International Journal of Multidisciplinary Research and Growth Evaluation.

Modern trends in teaching and learning chemistry in Nigeria: Prospects and constraints

Chukwu Godwin A [1*], Adolphus T [2]
[1-2] Department of Science Education, Faculty of Education, Rivers State University, Port Harcourt, Nigeria

* Corresponding Author: **Chukwu Godwin A**

Article Info

ISSN (online): 2582-7138
Volume: 03
Issue: 04
July-August 2022
Received: 01-06-2022;
Accepted: 17-07-2022
Page No: 248-255

Abstract
This paper reviewed the modern methods of teaching and learning chemistry used by teachers in Nigeria. Every chemistry teacher has to evolve some new methodology to teach his subject. The method by which the teacher presents the lesson to students affects their interest and attitude towards the subject. Faulty teaching method can hinder or create a dislike for chemistry by the students. The traditional method of teaching chemistry which includes textbooks and teachers has proved to be inefficient. Teaching and learning requires that the class teacher uses appropriate teaching methods to help students attain maximum achievement in their learning tasks. Thus, in modern teaching methods, curriculum teaching and planning are done keeping the learner as the primary target. In the same vein modern techniques of teaching the subject have been designed to make teaching and learning easier, and promote better understanding by learners. Modern teaching strategies save resources and time and, also make learning more interactive and attractive. Consequently, through the use of modern teaching methods, performances in chemistry and in science generally should be of high levels. Therefore, modern techniques of teaching chemistry hold the key to a better future in the field of chemical education in Nigeria.

Keywords: trends, teaching, learning, chemistry, prospects, constraints

Introduction

Chemistry as a branch of science is very important in modern societies because of its requirement as a pre-requisite to the study of many other science oriented courses. Hence, for a nation to develop in science and technology, the teaching and learning of chemistry need to be improved (Aluko, 2008) [3]. In recent years, the scope of information in chemistry and technology has dramatically increased, and the potential for teachers and students to adapt to new information in chemistry and technology has additionally increased. So, there is a massive need for progressive and innovative minds to explore unknown chemical concepts. To cope up with the modern world and the knowledge-pushed technology, adopting modern teaching approaches are the only way to survive. The main objectives of teaching chemistry in schools are to enable students to develop their knowledge and skills in chemical science and project their efforts in education so as to be useful to themselves and the society in general. These objectives are summed up by Singh (2013) [27] who defined teaching as the inculcation of ideas, transfer of knowledge, innovations to imbibe a thought and a mechanistic approach to change the raw brain into a learned one. It is becomes evident that the primary purpose of teaching at any level of education is to bring a fundamental change in the learner to facilitate the process of knowledge transmission.

The importance of improving teaching and learning of chemistry in schools lies in the fact that technology and knowledge plays an important role in value-addition to the core competence of natural and human resources. This implies that no matter how well designed or how well intended the visions of an education system are, they can only be actualized through a well-equipped, visionary, well trained, efficiently committed and qualified teachers. The traditional methods of teaching which began with writing on clay tablets with stick, recitation and drawing pictures on the walls of caves, and later transformed to textbooks and teachers have proved to be inefficient. Therefore, the education of tomorrow should play its role more effectively by making the individual creative, innovative and effective.

To achieve this purpose, teachers must have a good level of competence and mastery of the subject before venturing into teaching. This will enhance effective teaching of chemistry and other science subjects.

According to Neboh (2012) [14], several innovative teaching techniques which adopt student/learner centered approach have been developed to bring about improvements in teaching and learning of science subjects in Nigerian schools. These technology-based pedagogies can contribute substantially to active learning, being used as an aid in the teaching and learning process and promote interaction between content and students, students and students and students and teachers (Singh, 2013) [27]. Learning technologies can also increase educational productivity by expanding the learning experience, increasing student engagement and motivation, and accelerating learning. Therefore, this paper attempts to present the modern strategies of teaching and learning chemistry that had been tried and found to be practicable and adaptable to the Nigerian schools.

