World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(RESEARCH ARTICLE)

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Enhancing engineering research productivity through institutional reform: Evidence from Faculty and Industry Engagement in Nigerian HEIs

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World Journal of Advanced Engineering Technology and Sciences, 2025, 16(03), 410-422

Publication history: Received on 09 August 2025; revised on 20 September 2025; accepted on 22 September 2025

Article DOI: https://doi.org/10.30574/wjaets.2025.16.3.1348

Abstract

This paper offers a comprehensive review of the Nigerian university research landscape, drawing on insights from a Royal Academy of Engineering–HEPSSA-supported needs assessment survey. The study conducted across three Nigerian universities is focused on understanding the current state of research engagement and productivity, identifying key barriers, and proposing strategies for institutional reform. Utilizing both quantitative and qualitative methods, the survey captured the perspectives of 150 academics and 50 industry professionals. Key findings reveal a significant research productivity gap, primarily driven by inadequate funding, outdated infrastructure, and a lack of a cohesive research culture. A disconnect between academia and industry was also identified, limiting students' exposure to real-world applications and innovation. Recommendations for reform include the implementation of performance-based research incentives, the establishment of dedicated offices for academia-industry collaboration, and the strategic upgrading of research infrastructure. Despite limitations in sample size and disciplinary focus, the study offers a valuable foundation for institutional reform and policy direction within Nigerian universities, providing a roadmap for fostering a more dynamic and globally competitive research environment.

Keywords: Nigerian Universities; Research Productivity; Institutional Reform; Academic-Industry Collaboration; Needs Assessment Survey; Inadequate Funding; Outdated Infrastructure; Policy Direction

1. Introduction

In the modern knowledge economy, research and innovation play a pivotal role in driving economic development, technological advancement, and societal transformation [1,2]. Economic development hinges on fostering innovation. According to Garcia and Crawley [3], research shows that countries that succeed in building and sustaining strong innovation capabilities and effective systems of governance do well economically, while those that fail tend to fall

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behind. Academic institutions are central to this process, acting as a crucial bridge between fundamental knowledge creation and its application for societal benefit.

Higher education institutions, particularly universities, are expected to serve as incubators for innovation, producing skilled graduates equipped with the capacity to solve real-world problems [4,5,6]. However, the research ecosystem in many Nigerian universities faces persistent challenges, including inadequate funding, outdated infrastructure, and a disconnect between academic research and industry needs. These issues undermine expectations, leading to a significant gap between academia and industry, which limits students' exposure to real-world applications and innovation [7,8]. These include inadequate funding, outdated infrastructure, limited access to modern tools and databases, and a disconnect between academic research and industry needs. [9,10,11,12.13]

The pressing need for reform in this area has prompted various interventions, one of which is the Royal Academy of Engineering – Higher Education Partnerships in Sub-Saharan Africa (HEPSSA) initiative. As part of its mandate, it seeks to build capacity among African universities through strategic partnerships, including improved collaboration between academia and industry [14,15]. This paper seeks to address the gap between academic research and industry needs by presenting findings from a needs assessment survey conducted under the Royal Academy of Engineering's Higher Education Partnerships for Sub-Saharan Africa (HEPSSA)-funded program. Hence, this study examines the institutional and systemic barriers to research productivity within universities and proposes evidence-based reforms to bridge the gap between academic research and industrial application in Nigeria.

2. Methodology

The study employed a descriptive and exploratory research design using a structured survey to capture relevant data from faculty members and researchers across three Nigerian universities: Abubakar Tafawa Balewa University (ATBU), Bauchi; Lagos State University of Science and Technology (LASUSTECH), Ikorodu; and the University of Calabar (UNICAL). The focus was to assess the current state of faculty engagement in research, student supervision, research support mechanisms, and collaboration with industry partners.

The study utilized a mixed-methods approach with a Google Form as the primary data collection tool [16]. The survey was designed to gather comprehensive insights on the demographic and professional backgrounds of respondents, their involvement in student research, the challenges they faced, and the availability of mentorship systems and industry collaborations. The survey was distributed to faculty members at three Nigerian universities via digital channels like email and WhatsApp, capturing the perspectives of 150 academics and 50 industry professionals. The responses were obtained from engineering faculty and industry professionals in key sectors such as oil and gas, manufacturing, and telecommunications.

