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DEVELOPING THE ADEPTNESS OF CHEMISTRY EDUCATION PROGRAMME THROUGH INNOVATIVE METHOD OF TUTORING

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ABSTRACT

Sustainable approach towards making chemistry teaching and learning effective has been an issue of great concern in the education sector. Although this issue has been properly managed by some developed countries of the world, it has however been a major issue of great concern to Nigerian education sector, resulting from teachers' uninterrupted use of non-Innovative method of tutoring (NIMT) which sees students as passive receiver of knowledge, instead of Innovative method of tutoring (IMT) that gives students the opportunity to be active and acquire the requisite foundation during teaching and learning process. This necessitates the demand for chemistry tutors in Nigerian schools to always adopt IMT when tutoring, which enhances students' active participation and helps to build in them the competence to meet with the challenges they would face in life. Though is unimaginable that some chemistry teachers in Nigeria schools seems not to be improving the adeptness of chemistry programme through the use of IMT by their tutors. Hence this paper examined the adeptness of chemistry programme through IMT. Drawing upon the debate in the literature, this paper argues that schools in Nigeria, are saddled with the responsibility of inculcating its students/citizens the requisite solid background that will make them innovative. IMT is a better approach to use towards developing necessary competence for success, especially for chemistry students. It is observed that if schools in Nigeria are encouraged with the necessary resources for the effective application and implementation of IMT our graduates will be more resourceful. Amongst the recommendations is that, aggressive sensitization and enlightenment programmes should be mounted by all concerned stakeholders aimed at highlighting the need for our chemistry students to acquire the major innovative background upon-graduation. Quality innovative teachings should be embarked upon by chemistry

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teachers so as to fully engage their students in a bid to maximally explore their potentials for better future.

Keywords: *Chemistry education, Innovative method of tutoring (IMT)*

Introduction

The attainment of requisite sound background by chemistry students is highly essential than the grades they acquire in their certificate. The solid foundation they acquired, does not manifest without a process. This process started from the foundation laid for them by their teachers based on quality teaching and learning. For some years now the number of applicants seeking to study chemistry in Nigerian schools are rapidly growing. This is because courses in chemistry and science generally have become a worthwhile area of interest, and because the major source of Nigerians revenue is from manufacturing and production industries, oil and gas, health, agriculture, information and communication technology, petroleum and petrochemical products which requires some good knowledge of chemistry. Regardless of the worth of chemistry in Nigeria, in recent time, it has unsuccessful produced persons who can stand out in the highly demanding global labor market (Stains, Harshman, Barker., Chasteen, Cole, DeChenne-Peters & Young., 2018) and Omiko, 2025). Consequently, employers have pleaded with all the institutions of learning especially secondary level to put in their best by ensuring that they inculcate their students with the requisite knowledge that will make them function effectively at the tertiary level and in work environment upon graduation.

Considering the fact that Nigeria is determined to become a developed nation, schools in the country need to help students develop knowledge that goes beyond technical competence in their discipline, especially now that the demands for globalization are intense. Innovative method of tutoring (IMT) is a revolutionary method aimed at making the students actively involved during learning. Innovative methods of tutoring (IMT) are a teaching and learning strategy that inhibits the learner from being only a note taker during teaching and learning process. Using this approach, students are motivated to learn and no longer remain passive during the teaching process in a flexible learning environment that actively engages them.

The teachers' job when IMT is used is to make students to investigate, imagine and even get to the solution of problems themselves by offering students with some innovative knowledge that will give them the understanding to rearrange, predict, manipulate object, pose question. By bringing preceding ideas and knowledge to present tasks, students acquire cognitive and none technical skills such as critical thinking, appraisal, communication, negotiation, teamwork, interpersonal, as well as problem solving. Students of chemistry needs competence to meet with the complex demands of the innovative and technological advancement existing

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within our society today. Hence, this paper discusses, among other things, Chemistry, Knowledge required for chemistry students, the meaning of Innovative method of tutoring (IMT), Types of IMT, merits of IMT, and challenges facing IMT in Nigerian School.

