THE CRISIS IN PHYSICS EDUCATION IN NIGERIA: CAUSES, CONSEQUENCES, AND STRATEGIC INTERVENTIONS

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Abstract

Physics education is fundamental to Nigeria's ambitions for technological growth, yet recent trends indicate a troubling decline in its effectiveness. Nigeria is experiencing a growing crisis in physics education, marked by declining student enrollment, poor academic performance, inadequate instructional resources, and a shortage of qualified teachers. This article examines the causes, consequences, and strategic interventions required to address this crisis. Drawing on recent empirical studies and policy reports, the paper identifies major contributing factors, including low student interest and physics phobia, weak teacher preparation and limited professional development, scarcity of laboratory facilities, a curriculum that is irrelevant to students' daily realities, and persistent learning difficulties and misconceptions. These challenges have led to poor examination outcomes, a shortage of physics teachers and STEM professionals, widening educational inequalities, and reduced national capacity for scientific and technological development. To reverse this trend, the paper recommends sustained teacher professional development, improved provision of laboratory infrastructure, curriculum reform and contextualization, adoption of learner-centered and problem-based pedagogies, strategic integration of digital technologies, early development of interest in science, and strong policy support. The paper concludes that addressing the physics education crisis requires coordinated systemic reforms to ensure Nigeria's long-term technological and economic growth.

Keywords: Physics education; Science education reform; Teacher professional development; Curriculum relevance; STEM development

Introduction

According to Adeniyi *et al*. (2024), the set of skills that physics could offer to the engineering field, such as creativity, innovation, problem-solving skills, and technological development (physics-related technologies), and the interdisciplinary collaboration (between the engineering, computer science, medicine, and material science domains, among others) are all the aspects of entrepreneurship education that physics could contribute to. Since the goal of physics education is to produce scientists capable of creating innovations in the technologies that may make life easier and comfortable to earn livelihood, it should follow that physics students across all educational levels (secondary and tertiary)should be able to develop intellectual and entrepreneurial capabilities that will facilitate their creation of wealth or creation of jobs. This will assist in reducing the rate of unemployment (Badmus & Omosewo, 2018).

Adebisi et al. (2020) sees Physics as one of the science prerequisites for enrolment in sciences and engineering programs at Nigerian Universities, Polytechnics, and Colleges of Education. Many of the innovations that are influencing modern technology have been greatly influenced by this subject, and it continues to do so. Many of the natural occurrences that one encounters in daily life have also been explained by the subject. However, Adebisi and Ogunmola (2023) opined that physics is a subject that shares characteristics with nature of science, relying on hands-on learning at all educational levels. It must be activity-based and practical in order for it to be genuine, doable, anxiety-free, and acceptable to the all students.

Physics constitutes part of science that highly depends on practice. According to Omosewo (2012), physics is the study of the matter, energy and how they interact. Physics is the subject that is more or

less related to other subjects of science due to its important role in the knowledge of the surrounding world. Bada *et al*. (2018) believes that one of the subject areas of focus in science is physics as it is connected with the other sciences. Physics is a study that makes its significant contribution when it comes to the technological growth of a nation. Therefore, the invention of gadgets like television, phone and other technology motivated products linger testaments in appreciating the significant role played by physics in the ease of life of man. This has brought physics to an enormous stature in terms of a technologically developed nation. Countries like Nigeria makes the study of physics a high priority and has instituted the national policy on education as a key towards achieving the goal of technological development (Federal Republic of Nigeria [FRN], 2013).

The general aims of the physics curriculum were outlined as follows in an effort to address the difficulties of effective physics teaching and learning in Nigeria and to make the curriculum relevant and appropriate in its content and context:

1. impart fundamental physics "literacy" for societal functioning;
2. learn fundamental physics concepts and principles in order to prepare for future research;
3. develop fundamental scientific attitudes and abilities in order to prepare for the technological application of physics; and
4. Encourage and improve creativity (FME, 2013).

Students must participate in practical activities with sufficient resources in order to develop "basic concepts,""essential skills," and "attitudes" for using technology and to foster creativity. For each of the curriculum's many lessons and themes, the curriculum offers clearly defined activities for both teachers and students.

However, many researchers have reported a consistent drop in the enrolment of physics at the secondary and post secondary level among students (Adolphus, 2019; Amusa, 2020; Mamah et al., 2021). Oladejo et al., (2023) in their analysis showed that students performance in Physics in WASSCE has declined over the years.

They noted that students' performance in the examination reached a peak high when 68% of students passed Physics in the year 2012, but dropped sharply to 46% the following year and has since then been on the decline.