After the collection phase, the data was downloaded into a spreadsheet and cleaned to remove duplicate or invalid entries. Quantitative responses were subjected to descriptive statistical analysis, with frequency distributions used to interpret patterns across institutions, academic disciplines, and years of experience. Qualitative inputs from open-ended responses were categorized thematically to uncover deeper insights and contextual explanations behind quantitative trends. Visualization tools such as pie charts and bar graphs were employed to enhance the clarity of the findings, and to facilitate interpretation by both academic and non-academic audiences. The methodology was designed to ensure transparency, replicability, and relevance to policymakers, university administrators, and industry stakeholders interested in the development of research in Nigerian higher education institutions [16].

3. Key Findings

The study yielded a wealth of data highlighting various facets of the research landscape in Nigerian universities, particularly in relation to faculty involvement, student research supervision, infrastructural support, and academia-industry collaboration (refer to Figure 1). The respondents were drawn predominantly from three institutions: ATBU, LASUSTECH, UNICAL. The geographical and institutional distribution of the responses was relatively balanced between ATBU and LASUSTECH, each contributing approximately 42.85% of the total responses, while UNICAL was underrepresented, accounting for only 14.28% (refer to Figure 2).

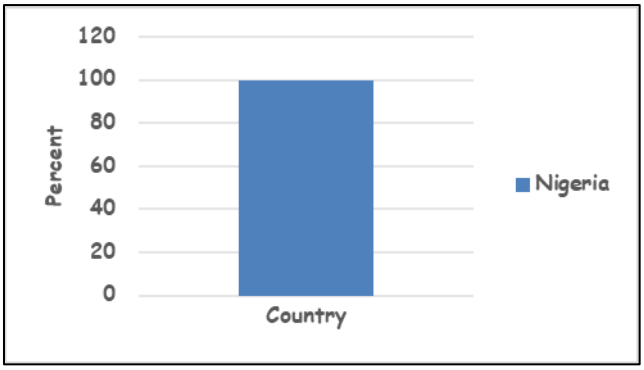

Figure 1 Country location of Survey

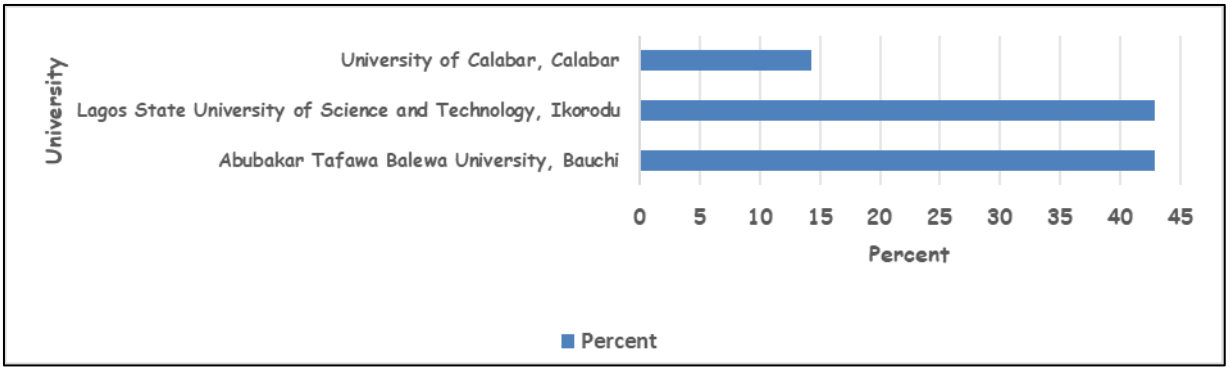

Figure 2 Distribution of Participating Institutions

The majority of the respondents came from departments within the engineering faculty, confirming that the findings largely reflect the state of research within these technical and engineering fields, which tend to be more resource-intensive and innovation-driven. The other programs were less represented. (refer to Figure 3).

