Journal of Biology and Genetic Research Vol. 11 No. 3 2025 E-ISSN 2545-5710
P-ISSN 2695-222X www.iiardjournals.org online version

Role Of Biotechnology in Building a Skilled Bioeconomy Workforce for The Contemporary Society in Rivers State.

Bruno, Ibeabuchi Anwuri, Oduah, Asuodini Anthony, & Oreke, Obusor Happiness
Department of Biology Education,
Federal Collage of Education (Technical) Omoku,
Rivers State.
Email: anwuribruno@gmail.com, oduah.asuodinianthony@fcetomoku.edu.ng,
orekehappiness@gmail.com
DOI: 10.56201/jbgr.vol.11.no3.2025.pg1.8

Abstract
Biotechnology is a key driver of economic growth and innovation, particularly in developing regions like Rivers State, where a skilled bioeconomic workforce is essential for sustainable development. This study investigates the role of biotechnology education in equipping individuals with industry-relevant skills, addressing labor market demands, and fostering entrepreneurial aspirations. Using a quasi-experimental research design, data were collected from students, educators, and industry professionals to evaluate the current state of biotechnology education, existing challenges, and its impact on entrepreneurship.
Findings reveal that while biotechnology education contributes significantly to workforce development, challenges such as outdated curricula, inadequate funding, and poor infrastructure hinder its effectiveness. financial constraints and policy gaps limit opportunities for biotech startups. To bridge these gaps, the study recommends curriculum modernization, enhanced industry-academia collaboration, increased funding, and the establishment of biotechnology innovation hubs.
This research underscores the need for strategic policies and targeted interventions to strengthen biotechnology education, ensuring alignment with industry needs and fostering a thriving bioeconomy.

Keywords: *Biotechnology Education, Bioeconomy, Workforce Development, Entrepreneurship, Curriculum Reform, Industry-Academia Collaboration, Rivers State.*

Introduction

Biotechnology has emerged as a cornerstone of innovation, shaping contemporary society and redefining economic paradigms. By leveraging biological systems and organisms to develop cutting-edge products and services, biotechnology has revolutionized key sectors such as healthcare, agriculture, environmental management, and industrial processes (OECD, 2019). These advancements have given rise to the bioeconomy—a knowledge-based economic framework predicated on sustainable and innovative biotechnological applications (Bugge et al., 2016).

Biotechnology is increasingly recognized as a critical sector in addressing global challenges and contributing to economic growth. According to Smith et al. (2019), biotechnology plays a vital role in the development of sustainable solutions in agriculture, healthcare, and environmental management. As a result, many countries have prioritized the sector as a means of economic

diversification and job creation. In Nigeria, biotechnology has been identified as a key area for diversification away from oil dependence (Okeke & Nwachukwu, 2018). The potential of biotechnology to drive economic development in Rivers State is clear, as the region seeks to transition to a more diverrsified economy that leverages its natural resources and human capital.

The global shift toward bioeconomy-driven growth has underscored the necessity of a skilled and adaptive workforce. A well-prepared workforce is essential not only for sustaining bioeconomic progress but also for addressing pressing societal challenges such as climate change, food insecurity, and emerging health crises (McCormick & Köhler, 2020). However, achieving this goal requires a robust education system capable of equipping individuals with interdisciplinary knowledge, technical expertise, and entrepreneurial competencies (El-Chichakli et al., 2016).

Despite the transformative potential of biotechnology, significant challenges persist in aligning educational outcomes with the practical demands of the bioeconomy. Many educational institutions continue to prioritize theoretical knowledge over industry-relevant training, creating a skills gap that hampers workforce readiness (Bugge et al., 2016). This issue is particularly pronounced in developing economies, where limited access to resources and advanced technologies exacerbates the disparity between labor market needs and workforce capabilities (OECD, 2019).

Furthermore, the bioeconomy thrives not only on employment but also on innovation and entrepreneurship. Empowering biotechnology graduates with entrepreneurial skills can catalyze the creation of bio-based enterprises, fostering job creation and sustainable economic development (McCormick & Köhler, 2020). As a result, there is an urgent need for education reforms and policy interventions that bridge the gap between academia and industry, while also promoting entrepreneurial ventures within the biotechnology sector.

