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CALL FOR PAPERS
INTERNATIONAL JOURNAL OF CONTEMPORARY ISSUES IN INTEGRATED SCIENCE EDUCATION (IJCIISE)

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EDITORIAL

Dear Readers,

We are excited to announce the launch of International Journal of Contemporary Issues in Integrated Science Education (IJCIISE). This Association Integrated Science Educators' Association of Nigeria (ISEAN) play a vital role in promoting scientific advancement, supporting science education, informing science policy, recognizing science excellence and fostering community engagement. The desire to float this journal was borne out of the passion to organize a yearly conference of Integrated Science by the Integrated Science Educators' Association of Nigeria, of which selected scholarly articles will be published after a thorough review. The journal dedicated to advancing knowledge and fostering dialogue within. Our mission is to publish high-quality research, innovative ideas, and critical analyses that contribute to the understanding and development of Integrated Science. At IJCIISE, we believe in the power of interdisciplinary collaboration and inclusivity. We welcome contributions from scholars, practitioners, and thought leaders worldwide, providing a space for diverse perspectives and groundbreaking work. As we embark on this journey, we invite you to submit your research, engage with our content, and join us in creating a vibrant academic community. Together, we can push the boundaries of knowledge and inspire future generations. Thank you for your support as we launch this exciting new endeavour.

This edition moves around issues that border on **"Enhancing Quality Assurance in Integrated Science in Nigeria."** It is believed that diverse contributions from scholars and researchers expressed in this edition will provoke the understanding of issues that could foster education for societal transformations on a global scale
We look forward to your contributions!

For further information on future conference activities, visit **http://ijciise.org/index.php/ijciise**

Warm regards,
Professor O. S. Agboola
President, Integrated Science Educators' Association of Nigeria (ISEAN)

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STRENGTHENING QUALITY ASSURANCE IN CHEMISTRY EDUCATION IN NIGERIA: STRATEGIES FOR IMPROVEMENT

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Abstract
The scientific and technological development of a nation is completely dependent on the quality of its education as, education is known for the critical role it plays in the pursuit and attainment of scientific and technological advancement of a nation. The quality of education offered to the citizens of a nation will definitely reflect on the output of the products of such education system since no nation can rise above the quality of its education. Nigeria is not advanced in scientific and technological development due to the quality of (science) education it offers. This may be adduced to several factors identified by education experts among which include a weak curriculum, inadequate number of trained chemistry teachers, poorly trained ones, lack of infrastructural facilities and equipment and resources, poor utilization of government funds for improvement of all of the factors mentioned earlier. That there is think-tank for quality assurance in science education is not in doubt, what needs to be improved upon is the process cum application mechanisms. To reverse this negative trend and sustain this all important development, the quality of science/chemistry education offered must be scrutinized properly and sustained through effective monitoring and supervision with the aid of quality assurance and mechanism. This paper explores strategies to enhance the quality assurance of chemistry education in Nigeria through various mechanisms such as curriculum review by incorporating modern techniques and technologies, emphasizing practical learning experiences; improving on teacher professional development; utilization of digital tools; timely assessment and prompt evaluation; accreditation and quality control; student engagement and motivation.
Key words: Curriculum, Teacher education, Quality assurance, Quality control

Introduction

The bedrock of any nation that seeks to develop scientifically and technologically firmly rest on the quality of education such nation gives to her citizens. An examination of the state of Nigerian education shows that her education has failed to develop at an acceptable rate to that at which the world is advancing or developing scientifically and technologically because it is faced with myriad challenges. Nigeria has been categorized as a developing nation using several parameters one of which is the state of development of her education and one of the

most significant challenges facing international efforts towards achieving quality education is the disparity in access to education between developed and developing countries.

According to the World Bank, in 2019, approximately 617 million children worldwide were out of school, with the majority being from Sub-Saharan Africa and South Asia. Additionally, many schools in developing countries lack basic amenities such as electricity, clean water, and sanitation facilities, making it difficult for students to learn effectively (Wikifreedomarticles, 2024). In 2023, United Nations International Children Education Fund, UNICEF, reported that 75% of children aged 7-14 lack basic literacy and number skills; The World Economic Forum ranked Nigeria's quality of primary education at 120th and its quality of tertiary education at 117th out of 137 countries in 2017/2018 (Chukwuemeka, 2023). For a nation whose majorly youthful population is one of her greatest assets, ensuring quality education becomes more important/germane.