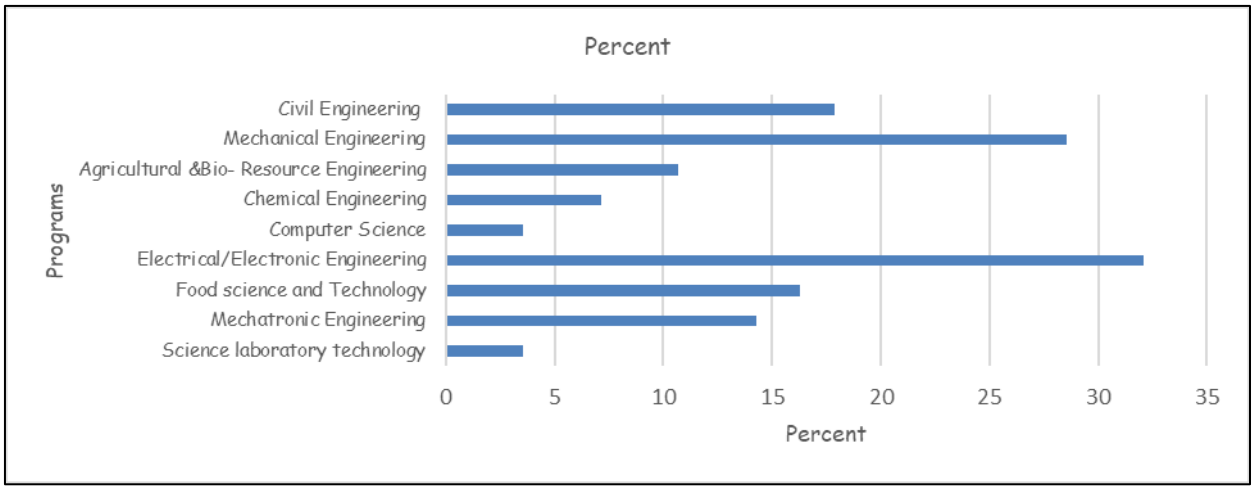

Figure 3 Distribution of Academic Program of Respondents

In terms of academic qualifications, the respondent pool was highly educated. A majority of the participants—60.71%—held doctoral degrees, while 32.14% possessed master's degrees (refer to Figure 4). Only a small fraction had bachelor's degrees or postgraduate diplomas. This skew toward advanced qualifications suggests a sample of experienced faculty members, well-positioned to comment on issues related to research capacity, supervision, and institutional challenges. The high level of qualification also implies that the faculty members surveyed are likely to be actively engaged in or exposed to scholarly research, publication, and mentorship responsibilities.

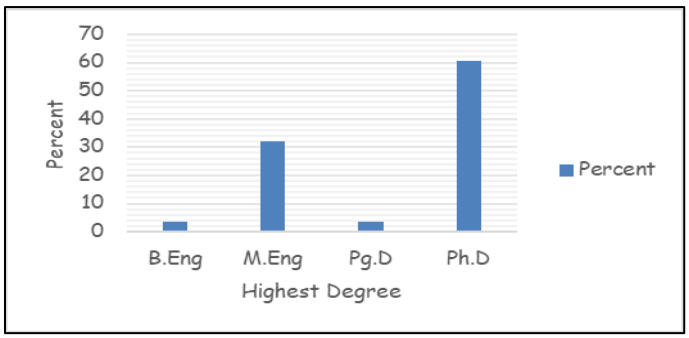

Figure 4 Distribution of the Highest qualification attained by Respondents

A significant finding from the data was the degree of faculty involvement in supervising student research projects. Approximately 75% of respondents reported that they were actively supervising undergraduate or postgraduate research (refer to Figure 5). This finding indicates that research mentorship is a core component of faculty duties and that a substantial portion of academic staff are invested in guiding students through the research process. However, 25% of respondents did not supervise any student research at the time of the survey, highlighting a potential underutilization of faculty resources or a misalignment in responsibilities, which could be addressed through policy reform or mentorship support programs.

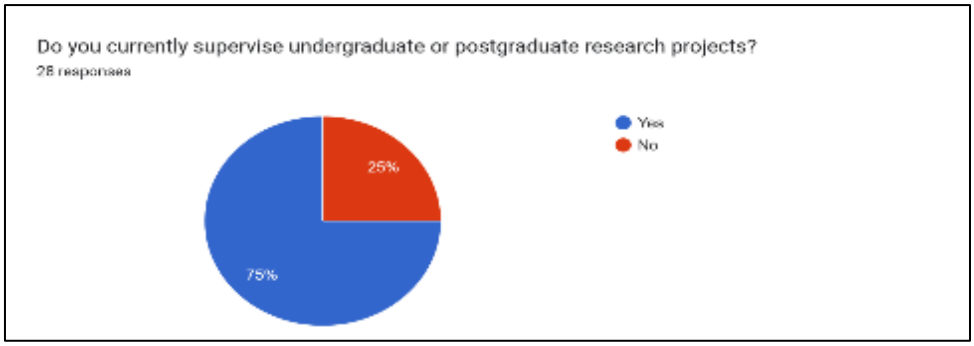

Figure 5 Supervision of research projects.

