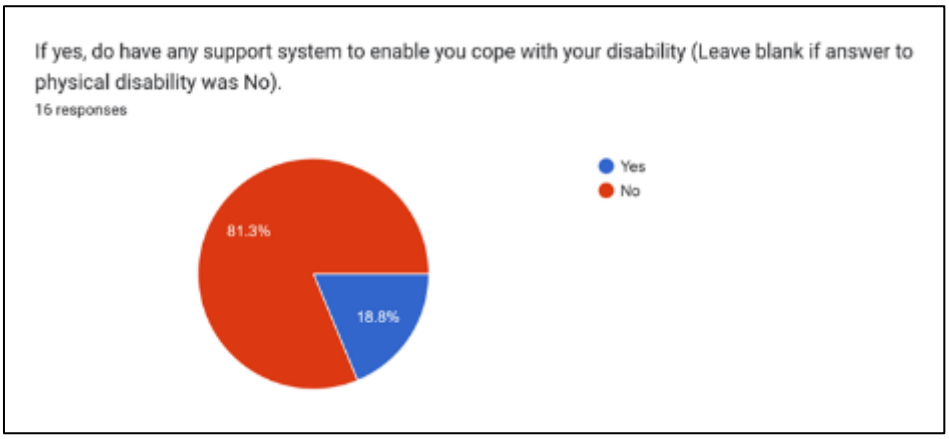

Figure 22 Support system for coping with disability

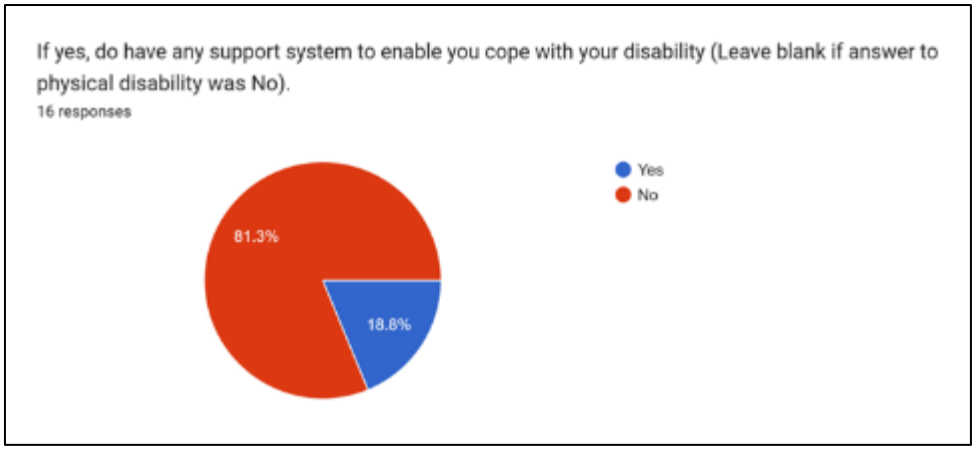

Figure 23 Support system for coping with disability

While the number of respondents with disabilities may be small, the systemic lack of support they face sends a message to other marginalized groups and sets a precedent for broader exclusion. To create an equitable research environment, it is essential to invest in inclusive design, assistive technologies, and specialized support services. Non-inclusive policies, poor infrastructure, and discriminatory attitudes toward individuals with disabilities create significant barriers that severely hinder their participation and research activities in Nigerian universities [48, 49, 50, 51].

In summary, these key findings paint a picture of a research landscape where students possess enthusiasm and potential but are severely limited by structural, financial, and pedagogical constraints. Students are willing and confident to engage in research and are eager for mentorship; however, they are operating within a system that is ill-equipped to support them. To foster research excellence, universities must move beyond passive frameworks and proactively build a culture that supports inquiry, nurtures talent, and ensures equitable participation for all students.