Chukwuemeka (2023) viewed the challenges of education in Nigeria from three major gaps which needs to be addressed, namely: the Access Gap which groups the challenges limiting the Nigerian populace's access to appropriate education. These include issues of out-of-school children, low completion rates, low percentage of transitions between education tiers, adult illiteracy, education in emergencies, etc.; the Quality Gap which encompasses challenges that result in inadequate equipping capacity of the available education and; the Outcome Gap which covers the human capital implications of the low skills that result from low-quality education.

Under quality gap, issues such as weak curriculum, teacher quality, lack of infrastructural facilities, equipment and resources, financial constraints and poor utilization of government funds, quality of candidates admitted for teacher education; b) shortage of qualified teachers; c) inadequate funding; d) poor teaching methods; e) lack of commitment on the part of supervisors; f) accreditation; g) teacher motivation and remuneration; h) lack of professional development opportunities are key challenges as identified by Akogun & Subair (2020), Osayamen, Jane, Oyaziwo, Gabriel & Tunde (2023). Akogun & Subair (2020) are of the view that poorly trained teacher and by extension, teaching quality, results mostly from a combination of factors ranging from untrained teachers that passed on their ignorance to the students, inadequate number of trained (Chemistry) teachers. Teachers that do not have access to training programs that could improve their skills and knowledge will struggle to keep up with new educational trends and techniques. New learners necessitate fresh teaching strategies. Modern technologies have penetrated the classroom, altering the character of student-teacher relations. Aspects influencing educational quality assurance include adequate monitoring, student staff, institutional mechanisms, available programmes and other factors.

The development, design, content, and implementation of a viable curriculum have a significant impact on the quality of education because it (curriculum) is a critical input of education and at all levels of education in Nigeria.

What have been observed to be in place is a weak, overloaded and outdated science curriculum that will not be able to provide the needed drive for a scientific and technological breakthrough highly sought. Chukwuemeka (2023) reported that the weak curriculum challenge mutates at different tiers of education. At the primary and secondary levels, the proliferation of unregulated private schools has particularly weakened the curriculum. Whereas at the tertiary level, the curriculum is mostly theoretical with little practical input that can help students connect their learning to the realities of their daily personal and community needs. An investigation into the state of primary education system in a particular state in Nigeria shows that poverty, negligence, poor remuneration of teachers, and poor condition of the learning environment are factors contributing to the growing number of out-of-school children at the primary school level (Taiwo, 2024).

> "Several decades after the end of colonialism, sub-Saharan Africa has not made much progress in liberating the education process from the clutches of imperialism and dependency. Only marginal improvements have been recorded, such as an increased rate of enrollment, expanded infrastructure, training, and recruitment of more teachers, and other improvements that are peripheral to the core issue of curriculum transformation. African pupils and students graduate from different levels of education, with a sense of helplessness, inferiority, and deference to Europe. In other words, the more the African studies, the deeper his inability to utilize his knowledge to directly and progressively influence his immediate environment for the better." Ezeanya-Esiobu (2019).

The United Nations Educational Scientific and Cultural Organizations, UNESCO emphasizes that quality education should be accessible to all individuals regardless of their social or economic background and there is no doubt that the hopes and aspirations of a Nigeria's advancement scientifically or otherwise is being shaped in its classroom and as such, a sound and robust programme of (Science) teacher education plays a significant role in natural development since the quality of education programme is greatly determined by the quality of teacher education and by extension, the teacher. Quality Education, QE is inseparable from Quality Assurance, QA, as, there cannot be the former without the later. Therefore, understanding why there is the need to strengthen Quality Assurance, requires knowing what Quality Education means.

Quality Education

Being an essential part of human development, Quality Education has been a topic of discussion among international organizations for decades. The concept of Quality Education is multifaceted and comprises of various aspects such as curriculum design, teaching methods, assessment practices, culture of the school

system, and society/community engagement.Quality Education refers to an educational system that provides students with the necessary knowledge, skills, and values required for personal growth, social development, and economic success. It involves creating an environment where learners are engaged in meaningful learning experiences that challenge their thinking and encourage them to take ownership of their own learning. (Wikifreedomarticles, 2024)

Gray Group (2024) refers to Quality Education as an educational system that focuses on academic excellence and considers students' holistic development. It is an education that prepares individuals for life, equipping them with the necessary skills and knowledge to navigate their challenges while the United Nations Educational, Scientific and Cultural Organization (UNESCO) defines Quality Education as "the process by which learners acquire the knowledge, skills, attitudes and values they need to achieve their full potential."