The survey also probed the challenges affecting student research, and the responses painted a stark picture of systemic limitations. Financial constraints emerged as the most pressing concern, cited by 89.28% of participants (refer to Figure 6). Limited access to research resources—including equipment, software, databases, and laboratories—was also a major issue, affecting over 82% of the respondents. This finding underscores a chronic underfunding of research infrastructure in Nigerian universities; a problem echoed in recent studies on university funding models in developing economies [**17,18,19,20**]. Moreover, more than half of the respondents (53.53%) noted that many students lack prior research experience, further compounding the difficulties in producing high-quality research. Inadequate mentorship and time constraints were also identified as contributing factors, with 39.28% of respondents highlighting the need for improved faculty-student guidance mechanisms.

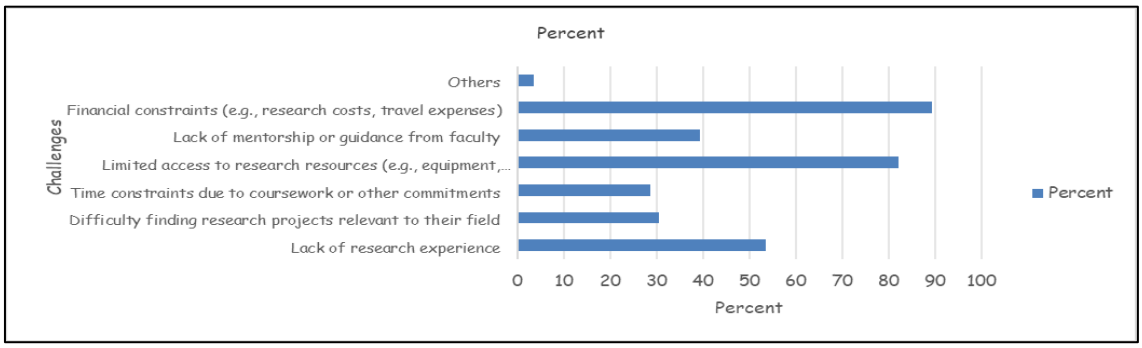

Figure 6 Challenges confronting student research activities

The primary finding is that financial support and access to resources are overwhelmingly considered the most critical factors for improving student research activities (refer to Figure 7). A significant majority of respondents (92.85%) emphasized increasing research funding opportunities for students, followed closely by improving access to research facilities and resources (85.71%). This highlights a clear and urgent need for tangible, practical support to enable students to conduct quality research [21].

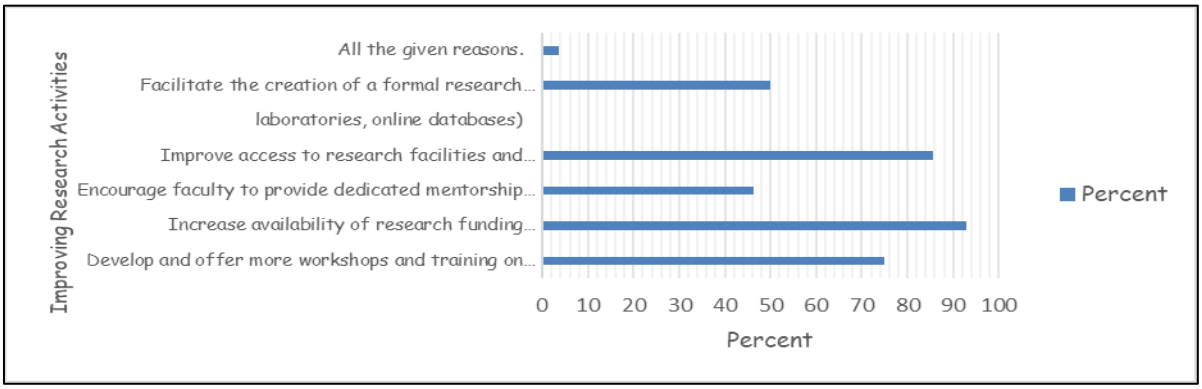

Figure 7 Enhancing research activities

Another key insight pertains to faculty readiness for effective research mentorship. While a slight majority of respondents (57%) believed that faculty members were adequately prepared to guide student research, an overwelming minority (42.9%) expressed disagreement (refer to Figure 8). The concerns raised included insufficient training in contemporary research methodologies, limited access to modern tools and platforms, and institutional barriers such as overwhelming teaching loads, poor remuneration, and a lack of formal incentives for research mentorship [22]. These factors contribute to an environment in which even highly qualified faculty may struggle to offer consistent, high-quality supervision.