4. Implications of Key Findings on National and Sub-regional Development

The key findings on low student research engagement, coupled with inadequate infrastructure, mentorship, and funding in Nigerian universities, have profound implications for both national and sub-regional development. These issues create a significant barrier to Nigeria's progress in cultivating a knowledge-based economy and addressing its unique challenges which include:

4.1. Undermining Human Capital Development and Employability

The study reveals that most students lack exposure to research, missing out on critical skills like data analysis, problem-solving, and critical thinking. This gap in practical competencies undermines the employability of graduates, who are ill-equipped to meet the demands of modern employers in the 21st century. As a result, Nigeria risks producing a workforce that cannot contribute meaningfully to innovation and industrialization efforts, perpetuating a cycle of graduate unemployment.

4.2. Constraining Innovation and Technological Advancement

Nigeria's capacity for homegrown innovation is severely hampered by the lack of student research. The absence of adequate research facilities and funding stifles creativity and prevents the development of student-led projects that could lead to patents, prototypes, or startups. Instead of being a producer of local solutions, the country remains a consumer of foreign technologies. This dependency limits Nigeria's ability to tackle critical issues like the power crisis and diversify its oil-dependent economy.

4.3. Weakening Industrial Development and Knowledge Transfer

A lack of robust student research ecosystems weakens the link between academia and industry. Universities are unable to transfer fresh ideas and adaptive technologies to the industrial sector, which in turn hinders economic growth. Investing in student research creates a crucial feedback loop where students gain real-world experience and industries benefit from cost-effective R&D partnerships. Without this collaboration, Nigeria's industrial sector will struggle to compete, and the country will lack the skilled workforce needed to achieve its ambitious economic development plans.

4.4. Hindering Inclusive Development and Social Equity

The findings also expose significant issues with inclusivity, particularly concerning gender and disability. A notable gender imbalance in engineering research and a lack of support for students with disabilities highlight deep-seated inequities. This exclusion of large segments of the population from research opportunities stifles a diversity of thought and limits the scope of innovation. To align with global development goals and achieve true progress, Nigeria must ensure that all individuals, regardless of gender or ability, are empowered to contribute to the research agenda.

4.5. Diminishing Academic Excellence and Global Competitiveness

Nigeria's aspirations to be a regional and global leader in education are compromised by the poor state of its research ecosystem. Low research output, a lack of formal mentorship, and inadequate infrastructure undermine the credibility of its academic institutions. This not only affects global university rankings but also limits the country's attractiveness for international collaboration and investment. Without a strong research culture, Nigeria's ability to compete on the global stage is significantly diminished.

4.6. The Need for Policy Alignment and Institutional Reform

The identified challenges point to a critical gap between policy and practice. To address these issues, Nigeria must implement structural reforms. This includes: mandating early research exposure in university curricula; establishing dedicated grant schemes for student research; creating national frameworks for mentorship and supervision; and incentivizing university-industry collaboration.

By institutionalizing these reforms, universities can become powerful engines for innovation and development, helping Nigeria unlock the vast potential of its youth population and secure its position as a knowledge hub in Africa.

5. Study Contributions, Limitations, and Future Research

5.1. Contributions of the Study

This study provides a student-centered perspective on the state of research in Nigerian universities, a viewpoint often missing from academic discourse. Its key contributions include:

- The study offers direct, empirical evidence from engineering students at three Nigerian universities, highlighting the systemic barriers they face.
- It identifies critical systemic barriers to student research, such as poor funding, lack of mentorship, and inadequate infrastructure.
- The research exposes a significant disconnect between institutional support services and student awareness, pointing to a need for better communication and resource planning.
- It reveals a strong, but unmet, demand for research training and mentorship among students, indicating that focused interventions could have a substantial impact.
- By linking student research engagement to national and sub-regional development, the study bridges the gap between educational reforms and larger policy outcomes like human capital development and innovation.