United Nations International Children Education Fund, UNICEF, provides a very comprehensive definition of quality education that includes healthy learners who are… ready to participate and learn, whose learning is supported by their families and communities; in healthy, safe, and supportive environments; content that includes the foregoing elements and peace; inclusive child-centered processes that are facilitated by competent self-driven teachers; and actual outcomes that encompass life-supportive knowledge, skills and attitudes, and are linked to national goals for education (equity) and positive participation in society.

Hornby (2012) viewed Quality Education as a set of elements that shape the input and output components of the production process of the education system that completely satisfies external and internal strategic constituencies by meeting their explicit and implicit expectations…signifying an educational experience that effectively supports and promotes the holistic development of students. The term Quality Education as defined by the United Nations (UN) implies the equitable access of education that promotes the life-long opportunities for all and which must fulfill the 21st century learners' need. It encompasses meaningful learning, relevant content, effective teaching methods, assessment aligned with learning goals and the development of critical thinking, problem-solving and lifelong learning skills which is encapsulated in Goal 4 (4.1 to 4.7c) of the United Nations' Sustainable Development Goals (2015).

Quality Education is therefore the kind of education that should be provided/given by a society where emphasis is focused on five important elements such as quality learners, quality learning, and environment with quality content, processes and outcomes. (Igi, 2024). This translates to an education that is well designed to provide the recipient with functional skills and potentials to achieve success in their future endeavors in a society such as improved economic opportunities, better health outcomes, and increased social mobility. Quality Education can be seen as the cornerstone of a thriving and progressive society that equips individual members of such society with knowledge base, skills, and attitudes needed to lead a fulfilling life and contributing meaningfully to growth and

development of such society. While It (Quality Education) ensures students have the knowledge and skills to fulfill their potential and lead fulfilling lives, it must also address the implementation in the education system to make this a reality for everyone.

Generally, the key elements of quality in education as identified by education experts (Akogun & Subair, 2020; Osayemen, Jane, Oyaziwo, Gabriel & Tunde, 2023; Thinley, 2023,) are:

1 The teacher and teaching methods. This makes the teacher as perhaps, the most important factor in the quality of education.
2 Educational content. Are the curriculum of chemistry education and the teaching material relevant?
3 Learning environment.
4 School management.
5 Preconditions for pupils.
6 Funding and organization.

Hence, achieving qualitative education will not be without challenges as, the identified challenges must be confronted to achieve true educational equality. This clearly signifies that there must be a kind of gauging tool or mechanism that will ensure quality education and that tool is quality assurance. It is therefore not out of place to look at strategies and key elements essential for successful quality education implementation through the strengthening of Quality Assurance since both are one side of the same coin: One (QE) is a product of the other (QA).

Quality Assurance

Quality Assurance is necessary if it is desired that quality education is to be provided. Woodhouse (1998) defined quality as 'fitness for purpose' and quality assurance is as 'those systems, procedures, processes and actions intended to lead to the achievement, maintenance, monitoring and enhancement of quality (p. 258) while Oxford Languages, sees Quality Assurance as the maintenance of a desired level of quality in a service or product, especially by means of attention to every stage of the process of delivery or production. Quality assurance involves the systematic review of educational provision to maintain and improve its quality, equity and efficiency. It encompasses school self-evaluation, external evaluation (including inspection), the evaluation of teachers and school leaders, and student assessments. (European Commission, n.d)

Through its use, it is ensured that appropriate academic standards are maintained and enhanced in each programme of an academic institution. The Federal Ministry of Education submitted that Quality Assurance involves the process of monitoring, assessing, and evaluating as objectively as possible all aspects of school life and communicating the outcome to all concerned with the aim of improving the standard of education.

In education, Quality Assurance involves the systematic review of educational provision to maintain and improve its quality and efficiency which

encompasses school self-evaluation, the evaluation of teachers and school leaders, as well as student assessments (Fadokun, 2015). Quality Assurance is therefore used to carry out quality management and is a method to help make sure certain quality standards (of teacher education) are fulfilled/met (Twinkl.com.ng, 2023). Quality Assurance can be particularly important to ensure that education develops and performs in line with the curriculum and standards in place i.e. Quality Assurance points to meeting or conforming to generally accepted standards as defined by Quality Assurance bodies or appropriate academic and professional committees (Ellis, 2018; Hayward, 2006). These standards can be assessed both internally and externally.