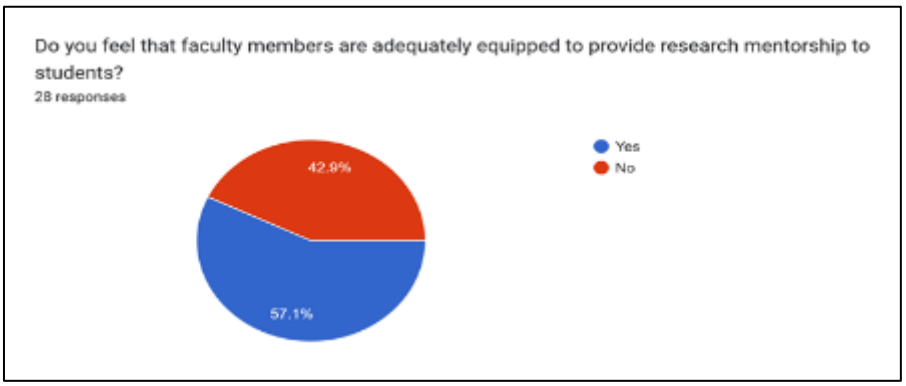

Figure 8 Provision of research mentorship

The issue of academia-industry collaboration emerged as a critical area of concern. An overwhelming 75% of respondents indicated that their departments had no existing collaborations with industry partners on research-related projects (refer to Figure 9). This absence of engagement with the private sector represents a missed opportunity for practical application of research and limits students' exposure to industry-relevant skills and contexts. The benefits of robust academia -industry linkages for innovation and graduate employability are well-documented globally [23,24,25, 26,27].

The remaining 25% of respondents who reported some form of industry collaboration noted tangible benefits for students, including improved research relevance, skill development, and exposure to real-world challenges. However, even within this minority, some faculty suggested that the benefits of collaboration had yet to fully manifest, pointing to the need for better goal-setting, communication, and coordination between academia and industry stakeholders.

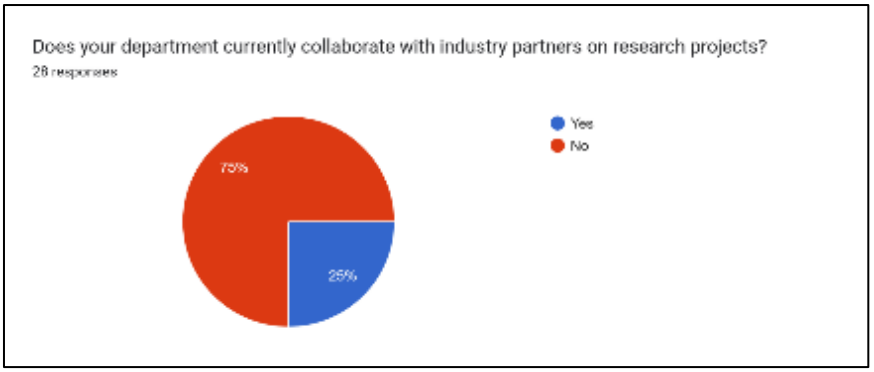

Figure 9 Research collaboration with industrial partners

4. Promoting Research Excellence in Nigerian Universities: Surmounting the Challenges

Nigerian universities possess a strong foundation of highly qualified and engaged faculty, suggesting immense potential for a thriving research culture. However, this study reveals that this potential is consistently stifled by deep-seated structural, financial, and organizational impediments. These systemic constraints severely hinder effective knowledge creation, dissemination, and application, ultimately limiting the impact of academic contributions.

4.1. Pervasive Resource and Financial Constraints.

A critical and recurring theme is the limited access to research resources and persistent financial constraints. This challenge, while not new to sub-Saharan African higher education, remains profoundly embedded [28]. Without sufficient investment in well-equipped laboratories, access to academic journals, robust computing facilities, and reliable internet, even the most dedicated faculty and students face significant hurdles. The impact is particularly acute in engineering and technical disciplines, where the need for expensive hardware, specialized software, and experimental infrastructure often goes unmet. This directly compromises the quality and scope of research projects, limiting their potential societal impact [29].

These financial and resource deficiencies are perceived by students and other stakeholders as fundamental barriers. The overwhelming emphasis on increasing research funding opportunities for students (92.85%) and improving access to facilities and resources (85.71%) underscores this critical need. Without adequate funding, students struggle with project costs and conference attendance, while limited access to essential equipment and information severely restricts the quality of their work. Institutions must prioritize budgetary allocations and infrastructure development to address these core needs head-on [30,31].

