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Overhauling Senior Secondary School Chemistry Curriculum Delivery in the Face of Security Challenges in Nigeria

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Abstract

This paper examined the need to revamp the delivery of the Chemistry curriculum in senior secondary schools in Nigeria amid ongoing security challenges. It explored the definition of curriculum, specifically focusing on the chemistry curriculum, and discussed various issues hindering its effective implementation, including safety concerns in schools, teaching methods, and deficiencies in the curriculum itself. Furthermore, the paper offered solutions to these challenges such as the integration of technology, learner – centered method of teaching and representative curriculum. The conclusion emphasizes the necessity of transforming chemistry education in secondary schools to prepare students for future challenges. The proposed progressive approach, integrated with technology, prioritizes student learning and engagement through project – based and hands – on activities, which are crucial for practical chemistry education. Consequently, the paper suggested investing in technological resources for effective chemistry instruction, ensuring that educators receive regular training in modern and advanced digital teaching tools and implementing blended learning strategies to accommodate diverse learning needs.

Keywords: Progressive Curriculum, Traditional, Security and Digital tools.

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INTRODUCTION

The teaching of chemistry at the secondary school level has consistently produced unsatisfactory results over the years. According to Igboanugo (2022), several factors contributing to these outcomes include traditional teaching methods, insufficient integration of technology, a flawed curriculum and insecurity in schools. Particularly, educational institutions in northern Nigeria have become vulnerable targets for Boko haram, bandits and kidnappers in states like Kaduna, Niger, Zamfara, Borno, and Kastina. These security issues have led to incidents such as student abductions, fatalities among students and teachers, school closures, disrupted academic calendars, absenteeism and subpar performance in standardized test like the West African Examinations Council (WAEC) and National Examinations Council (NECO). Additionally, Ibrahim and Adamu (2017) highlighted concerning fluctuations in chemistry results over the past eight years, alongside students' negative perception of the subject, which may stem from fear and inconsistent instructional methods. Chemistry, which requires both theoretical understanding and practical application, deserves ample instructional time to ensure effective teaching. It is crucial for understanding the nature, composition, properties (physical and chemical) and practical application of matter, in addition to the changes matter undergoes under various conditions. Moreover, chemistry is integral to national development, especially in industrial contexts and should be taught in a manner that transforms students into not just theoretical practitioners but also innovators, critical thinkers, inventors and entrepreneurs (Ayodele, 2018).

In 21st century, amid ongoing security challenges, it is essential to move from traditional teaching methods to more functional and progressive approaches that incorporates digital tools

in chemistry education, A progressive teaching methodology allows for the integration of digital resources that empower students to engage through practical projects, hands - on activities and assignments. This paper aims to examine the replacement of traditional teaching methods and physical classroom with progressive approaches to chemistry education while also exploring how technology can effectively substitute for in – person instruction in the context of security challenges.

Concept of Curriculum delivery

Curriculum delivery refers to the process of conveying educational content that students are expected to learn, regardless of whether it occurs in a physical or virtual environment. It is specifically designed to cater to the diverse needs of students across different year levels, including those with disabilities and other special requirements. Educators employ a variety of strategies to implement the curriculum, with digitalization being one of them. Tools such as Google Classroom, YouTube, and WhatsApp exemplify these strategies. According to Majeed (2019), effective approaches to curriculum delivery include:

- Understanding the abilities and background of learners.
- Leveraging digital tools
- Usage of up-to-date teaching materials
- Delivery should incorporate classroom teaching and outbound teaching.
- Corporative learning.

These strategies are systematically implemented to eliminate barriers to learning and to facilitate knowledge acquisition in chemistry. Effective curriculum delivery` should be characterized by clear organization, clear explanation, clarity in assessing student performance and clear examples and guided practice, all of these contribute to solid foundation for teaching chemistry. Given that chemistry is primarily a practical discipline, teaching and learning should adopt student – centered approach incorporating projects, hands - on activities and engagement (Solomon, 2019). This student- centered method aligns with educational philosophy of Dewey (1938). Dewey viewed the classroom as a social environment where students learn collaboratively and solve problems together. In such classrooms, learners are recognized as unique individuals who actively construct knowledge through personal understanding rather than merely absorbing teacher – directed content (Ben, 2020). Within the scope of this paper, emphasis is placed on a progressive curriculum and the integration of digital tools in chemistry education, as it is essential for learning to persist despite security challenges.