Also, Adolphus, (2019) discussed in their findings that students register and take more of other science subjects, such as Biology and Chemistry more than they do for Physics, confirming the assertion that students try avoiding to register for Physics. Akinmoju et al., (2024) also noted a decline in the enrolment of students in Physics, citing lack of interest by the students due to the mathematical nature of the subject as the leading cause.

However, the study by Aina and Ayodele (2018) which was carried out to study the enrolment of students into science education in various Colleges of Educations in Nigeria for a period of five years found that out of 3,174 students that were admitted for various science education programmes, 2,187 (68.9%) were admitted for Biology, 712 (22.4%) were admitted for Chemistry while 275 (8.7%) were admitted for Physics.

Such a negative trend is not just an indication of a change in the popularity of the subject; it can be described as a developing crisis in preparing and supplying qualified professionals who are needed to teach physics effectively. The lack of physics teachers compromises the ability of schools to develop in students the scientific orientation, critical thinking capability and underlying competences that are essential in scientific innovation and creativity. The decreasing enrolment will consequently not just jeopardize the sustainability of physics education, but also have long term consequences on the national growth in the science and technology sector.

Physics in Nigeria is perceived to be in a complex crisis that is jeopardizing the technological growth of the country as well as the future of students. This discussion explores the key reasons, the long-term effects, and necessary strategic solutions to resolve this system issue.

Statement of Problem

Physics is a field of study that has the ability to develop scientific inquiry skills, problem-solving skills and as well provide a foundation for technological advancement. This is because of the dual nature of the subject. That is, the practical and theoretical aspects. However, despite the importance of Physics to scientific and technological growth, provision of man-power and entrepreneurship opportunities, many lapses have been noticed in the field in Nigeria. For instance, the rate of enrolment in the subject at secondary level and further at higher education has been alarming (Aina & Ayodele, 2018; Adolphus, 2019; Akinmoju et al., 2024). Moreso, poor quality of physics teachers and lack of professionalism (Eze & Made, 2022), lack of adequate teaching resources (Akinbobola & Bada, 2019), students misconceptions about Physics have all plagued the smooth learning of the subject (Adeduyigbe et al., 2024). These problems however, may result in poor results of students in the subject, shortage of teachers and professionals in physics, inequality in education, lack of interest in the subject. However, these crises can be averted by putting the right course on track. coherent teacher development; sufficient resource deployment as well as infrastructure; curriculum reform and contextualization; innovation in pedagogy and learner-Centeredpedagogy (interactive and practice-based approaches, collaborative learning, problem-based learning); digital learning resources and technology integration; early intervention and development of interest; policy support and systemic change.

Causes of the Crisis of Physics Education

Lack of Student Enrollment and Student Interest

Physics education in Nigeria is typified by low student enrollment and interest rates which are on the downward trend. This trend has been confirmed by several researchers (Ademoju et al., 2024; Adolphus, 2019; Oladejo et al., 2023).Many students progressively avoid enrolling in physics, even from the junior secondary level onwards (Aina & Ayodele, 2018; Akinmoju et al., 2024). In

Adolphus, (2019), the low popularity of physics among secondary school students in Rivers State was investigated, which indicated that the teacher qualities, the availability of the resources, and the efficient use of the available materials play an important role in the choice of the student to attend the school. Moreover, Students often develop physics phobia, a fear rooted in the perceived complexity and abstract nature of the subject (Ihekwaba, 2020). The phobia is early onset and self perpetuating where students will not go near the subject instead of trying to master some of the concepts.

Poor Teacher Qualities and Professionalism

A significant proportion of physics teachers lack the necessary qualifications, which impairs instructional quality and student engagement. A large number of secondary schools do not have teachers with the proper qualifications to teach physics, thus the schools have to use non-specialist teachers who have to teach physics (Eze & Madu, 2022). The authors investigated the problems of teaching physics in the curriculum to non-Physics majors in Rivers State (Aderonmu & Adolphus, 2023) and discovered that many of the teachers teaching Physics do not possess adequate knowledge of the subject but have to fill in due to lack of specialist teachers. This poses a snowball effect, that is, poor teaching by unqualified teachers results in poor student comprehension and a subsequent loss of interest (Fadipe et al., 2022).

Also, there is still abject deficiency in professional growth of physics teachers. According to Onyekwelu, (2024), the general approach to improving the quality of education involves conducting regular training workshops in which teachers of secondary schools will be asked to improve their knowledge of the subject studied, mentorship programs will be created, and time in which teachers can learn about new teaching methods will be provided. However, these are hardly applied. The teachers are not trained in innovative instructional strategies as well (Yakubu & Abdukareem, 2024), and the government and other stakeholders do not provide them with

sufficient training and retraining opportunities especially in information and communication technology (ICT).