5.2. Limitations of the Study

The research was limited in scope, as the survey was conducted at only three universities, with a significant majority of responses coming from just one of those institutions. This makes it difficult to apply the findings to a broader context of other Nigerian universities. Furthermore, the sample size of 216 was sufficient for an initial assessment but lacked the statistical power needed for deeper comparisons across different subgroups, such as gender or academic year. Lastly, the study's reliance on self-reported data introduces the possibility of bias, as responses may not always be accurate.

5.3. Future Research

To build on this study's findings and address its limitations, future research should expand its scope by conducting surveys at a wider variety of public and private universities across Nigeria. Additionally, longitudinal studies are recommended to track the long-term impact of new interventions, such as mentorship programs or curriculum changes, on student engagement and academic outcomes. Finally, research should incorporate multiple perspectives, including those of faculty, administrators, and industry partners, to create a more comprehensive understanding of the entire research ecosystem.

5.4. Recommendations for Reforms and Alignment

This paper highlights an urgent need for a comprehensive, multi-pronged reform agenda to address the systemic challenges hindering student research in Nigerian universities. A successful strategy must target institutional policies, curriculum reforms, infrastructure provisions, and faculty practices to create a more supportive and inclusive research environment. Hence, the following recommendations:

- **Curriculum Reform and Early Research Integration:** Universities should update their curriculum to introduce research fundamentals to students early, ideally in their first year. This includes making research methodology a core requirement for all students and using interdisciplinary approaches to build problem-solving skills.
- **Mentorship Development and Faculty Engagement:** To improve mentorship, universities should create formal mentorship programs that pair students with faculty. To encourage faculty participation, they should offer incentives like awards or adjusted workloads. Regular advisory sessions and training for faculty on best practices for inclusive supervision are also crucial.
- **Infrastructure Investment and Digital Access:** Both universities and the government need to invest in modern research infrastructure, such as labs and innovation hubs. It's also vital to improve digital resources by providing access to research databases and better internet connectivity. All physical facilities should be upgraded to be disability-inclusive.
- **Financial Support and Resource Equity:** To remove financial barriers, universities should create dedicated research grants for students, offer stipends for fieldwork, and help with conference attendance. They should also subsidize essential research materials, particularly for students from disadvantaged backgrounds.
- **Awareness, Orientation and Communication:** Universities should launch targeted campaigns through various channels (websites, newsletters, orientations) to inform students about available support services. They should also establish centralized research support units to guide students on proposal writing and data analysis.
- **Inclusion, Equity, and Gender Mainstreaming:** Institutions must take proactive steps to address gender imbalance and barriers for students with disabilities. This includes implementing gender-sensitive policies like scholarships for women in STEM, ensuring all infrastructure is physically accessible, and providing diversity training for staff.
- **Monitoring Evaluation and Continuous Improvement:** For sustainable reform, universities should regularly conduct student surveys to track progress and form student research advisory boards for continuous feedback. Using data dashboards and performance indicators will help ensure reforms are effective and aligned with national goals.
- **Industry Collaboration and National Alignment:** To make student research more impactful, universities should partner with industries on projects and internships. They should also encourage research commercialization through innovation hubs and ensure that research priorities align with national development strategies.

The recommendations provide a roadmap for unlocking student potential, strengthening the research ecosystem, and aligning with national development goals through collaboration among academia, government, and industry.

6. Conclusion

In conclusion, this study evaluates students' research experiences, skill levels, and access to training to identify both strengths and gaps. It also assesses the availability and effectiveness of research support systems, such as infrastructure, inclusive practices, mentorship, and faculty engagement. The findings indicate a clear need for improved resources, more inclusive policies, and enhanced collaboration between faculty and students. The study concludes with strategic recommendations for universities and policymakers, urging them to cultivate a student-centered and inclusive research culture. This approach aims to encourage innovation, tackle systemic issues, and align with national development priorities, thereby promoting sustainable academic and societal progress.

Compliance with ethical standards

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All authors declared that there are no competing interests to disclose.