Education in biotechnology is critical for the development of a skilled workforce capable of addressing the growing demands of the bioeconomy. Biotechnology education programs should equip students with the technical, managerial, and entrepreneurial skills necessary for success in the biotechnology industry. According to Agboola & Osunsanmi (2020), the development of a bioeconomic workforce requires a concerted effort to integrate biotechnology education with industry needs, ensuring that curricula reflect the latest technological advancements and market demands. However, in many developing countries, including Nigeria, the education system has not fully aligned with the fast-paced developments in biotechnology, creating a mismatch between the skills taught in schools and those required by the labor market (Chikere & Okorie, 2016).

In Rivers State, the challenge lies in ensuring that local educational institutions have the necessary infrastructure and expertise to teach cutting-edge biotechnology concepts. Studies show that a lack of modern laboratory facilities, insufficient funding, and outdated curricula are significant barriers to developing a skilled workforce (Okeke & Nwachukwu, 2018). Moreover, there is limited collaboration between educational institutions and biotechnology industries, further exacerbating the gap between educational outputs and industry needs (Udechukwu & Orji, 2017).

In addition to workforce development, biotechnology education has the potential to stimulate entrepreneurial activity and foster innovation. Biotechnology entrepreneurs can create startups that address local challenges in healthcare, agriculture, and environmental sustainability. According to Akinmoladun & Nnamdi (2020), biotechnology entrepreneurship plays a crucial role in the broader bioeconomy, contributing to economic diversification and job creation. In Rivers State, there is untapped potential for biotechnology-based startups, but the lack of a supportive ecosystem and

the absence of practical entrepreneurship training in biotechnology education programs have hindered this potential.

Recent studies suggest that universities and research institutions should serve as hubs for innovation and entrepreneurship. They argue that an entrepreneurial mindset, fostered through education and mentorship, is key to translating scientific knowledge into marketable solutions (Agboola & Osunsanmi, 2020). Despite this, the lack of entrepreneurial infrastructure in Rivers State, such as business incubators and venture capital, limits the ability of biotechnology graduates to launch successful startups (Udechukwu & Orji, 2017).

A major theme in the literature is the need for biotechnology education to be responsive to labor market demands. In many developing regions, educational institutions struggle to adapt their curricula to the evolving needs of the biotechnology industry. According to Okeke and Nwachukwu (2018), while biotechnology education in Nigeria has grown in recent years, there remains a significant gap between the skills acquired by graduates and the skills required by employers in the biotechnology sector. This misalignment is particularly evident in fields like bioinformatics, biopharmaceuticals, and environmental biotechnology, where there is a high demand for skilled professionals but a shortage of qualified candidates (Smith et al., 2019).

In Rivers State, this gap is compounded by the relatively low level of biotechnology industry development. Local industries often seek professionals with specialized knowledge and hands-on experience, but many biotechnology graduates lack the practical training needed to thrive in these sectors (Akinmoladun & Nnamdi, 2020). Addressing this gap requires close collaboration between educational institutions, industry stakeholders, and government bodies to ensure that biotechnology education meets the evolving needs of the bioeconomy (Chikere & Okorie, 2016).

The challenges faced by biotechnology education in Rivers State mirror those of many developing regions. According to Agboola and Osunsanmi (2020), the key barriers include inadequate infrastructure, a lack of skilled faculty, limited funding, and outdated curricula.

Statement of the Problem

The biotechnology sector has become a critical component of the global economy, offering potential solutions to pressing issues such as healthcare, food security, and environmental sustainability (OECD, 2019). However, in Rivers State, Nigeria,according to Chikere & Okorie (2016), the integration of biotechnology into the education system faces significant challenges, including limited infrastructure, outdated curricula, and a mismatch between educational outputs and labor market demands. These challenges limit the potential for creating a skilled bioeconomic workforce that could drive the region's economic diversification beyond the oil sector.

Despite the growing interest in biotechnology as a driver for national development, the absence of a well-structured and industry-responsive education system has hindered the effective development of a workforce capable of seizing entrepreneurial opportunities in the bioeconomy Udechukwu & Orij (2017). While some strides have been made in biotechnology education, the alignment between what is taught and the practical skills required by the biotechnology industry remains insufficient (Okafor, 2022).

This study seeks to explore how biotechnology education in Rivers State can be enhanced to meet labor market demands and support entrepreneurial aspirations, thereby contributing to the development of a skilled bioeconomic workforce in the region.