Severe Resource Scarcity

Physics as a subject needs proper laboratory equipment. This is because there is a need for students to carry out various experiments. textbooks and teaching supplies-things that are severely missing in most of the Nigerian secondary schools. For instance, Tamunoiyowuna and Omeodu (2022) found a very low availability of laboratory equipment for Physics laboratory among schools in Rivers state. More than 65% of the schools in their study lacked the basic laboratory equipment (Ammeter, knife edge, thermometer, batteries, mass, voltmeter, key, etc.). It was also found out that the modern and specialized equipment of physics labs is lacking in many secondary schools in Nigeria (Oyelowo, 2023; Emeka et al., 2021), and that the decayed conditions of most workshops do not allow performing any meaningful practical work. The lack of access to electricity even four hours per day in schools only 30 percent of schools have access to electricity which makes it impossible to teach in laboratories.

It is not limited to the problem of equipment shortages. As Akinbobola &Bada, (2019) observed, although physics is the foundation of science and technology, most schools do not offer sufficient non-human resources (materials, physical, and financial) in this subject. The learners are denied the practical practical situations that are important in the interpretation of scientific concepts resulting in the overuse of textbook-based learning that does not engage learners or enhance practical skills.

Lack of Relationship between Curriculum and Student Realities

The curriculum often emphasizes abstract, Western-centric concepts, neglecting local contexts that could make physics more relatable and engaging. A number of these studies have revealed that a large number of students are not able to correlate what they learn in physics classes and their daily lives (Oladejo et al. 2023; Abiola et al. 2025;

Ogundeji, et al. 2025). This detachment is due to the fact that most times teaching in physics is taught in an abstract and formulaic way with little attention being given to practical applications in life. Consequently, students are inclined to think physics as a set of mathematical equations and theories and not as a science that explains natural phenomena and daily experiences like motion, energy consumption, electricity, sound, and heat.

Studies show that classroom teaching fails to provide students with a clear connection of concepts with their daily experiences, thus learners find it difficult to gain significant learning and long-term knowledge (Babalola & Ojobola; 2022; Oladejo et al. 2023). A large number of students cannot use physics theories in the real world beyond the classroom like learning the working mechanisms of domestic appliances, the rules of the road, or how to decipher everyday technological mechanisms. This irrelevance usually results in loss of interest and lack of motivation to the subject and negative attitudes.

Moreover, the conventional teacher-centered approach and teaching techniques that focus on exams are one of the causes of this issue, as they promote memorization rather than the understanding of concepts and ability to resolve problems. For instance, Babalola and Ojobola (2022) stated that lack of hands-on activities, experiments, demonstrations, and real-life examples makes it hard to make students realize that physics can be useful when it comes to solving real-life problems. Therefore, the lack of physical connection between physics concepts and real-life experiences is one of the key issues in physics education and the reason why instructional methods that focus on the contextual study, activities, and student-centered approaches should be used. This detachment makes physics abstract and unattainable to the majority of students who cannot see its applicability to their lives.

Learning Difficulties and Misconceptions

The students have a problem of learning the basics of physics, there is a general misunderstanding of electricity, force, motion and energy(Adeduyigbe et al., 2024; Obafemi & Aderonmu, 2022). According to Adeduyigbe et al., (2024), the misunderstandings about electricity are very common, and the percentage of students who have issues in simple understanding of the electricity concepts like flow of current and arrangement of a circuit is high. This is still perpetuated by the fact that these students do not have concrete examples and practical demonstrations that would equip them to relate the abstract to the observable. Also, there is the mathematical difficulty of physics, which needs knowledge of equations, formulas, graphs, and problem-solving, poses a challenge to students with weak background in mathematics.

Consequences of the Physics Education Crisis

Poor Educational Results

The effects of failure of physics education are vividly reflected in the results of exams. There has always been poor performance of students in physics as compared to other science subjects. As Erinosho, (2013) discussed, three key causes of learning difficulty as nature of subject, teaching/teacher factors and curriculum/assessment issues. This has the effect that less than 30 percent of SSCE applicants enroll in physics and among those who do, only a little more than 30 percent pass physics to credit level as opposed to well more than 40 percent of biology and chemistry. This disparity in performance enlarges the opportunities between the students in physics and other subjects.