Chemistry Curriculum

The Nigeria Senior Secondary School (SSS) chemistry curriculum covers three classes, senior secondary classes 1-3 and was developed around four themes which are chemistry and industry, chemical world, chemistry and environment and the chemistry of life (Gloria, 2016).

Summary of Nigeria SS1-3 Chemistry syllabus

Themes/class	SS1	SS2	SS3
Chemical and industry	Chemical and industry	Periodic table, chemical reactions, mass volume relationship	Quantitative and qualitative analysis
The chemical world	Introduction to chemistry, particulate nature of matter, symbols,	Acid – base reactions, water, air, hydrogen, nitrogen, sulphur.	Petroleum mental and their compound iron, ethical legal and social issues.

	formulae and equation, chemical combination, gas laws.		
Chemistry and environment	Standard separation, technique for mixtures. Acid bases and salt water	Oxidation reduction (redox) reaction ionic theory electrolysis.	Topics asterisk below are to be treated at this point to enable students prepare and write their examination towards the end of the term.
The chemistry of life	Carbon and its compound	Hydrocarbon alkanols	*fats and oil soap and detergent giants molecules.

Source: NERDC

Problems Associated with Chemistry Curriculum Delivery

The importance of chemistry cannot be overemphasized as it forms the cornerstone of all science and science related courses at a tertiary institution as any student wishing to study engineering, agriculture, medicine, pharmacy, nursing etc. Chemistry is yet to make any noticeable impact in the nation due to lack of commitment on the part of the government and stakeholders. Several factors have been identified to have bedeviled the delivery of chemistry curriculum (Ibrahim & Adamu, 2017). These incudes:

1. Insecurities in schools: lately, northern parts of Nigeria have experienced chaos and students are being targeted for ransom, recruitment, suicide bombers and spies. There are so many militia groups and their existence hinders the smooth operation of schools especially secondary schools in the northern part of Nigeria. The terrorist group Boko haram (Western Education Forbidden) which emerged in the year 2009 has spawned newer small armed groups such as bandits, herdsmen, kidnappers and all seem to be enemy of secondary schools. According to UNICEF (2018) over 1000 students have been kidnapped in Nigeria. Since the conflict started in Northeastern Nigeria nearly 12 years ago, at least 2,295 teachers have been killed and more than 1400 schools have been destroyed. This constant violence results to school closures, disruptions to the school calendar, irregular schedule of school term and brings fear to both students and teachers. It has also made the face-to-face mode of teaching difficult because students no longer feel safe in schools. Studies have shown that when students feel safe and engaged at school, they are more successful in all aspects of life, not just academics. Unfortunately, the atrocities unleashed in the school led to fear, truancy and school closings, absenteeism and underachievement in standardized test. For instance, those that passed May/June examination (WAEC) from 2014 - 2020 were as follows 31.28% in 2014, 38.68% in 2015, 52.97% in 2016 and 59.22% in 2017, 50% in 2018, 64% in 2019 and 65% in 2020. Fluctuations in results from 2014 may be the result of threats to schools, especially in the Northern part of the country, where teaching is significantly interrupted. These challenges have affected and may affect the provision of chemistry as the subject requires a conducive and safe environment as it requires maximum concentration and requires a lot of practical work and requires students to be present in school for effective teaching and learning. To continue teaching and effectively deliver chemistry, technology must be incorporated into the teaching process where students are not necessarily in the classroom (Majeed, 2019).