Benefits of Quality Assurance

Quality Assurance helps ensure that provision of Quality Education is delivered. Hence, the benefits of a Quality Education is a product of a functional Quality Assurance. According to Twinkl.com.ng (2023), the benefits of Quality Assurance and of particular interest, chemistry education includes but not limited to the following:

1. Quality Assurance helps to save time and creates more efficient process to evaluate an educational programme such as chemistry education
2. Quality assurance provides accountability
3. Supports ongoing development of schools, teaching and learning
4. Serves as a good source of internal accountability, and allows for creation of a set of goals to work towards
5. Quality assurance creates room for improvement

To achieve Quality Education in chemistry education therefore, Quality Assurance plays a significant role as summed up below:

1. A well-educated population leads to higher employment rates, increased productivity, and improved economic growth. When individuals receive qualitative education, they are better equipped to find meaningful employment and contribute to the workforce. This, in turn, leads to economic prosperity and a higher standard of living for society.

2. Quality Education also plays a crucial role in reducing inequalities. It provides equal opportunities for individuals from all backgrounds to access education and fulfills their potential, a socio-emotional positive achievement. By addressing educational inequalities, Quality Education helps to level the playing field and create a more equitable society.

3. It is also instrumental in promoting social cohesion and fostering a sense of community. When individuals receive a quality Education, they develop a deeper understanding and appreciation for diversity. They learn to respect and value different perspectives, which helps to bridge social divides and promote social harmony.
4. Quality Education is a catalyst for positive social change. It empowers

individuals with the knowledge and skills to address societal challenges and contribute to the betterment of their communities. Quality Education nurtures active citizenship and encourages individuals to become change agents, working towards a more just and sustainable world. (Gray Group International, 2024)

Strategies for Enhancing Quality Assurance in Chemistry Education in Nigeria

Quality assurance in chemistry education is crucial for producing competent graduates who can drive Nigeria's scientific and technological advancements. That there is quality assurance unit saddled with the responsibility of ensuring its implementation at all levels of education in Nigeria is an understatement. What may be missing is proper implementation. Achieving quality education in chemistry education is achievable by strengthening Quality Assurance and this can be done by addressing the following 6 key components of quality assurance:

1. Curriculum Review and Development in chemistry education: -

I. By Aligning Curriculum with International Standards and Industry Needs

One of the key elements to ensuring strong Quality Assurance values in quality chemistry education is by ensuring periodic review of the curriculum and aligning as well as subjecting it to both national international standards of testing. If the curriculum is designed to be comprehensive and challenging, it requires for students to acquire a strong foundation in essential subjects or courses. Ensuring academic rigor in chemistry education prepares students for getter qualitative education and equips them with the necessary skills for future success. In Chand's (2024) view, a curriculum aimed at providing quality education must be designed to meet the present and future needs of students, society, and the workforce. It is critical to develop a curriculum that is responsive to the complexities and challenges of the contemporary world (Okorafor & Uchechi, 2011; Pene, Taufe'ulungaki, & Benson, 2021).

A well-designed/developed or reviewed curriculum in chemistry education should be such that it is relevant, engaging, and responsive to the changing needs of students and society. Chemistry education curriculum should provide a balanced emphasis on academic, practical, and social-emotional learning. A quality curriculum for chemistry education should incorporate interdisciplinary approaches, allowing students to connect with different subjects and develop a holistic understanding of the world. This can be achieved through project-based learning, where students work on real-world problems and collaborate with their peers to find innovative solutions. More importantly, effective curriculum implementation involves periodic evaluation, feedback mechanisms, and continuous improvement. This where the curriculum finds most relevance in that its standard is gauged to determine its effectiveness.

Commitment to continuous curriculum improvement plays a crucial role in the success of Quality Assurance. Such education system will constantly evolve with

regular evaluations and revisions to ensure it remains effective and relevant. Singapore and Finland are two countries that are reported to have achieved remarkable educational outcomes through such approach. They both consistently rank among the top performers in international assessments, demonstrating the effectiveness of its education system.

ii. By Incorporating Modern Techniques and Technologies in Chemistry Education.