References

[1] Sarpong, D., Boakye, D., Ofosu, G., & Botchie, D. (2022). The three pointers of research and development (R&D) for growth-boosting sustainable innovation system. *Technovation*, *122*, 102581.

[2] Kaplinsky, R. (2019). Technology and innovation for sustainable development. In *The Palgrave Handbook of Development Economics: Critical Reflections on Globalisation and Development* (pp. 589-626). Cham: Springer International Publishing.

[3] Katz, Y. (2025). The Role of Government in Institutional Enhancement of Innovation and Competition. *Athens Journal of Politics & International Affairs (forthcoming) https://www. athensjournals. gr/politics/2024-5986-AJPIA-Katz-02. pdf*.

[4] Wanjohi, A. M. (2025). Environmental, Social, Economic, and Political Sustainability in Sub-Saharan Africa. In *The Palgrave Handbook of Practical Sustainability* (pp. 31-58). Cham: Springer Nature Switzerland.

[5] Ng'ethe, N., Assie-Lumumba, N., Subotzky, G., & Sutheland-Addy, E. (2003). Higher education innovations in sub-Saharan Africa: With specific reference to universities. *Retrieved from AAU website: http://www. aau. org/wghe/publications/wghe_innovations_ref_univ. pdf on August*, *20*, 2012.

[6] Bailey, T., Cloete, N., & Pillay, P. (2011). Universities and economic development in africa case study: Kenya and University of Nairobi.

[7] Olajide, T., Arokoyo, K., Adesola, A., Okeke, S., Abdullateef, R., Anele, F., ... & Akinyemi, R. (2024). Building a research culture among nigerian medical students: the modus operandi of the college research and innovation hub. *BMC medical education*, *24*(1), 1465.

[8] Manishimwe, T., Frazier, D. P., & Yusuf, H. (2024). Frugal innovation and entrepreneurial university: a case study of African first development university in Africa. *Discover Education*, *3*(1), 190.

[9] Becker, S. A., Brown, M., Dahlstrom, E., Davis, A., DePaul, K., Diaz, V., & Pomerantz, J. (2018). NMC horizon report: 2018 higher education edition. *Louisville, CO: Educause*.

[10] National Research Council. (1995). *Engineering education: Designing an adaptive system*. National Academies Press.

[11] Ashford, N. A. (2004). Major challenges to engineering education for sustainable development: what has to change to make it creative, effective, and acceptable to the established disciplines? *International Journal of Sustainability in Higher Education*, *5*(3), 239-250.

[12] Lantada, A. D., Muñoz-Guijosa, J. M., Chacón, E., Echávarri, J., & Muñoz, J. L. (2016). Engineering Education for all: Strategies and challenges. *International Journal of Engineering Education*, *32*(5), 2155-2171.

[13] Aguboshim, F. C., Onwuka, I. N., Obiokafor, I. N., & Oboti, N. P. (2021). Factors challenging research and innovation in tertiary education in Nigeria. *World Journal of Advanced Research and Reviews*, *10*(1), 224-229.

[14] Amaghionyeodiwe, L., & Osinubi, T. (2012). The development impact of higher education in Nigeria. *OIDA International Journal of Sustainable Development*, *4*(9), 85-120.

[15] Akudolu, L. R., & Adeyemo, K. S. (2018). Research and PhD Capacities in Sub-Saharan Africa: Nigeria Report. *Online Submission*.

[16] Lambert, W. M., Nana, N., Afonja, S., Saeed, A., Amado, A. C., & Golightly, L. M. (2025). Addressing structural mentoring barriers in postdoctoral training: a qualitative study. *Studies in graduate and postdoctoral education*, *16*(1), 1-24.

[17] Moore, T. L., & Ward, K. (2010). Institutionalizing faculty engagement through research, teaching, and service at research universities. *Michigan Journal of Community Service Learning*, *17*(1), 44-58.