Physics Teachers and Professionals Shortage

The dropping numbers of enrollment and low achievement in physics cause a shortage of severe shortage of physics-qualified teachers and STEM specialists. According to Emeka, et al. (2021) and supported by Anwo (2021), it was found that in Many secondary schools operate without professionally qualified physics teachers, resulting

in reliance on teachers from other disciplines. This continues to aggravate the poor teaching and loss of interest in the subject. Also, the universities physics departments are still experiencing a shortage of students and most of the enrollees have physics as an alternative way of not gaining admission and as such the performance levels are very low and turnover is very high (Adolphus, 2019).

Less Capacity of Scientific and Technological Development

The ruin of physics education poses a direct threat to the ability of Nigeria to develop scientifically and technologically. According to (Ayodele, 2024), technological development requires quality physics teaching, but the existing system prevents this possibility because of its failures. Nigeria may not be able to produce the human capital required in technological innovation, engineering development or scientific research without having good physics education. This has a long-term effect on the competitiveness and economic growth of the nation. And as such, may forestall the development of the nation technologically. Also, this may have effect on producing scientists who should drive the development of the nation in different areas of science.

Educational Inequity

Educational inequity is increased by resource disparities in physics. According to Adeduyigbe et al., (2024), the type of school made a significant difference in the difficulties experienced by students, with high scores in the private schools and low scores in the public school students on the measure of difficulty (Adesina, et al., 2024; Josiah & Oguoko, 2025). This implies that although wealthy private schools might possess a little higher resources there is still a lack of proper physics instruction in the two sectors. The rural students are more disadvantaged because they have fewer opportunities to access qualified teachers and laboratories (Adeoye et al. 2023).This inequality can strengthen social class divisions, limit opportunities to rise, and marginalise students from poor backgrounds.

Student Disinterest and Unhealthy Perceptions

The crisis related to physics education results in the general failure of students to engage and develop a negative opinion towards the subject. As Erinosho, (2013) discovered, the lack of motivation and attitude towards the subject and perceived difficulty form a self-fulfilling prophecy: students believe that they cannot succeed in physics, they do not even want to work on the material, and perform poorly (self-efficacy theory by Albert Bandura, Expectancy-value theory). This vicious cycle can hardly be reversed without a significant level of intervention such as counselling and mentoring, use of instructional strategies that can improve the interest of the students, relating the contents to everyday life, use of active and inquiry-based learning and others.

Strategy Interventions and Solutions

Coherent Teacher Development

The crisis of teacher qualification should be well addressed. To support this point, Onyekwelu (2024) suggests That Implementing continuous professional development and mentorship is vital to enhancing teachers' competence and pedagogical skills. The teachers need to be trained not just in the subjects but also in new innovative student-centered styles. According to (Dung et al., 2024), continuous professional growth will substantially enhance the knowledge of teachers on the main concepts of STEM and the strategies of teaching which will help to increase confidence in classroom management.

Besides, the modern teaching models, problem-based learning, inquiry-based instruction, and the integration of technologies, should be discussed in in-service training sessions. The teachers should also be assisted in curriculum innovation which includes culturally relevant pedagogy (Mathis, et al., 2023), so that students can view physics as a part of their experiences and communities.

Sufficient Resource Deployment as well as Infrastructure

Physics education infrastructure requires serious efforts by government funding. This includes:

- Making available up to date laboratory equipment and consumables to do practical work (Olajide et al., 2017).
- Assuring the good supply of electricity in schools in which they will use in laboratories.
- Creating low-cost, home-made laboratory equipment in case of limited budgets (Galanos et al., 2025).
- Offering new texts in physics and other learning resources (Abidoye et al., 2022).

According to (Arumuru and David, 2024), there is a positive association between the resource availability and the academic performance, indicating that adequately furnished learning environments have a strong impact on the accomplishment of students. The institutions need to focus on the strategic allocation of resources and the joint partnerships that will guarantee the funding of the entities external to the institutions.

Curriculum Reform and Contextualization

There should be a reconsideration of physics education which ceases to be colonial and Western-only epistemology. The proposal to implement a physics curriculum that prejudices agency on the part of the teachers in rebranding physics with culturally relevant content suggests (Yusuf & Kaoje, 2025) is right. Physics should be made meaningful and applied in the lives of students through curriculum-based applications that are actually relevant to Nigerian situations-agriculture, mining, energy, healthcare, and traditional technologies.
The teachers need to be empowered and enabled to modify the textbook content by incorporating the local examples and challenges within the community. Problem-based learning strategies have demonstrated to be better in developing problem-solving skills and interests as compared to conventional strategies especially when the problems are connected with real world experiences of the students.