One of the most significant impacts of technology on education is its ability to provide greater accessibility to educational resources. Hence, another approach to improving Quality Assurance is ensuring the integration of technology into classroom teaching through its curriculum. Technology can and has been playing a significant role in promoting quality education. It has revolutionized the way we see and approach education by providing new opportunities for teaching and learning. It's vital role in enhancing the quality of education by improving accessibility, increasing engagement, and personalizing learning experiences in chemistry education has been of immense importance.

By integrating technology enhanced approaches into the curriculum of chemistry teaching, student engagement can be improved through interactive and immersive learning experiences. Personalized learning is facilitated as a result of its potency of providing students with new ways to explore and interact with the content from online resources and educational applications (apps) to interactive whiteboards and virtual reality and augmented reality technologies which have made learning more fun and interesting for students. With online platforms, students from all over the world can access quality educational materials that they may not have been able to otherwise Josep, 2024; Igi-global.com (2024) . This can especially benefit those who live in remote or underprivileged areas where traditional classroom settings are limited by giving such students opportunity to interact and share learning experiences with their fellow students anywhere in the world by the click of a button in real-time (Explorance, 2024). This adds value to education with its creation of a sense of community and collaboration.

Adaptive learning systems use algorithms to adjust the difficulty level of questions based on individual student performance, allowing them to learn at their own pace. Additionally, artificial intelligence (AI) chatbots can answer students' queries instantly, providing immediate feedback and support (Wikifreedom42872articled, 2024). Though Nigeria has made significant strides in expanding internet access and integrating technology into education and chemistry education in particular, there is still much to be done. As we move forward, we must continue to leverage technology into Quality Assurance to enhance the quality of chemistry education and ensure that every student has equal opportunity for growth and success.

iii Emphasize Practical and Experiential Learning in Chemistry Education

In addition to enhancing teacher training in chemistry education programs, it is also essential to implement effective learning methods such as project method, experiential learning, e.t.c in the classroom which involves providing students with hands-on experiences either through field trips, internships, or simulations. Experiential learning in chemistry education for example enables students to better understand the subject matter and its real-world applications in that such learning method allow them to apply theoretical concepts in practical settings whether through field trips, internships, or simulations. Learner-centered approaches which encourage active student engagement, collaboration, and independent thinking and prioritize the needs and interests of students have been shown to enhance student learning outcomes significantly. These approaches should be the focus of an enhanced Quality Assurance chemistry teacher education.

This commitment to ongoing improvement will allow education in Nigeria to stay at the forefront of educational innovation and adapt to the changing needs of students and society.

2. Teacher Professional Development: is another vital area by which Quality Assurance of chemistry education can be strengthened. This is possible by

i. Providing Regular Training and Workshop for Teachers in Chemistry Education

As rightly observed by education experts, Quality Education is impossible without quality and qualified teachers and as the major human capital in the mix of factors of education, teachers hold a crucial role in the work of ensuring quality education in Nigeria. A quality teacher can produce a quality student and a quality student can change the epitome of the nation qualitatively. Chemistry education teachers are at the heart of quality education in chemistry education. Highly qualified, motivated, and well-supported teachers are crucial in fostering student learning and development. Professional development programs should be of high priority through strengthening of the quality assurance because they are vital for equipping chemistry teachers with pedagogical skills, content knowledge, and understanding of diverse learner needs.

Enhancing teacher training and professional development programs involves equipping chemistry teachers with the necessary pedagogical skills needed to engage students in the learning process effectively following strictly, Quality Assurance procedures that ensures qualitative training is put to use effectively. These include training teachers on evidence based teaching methods that encourage critical thinking, problem-solving, and active student engagement. Additionally, teacher training and professional development programs of chemistry teachers should focus on providing teachers with a deep understanding of their content, enabling them to explain complex concepts in chemistry to their students effectively. They are to be made to undergo rigorous training and professional development to ensure they have

the knowledge and skills to deliver quality education.