4.2. Deficiencies in Student Research Experience and Mentorship

A particularly troubling finding is the substantial number of students who reportedly lack basic research experience. This deficiency often stems from weaknesses in undergraduate curricula, which frequently defer meaningful research engagement until the final year. Compounding this issue is the absence of structured mentorship programs. Without early exposure to research methods and the guidance of skilled mentors, students struggle to develop crucial critical thinking, problem-solving, and analytical skills. This problem is further exacerbated by the heavy workload of faculty members, who often balance extensive teaching responsibilities, administrative duties, and personal research goals with insufficient institutional support or compensation, limiting their capacity for effective student mentorship [32].

The data reveals a clear and critical need for structured training and mentorship programs for students. The high demand for workshops on research skills (75%) and the recommendation for formal research mentorship programs (50%) clearly indicate that students require more than just resources; they need structured guidance to develop competencies and navigate the research process effectively. This highlights the importance of curriculum reform and programmatic initiatives that integrate comprehensive research training and facilitate robust mentorship connections.

4.3. The Nuance of Faculty Mentorship and Institutional Barriers.

The discussion around faculty mentorship is nuanced and highlights a significant institutional challenge. While 57% of faculty members believe they are adequately equipped to mentor students, a substantial 42.9% disagree. The critiques from those who disagree with the current research environment are telling. They cite a lack of training in contemporary

research methodologies (53 % of respondents), insufficient access to modern research tools (82 % of respondents), and a generally poor academic work environment due to financial constraints (89% of respondents). These findings, as presented in Figure 6, highlight that the primary obstacles are systemic and require comprehensive institutional reform rather than isolated interventions. Until these structural barriers are addressed through professional development, mentorship training, and improved faculty welfare, the quality of student research output as emphasized by studies on faculty readiness for contemporary research mentorship, will remain inconsistent at best [33,34,35,36,37,38].

This lack of consensus on faculty preparedness for mentorship is critical because it points to systemic deficiencies that hinder faculty's ability to effectively guide students. It suggests a cyclical problem: if faculty members themselves lack sufficient training, resources, and institutional backing for their own research and mentorship roles, they cannot adequately support students.

4.4. The Absence of Effective Academia -Industry Collaboration

Another striking theme is the near absence of effective academia-industry collaboration. In today's global research landscape, innovation ecosystems are increasingly defined by strong links between academia, industry, and government. Nigerian universities appear to be significantly lagging in this regard. The study reveals that three-quarters of departments do not engage in any form of industry partnership, and even among the remaining 25%, the impact of such collaborations is marginal. This disconnect has profound implications. Industry partnerships could provide invaluable funding, equipment, data, and real-world problem statements that significantly enrich student research. They also offer crucial pathways for commercialization and policy impact, which are key metrics of research utility in the 21st century. Moreover, industry collaboration helps bridge the employability gap by exposing students to the skills, tools, and challenges they will encounter in the workforce. Where collaborations do exist, they are often informal, unstructured, and poorly communicated, lacking clear goals or mechanisms for knowledge transfer (e.g., joint publications, co-developed technology, or student internships) [39,40].

The findings suggest that where collaborations exist, they are often informal, unstructured, and poorly communicated. Respondents noted a lack of clearly defined goals and limited mechanisms for knowledge transfer, such as joint publications, co-developed technology, or student internships. Such informal mechanisms of university knowledge transfer do not directly enhance firm-level innovation. Instead, their positive influence is entirely channeled and mediated through the establishment and strengthening of knowledge networks. This suggests that casual, ad-hoc interactions between universities and firms are largely insufficient on their own. Only robust, well-coordinated social systems and networks are indispensable for knowledge to effectively translate into tangible innovation. This informal nature is a common barrier to effective academia-industry partnerships in emerging economies [41,42,43,44]. This underscores the need for more formalized partnership frameworks, governed by Memoranda of Understanding (MoUs), with clearly articulated objectives, timelines, and deliverables, along with mechanisms for continuous evaluation.

4.5. Lack of Institutional Recognition and Reward Systems

An equally important observation is the lack of institutional recognition and reward systems for faculty who engage in research mentorship or industry collaboration. Without tangible incentives—such as promotions, research grants, sabbaticals, or performance bonuses—faculty may be reluctant to invest their valuable time in mentoring students or building external relationships. Universities must establish robust systems that actively reward faculty engagement in research, recognizing it as both a means of professional growth and a catalyst for broader institutional development [45,46,47].