Innovation in Pedagogy and Learner-Centered pedagogy
Several competent pedagogical approaches have potential to enhance physics learning:

Interactive and Practice-based Approaches: According to Ukoh, (2022) students understand the concept of electromagnetism more and reported enjoying instruction through the application of interactive-invention instructional strategies involving practical exercises compared to other teaching methods that involved lectures. The practical work during the course should not be moved to some rare laboratory sessions. Rather, practical/experimental work should be made a vital component of the lesson. This is because it can develop the inquiry skills of the students as well as nurture the problem-solving skills which arise from having hands-on of the concepts being taught in the classroom. Studies have shown that this approach has the ability of improving the learning outcomes and interest of students in Physics by 50% (Ukoh, 2022)

Collaborative Learning: Akinbobola, (2009) discovered that cooperative learning strategies were the most efficient in enabling students to have positive attitude towards the field of physics as opposed to competitive or individualistic methods. The group work promotes peer support and problem-solving. Studies have shown that group work can positively impact the learning outcomes of students such as understanding concepts, learning motivation and social skills.Several studies have shown that the collaborative/cooperative learning leads to a higher achievement, better retention, and more positive attitude of students when compared to the traditional learning (Adolphus et al., 2015; Agbele et al., 2020; Oluwaseyi, 2022)

Problem-Based Learning: Sarkingobir and Bello, (2024a) revealed that students who were exposed to problem-based learning models had a higher average score and improvement in problem-solving capacities on different indicators such as problem understanding, plan development, and solution implementation and reflections.

Different scholars have shown the efficacy of Problem-Based Learning. Omaga et al., (2017), Sarkingobir and Bello (2024b) and Davidson et al., (2025) all found a positive effect of problem-based learning on the learning outcomes (performance, interest, attitude, learning ability) of students in Physics.

Digital Learning Resources and Technology integration

In a reserved note with regard to the issue of access, and other barriers such as internet connectivity, strategic integration of technology has solutions. Partly, shortage of physical equipment can be overcome in virtual labs and simulations especially when it comes to costly or dangerous experiments. The study has revealed that there is a positive relationship between technology improved teaching and better student engagement and conceptual learning in physics (Venice et al., 2025). However, the use of offline digital contents, radio and/or mobile-based applications could provide scaling access where internet and constant electricity are barriers to the use of technological tools in

Nonetheless, changes should be brought in with a consideration of infrastructure barriers. In the case of teacher development and equal distribution of technology, Faresta et al., (2024) stated that it is crucial to focus on the development of teachers and the allocation of technology to benefit the learning process to the fullest. The use of mobile technologies and available open education resources can take learning out of the limitations of urban centers that are well-equipped.

Early Intervention and Development of interest

Prevention of crisis in physics education must be started at an early stage. According to Afolabi, (2013), child-to-child activities in basic science and technology education at early phases might be used to establish an initial interest in science. Developing constructive attitudes and interest at an early age can help avoid the physics avoidance that occurs in the secondary school.

Policy Support and Systemic Change

Systemic change requires policy-level interventions. Fakai et al., (2024) found that collaborative professional development significantly enhances teaching practices and student outcomes but requires adequate resources, regular administrative support, and fostering of collaborative school cultures. Policies must mandate and fund:

- Regular professional development for all physics teachers
- Equitable resource allocation across rural and urban schools
- Monitoring and evaluation of physics teaching quality
- Integration of culturally relevant pedagogy into curriculum guidelines
- Support for teacher-led innovation in physics instruction

Conclusion

Nigeria physics education crisis is not inescapable and irreversible. It is a consequence of systemic failures that can be identified as insufficient training of teachers, the lack of resources, the inability to connect with the culture, and limitations of pedagogy and can be eliminated in the form of multi-level intervention. With such holistic interventions and agency and resourcefulness of foregrounding the teachers, it is possible to make physics education a resource instead of a crisis that could be used to create better scientific literacy, technological development and student empowerment in Nigeria.

Recommendations

To be successful, it takes government dedication to funding, professional development of the teachers, both scientific knowledge and innovative pedagogy, curriculum development based on the realities of the students, strategic integration of technologies, and the development of learning environments in which practical work, collaborative learning and problem-solving are the major priorities.
Furthermore, there are responsibilities on the part of the teachers to make the teaching and learning of Physics interesting and attractive. Students should be motivated to learn the subject both at secondary and tertiary level. This can be achieved when the teachers are

deliberate about the hands-on aspect of the subject. Teachers are expected to engage in frequent developmental and career enhancing activities such as attending seminars and workshops, gaining knowledge through online courses and gaining more knowledge through self-development and skills acquisitions.

School administrators are also expected to make the learning of Physics more attractive by providing an enabling environment for the learners, provide adequate learning resources for both practical works and technological integration.