Preparation for the age of Innovative Teaching

The biggest challenge for any teacher is capturing students' attention, and conveying ideas effectively enough to create lasting impression. The modern education system prevailing in the 21st century requires advanced methodologies that would create a unique and progressive space for both teachers and students compared to the old educational methods. The new teaching techniques have developed new horizons of learning which school administrators, teachers and students should explore. Improving the learning experience is directly related to the needs and life habits of students. Students use social media and the internet and play video games on daily basis hence they expect teachers to present class lessons in the same way. This suggests that lesson content should be pictorial, entertaining and captivating to attract the attention of learners, as well as contain as little irrelevant information as possible. This is one of the major shortcomings of the traditional teaching strategy. However, Kirschner, Sweller & Clark (2006) [11] argue that using modern teaching strategies in classrooms creates lazy, disconnected students, and this may be a myth. Nevertheless, like other fields, the face of education has evolved to the extent that teachers can teach students with more depth and efficiency and also clear all their doubts with modern teaching strategies. According to Singh (2013) [27], to work upon the improvement of teaching of chemistry and for better understanding of the subject, tools such as models, microkits and miniature labs, kitchen chemistry, smart classes, audio-visual aids and online learning can be used.

The effectiveness of the teacher depends largely on his/her ability to adapt instruction to the needs of students. For instance, the teacher can capitalize on the importance of chemistry in everyday life to engage his/her students. To motivate students and deepen their understanding of chemistry, teachers need to plan thoughtful lessons in advance and establish clear learning goals. The teachers as experts who have good exposure and experience in chemistry are expected to foster the adjustment of students, matching curricular offerings to levels of mental development, understand students' basic cognitive and social problems, making curricular specifications relevant, and motivate the students to learn the subject (Aluko, 2008) [3]. This is the reason nations of the world are replacing their teaching aids and supplies with technological devices such as Computers, Tablets for note-taking, Projectors and Televisions for delivering lessons etc. These facilities act as tools for teachers to explain chemical concepts in more effective and lucid manner. Ideally, it is up to teachers to consider for their classes a critical, creative and dynamic perspective in their methodological approaches so that learning technologies are not simply inserted into a lesson to meet a prerequisite or standard expectation. Innovative education technologies should be integrated into the classroom in a way that adds pedagogical value and contribute to other aspects of the learning and teaching process.

Teaching Strategies and Students' Performance in Chemistry in Nigeria

The trend of poor performance in most secondary school subjects in Nigeria, including chemistry has been a disturbing phenomenon to all stakeholders and it has been found to be due to the lack of the use of appropriate instructional media (Taiwo, 2020; Nbina, 2012; Ojukwu, 2016) [29, 13, 22]. Research conducted by Aluko (2008) [3] observed that prominent factors contributing to the persistence of students' poor performance in chemistry are: ineffective teaching methods adopted by the chemistry teacher; lack of infrastructures and teaching materials; and lack of professionally qualified teachers among others. In order to address this issue, Nwobasi & Nwani (2020) [19] suggested that teachers need to be exposed to appropriate teaching and learning strategies which require the use of modern instructional materials.

On the other hand, the major cause of poor performance of students in the school subjects may be attributed to their retention capabilities. Retention cannot be totally separated from the teaching strategies and instructional materials adopted by the teacher. This is because, teaching and learning are complex processes composed of interaction among teachers, students, instructional content and the environment (Ogunleye & Ojeku, 2019). Therefore, in order to achieve the set out instructional objectives, the teacher must adopt a proper instructional delivery strategy. The traditional teaching and learning approaches in vogue have not really being able to achieve these objectives fully because they make students understand chemistry concepts at knowledge level without understanding the real meaning (Nwobasi & Nwani, 2020) [19]. As a result, it is important that modern teaching methods be adopted to teach the difficult concepts in chemistry. The reason is that retention of concepts can be improved by explicitly creating memorable events involving visual or auditory images.

The application of educational technologies in the classroom enhance meeting the needs of all categories of learners by stimulating their interest, arousing their curiosity, and raising standards to improve attainment by using self-paced individualized and interactive material to increase retention. Interestingly enough, teachers also benefit from new technologies and teaching strategies, because many segments of their job have been simplified. The place that used to belong to textbooks and notebooks is now occupied by tablets, videos, animations, internet, audio recordings, collages, etc. Technology will no doubt continue to evolve, and it is important that teachers adjust their classroom style to align with its advancement. In turn, schools can use technology resources in various ways to support the educational and schooling process.

Challenges of using Learning Technologies in Nigeria

Despite the merits already seen in the use of learning technologies in school practice, the challenge remains to expand its use. The findings of the work of Adetimirin (2019) which stated that "The major challenges were limited access to some of the technologies, fluctuation in internet connectivity and poor ICT literacy skills" support this view. Improvement in the level of ICT use requires the development of relevant infrastructure and ICT literacy training which are critical for its successful deployment. Tinio (2002) [30] also stated that the constraints in the use of learning technologies include digital culture and literacy, ICT and teacher professional development, global awareness, investment benefits in ICT, resource constraint, context, effectiveness, cost, equity, and sustainability. In Nigeria, basic ICT infrastructure is inadequate and access to the internet in schools is lacking. There is also the problem of electricity as several rural areas in Nigeria are yet to have electricity, while urban areas experience epileptic power supply. However, it is important to motivate teachers to explore digital technologies in their teaching activities. In most schools, teachers use almost exclusively traditional methods of teaching, and when they make use of the tools available on the internet, at least in the Nigerian context, their preponderant use is limited for use in social networks; research on search engines and downloading materials.