Purpose of the Study:

The purpose of this study is;

1. To assess the current state of biotechnology education in Rivers State, focusing on its alignment with local and national labor market demands.
2. To identify the challenges and gaps in biotechnology education that impede workforce development and entrepreneurial growth.
3. To examine how biotechnology education can foster innovation, entrepreneurship, and the development of biotech startups in Rivers State.

Research Questions:

The study addressed the following research questions:

1. To what extent does the current status of biotechnology education in Rivers State, and address the needs of the labor market in the bioeconomy?
2. What at are the key challenges faced by biotechnology education programs in Rivers State,?
3. How does biotechnology education influence the entrepreneurial aspirations of students and fostering biotech startups?

Methodology

This study employd a quasi-experimental research design to examine the role of biotechnology education in building a skilled bioeconomic workforce in Rivers State. The population consist of 2500 respondent's where 345 respondent's were selected using purposive and stratified random sampling.

The instrument for data collection was a structured questionnaire titled "Role of biotechnology in building a skilled bioeconomy workforce for contemporary society in Rivers State". the instrument was subjected to face and content validity by two experts.

Data collected from the respondents was analyzed using descriptive statistics to analyze questionnaire responses, and inferential statistics : paired sample t-test was used to compare per-test and post-test, while ANOVA was used to test significant difference between experimental and control groups.

Results

Below are the statistical distribution tables for each of the research questions, showing the responses from different stakeholders. The data is organized based on responses from biotechnology students, educators, and industry professionals.

Research Question 1:
To what extent does current status of biotechnology education in Rivers State, address the needs of the labor market in the bioeconomy?

Response Category	Students (N=250)	Educators (N=55)	Industry Professionals (N=40)	Total (N=345)	Percentage (%)
Strongly Agree	40	10	5	55	15.9%
Agree	85	20	10	115	33.3%
Neutral	50	15	10	75	21.7%
Disagree	55	5	10	70	20.3%
Strongly Disagree	20	5	5	30	8.7%
Total	**250**	**55**	**40**	**345**	**100%**

Key Insight: About **49.2% (Agree + Strongly Agree)** believe biotechnology education is addressing labor market needs, while **29% disagree or strongly disagree**, indicating a need for curriculum improvements.

Research Question 2:
What are the key challenges faced by biotechnology education programs in Rivers State,?

Challenges	Students (N=250)	Educators (N=55)	Industry Professionals (N=40)	Total (N=345)	Percentage (%)
Outdated Curriculum	80	30	15	125	36.2%
Poor Infrastructure	60	15	10	85	24.6%
Inadequate Funding	70	5	10	85	24.6%
Lack of Industry Linkages	40	5	5	50	14.5%
Total	**250**	**55**	**40**	**345**	**100%**

Key Insight: Outdated curriculum (36.2%) and inadequate funding (24.6%) are the top challenges affecting biotechnology education in Rivers State.

Research Question 3:
To what extent does biotechnology education influence the entrepreneurial aspirations of students and fostering biotech startups in Rivers State?

Response Category	Students (N=250)	Educators (N=55)	Industry Professionals (N=40)	Total (N=345)	Percentage (%)
Very High Influence	60	15	10	85	24.6%
High Influence	80	20	10	110	31.9%
Moderate Influence	50	10	10	70	20.3%
Low Influence	40	5	5	50	14.5%
No Influence	20	5	5	30	8.7%
Total	**250**	**55**	**40**	**345**	**100%**

Key Insight: About **56.5% (Very High + High Influence)** believe biotechnology education positively influences students' entrepreneurial aspirations, while **23.2% feel the impact is low or nonexistent**, suggesting the need for more entrepreneurial support.

Discussion of Findings

The study examined the role of biotechnology education in developing a skilled bioeconomic workforce
in Rivers State. The findings provide critical insights into the current state of biotechnology education, the challenges faced, and its influence on entrepreneurial aspirations.

Findings in table 1 suggest that biotechnology education in Rivers State is still evolving, with 49.2% of respondents agreeing that the curriculum aligns with labor market needs. However, significant gaps remain, particularly in practical training, industry partnerships, and research infrastructure. These findings align with studies by Okafor et al. (2022) and Nwosu & Ibrahim (2021), which emphasize the need for biotechnology curricula to incorporate more industry-focused skills.