References

Abidoye, F. O., Aliyu, M. Z., Ahmed, A. R., & Oluwole, O. S. (2022). Instructional resources for teachıng bıology ın secondary schools ın Moro, Kwara State-Nigeria. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *8*(2), 187-193.

Abiola, S. A., Audu, A., & Muhammad, M. B. (2025). An Evaluation of the Performance of Students in Science Subjects Gombe State Nigeria. *Journal of Contemporary Education Research*.

Adebisi, N. A., Akanbi, A. O., & Yusuf, A. A. (2020). Difficulty Levels of Senior School Physics Concepts as Perceived by Students and Teachers in Ilorin, Kwara State, Nigeria. *FUDMA Journal of Educational Foundations (FUJEF)* 3 (2), 11-19

Adebisi, T. A. & Ogunmola, O. A. (2023). Effects of I-Do-We-Do-You-Do Instructional Strategy on TheAcademic Performance of Students in Physics Practical in OndoState, Nigeria. *Journal of Education and Practice*, 14(15), 94-100

Adeduyigbe, A. M., Ukoh, E. E., & Okeke, U. K. (2024). Influence of school type on senior secondary school physics students' learning difficulties and misconceptions about electricity in Ondo West Local Government, Ondo State, Nigeria. *African Journal of Teacher Education*, *13*(3), 192-207.

Adeniyi, G. I., Akanbi, A. O., Mohammed, R. E., Shehu, A., Adebisi, N. A., & Adewuyi, A. S. (2024). Development of

Entrepreneurial Skills among Pre-Service University Teachers through Physics Education in Ilorin, Nigeria. *Ilorin Journal of Education*, *45*(1), 98-107.

Adeoye, M. A., Akinnubi, O. P., & Lasisi, A. K. (2023). Addressing socioeconomic disparities in developing student-centred learning environments. *Journal of Didactic Studies*, *1*(2), 90-98.

Aderonmu, T. S. B., & Adolphus, T. (2023). Examining the challenges of non-physics majors teaching physics curriculum contents in secondary schools in Rivers State, Nigeria. *International Journal of Education and Evaluation*, *9*(7), 82–96. https://doi.org/10.56201/ijee.v9.no7.2023.pg82.96

Adesina, O., Obokoh, L., & Salami, O. (2024). Does the high school external examination grades and the type of high school attended impact the academic performance of freshmen university students?. *STEM Education*. https://doi.org/10.3934/steme.2024019.

Adolphus, T. (2019). Why students in secondary schools choose not to do physics? Implications for policy and practice in developing countries. *European Scientific Journal ESJ*, *15*(34), 103-124.

Adolphus, T., Onwioduokit, F., & Dike, J. (2015). The Relative Effectiveness of Collaborative Learning Approach on Secondary School Students' Understanding of the Concept of Electromagnetic Induction. *British Journal of Education, Society & Behavioural Science*, 6, 210-217. https://doi.org/10.9734/bjesbs/2015/9427.

Afolabi, F. (2013). Catch them young in basic science and technology education through child–to-child approach. *Journal of Educational and Social Research*, *3*(7), 38-45.

Agbele, A., Oyelade, E., & Oluwatuyi, V. (2020). Assessment of Students' Performance in Physics Using Two Teaching Techniques., 07, 55-59. https://doi.org/10.51244/ijrsi.2020.7702.

Aina, J. K. & Ayodele, M. O. (2018). The decline in science students' enrolment in Nigerian Colleges of Education: Causes and Remedies. *International Journal of Education and Practice*, 6 (4), 167-178.

Akinbobola, A. O. (2009). Enhancing students' attitude towards Nigerian senior secondary school physics through the use of cooperative, competitive and individualistic learning strategies. *Australian Journal of Teacher Education (Online)*, *34*(1), 1-9.

Akinbobola, A. O., & Bada, A. A. (2019). Assessment of resources for physics teaching in Nigerian senior secondary schools. *International Journal of Humanities Social Sciences and Education*, *6*(8), 1-13.

Akinmoju, O., Akinyemi, A., & Aremu, A. (2024). Flipped Learning with Gamification and Secondary School Students' Interest in Physics in Nigeria. *KIU Journal of Education*. https://doi.org/10.59568/kjed-2024-4-1-03.

Amusa, J. (2020). Appraisal of the physics education programme in the National Open University of Nigeria. *Annual Journal of Technical University of Varna, Bulgaria*. https://doi.org/10.29114/ajtuv.vol4.iss1.158.

Anwo, A. O. (2021). Teaching facilities, teacher's quality and students' academic performance in physics in Ilorin Metropolis' secondary schools, Kwara state. *International Journal of Contemporary Education Research*, *20*(8).