To overcome the challenge of using learning technologies among chemistry teachers, effort should be geared towards providing professional development course on strategies and innovative instructional resources in teaching chemistry. It may be designed as a continuing education course for chemistry teachers. Udu (2018) [31] recommended that intensive in-service programs should be organized to get the science teachers acquainted with and trained on how to effectively utilize innovative practices for enhanced students' academic achievement in science subjects. The adoption and effective implementation of these training strategies will broaden and deepen the teaching knowledge and pedagogy when teaching chemistry and at the same time consider cultural, historical, social, epistemological and methodological aspects involved in the teaching and learning process.

The importance of teacher training lies in the fact that the age of old classrooms is over, as technology and equipment are changing learning environments into smart classrooms. The teacher's classroom and professional competencies is therefore, of great importance for effective teaching and learning of chemistry. To provide students with sound education, there should be an amalgamation of a skilled teacher and innovative ways of teaching. The teacher should possess the capacity to introduce different innovative ideas to explain chemical concepts to students. It is for this reason that Awoniyi in Okpala (2006) [23], affirmed that to be effective, the teacher has to be many things: a source of information and a guide, an organizer of opportunities for learning, someone who can structure a suitable environment for learning, a superior and a consultant. The teacher has to be aware of the current innovations in teaching so as to determine the most suitable method for a particular situation. The method used in teaching will either promote or inhibit learning. Hence, teachers should be equipped with the knowledge to use appropriate methods that can stimulate the interest of students towards learning chemistry. Teachers need to understand and build on the cultural resources which include knowledge, interests, and experiences that learners bring to the practice of scientific argumentation. This can only be achieved through proper training and retraining of teachers.

In as much as it is important that the teacher must have command over a wide repertoire of different teaching strategies, he/she must also understand the learning processes of students. It is on this premise that teachers base all problems solving in the line of work. According to Nwachukwu (2009) [17], "It is well known that a teacher's way of thinking and beliefs guides his or her behavior and decisions inside and outside the classroom". Teachers must understand that the background and environment of the students reflect their knowledge development. This is very vital for effective teaching of chemistry. Since any knowledge acquired has levels of obstruction, teachers should know the level of mental development of the students and make sure that the teaching technique used is adequate for them so that they can give feedback (Avwiri, 2011) [6]. For instance, it will be inappropriate for a chemistry teacher to teach junior secondary school students saturated, unsaturated and aromatic compounds which are topics in hydrocarbon chemistry because it will be difficult for the students to understand as it is above their level of mental development. Therefore, for effective teaching of chemistry the activities to be performed must suit the mental development of the students otherwise teaching will be ineffective.

Methods of Teaching Chemistry

The face of education has evolved drastically over the period just like other fields of human endeavor. Before now, teachers were the only means to create a bridge between education and learners as they merely used conventional pedagogical methods to explain the topic or to provide notes for learners. However, modern education sees a vast scenario which encourages students to learn profoundly and study to satisfy their curiosity. The emergence of modern technologies has revolutionized teaching and learning hence the Nigerian school system must also embrace the changes to meet the demands of the present generation. Modern teaching methods used by teachers in Nigeria include amongst others:

1. Brainstorming
2. Micro-Teaching Technique
3. Programmed Learning
4. Inquiry-Based Learning
5. Mind Map
6. Cooperative Learning
7. Inductive Approach
8. M-Learning, and
9. E-Learning

According to Olagunju *et al*. (2003) [24], most of these strategies are concerned with the following:

1. Uncovering students existing ideas.
2. Promoting the reconstruction of ideas about a particular content based on creating a balance between content and the experiences which students bring to class.
3. Examining the consistency of ideas which students have across a variety of contexts.
4. Using inbuilt mechanisms for assessing student's learning.