Teacher training programs should also address the importance of cross-cultural competencies via strengthening of its Quality Assurance process. In today's interconnected world, chemistry teachers must be equipped with the skills to create inclusive and culturally responsive learning environments. This involves understanding and valuing their students' diverse backgrounds and experiences and incorporating culturally relevant teaching materials and approaches into their instruction (GGI, 2024). Providing ongoing professional development opportunities and mentoring by continuously updating their knowledge and skills, teachers can stay abreast of the latest research and best practices in education.

iii. Fostering Collaboration with Industry Experts and Researchers in Education
Also, teacher collaboration, and mentorship programs can also enhance the quality of education. When teachers have opportunities to share best practices with industry experts in chemistry, learn from each other, and receive guidance from experienced educators, it leads to a continuous cycle of improvement in teaching practices (Alberta Teachers' Association, 2017; GG Insights, 2024). Mentoring programs too through team teaching for instance, provide teachers with guidance and support from experienced educators, allowing them to reflect on their practice and continuously improve (Grillo, Morehead & Bedesem, 2011). Mentoring relationships are most commonly used to help pre-service teachers grow and to guide new teacher induction. It also helps beginning teachers feel connected to their profession and their school and helps foster the development of a professional identity. Professional teacher mentoring builds school culture by supporting educators' professional growth and psychological development. Harvard Graduate School of Education, 2024).

Other areas of Teacher Professional Development that will strengthen Quality Assurance in chemistry education are**:**

iv. Provision of regular training and workshops for chemistry teachers;

v. Encourage participation in conferences and seminars where innovative instructional practices will be imbibed through peer mentoring and reviews.

3. Laboratory Infrastructure and Resource is also a way to Strengthen Quality Assurance in chemistry education in Nigeria.

i. A positive and inclusive learning environment is essential for quality education and the chemistry laboratory should not be left out. Schools should be provided with safe, well-equipped facilities and resources that promote collaboration, creativity, and critical thinking. Access to up-to-date learning resources, which include books, technology, and educational materials, is vital for effective teaching and learning. Adequate resources are essential for

delivering high-quality education programs. For Quality Assurance therefore, Schools and universities must ensure that these resources are available and accessible to all students, regardless of their socioeconomic status or geographic location. The learning environment should reflect the diversity of students and promote inclusiveness which is achievable through culturally responsive teaching practices, where educators acknowledge and value their students' unique backgrounds and experiences (UNESCO, 2000; University of Massachusetts, 2024). Creating a sense of belonging and acceptance in the classroom fosters a positive learning environment and enhances student engagement.

ii. Upgrade and maintaining laboratory facilities, ensuring safety and accessibility in laboratories,

iv. Utilization of digital tools and simulations for enhanced learning and;

v. Equipment are equally important aspects of strengthening quality assurance in chemistry education.

4. Assessment and Evaluation in Chemistry Education
Assessment and evaluation of education programmes involves assessing their effectiveness in achieving the desired learning outcomes. Generally, evaluating the quality of an education program requires considering multiple factors beyond just academic performance alone. Developing and implementation of robust assessment methods also helps in ensuring Quality Assurance. Assessment practices should be fair and accurate, providing feedback on student progress and areas for improvement (Wikifreedomarticles, 2024)

Five identified criteria by that can be used to evaluate the quality of an education program which can be attained through Quality Assurance include:

i. Learning Outcomes: The primary criterion for evaluating any educational program should be its ability to produce learners who have achieved the intended learning outcomes. Learning outcomes refers to measuring student performance through exams or other assessments, analyzing feedback from students and teachers, and examining graduates' success rates in their careers;

ii. Relevance to society: These are measured by its level of addressing the needs of society through the provision of relevant knowledge and skills, in addition to preparing students for future challenges and opportunities in the job market, as well as contribution to social and economic development. These are equally evaluated by looking at how well the curriculum aligns

with industry standards and trends, and whether it promotes critical thinking and problem-solving abilities. Other areas are:

iii. Teaching methodology

iv. Resources as identified earlier and;

v. Support services: These should be responsive to students' needs and preferences, including those related to disabilities, language barriers, and cultural differences. (Wikifreedomarticles, 2024).

In addition to the use of technology-enhanced assessment tools, encouraging continuous assessment and feedback goes a long way in attaining the desired ends. By assessing how well the quality of education addresses these 5 areas and promotes student success, then it can be determined if it meets the criteria for high-quality education programs.