Arumuru, L., & David, T. O. (2024). The Impact of Instructional Resources on Academic Achievement: A Study of Library and Information Science Postgraduates in Nigeria. *Asian Journal of Information Science and Technology*, *14*(1), 54-60.

Ayodele, O. I. (2024). Relevance Of Physics Teacher Education Curricula In Southwestern Nigerian Universities To Senior Secondary Physics Curriculum For Sustainable Development In Nigeria Educational System. *Journal of Emerging Trends in Educational Research and Policy Studies*, *15*(5), 171-178.

Babalola, F. E., & Ojobola, F. B. (2022). Improving Learning of Practical Physics in Sub-Saharan Africa—System Issues. *Canadian Journal of Science, Mathematics and Technology Education*, *22*(2), 278-300.

Bada, A. A, Akinbobola, A. O., & Damoeroem, E. O. (2018). Measured identification and remediation of students' weakness in Nigerian senior secondary school physics curriculum. *International Journal of Innovative Research and Advanced Studies*, 5(10), 13- 19.

Badmus, O. T & Omosewo, E. O. (2018). Improving science education in Nigeria: The role of key stakeholders: *European Journal of Health and Biology Education*, 7 (1) 11-15 https://doi.org/10.29333/ejhbe/87086

Davidson, V., Maduegbunam, T., Odo, J., Adonu, I., & Agbo, C. (2025). Effect of STEM Problem-Based Learning on Achievement in Basic Science among Secondary School Students. *International Journal of Research in STEM Education*. https://doi.org/10.33830/ijrse.v7i1.1783.

Dung, M. D., Nanbal, J. L., & Danladi, I. (2024). Role of ongoing professional development in equipping teachers with effective STEM teaching practices in colleges of education in Plateau State, Nigeria. *Greener Journal of Educational Research*, *14*(1), 150-157.

Emeka, A., Margaret, A. F., Jacob, O. N., & Olatunde-Aiyedun, T. G. (2021). Problems facing science teachers in public secondary schools in Nigeria and way forward. *International Journal of Discoveries and Innovations in Applied Sciences*, *1*(5), 118-129.

Erinosho, S. Y. (2013). How do students perceive the difficulty of physics in secondary school? An exploratory study in Nigeria. *International Journal for Cross-Disciplinary Subjects in Education*, *3*(3), 1510-1515.

Eze, A. E., & Madu, F. O. (2022). An investigation into the level of adequacy of resources for teaching secondary school physics in Enugu State, Nigeria. *Advance Journal of Management, Accounting and Finance*, *7*(9), 9-20.

Fadipe, B. M., Bahago, B. S., & Gana, C. S. (2022). Teacher Qualification and Students Performance in Physics Implication for Counseling: A Study of Schools in Suleja Local Government Area of Niger State. The Review of Contemporary Scientific and Academic Studies, 2(2), 1-9

Fakai, U. R., Sa'adu, A., Argungu, M. A., & Aliyu, A. S. (2024). Collaborative Professional Development: A Catalyst for Science Education Reform in Nigeria. *Formosa Journal of Science and Technology*, *3*(9), 2191-2210.

Faresta, R. A., Nicholas, T. Z. S. B., Chi, Y., Sinambela, I. A. N., & Mopoliu, A. Z. (2024). Utilization of technology in physics education: A literature review and implications for the future physics learning. *Lensa: Jurnal Kependidikan Fisika*, *12*(1), 1-27.

FRN. (2013). *National Policy on Education*. Federal Republic of Nigeria. https://educatetolead.files.wordpress.com/2016/02/national-educationpolicy-2013.pdf

Galanos, V., Trygonis, V., Mazaris, A. D., & Katsanevakis, S. (2025). A Low-Cost Passive Acoustic Toolkit for Underwater Recordings. *Sensors*, *25*(23), 7306.

Ihekwaba, C. (2020). Phobia and its Effect on the Academic Achievement of Physics Students in Imo State, Nigeria. *Advances in Social Sciences Research Journal*, *7*(2), 87–94. https://doi.org/10.14738/assrj.72.7791

Josiah, O., & Oguoko, R. A. (2025). Assessment of Biology Content Knowledge on Academic Performance among Senior Secondary Schools in Kwara State, Nigeria. *Federal University Gusau Faculty of Education Journal*. https://doi.org/10.64348/zije.202577.

Mamah, M., Nnadi, F., & Iwuagwu, T. (2021). Home Education Environment and Motivation as Correlates of Students' Academic Achievement in Physics in Nsukka Education Zone, Enugu State, Nigeria. *Journal of Education and Practice*. https://doi.org/10.7176/jep/12-23-06.