The effectiveness of these teaching approaches in improving teaching and learning, have also been studied by researchers in Nigeria. They include among others, the work of Odoh (2013) [20], Owo, Idode & Ikwut (2016) [26], and Wagbara

(2020) [32] who reported significant difference between the mean scores of pre-test and post-test of the students taught chemistry by the use of brainstorming strategy and that of lecture method in favor of brainstorming strategy. Amobi (2005) examined the reflections of prospective teachers using microteaching and concluded that student teachers considered micro teaching as a favorable and meaningful learning experience. Similarly, Onasanya, Nuhu, Samuel and Ishiola (2020) [25] reported significant difference between the academic performances of undergraduate students exposed to Chemistry Learning-App and those that were taught with the conventional lecture method. Also, Adodo (2019) reported that the use of mind maps to teach Basic Science content had significant effect on the academic achievement of the students. Results of research work along retention line by Oludipe (2012) revealed that jigsaw and learning together strategies of cooperative learning aided students' retention of basic science concepts. Ogunleye and Bamidele, (2010) [21] in an investigation into the effect of inquiry-based instructional approach on chemistry students' achievement and problem solving in volumetric analysis found that the inquiry-based instructional approach was more effective than the conventional practical lesson in achievement as well as in problem solving. The researchers therefore stated that inquiry-based learning is important to ensure that learners are provided with continuous experience in skills of defining problems, recognizing assumptions, critical thinking, hypothesizing, observing, collecting and recording data among other skills. The possession of these skills is basic to scientific inquiry and the development of intellectual skills and attitudes needed to learn concepts

Prospects for Modern Techniques of Teachings

As the world we live in changes to embrace future developments in science and technology, the methods of teaching and what is taught in schools will also be reshaped to keep up-to-date with the growing demands of the 21st century. With an emphasis on innovation and generating curiosity, new teaching techniques inspire the entrepreneurial spirit, a crucial vehicle in the development of society. The traditional approach of memorizing and reciting, implemented on a mass scale, leads to a stagnated society. New technologies promise to make it easier and faster for students to learn. The inability to present science in a way as to enable students to experience science is one of the gaps that modern teaching methodologies are poised to fill in science education (Udu, 2018) [31].

Modern teaching strategies do not only make the classroom experience of students fun and engaging but also helps in saving time and resources. The adoption of modern methods of teaching chemistry in Nigerian schools will facilitate the education of knowledge and skills in students through increased efficiency and effectiveness of the teaching process; the utilization of available teaching technologies; enhance and improve the academic achievement of students; and boost the confidence of teachers. Furthermore, modern instructional strategy in chemistry can provide opportunity for educational content to be delivered outside the classroom to create a dynamic learning experience. Technology-based method of teaching chemistry will help to effectively and efficiently monitor and assess students in a better way, and also reduce human errors. The prospects of modern methods of teaching chemistry according to Harappa (2022) [9] may be summarized as follows:

1. Students can Connect, Collaborate and Co-create Learning

The traditional stereotype of the teacher, as one who stands in front of the classroom full of students who listen and respond to direction is increasingly a thing of the past. Modern teaching methods emphasize that learning objectives be met through classroom interaction, collaboration and active participation in engaging activities (Olatunji *et al*. 2003). Current innovations in teaching and learning suggest that student learning spaces will supercede the typical classroom of today. This will result to students becoming partners or co-creators of their own learning. Hence, it becomes pertinent to diversify the method of teaching chemistry from lecture method to modern activity-oriented methods that focus on student's creative thinking and collaboration among the students (Wagbara, 2020) [32]. Experiences that allow collaboration, communication and teamwork for all students often happen beyond classroom walls. There is need to facilitate these experiences in context, and the classrooms need to be a reflection of this. In the near future, formal classroom will be replaced by learning areas that allow individuals, small groups or larger groups to collaborate face-to-face or virtually on learning projects. New technologies in education make it easier and faster for students to learn, increase student motivation, produce greater student engagement, and offer teachers a greater support in monitoring learning activities.

2. Learning can take place anywhere anytime

The way students learn has been largely affected by modern methods of teaching. Distance Education Mode is becoming a more vital part of higher education in Nigeria. It reaches a broader student audience, better addresses student needs, saves money, and more importantly uses the principles of modern learning pedagogy. Students no longer move some distance to access libraries or bookshop to search for information. Almost every student has a smart phone connected to internet with which they check information received from their teachers. Innovations in technology have therefore made access to information much easier for students. Thus, the knowledge gained by students is no longer solely dependent on what they receive from their teachers.

According to Harappa (2022) [9] modern teaching techniques avoid spoon-feeding students and encourage creative thinking and problem-solving. The use of modern methods of teaching is something that needs to be incorporated in the future of education at all levels in Nigeria in order to ensure that students are equipped with the skills to cope in a competitive world. Innovations in teaching methodologies have created endless boundaries of where learning can occur, with whom and why. The reality is, classrooms can be anywhere anytime.