2. Method of teaching: Godfrey (2012) stated that the most common method is the lecture and explanation method. It is most widely used in the teaching of chemistry. Teachers read notes while students listen and occasionally copy notes. Anecdotal information from empirical studies shows that there is over - reliance on lecture method, which is in stark contrast to the intended learner orientation of teaching. The lecture method, which is the predominant method of teaching chemistry, is currently under threat in schools as schools have experienced tragic riots that have negatively impacted students' approach to education and learning. The face-to-face method of imparting knowledge has recently been threatened by kidnappers, bandits, Boko haram and herdsmen, resulting in a high proportion of children out of school and even those who are at school have not been performing in chemistry. Activities that could enrich the teaching and learning process in chemistry like practical exercises, field trips and tutorials have been halted because schools operate basically to cover schemes and curricula without going through specific knowledge (Biodun, 2014). Lecture or explanation method may prevail but lately it is not a safe and suitable method of teaching chemistry, because students no longer stay in school for fear of kidnappers and bandits, visual and audio tools should be used to teach chemistry while students are at home. The problem is that these tools are lacking in schools. This makes the teaching of chemistry which is practically oriented "difficult" ` (Bassey, 2016).

3. Flawed Curriculum: According to Ibrahim (2017) the current curriculum in our schools is old and not designed for the all - round development of the students because the aspect of science and technology that would create entrepreneurial skills for self – reliance has been ignored. Originally, the curriculum focused on changing value and changing perception by developing life skills, poverty eradication thinking skills, entrepreneurial empowerment and attitude improvement skills in students, but that was not the case in Nigeria. This has led to constant conflicts and various insecurities ravaging the education sector. The deliberate targeting, burning and looting of schools' results in a weak education system, reduced quality of teaching, overburdened educational facilities, poor curriculum design and implementation. Poor curriculum implementation and delivery have turned the country in general into mere consumers rather than producers. Chemistry syllabus is overloaded with so many notes and theoretical teaching and at secondary school level, practical classes form the main part of the curriculum but due to insecurity in most schools, practical classes are missing, so chemistry teachers just wait for examining bodies to send practical specimens. This is the only time practical classes are taught in a hurry, which contributed to low chemistry scores on the standardized test.

4. **Absence of laboratories**: Avi (2017) stated that apart from the classroom, boards, videos and radio, the laboratory is an important facility for conducting practical chemistry teaching. The absence of laboratories in schools hinders project activities or hands - on activities with chemicals. The teacher is forced to teach chemistry in an abstract mode, leading to hatred of the subject and fluctuating performance in standardized examination such as the West African Examinations Council and National Examinations Council. According to the study carried out in 2006 by America's laboratory report on secondary schools revealed that laboratories are designed to support a variety of student, most of which are also general science education goals. The body also highlighted some objectives of laboratory experience:

a. Improving subject mastery. Laboratory experiences can enhance students' understanding of specific scientific facts and concepts and the way in which facts and concepts are organized in scientific discipline.

b. Developing scientific reasoning: laboratory experiences may promote a student's ability to identify questions and concepts. Ben (2012) averred that as important as laboratory is to science learning, especially chemistry, it is lacking in our schools. According to UNICEF (2018)

conflicts especially in the north have devastating impact on school infrastructure, and the laboratory is not left out. The few that were erected are no longer available as the schools have been targeted by Boko haram, bandits and herdsmen. From 2009 to 2018, 611 teachers were killed and 910 schools including laboratories were damaged. More than 1500 schools have been forced to close and some 4.2 million children in the northeast are at risk of losing their education. Hundreds of girls have been abducted, some even in their schools, which are supposed to be safe zones. Attacks on schools, communities and education itself are the tragic consequences of a protracted conflict that has left an entire generation of children traumatized. This has affected the provision of chemistry in our schools as the structures to deliver practical lessons no longer exist.