[18] Pierszalowski, S., Bouwma-Gearhart, J., & Marlow, L. (2021). A systematic review of barriers to accessing undergraduate research for STEM students: problematizing under-researched factors for students of color. *Social Sciences*, *10*(9), 328.

[19] Ejilah, I. R., Bankole, Y. O., Omamo, A., Viza, E., Agboneni, O., Daser-Adams, J. L., Omoyi, C. O., & Mohammed, B. (2025). Enhancing Engineering Research Productivity through Institutional Reform: Evidence from Faculty and Industry Engagement in Nigerian HEIs. World Journal of Advanced Engineering Technology and Sciences, 2025, 16(03), 410-422. Article DOI: https://doi.org/10.30574/wjaets.2025.16.3.1348.

[20] Ejilah, I. R. (2025, January 3). Identifying Students Needs and Research Gaps in Nigerian Universities: A Report on RAEng- HEPSSA -Sponsored Survey on Student Research in Selected Nigerian Universities. Abubakar Tafawa Balewa University.Bauchi, Nigeria.

[21] Ejilah, I. R., Omamo, A., Viza, E., Agboneni, O., Daser-Adams, J. L., Bankole, Y. O., Omoyi, C. O., & Mohammed, B. (2025). Bridging the gaps and building synergy: A Survey of University-Industry Collaboration for Engineering Students Research Activities of Selected Nigerian Industries and Universities. *World Journal of Advanced Engineering Technology and Sciences, 16*(01), 603–616. https://journalwjaets.com/sites/default/files/fulltext_pdf/WJAETS-2025-1248.pdf

[22] Wang, M. T., & Degol, J. L. (2017). Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions. *Educational psychology review*, *29*(1), 119-140.

[23] Casad, B. J., Franks, J. E., Garasky, C. E., Kittleman, M. M., Roesler, A. C., Hall, D. Y., & Petzel, Z. W. (2021). Gender inequality in academia: Problems and solutions for women faculty in STEM. *Journal of neuroscience research*, *99*(1), 13-23.

[24] Adekunle, P. A., & Madukoma, E. (2022). Research self-efficacy and research productivity of doctoral students in universities in Ogun State, Nigeria. *Library Philosophy and Practice*, 1-23.

[25] Ogunode, N. J., & Musa, A. (2020). Higher education in Nigeria: Challenges and the ways forward. *Electronic Research Journal of Behavioural Sciences*, *3*.

[26] Ogidi, R. C., & Udechukwu, J. Challenges in Acquisition of Research Skills Among Lecturers in Education Degree Awarding Institutions in Rivers State.

[27] Uleanya, C. (2020). Exploring effects of lecturers–students' relationship on students academic performances in selected rural universities. *Interchange*, *51*(4), 345-360.

[28] Oraif, F. A. (2007). *An exploration of confidence related to formal learning in Saudi Arabia* (Doctoral dissertation, University of Glasgow).

[29] Okoduwa, S. I., Abe, J. O., Samuel, B. I., Chris, A. O., Oladimeji, R. A., Idowu, O. O., & Okoduwa, U. J. (2018). Attitudes, perceptions, and barriers to research and publishing among research and teaching staff in a Nigerian Research Institute. *Frontiers in Research Metrics and Analytics*, *3*, 26.

[30] Bako, S. (2005). Universities, research and development in Nigeria: time for a paradigmatic shift. *Proceedings of the 11th General Assembly of CODESRIA, on Rethinking African Development: Beyond Impasse, Towards Alternatives*, 6-8.

[31] Oye, N. D., Salleh, M., & Iahad, N. A. (2011). Challenges of e-learning in Nigerian university education based on the experience of developed countries. *International journal of managing information technology*, *3*(2), 39-48.

[32] Ogunode, N. J., & Musa, A. (2020). Higher education in Nigeria: Challenges and the ways forward. *Electronic Research Journal of Behavioural Sciences*, *3*.