3. Individualized Learning can be customized

Considering the changing notions of what constitutes a classroom, the ideas about the way teaching is delivered must also be reshaped. In the medical profession doctors have individualized treatment plans for each patient. Education should not be different. The interest of each student in the class is different and is dependent on aptitude, attitude, motivation, mental health and aspiration towards the goals of their life. Modern teaching techniques tailor learning around individual students' needs, interests and abilities. The teacher

acts as a facilitator, paving the way for the student to learn, by providing the necessary resources and support. New teaching techniques and modern learning methods have been found effective in schools (Harappa, 2022) [9]. In the traditional lecture method of teaching, students are given the same work regardless of their abilities or skills. This practice contributes to disengagement, misbehaviour and poor outcomes. Modern teaching strategies offers teachers individualized learning plans for students, which will enable each student to learn at a pace that best suits their abilities and to engage with content that is most beneficial to them. Classrooms of tomorrow need to focus on a combination of student engagement in learning, enquiry-based approaches, curiosity, imagination and design thinking.

4. Less Emphases on Testing

Students are heavily focused on the end result of learning – achieving high score or receiving a distinction in class rather than improving learning. Consequently, it is awfully hard for students to face a test without feeling the burden of stress. Tests can also make students feel like they are trying to outdo one another. Also, teachers and school administrators too easily jump onto the test results in isolation of what they need to achieve (Stearns, 2022) [28]. This can lead to focus in the wrong direction as to what is really important, and take away the sense of community that teachers work so hard to build. Testing is a waste of time if its purpose is solely to point out who is at the top and who is at the bottom. Stearns (2022) [28] opined that when testing is timed, students who have struggled in educational contexts in the past are likely to feel the stress most acutely. Education of the future will prove that results do not define the student. With modern methods of teaching, assessments in the future will be evidence based, using measures that allow learning plans to be drawn up and personalized. Thus, education of the future will focus on a society in which everyone is able to do the job and elements of it competently.

5. Future Teachers

Teaching and learning has extended beyond the classroom and will continue to do so as education changes to suit the future needs of individuals and society. The role of the teacher must also adapt and grow. It is the responsibility of the teacher to empower students to be innovative and exploit opportunities given to them. The teacher should have the capacity to move students beyond mere curiosity and into critical thinking and understanding, encouraging them to ask questions and supporting them as they investigate. In the light of a shift towards a more personalized learner-centered teaching experience, teachers of the future must be prepared to be data collectors, analysts, planners, collaborators, curriculum experts, synthesizers, problem-solvers and researchers. Technology will continue to evolve, and it is important that teachers adjust their classroom style to align with its advancements. Mojgan, Kamariah, Wong, Bahaman and Foo (2009) [12] succinctly stated that every teacher is expected to use ICT to enhance teaching and learning of all subjects because they keep learners engaged during the lesson and make them active participants of the instructional process. Teaching is no more local because it has become borderless. Thus, educators in Nigeria must train themselves to make use of technology in such a way that it can aid them in their classrooms to provide students with real-life experiences that help them develop a love of learning.

Constraints of Modern Techniques of Teaching Chemistry

Despite the prospects already seen in the use of modern learning technologies in school practice, the challenge remains to expand its use. Socio-cultural surroundings, attitudes, and pedagogical considerations work together to influence how teachers integrate classroom technology. One major challenge is to motivate teachers to explore digital technologies in their teaching activities. New technology innovations in education have connected classroom learning with real-world digital skills. Teachers ought not to be afraid to try new ways for students to learn and stay engaged. In modern era, technology can act as a mediator for a better learning and teaching processes and raising the standards of learning inputs. Some of the constraints of modern methods of teaching chemistry in Nigerian schools according to Aluko (2008) [3] and Harappa (2022) [9] curriculum design, attitudinal challenge to classroom technology, excessive reliance on mobile, teachers' competence level, lack of infrastructure and inadequate funding.

1. Curriculum Design

The curricula should be relevant and reflect the dynamism of the larger society. According to the Nigerian Educational Research and Development Council, NERD (1999) some of the teething curriculum issues in Nigerian educational system include the fact that curriculum content is continually expanding and becoming overloaded as a result of additions and integration of new materials. Secondly, the interests and needs of learners and of the society at large are changing with times forcing the curriculum also to adopt changes. Also, curriculum review, revision and adaptation are lagging behind and need to be considered as priorities. According to Buba and Adama (2010) [7] it has been well established that no curriculum succeeds if the classroom teachers do not approach it from the standpoint of knowledge and enthusiasm. One of the major challenges of adopting modern teaching methods in Nigerian schools is the modification and alignment of the curriculum to accommodate teaching and learning strategies. The curriculum should instill a desire to investigate the wonder, excitement, and dynamic nature of science.