5. Accreditation and Quality Control of Chemistry Education

This is another vital area that can be used to strengthen Quality Assurance I chemistry education. Quality control practices in educational system is based essentially on school inspection, monitoring and control for obtaining data on policy implementation and for strategic planning and aid public accountability. It involves measures like internal quality assurance, performance measurement systems, and total quality management principles to empower employees, optimize resources, and foster a culture of excellence and innovation within… education institutions (SciSpace, 2024). Four take aways of quality control as identified by Adam (2024) in business that can be adapted to best practices in education are:

- Quality control (QC) in education should be a process through which the education system seeks to ensure that both the teachers' and learners' quality is maintained or improved.
- Quality control requires the education system to create an environment where management and employees strive for perfection. This is done by training personnel, creating benchmarks for Quality Assurance, and testing the teaching and learning process(es) as well as their support mechanisms to check for a "shift" from the specified standard.
- Quality control involves testing each of the units involved in the process and determining if they are within the specifications for the final desired standard.
- Quality control creates safe measures that can be implemented to make sure deficient teachers do not end up in the classroom without retraining.

In a nutshell, quality control ensures that the right things are being done as it focuses on detecting issues and correcting them while quality assurance ensures that the results come out as expected since it aims to improve processes in order to

prevent things from going wrong in the future (Rezaid, 2024).

Ensuring Quality Assurance in chemistry education will require that quality standards are set; operational processes that will solve the problems are developed; outcomes are reviewed based on the previous two; utilization of the feedback to gather valuable information and; the use of data for improvements. Thus if the necessary regulatory bodies strengthen accreditation processes for chemistry education programs; update established quality control measures for laboratories and equipment and; collaborate with professional bodies for Quality Assurance, the ripple effect will be such that the quality of education delivery is enhanced.

6. Student Engagement and Motivation

Strengthening of Quality Assurance to provide quality chemistry education is not just about providing access to schools and classrooms only but also ensuring that students are given an education that equips them with the necessary skills, knowledge, and competencies to fit well in an ever-changing world by teachers that are well trained (GGI Insights, 2024). Investing in comprehensive teacher training and professional development programs in chemistry education that go beyond the basics is essential to achieve this. Fostering a supportive and inclusive learning environment to students with various resources and support services, including tutoring programs, counseling services, and extra/co-curricular activities are support systems that help students develop holistically and provide the necessary tools to excel academically and personally in chemistry education(Igi, 2024).

Encouraging student of chemistry education participation in research and projects, providing mentorship and career guidance are also vital in ensuring Quality in education thereby fostering Quality Assurance. School culture should be supportive and inclusive, promoting collaboration and critical thinking. Community engagement should involve parents, stakeholders, and local organizations in shaping the educational experience for all students (Grillo *et al.,* 2011).

Conclusion

Quality education is not just important but fundamental to the success and prosperity of any society it is the key to unlocking potentials of a nation. We should therefore, not forget the role of government policy and legislation in shaping education. Government policies play a crucial role in fostering quality education and achieving quality education requires a comprehensive approach encompassing various strategies and key elements. By establishing supportive frameworks, allocating adequate resources, and setting high standards in chemistry education, policymakers can create an environment conducive to quality education. Furthermore, legislation should prioritize inclusivity, equity, and lifelong learning to ensure the sustainability of education systems.

Enhancing Quality Assurance in chemistry education in Nigeria requires a multifaceted approach that addresses all of the aforementioned. By implementing

these strategies, Nigeria can produce high-quality chemistry educator graduates who can drive innovation and growth. The strengthening of Quality Assurance in chemistry education has a direct positive impact on quality education which provides numerous benefits to both individual students and society as a whole, ranging from improved economic opportunities to better health outcomes and increased social mobility. Overall, Quality Assurance in chemistry education requires a commitment to excellence in every aspect of the educational process, from classroom instruction to community/society outreach. It is clear that investment in quality education by strengthening Quality Assurance is essential for building a stronger, more prosperous future.

In conclusion enhancing Quality Assurance in chemistry education in Nigeria requires a multifaceted approach that addresses all of the aforementioned. Quality Education is not just about academic excellence but about fostering holistic development, promoting inclusivity, and equipping individuals with the skills and knowledge necessary to thrive and positively impact society. This is possible by implementing effective curriculum design, supporting teachers' professional development, in a rapidly changing world through ensuring appropriate implementation of Quality Assurance. By investing in Quality Education through this gauging tool (Quality Assurance), we invest in the future of individuals, communities, and society and the Nigerian nation. By implementing these strategies, Nigeria can produce high-quality chemistry educator graduates who can drive innovation and growth.

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