[33] Yusuf, S., & Ibrahim, M. A. (2024). Educational services in Nigerian universities: Prospect, challenges and way forward. *Fuoye Journal of Educational Management*, *1*(1).

[34] Idubor, E. E., & Adekunle, S. A. (2021). Challenges of mentoring among university academics in Nigeria.

[35] Friel, N. (2014). *Student projects: investigating the psychological factors of students and supervisors that impact on student success and development* (Doctoral dissertation, University of Glasgow).

[36] Onukwu, J. N. (2024). Academic Mentoring Among Lecturers in The Universities. What Is the Situation in Bayelsa State? *Journal of Education in Developing Areas*, *32*(1), 162-176.

[37] Ndubuisi, W. C., & Ndubuisi, V. N. (2024). Mentoring in Nigerian University System: Challenges and Prospects. *International Journal of Sub-Saharan African Research*, *2*(4), 483-495.

[38] Igiri, B. E., Okoduwa, S. I., Akabuogu, E. P., Okoduwa, U. J., Enang, I. A., Idowu, O. O., ... & Onyemachi, D. I. (2021). Focused research on the challenges and productivity of researchers in Nigerian academic institutions without funding. *Frontiers in research metrics and analytics*, *6*, 727228.

[39] Baro, E. E., Bosah, G. E., & Obi, I. C. (2017). Research funding opportunities and challenges: A survey of academic staff members in Nigerian tertiary institutions. *The Bottom Line*, *30*(1), 47-64.

[40] Okeke, I. N., Babalola, C. P., Byarugaba, D. K., Djimde, A., & Osoniyi, O. R. (2017). Broadening participation in the sciences within and from Africa: Purpose, challenges, and prospects. *CBE—Life Sciences Education*, *16*(2), es2.

[41] Lawan, A. U., & Ibrahim, H. Awareness and Utilization of Information Services. (Students of North-East, Nigeria's Polytechnics).

[42] Orsu, E. N. (2017). Challenges of utilization of online information resources by undergraduate students: Implications for information services. *Library Philosophy and Practice*.

[43] Yusuf, S., & Ibrahim, M. A. (2024). Educational services in Nigerian universities: Prospect, challenges and way forward. *Fuoye Journal of Educational Management*, *1*(1).

[44] Akuegwu, B. A. (2015). Research Utilization in Teaching among Lecturers in South Nigerian Universities: Extent, Challenges, and Coping Strategies. *International Journal of Learning in Higher Education*, *22*(3).

[45] Okiki, O. C. (2012). Electronic information resources awareness, attitude and use by academic staff members of University of Lagos, Nigeria.

[46] Ashaver, D. D., Igyuve, S. M., & Afolabi, O. A. (2024). Awareness and utilisation of digital resources among postgraduate students in selected universities in North-Central, Nigeria. *Journal of Library Services and Technologies*, *6*(1), 49-63.

[47] Christian, G. (2009). Issues and challenges to the development of open access institutional repositories in academic and research institutions in Nigeria. *Available at SSRN 1323387*.

[48] Orim, S., Orim, O., & Matthew Ashike, L. U. I. Challenges of Research on Persons with Disabilities in Nigerian Universities.

[49] Ohajunwa, C., Mckenzie, J., Hardy, A., & Lorenzo, T. (2014). Inclusion of disability issues in teaching and research in higher education. *Perspectives in Education*, *32*(3), 104-117.

[50] Ijadunola, M., Akinyemi, P., Olowookere, O., Olotu, O., Goodman, O., Ogundiran, A., & Ijadunola, K. (2022). Addressing inclusiveness in tertiary co-education: Attitude of undergraduate and academic staff towards students with disabilities in a South-West Nigerian University. *International Journal of Disability, Development and Education*, *69*(1), 47-60.

[51] Isiaka, A. B. (2024). *"This space is not built for people like us": an institutional ethnography of the everyday work of students with disabilities in Nigerian universities* (Doctoral dissertation, University of East Anglia).