2. Attitudinal Challenge to Classroom Technology

The attitudes and beliefs of teachers are crucial factors in determining the role and effectiveness of technology in classrooms. Attitudes and beliefs about education technology and pedagogy in general, ultimately influence how teachers implement technology. Many teachers have demonstrated a resistance to change and unwillingness to adopt modern teaching strategies. This resistance is not because teachers dislike technology rather it is partly because teachers view learning a new teaching tool as a risky approach for which they are not adequately trained (Nsofor, Umeh, Ahmed & Sani, 2014) [16]. Some teachers were trained with pen and paper for teaching and research, and they are comfortable to continue to use them for knowledge delivery. Hence, lack of training; lack of familiarity with education technology and lack of support from schools make teachers resist transition to smart classes and adoption of new classroom tools. Some students are also not willing to embrace technology when learning as they study mainly for promotion to the next grade rather than acquisition of skills. Similarly, parents may oppose adoption of new education technology in cases where they think their kids are exposed to too much technology already.

3. Excessive Reliance on Mobile

Mobile technologies have great potential for facilitating innovative learning approach. In a study on teaching and learning chemistry using mobile phones, Arumugam, Talib and Aliyu (2020) [5] stated that "in the chemistry learning setting there is a need for collaboration and sharing of ideas and understanding concerning the abstract concept for better meaning construction. In this struggle, recent technologies such as mobile phone seem to be of significant function". In contrast, Osang *et al*. (2013) found that using mobile learning creates a lot of distraction. Many students open the mobile to learn something and end up using social media websites, chatting, sharing pictures or playing video games. These types of distractions waste time, which could have been used to perform a meaningful task. Some teachers believe that students rely more on mobile devices than attending classes when they are aware that they can access learning materials through their mobiles. Consequently, some educators try to prevent the students' reliance on mobile device being a substitute to classroom attendance by not putting learning content and materials online.

The effect of excessive reliance on mobile devices is that study performance can be hampered as valuable time will be wasted learning the use of the tool instead of studying. There are also software issues which range from changing trends in the IT field, software compatibility issues, not upgrading to new versions, regular system crashes etc. Also, the hardware can wear out after a period of time due to overuse, dust, using the device roughly etc. These factors interrupt the smooth working of mobile learning.

4. Teachers' Competence Level

The application of technology in the classroom, imply an extra effort on the teacher to create a successful smart classroom experience. A number of factors including socio-cultural surroundings, attitudes, and pedagogical considerations, work together to influence how teachers integrate technology. Some of the issues teachers face relate to the technology itself while others relate to the expectation of students, parents, and the professional development of teachers. Teachers need to get a deep understanding of the different approaches to teaching and learning to avoid just replicating the physical class environment and miss out on all the added advantages and tools that technology have to offer. Nbina (2012) [13] opined that where a teacher is deficient in a particular topic, the tendency is to dodge the areas of deficiency while the learner is bound to suffer. If teachers do not believe in using modern teaching techniques, they will fail to transform classes, align with learning goals and integrate technology into curricular content. So, it becomes the duty of the teacher to take a step towards accepting modern methods of teaching. The best teacher is one who is able to apply the best teaching method to teach students and guide them towards a quality learning process.

5. Lack of Infrastructure

Infrastructure is a key base for effective teaching and learning in schools. The goal of school infrastructure in education is to increase school attendance of students, enhance staff motivation and improve academic achievement of students. The influence of infrastructure in teaching and learning in the 21st century is very significant, considering that learning facilities are now beginning to vary with the development of their functions adapted to specific teaching methods. There is strong evidence that high-quality infrastructure facilitates better instruction, improves student outcomes, and reduces dropout rates, among other benefits. Unfortunately there is a decline in the quality of education in Nigeria due to the poor state of infrastructure in educational institutions (Amadi & Ohaka, 2018) [4]. Another major constraint of integration of technology usage into the classroom in Nigeria is irregular power supply, which is constantly needed to power electronic and network devices. The effect is that effective use education technologies in classrooms cannot be achieved in this kind of situation. Lack of infrastructure is of one the barriers that influence the use of technology in education in Nigeria.