Mathis, C., Southerland, S. A., & Burgess, T. (2023). *Physics teachers' dispositions related to culturally relevant pedagogy*. *International Journal of Science Education, 45*(3), 1–20. https://doi.org/10.1080/09500693.2023.2190850

Obafemi, D. T. & Aderonmu, T. S. B. (2022). Identification and sources of misconceptions held by secondary school physics students in heat energy in rivers state, Nigeria. *European Journal of Education Studies*, 4(9), 121-133.

Ogundeji, O. M., Aliu, A., Abubakar, S., Nwaghaluke, J. E., & Okoye, N. E. (2021). Predicting Physics Teachers' Effectiveness in Secondary Schools by their Subject-Matter Knowledge, Pedagogy and Technological Knowledge. *International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)*, *11*(4), 355-366.

Oladejo, A. I., Okebukola, P. A., Akinola, V. O., Amusa, J. O., Akintoye, H., Owolabi, T., ... & Olateju, T. T. (2023). Changing the narratives of physics-learning in secondary schools: The role of culture, technology, and locational context. *Education Sciences*, *13*(2), 146.

Olajide, S. O., Adebisi, T. A., & Tewogbade, T. A. (2017). Assessment of laboratory resources, teachers' and students' involvement in practical activities in basic science in junior secondary schools in Osun state Nigeria. *Journal of Educational and Social Research; 7*(3), 139-146

Oluwaseyi, O. (2022). Relative Effectiveness of Guided Inquiry and Collaborative Learning Instructional Strategies on Students' Performance and Retention Ability of Physics Students' in Akoko Southwest Local Government Area, Ondo State, Nigeria. *Aquademia*. https://doi.org/10.30935/aquademia/12378.

Omaga, J., Iji, C., & Adeniran, S. (2017). Effect of problem-based learning approach on secondary school students' interest and achievement in electricity in Bauchi State, Nigeria.

ATBU Journal of Science, Technology and Education, 5, 63-70.

Omosewo, E. O. (2012). Why dread the science of the state of the universe? The one hundred and eighteen (118th) inaugural lecture, University of Ilorin, Ilorin, Nigeria. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.734.1667&rep=rep1&type=pdf

Onyekwelu, R. A. (2024). Enhancing the quality of secondary education through professional development of teachers in Nigeria. *British Journal of Multidisciplinary and Advanced Studies, 5*(1), 194–205. https://doi.org/10.37745/bjmas.2022.0438

Oyelowo, P. O. (2023). Impact of availability and utilization of functional laboratories on students attitude in secondary school physics in Nigeria. *Journal of Science, Technology and Mathematics Pedagogy*, *1*(1), 233-241.

Sarkingobir, Y., & Bello, A. (2024a). Enhancing critical thinking through ethnoscience-integrated problem-based learning: A comparative study in secondary education. *International Journal of Ethnoscience and Technology in Education*, *1*(1), 1-14.

Sarkingobir, Y., & Bello, A. (2024b). Helping Students Become Proficient Physics Problem Solvers Through Problem-Based Learning. *International Journal of Essential Competencies in Education*. 3(1), 13-27https://doi.org/10.36312/ijece.v3i1.1813.

Tamunoiyowuna, S., & Omeodu, M. (2022). Extent of availability and usage of various laboratory equipment among physics students' in Port-Harcourt, Nigeria. *World Journal of Advanced Research and Reviews*. 13(03), 113–122 https://doi.org/10.30574/wjarr.2022.13.3.0190.

Ukoh, E. (2022). *Teaching electromagnetism using interactive-invention instructional strategy and the learning outcome of secondary school students*. *Momentum Physics Education Journal, 6*(1), 10–18. https://doi.org/10.21067/mpej.v6i1.5463

Venice, J. A., Sripathi, S. K., & Shichilaba, M. N. C. (2025). Integration of Technology in the Teaching and Learning of Physics in Zambia: Challenges, Opportunities, and Strategic Alignment with the 2023 Curriculum.

Yakubu, A. A., & Abdulkareem, S. (2024). Management of innovative strategies in teaching and learning for teacher education in 21st century. *Journal of Association of Educational Management and Policy Practitioners*, *6*(2), 318-324.

Yusuf, B., & Kaoje, H. (2025). Teaching Science in Indigenous Languages: Evaluating Feasibility and Effectiveness in Nigerian Schools. *South Asian Research Journal of Arts, Language and Literature*. 7(4), 117-123.https://doi.org/10.36346/sarjall.2025.v07i04.002.