Key challenges as outlined in table 2 include outdated curriculum (36.2%), poor infrastructure (24.6%), and inadequate funding (24.6%). Many educators highlighted the lack of modern laboratory equipment, while students expressed concerns over limited research opportunities. Similar challenges have been reported in biotechnology education across Africa (Akinwale, 2020), stressing the importance of government funding and industry-academia collaboration.

Findings in table 3 shows that; About 56.5% of respondents acknowledged that biotechnology education positively influences students' entrepreneurial ambitions, but financial constraints and policy gaps limit startup opportunities. These findings resonate with Chukwuma & Adeyemi (2023), who found that many biotechnology graduates struggle to access startup capital despite having innovative business ideas. Strengthening incubation programs and funding mechanisms can enhance biotech entrepreneurship.

Conclusion

The study concludes that while biotechnology education in Rivers State has potential to develop a skilled bioeconomic workforce, several structural issues hinder its effectiveness. Modernizing the curriculum, improving infrastructure, increasing funding, and fostering industry partnerships are necessary steps toward building a sustainable biotechnology sector. Additionally, integrating entrepreneurship training and financial support will enable students to transition into biotech startups, further contributing to economic development.

Recommendations

From the findings of the study, the following recommendations are proposed:

1. Industry-Academia Partnerships – Stronger collaborations with biotech firms, pharmaceutical companies, and research institutes will improve students' practical training and employability.
2. Curriculum Modernization – Universities should revise biotechnology curricula to integrate industry-demanded skills such as bioinformatics, industrial biotechnology, and synthetic biology.
3. Entrepreneurship and Innovation Hubs – Universities should establish biotechnology incubation centers to support students interested in biotech startups.

References

Agboola, D. A., & Osunsanmi, O. M. (2020). The role of biotechnology in fostering innovation and entrepreneurship. *African Journal of Business and Economic Studies*, 12(2), 121–134.

Akinmoladun, O., & Nnamdi, A. (2020). Biotechnology entrepreneurship in the Nigerian context: Challenges and prospects. *Journal of Entrepreneurship and Innovation in Emerging Economies*, 4(1), 45–60.

Akinwale, T. (2020). Challenges in Biotechnology Education in Africa. *African Journal of Biotechnology*, 19(3), 45-58.

Bugge, M. M., Hansen, T., & Klitkou, A. (2016). What is the bioeconomy? A review of the literature. *Sustainability*, 8(7), 691.

Chikere, C. B., & Okorie, D. I. (2016). The role of biotechnology in sustainable development: Challenges and opportunities. *International Journal of Scientific Research in Environmental Sciences*, 4(2), 45–58.

Chukwuma, E., & Adeyemi, O. (2023). Entrepreneurial Challenges in Biotechnology Education. *Nigerian Journal of Science and Innovation*, 27(2), 112-128.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

El-Chichakli, B., von Braun, J., Lang, C., Barben, D., & Philp, J. (2016). Five cornerstones of a global bioeconomy. *Nature*, 535(7611), 221-223.

Nwosu, J., & Ibrahim, K. (2021). Aligning Biotechnology Education with Industry Demands. *Journal of Applied Biotechnology Research*, 15(1), 78-91.

McCormick, K., & Köhler, J. (2020). The bioeconomy in Europe: An overview. *Sustainability*, 12(11), 4503.

OECD. (2019). The Bioeconomy to 2030: Designing a Policy Agenda. Organisation for Economic Co-operation and Development.

Okafor, P., et al. (2022). Curriculum Reforms in Biotechnology Education. *International Journal of STEM Education*, 20(5), 213-230.

Okeke, F. N., & Nwachukwu, J. I. (2018). Biotechnology education and its impact on labor market demands in Nigeria. *Journal of Educational Development*, 15(4), 134–145.

Smith, R., Jones, A., & Roberts, M. (2019). Biotechnology and economic development: The growing role of biotechnology in sustainable solutions. *Global Journal of Biotechnology and Bioeconomy*, 5(1), 15–30.

Udechukwu, I., & Orji, U. M. (2017). Bridging the gap: Aligning biotechnology education with labor market needs in Nigeria. *African Journal of Education and Technology*, 6(3), 122–130.