6. Inadequate Funding

Funding is considered all over the world as the life wire that propels the educational sector towards achieving her objectives (Nwafor, Uchendu & Akani, 2015) [18]. In Nigeria, there appears to be a perennial crisis of funding and lack of definite structures and strategies in funding education. The problem of inadequate funding has affected all aspects of education from primary to tertiary, to the extent that it is usually reported in all articles on problems and challenges of education in Nigeria. The problem of funding being faced by educational institutions in Nigeria has a devastating effect on the development of learning technologies. Poor learning environment resulting from inadequate funding negatively affects teaching and learning activities in Nigeria. Gross under-funding of the education sector, as well as its near total neglect by government, is one of the issues of main concern to stakeholders. The tertiary education sector in Nigeria has been plagued with incessant and prolonged strikes by university lecturers over poor teaching conditions and lack of infrastructure to enhance teaching and learning.

The challenges of Nigeria education sector in general and its funding in particular is traceable to policy and strategy instability as well as inconsistency, inefficient management, wastages and leakages. Inadequate funding remains a significant challenge facing the education sector in Nigeria and has persisted for decades, resulting in poor infrastructure development. Classroom teaching and learning, which is the mainstream of education has been badly neglected and this has adversely affected technology integration in education in Nigeria.

Benefits of modern Techniques of Teaching Chemistry:

The importance of technology and modern teaching strategies in chemistry is tremendous, and its impact is growing. Modern teaching methods are highly adaptable and they are geared towards making classrooms open and equitable, as well as address some of the issues diverse learners have in a traditional classroom. Studies have shown that effective use of modern methods of teaching chemistry is associated with huge benefits. The research work of Gambari *et al*. (2017) revealed that academic performance of students increased through the use of modern teaching techniques. Technology has the potential to make aspects of education easier and more equitable in many ways. Engaging students actively in learning through the use of modern teaching strategies will afford them the opportunity to think and re-create knowledge. This may be achieved through flipping the classroom, creating discussion forum and designing engaging activities that will lead to desirable competencies. Some education technology can be flexible, improves IT skills of learners,

creates greater learner-learner interaction, and is easily accessible to a wide knowledge base; with progress being tracked. The use of technology will ensure that everyone has equal access to education irrespective of time, space, disability and readiness.

Technology assisted classrooms have unlimited benefits such as authenticity, equal learning opportunities, individual attention, freedom of expression, accessibility, engagement, collaboration, convenience and technological literacy. It is of vital importance that teachers and educators use interactive software and programs as learning technologies in teaching chemistry so that students can be included in the classroom in ways they have never been before, and also respond to questions and lectures digitally.

Conclusion

Modern trends in teaching chemistry in Nigeria are connected with the world trends in the development of education – the introduction of a competence approach, effective and efficient information dissemination strategies, internet utilization, globalization and diversification of education. The application of or nonuse of innovative methods of teaching depends on the personality of the teacher, his methodological competence and pedagogical skills. The task of teacher training institutions is to actualize such a need, and to form methodological competence. The task of the school is to encourage and stimulate the development of the teachers' and students' creativity. The task of the government, school administrators and all stakeholders is to provide quality teaching and learning environment, and broadcast the pedagogical culture as well as the value aspects of teachers' thoughts through professional, vocational training and the system of raising teachers' qualifications. The teacher on his own part must constantly reflect and develop his pedagogical potential to the extent that the student will be an active and competent person. The government, school administrators, teachers and all other stakeholders in the education sector must work together to tackle the constraints of integration of technology into the classroom, and improve students' learning.