Solutions to problems associated with Chemistry Curriculum delivery

1. **Representative/ Progressive Curriculum**: The chemistry curriculum should be designed to be progressive, emphasizing projects and hands – on activities that focus on what students can accomplish in laboratories rather than lengthy hours of abstract instruction. A representative and progressive curriculum should extend beyond academics, promoting national security by instilling essential values such as honesty, sincerity, hard work, punctuality, productivity, innovation, patriotism, selflessness, brotherhood and friendship. It should aim to develop lifelong skills and knowledge, empowering individuals to rise above poverty and need. A flawed curriculum is often associated with poverty, which is a significant contributor to crime, including terrorism, banditry, kidnapping and militancy. According to a 2020 study by an American university, a progressive curriculum addresses the limitations of traditional and flawed educational systems, allowing students to engage creatively and passionately with their learning. Teachers should move beyond merely imparting information for memorization and perfect test scores; instead, they should facilitate experiential learning through projects, experiments and peer collaboration, thereby nurturing students into self – reliant entrepreneurs and innovators. Ben (2020) noted that teaching chemistry or other science subjects may require more than just a progressive approach; he emphasized that curriculum should reflect students backgrounds, ensuring they see themselves represented. He further argued that incorporating narratives into science curriculum can better connect it to students' cultural experiences to enhance the relevance of teaching for students. Educators should teach chemistry by using pertinent examples from local scientists, which not only adds value to our education but also fosters a sense of patriotism, unity, peace and respect for one's country.
2. **Learner - centered method of teaching**: A method is a procedure or technique employed to deliver content to students in the classroom. Lane (2016) reviewed several studies on student centered learning and found it to be an overall effective approach. A six- year study in Helsinki, comparing traditional instruction and more active teaching methods revealed that students in the active learning group developed superior study skills and comprehension. In the 21st century, it is believed that instructional methods should focus on being student – centered, engaging and designed to foster critical thinking, as the world increasingly requires innovators and scientists to address various challenges. Engaging instructional methods include:
    a. **Laboratory method:** This approach provides students with direct experience, enabling them to engage with phenomena related to the subject matter. They learn through hands – on practice rather than merely watching experiments. In the face of insecurity where school infrastructures are destroyed, teachers can utilize simulations and virtual laboratories to teach chemistry. In states where it has been inevitable but to shut down schools, the teaching and learning process must continue. It is not enough to just teach chemistry theoretically online; incorporating

practical sessions via simulations can effectively change chemistry education from a physical classroom to a virtual environment. The virtual chemistry laboratory allows students to link chemical computations with authentic laboratory experiences and also expose students to hundreds of standard reagents and how reagents can be manipulated in a manner that it resembles the real laboratory (Chandana & Chandrashekher, 2014).

b. **Project method:** This method was initially created by W. H Kilpatrick in 1918 and was refined by J. A. Stevenson 1921. The core concept of this method involves students engaging directly with tasks themselves. The essence of this method lies in the fact that a group of students do a purposeful task. Its fundamental principle is that groups of students perform a meaningful task. Students can carry out these activities in groups or individually over an extended time frame. Their work is assessed by submitting a report or showcasing the results of the activity. This method can thrive even as classes are disrupted by all manner of insecurities. Students can complete assigned tasks from home, which offers a safer alternative to in – school activities.

c. **Problem Solving:** According to Yew (2017), science is a crucial subject in school education. Nonetheless, the traditional teaching methods face criticism for their inability to foster critical thinking and a comprehensive learning environment for students. Subjects such as chemistry must cultivate scientific process skills, enabling students to measure, process information, classify, analyze and draw conclusions. Yaw also emphasizes the significance of creativity in problem – solving noting that children learn effectively through tackling challenges. This approach enhances scientific process skills, encourages brainstorming, and prepares students' to become innovators, developers, and creators.