5. Promoting a Knowledge-Driven Economy: How Policy Can Support Lasting National Development

This paper examines how Nigeria can foster a knowledge-driven economy for long-term development. It focuses on how higher education reforms, specifically through strong partnerships between universities and industries, can significantly boost research output. The benefits for national development are extensive and include:

- **Enhancing the Research Ecosystem:** Reforms that encourage collaboration and innovation within academic institutions aren't just for small improvements; they are a catalyst for a dramatic increase in both the quantity and quality of academic research. This directly accelerates Nigeria's scientific and technological progress. [16].
- **Strengthening Industry-Academia Connections:** By aligning university research with the needs of the industry, higher education institutions can become dynamic centers that drive economic growth. This is achieved through solving real-world problems, speeding up the transfer of new technologies, and developing a highly skilled workforce that the industry needs.

- **Unleashing Human Potential:** Empowering faculty and modernizing research policies are crucial steps. These actions not only improve the skills of individual researchers but also provide the foundation for a rapid expansion of a competitive, knowledge-based economy.
- **Informing Policy-Making:** The findings from this research provide a valuable, practical guide for government and education policymakers. They offer the necessary direction to reform research funding, improve incentive programs, and restructure institutional frameworks. The ultimate goal is to aggressively pursue national objectives like creating jobs, promoting industrialization, and achieving technological self-reliance.

6. Study Contributions, Limitations, and Future Research

This study contributes meaningfully to the discussion about improving research and institutional development in Nigerian higher education. By assessing the current state of faculty mentorship, research infrastructure, and collaboration with industry, it provides data-driven insights into the key issues that limit research productivity and impact in Nigerian universities.

6.1. Key Contributions

One of the study's main contributions is its specific focus. Instead of offering general recommendations, it's based on feedback from faculty members who are actively supervising research in engineering and technical fields. The findings are practical, targeted, and relevant to the specific challenges in these areas.

The study also provides empirical evidence of the disconnect between academia and industry. While collaboration is a common topic in academic literature, few studies have quantified the problem from the perspective of the faculty who are directly affected. This research fills that gap by highlighting the low level of current collaboration, the benefits where it does exist, and the opportunities for expanding these partnerships to improve student learning and problem-solving skills.

Furthermore, the study sheds light on mentorship readiness among faculty. It shows that many faculty members, despite their advanced qualifications, feel unprepared to effectively mentor student researchers due to a lack of institutional support and incentives. This finding broadens the discussion on faculty development and highlights the need for a comprehensive approach to capacity-building.

6.2. Limitations and Future Research

Despite its valuable contributions, the study has some limitations. The most significant is the small sample size of fewer than one hundred respondents. Although they were from three reputable institutions, the limited representation of non-engineering disciplines means the findings might not apply to the wider Nigerian university system. The study also relied on self-reported data, which could lead to bias, as participants might have exaggerated challenges or downplayed strengths. In addition, the survey method, while good for providing a general overview, doesn't offer the depth that qualitative methods like interviews or focus groups would. It tells us what is happening, but not always why.

For future research, it is recommended to use a mixed-methods approach that combines quantitative data with qualitative insights. Expanding the study to include more institutions from various regions and disciplines would also make the findings more robust. Finally, longitudinal studies are needed to track the long-term effects of reforms and assess whether improvements in funding, development programs, and industry collaborations are actually leading to better research outcomes.

Ultimately, this study provides a crucial foundation for future academic work and institutional policy development. It opens the door for further research into how Nigerian universities can strengthen their research ecosystems and better support faculty and students in creating knowledge that is both academically rigorous and socially relevant.

7. Recommendations for Reforms and Alignment

In light of the significant challenges identified in the study—including inadequate research funding, poor infrastructure, limited mentorship capacity, and the lack of robust academia - industry collaboration—it is imperative that Nigerian universities adopt a multidimensional reform strategy. The following enumerated recommendations are designed to address both institutional weaknesses and broader systemic inefficiencies, while aligning university research goals with national development priorities and global best practices:

- **Boost Research Funding and Financial Autonomy**. Universities must proactively diversify their research funding sources. This involves actively engaging government agencies, forging partnerships with the private sector, and securing grants from international donors. Critically, dedicated internal grants for both student and faculty research should be established and disbursed with complete transparency to ensure equitable access across all departments. Furthermore, universities should rigorously advocate for increased budgetary allocations from relevant government ministries responsible for education and innovation.
- **Modernize and Fortify Existing Research Infrastructure.** A fundamental step towards improving research quality is the strategic upgrading of laboratories, libraries, and digital research platforms. This includes the essential acquisition of specialized equipment, ensuring comprehensive access to academic databases, and guaranteeing reliable power supply and high-speed internet connectivity. Universities should make it a top priority to invest in infrastructure that specifically supports interdisciplinary and applied research, reflecting contemporary global trends.
- **Develop and Institutionalize Faculty Development Programs.** To cultivate a robust research culture, comprehensive training in research design, data analysis, effective supervision techniques, and successful grant writing should be regularly offered. These programs should be mandatory for new faculty members and readily available as continuous professional development for all staff. Crucially, mentorship training must be prioritized to build a sustainable culture of guidance and academic leadership that can nurture the next generation of researchers.
- **Create Structured Mentorship Frameworks.** Universities must establish formal mentorship policies that clearly define the roles, responsibilities, and expectations for both mentors and mentees. These frameworks should be seamlessly integrated into departmental activities and periodically evaluated for their effectiveness. To encourage sustained faculty engagement in this vital role, clear incentives such as recognition, workload reductions, or performance bonuses should be implemented.
- **Foster Strategic and Measurable Industry Collaboration.** Nigerian universities should proactively initiate and cultivate strategic partnerships with industry actors. This can be achieved by aligning university research priorities with real-world industrial challenges through joint research projects, student internships, guest lectures, and co-funded innovation hubs. Every collaboration must be governed by clearly defined Memoranda of Understanding (MoUs), Meticulously specifying goals, deliverables, and robust mechanisms for monitoring and evaluation to ensure mutual benefit and accountability.
- **Promote Early Student Engagement in Research.** To cultivate a strong research pipeline, research exposure should begin early in undergraduate programs. This allows students to gradually build competence in methodology, critical thinking, and innovation. Curriculum reforms that embed research-based learning throughout the academic journey are essential. Furthermore, capstone projects should be designed to address real-world problems, yielding tangible and impactful outcomes.
- **Align Research with National and Regional Development Agendas.** Universities have a vital role in national development. Their research output must be strategically aligned with Nigeria's key development goals, such as energy security, climate resilience, public health, agriculture, and digital transformation. Establishing research centers of excellence focused on these themes, and coordinating their activities with relevant government agencies and regional development bodies, will ensure research directly contributes to societal progress.
- **Enhance Faculty Welfare and Create Incentive Structures.** To retain and motivate academic staff, significant improvements in salaries, research allowances, and clear career progression pathways are critical. Furthermore, performance-based incentives linked to research output, mentorship quality, and successful industry engagement should be introduced [16]. These incentives will foster greater accountability and drive a culture of excellence within the academic community.

By embracing and rigorously implementing these prescribed reforms, the Nigerian university system can effectively reposition itself as a dynamic engine of innovation. This will not only equip students with the skills essential for a knowledge economy but also significantly strengthen the universities' relevance and impact in a rapidly evolving global landscape.

8. Conclusion

The study confirms that while a strong desire for research exists among Nigerian engineering faculty, significant systemic and institutional barriers hinder their productivity. The findings underscore the urgent need for a shift from outdated, individualistic research models to a collaborative, interdisciplinary, and industry-aligned approach.

The recommendations presented in this paper, including institutional reforms, policy adjustments, and capacity-building initiatives, offer a clear roadmap for creating a more dynamic and impactful research ecosystem. By adopting these measures, Nigerian universities can bridge the gap between academia and industry, fostering innovation and contributing meaningfully to national economic development.

Compliance with ethical standards

Acknowledgements

This paper, stemming from a student engagement activity, received generous support from the Royal Academy of Engineering, United Kingdom through its Higher Education Partnership in Sub-Saharan Africa project (Project No. HEPSSA-2425-5-100-116). The authors extend their gratitude to Abubakar Tafawa Balewa University, Bauchi; the University of Calabar, Calabar; Lagos State University of Science and Technology, Ikorodu; and Egbin Power, Plc for their support as spoke institutions or industry partners.

Disclosure of Conflict of Interest

The authors, Ejilah, I.R., Bankole, Y. O., Omamo, A., Viza, E., Agboneni. O., Daser-Adams. J.L., Omoyi, C.O., and Mohammed, B., have declared that there are no competing interests to disclose.

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