References

1. Adodo SO. Effect of Mind-mapping as a Self-regulated Learning Strategy on Students' Achievement in Basic Science and Technology. Mediterranean Journal of Social Sciences. 2013; 4(6):163-172.
2. Agbai E, Okafor A, Egbedoyin F. Comparative Study of Education Funding in Nigeria. Journal of Education and Practice, 2021, 12(5).
3. Aluko KO. Teaching Chemistry in Secondary Schools: A Case for Cooperative Instructional Strategy. Ethiopian Journal of Education and Science, 2008, 3(2).
4. Amadi NS, Ohaka AO. Influence of Poor Infrastructure on Vocational Teacher Education in Rivers State Universities. International Journal of Innovative Social and Science Education Research. 2018; 6(1):54-62.
5. Arumugam PA, Talib CA, Aliyu F. Teaching and Learning Chemistry Using Smartphones. Innovative Teaching and Learning Journal. 2020; 4(1):18-28.
6. Avwiri EH. Approaches for Effective Teaching of Chemistry in Nigerian Secondary Schools. Journal of Research in Education and Society, 2011, (2)1
7. Buba PB, Adama MM. Trends in Curriculum Planning and Implementation in the 21st Century Nigerian Society. Journal of Teacher's perspective, 2010, 4(2).
8. Gambari AI, Balogun SA, Alfa SA. Efficacy of Interactive Whiteboard on Psychomotor Skills Achievement of Students in Isometric and Orthographic Projection. Contemporary Educationa Technology. 2014; 5(4):316-330
9. Harappa. Modern Teaching Methods. Harappa Learning Private Limited, 2022.
10. Jegede S. Students' Anxiety towards the Learning of Chemistry in Some Nigerian Secondary Schools. Educational Research and Review. 2007; 2(7):193-197.
11. Kirschner PA, Sweller J, Clark RE. Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching. Educational Psychologist. 2006; 41(2):75-86.
12. Mojgan A, Kamariah A, Wong S, Bahaman A, Foo SF. Factors Affecting Teachers' use of Information and Communication Technology. International Journal of Instruction. 2009; 2(1):77-104.
13. Nbina JB. Analysis of Poor Performance of Senior Secondary Students in Chemistry in Nigeria. African Research Review, 2012, 6(4).
14. Neboh OI. Effect of Learning Activity Package (LAP) on Male and Female Students' Achievement in Secondary School Biology. Journal of Science and Computer Education. 2012; 2(1):1-13.
15. NERDC. The Curriculum. Nigerian Educational Research and Development Council, 1999.
16. Nsofor CC, Umeh AE, Ahmed B, Sani ID. Blended Learning Environment: An Innovative Pedagogy A roach for Redefining Higher Education in Nigeria. Research on Humanities and Social Science, 2014, 4(26).
17. Nwachukwu PO. Understanding Teachers Professional Competencies for Education Effectiveness. Owerri: Springfield Publishers Limited, 2009.
18. Nwafor NE, Uchendu E, Akani CO. Need for Adequate Funding in the Administration of Secondary Education in Nigeria. Global Journal of Educational Research. 2015; 14:119-124.
19. Nwobasi CS, Nwani PO. Videotape Instructional Package and its Effect on Students' Achievement and Retention of Concepts in Chemistry at Secondary Schools. International Journal of Research Science and Management, 2020, 7(10).
20. Odoh C. Effects of Brainstorming on Students' Achievement in Senior Secondary Chemistry, 2013. Online: semanticscholar.org
21. Ogunleye BO, Bamidele AD. Effect of Inquiry- based Instructional Approach on Senior Secondary School Students Achievement and Problem-solving in Practical Chemistry. International Journal of Applied Psychology and Human Performance. 2010; 6:1309- 1328.
22. Ojukwu MO. Perception of Students on Causes of Poor Performance in Chemistry in External Examinations in Umuahia North Local Government of Abia State. International Journal of Education and Literacy Studies, 2016, 4(1).
23. Okpala L. Towards Effective Teaching of Music in Nigerian Schools. International Journal of Research in Education. 2006; 3(1):157-163.S
24. Olagunju AM, Adesoji FA, Iroegbu TO, Ige TA. Innovations in Science Teaching for the New

Millennium. Education this Millennium-Innovations in Theory and Practice, 2003, 211-218.
25. Onasanya SA, Nuhu KM, Samuel N, Ishiola AO. Effectiveness of Chemistry Learning-App for Nigerian Undergraduates in a Blended Learning Environment Online, 2020. at: https://www.researchgate.net/publication/346023970
26. Owo WJ, Idode VO, Ikwut EF. Validity of Brainstorming Strategy on Students' Academic Performance in Chemistry in Selected Secondary Schools in South- South Nigeria. American Academic Research Journal for Engineering, Technology, and Sciences, 2016, 24(1).
27. Singh J. Modern Trends of Teaching Chemistry for Digital Natives. International Journal of Behavioral Social and Movement Sciences, 2013, 2(1).
28. Stearns C. The Effects of Standardized Testing on Students, 2022. Online at: Study.com
29. Taiwo AK. A Three Model Parameter of Chemistry Achievement Test among Secondary School Students in Ibadan Metropolis, Nigeria. International Journal of Scientific and Research Publication, 2020, 10(6).
30. Tinio VL. Information and Communication Technology in Education. UNDP Bureau for Development Policy, 2002. (Online); http://www.eprimers.org.
31. Udu DA. Innovative Practices in Science Education: A Panacea for Improving Secondary School Students' Academic Achievement in Science Subjects in Nigeria. Global Journal of Educational Research. 2018; 17:23-30.
32. Wagbara SO. Effect of Brainstorming strategy on Senior Secondary School Students Academic Achievement in Chemistry in Rivers State, Nigeria. Middle European Scientific Bulletin, 2020, 4.