3. **Assessment:** Given the persistent attacks on schools that have critically compromised the safety of lives and property, it is essential to design classroom and homework tasks that allow students to engage more in virtual environments rather than exclusively in – person setting. This shift could enhance the creativity of dedicated students. Various digital tools, such as Google classroom, DoddleChem, Adobe spark video, Quizlet, Socrative, Khan academy, can facilitate progressive assessments. These platforms focus on mastery rather than mere performance., prioritizing student – centered projects over traditional cumulative examination. The significance of practical experience in chemistry evidenced in standardized tests like West African Examinations Council (WAEC) where practical assessments account for 35%, objective questions for 25% and theory for 40%. This distribution indicates that practical work constitutes nearly half at the total score, highlighting the need for a more activity – based approach to chemistry education. West (2019) observed that progressive assessments provide a clearer indication of students' consistent achievement of desired learning levels compared to traditional evaluation methods, which often reflect only a snapshot of ability at a specific moment. These assessments intelligently select questions and activities aimed at maximizing the accuracy of evaluations based on insights gathered from prior responses. Furthermore, West emphasized that assessments should offer a detailed understanding learners' skills, foster active participation, facilitate self – assessment, improve concept retention and lead to successful outcomes.

4. **Incorporation of Technology into Chemistry Education:** Technology has served as a replacement or digital instructor for curriculum delivery in schools. Recent threats to education posed by Boko Haram, bandits and kidnappers, along with the pandemic, have made it essential to utilize technology for teaching and learning, even when students are not physically present in traditional classroom environments. To ensure

that chemistry education remains relevant and effective amid security challenges, content is delivered through various methods, including:

a. **Online Teaching:** This refers to the process of educating individuals through virtual platforms. It encompasses live classes, videos, webinars, conferencing and various digital tools such as Zoom, Google Classroom and YouTube. All these platforms facilitate the effective delivery of chemistry content, allowing students to learn without being physically present in a classroom. Online teaching utilizes a student – centered approach, enhancing student engagement and participation in virtual settings. This educational method is deeply rooted in progressive philosophy, as it empowers students to utilize technology independently. Various online tools, including the Google app for education which features a script called Doctopus for notetaking and editing serve as powerful resources for teaching chemistry. Additionally, practical components of the subject can be addressed through simulations and videos, such as ChemDoodle mobile, enabling students to learn chemistry effectively from home **(**Taylor, 2017).
b. **Blended Mode:** Despite the security concerns and disruption to the academic calendar, such as student relocations from affected areas and school closures, teaching must persist. The blended mode of instruction is effective for delivering chemistry education, as it integrates the strengths of traditional classroom practices with digitally enhanced methods. This approach combines the best aspects of both in – person and online learning, allowing students to learn without needing to suspend extensive time in school. The blended learning model permits a mix of digital and face - to - face instruction, alternating according to a predetermined schedule. Students might attend one class in person and another completely online from home (Ogundele, 2017).

CONCLUSION

Education cannot flourish amid chaos and unrest. It is crucial to reform the delivery of chemistry, as traditional face – to face instruction is jeopardized by threats such as banditry, kidnapping, Boko Haram and violent herdsmen. This reform is essential for providing a comprehensive education that fosters the development of the mind, spirit and body, as well as cultivating the attitudes, skills, abilities and competencies necessary for individuals to coexist and positively contribute to society. One effective strategy to address insecurity in our educational institutions and the nation as a whole is to adopt an entrepreneurial approach to teaching chemistry. This approach empowers committed students to become self – reliant. Supporting this idea, the Global Peace Index Rating from 2024 noted that Nigeria has faced challenges of terrorism, bandits, violent herdsmen and cross boarder smuggling. Consequently, Nigeria's Global peace Ranking has worsened from 2008. To ensure the continued relevance of chemistry education, it is imperative to overhaul the delivery. This entails improving curriculum representation, transitioning from physical classrooms to safer virtual environments, and shifting from traditional teacher – centered methodologies to progressive, students – centered approaches that integrate digital tools. Such changes will enhance student interest, engagement, project involvement and performance on standardized tests.

SUGGESTIONS

1. Private school owners and government bodies should ensure the availability of adequate technological resources for effective chemistry instruction.
2. Schools should develop strategies for blended learning that incorporate both in – person and virtual education.

3. Curriculum developers must design chemistry subjects that address the challenges of the 21st century.
4. Parents should support their children's learning by providing the necessary devices for the digital delivery of lessons.

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