Chemistry

Chemistry is a branch of science that studies the preparation, properties, structure and reactions of material substances. Chemistry focuses on the study of matter, its composition, structure, properties, and transformations. Chemistry **is** the science that deals with the properties, composition, and structure of substances (defined as elements and compounds), the transformations they undergo, and the energy that is released or absorbed during these processes. Every substance, whether naturally occurring or artificially produced, consists of one or more of the hundred-odd species of atoms that have been identified as elements. Although these atoms, in turn, are composed of more elementary particles, they are the basic building blocks of chemical substances; there is no quantity of oxygen, mercury, or gold, for example, smaller than an atom of that substance. Chemistry, therefore, is concerned not with the subatomic domain but with the properties of atoms and the laws governing their combinations and how the knowledge of these properties can be used to achieve specific purposes.

The great challenge in chemistry is the development of a coherent explanation of the complex behaviour of materials, why they appear as they do, what gives them their enduring properties, and how interactions among different substances can bring about the formation of new substances and the destruction of old ones. From the earliest attempts to understand the material world in rational terms, chemists have struggled to develop theories of matter that satisfactorily explain both permanence and change. The ordered assembly of indestructible atoms into small and large molecules, or extended networks of intermingled atoms, is generally accepted as the basis of permanence, while the reorganization of atoms or molecules into different arrangements lies behind theories of change. Thus, chemistry involves the study of the atomic composition and structural architecture of substances, as well as the varied interactions among substances that can lead to sudden, often violent reactions.

Chemistry also is concerned with the utilization of natural substances and the creation of artificial ones. Cooking, fermentation, glass making, and metallurgy are all chemical processes that date from the beginnings of civilization. Today, vinyl, Teflon, liquid crystals, semiconductors, and superconductors represent the fruits of chemical technology. The 20th century saw dramatic advances in the comprehension of the marvelous and complex chemistry of living organisms, and a molecular interpretation of health and disease holds great promise. Modern chemistry, aided by increasingly sophisticated instruments, studies materials as small as single atoms and as large and complex as DNA (deoxyribonucleic acid), which contains millions of atoms. New substances can even be designed to bear desired characteristics and then synthesized. The

rate at which chemical knowledge continues to accumulate is remarkable.

Intimately interconnected with the intellectual challenges of chemistry are those associated with industry. In the mid-19th century the German chemist Justus von Liebig commented that the wealth of a nation could be gauged by the amount of sulfuric acid it produced. This acid, essential to many manufacturing processes, remains today the leading chemical product of industrialized countries. As Liebig recognized, a country that produces large amounts of sulfuric acid is one with a strong chemical industry and a strong economy as a whole. The production, distribution, and utilization of a wide range of chemical products is common to all highly developed nations. In fact, one can say that the "iron age" of civilization is being replaced by a "polymer age," for in some countries the total volume of polymers now produced exceeds that of iron.

Chemistry, as we understand it today, is not a very old discipline. Engaging students actively during teaching is very important for fostering a deeper understanding of chemical concepts. Traditional teaching methods, which preponderantly relied on lectures and rote memorization, often failed to entry the concern of students or stimulated their curiosity.
Innovative method of tutoring offer energizing and mutual alternatives that could transmute the informatory experience. These methods not only made learning more gratifying but also catered to different learning styles, thereby improving academic executing and fostering a womb to tomb concern in chemistry (Yuminu. 2025; Egolum, Njelita and Ezeokeke 2014)

Knowledge required for chemistry students:

The basic knowledge required of chemistry students are those transferable ideas needed by an individual especially a science student to make them resourceful. That knowledge required of a chemistry student involves some necessary basics. Along with good technical understanding and subject knowledge, employers often outline a set of fundamentals they want from an employee. They are the skills and the key to the success of any workplace. It is a group of essential abilities that involves the development of a knowledge base, expertise level and mindset that is increasingly necessary for success in modern workplace (Eison, 2010).

Employers of labor are often looking for sound and competent individuals with fundamental ideas that go beyond qualifications and experience. Your education and experience may make you eligible to apply for a job but, to be successful in most roles; you will need a very competent background that you are likely to develop over time. Some will be specific to the job, but the vast majority will be so-called 'soft skills' that can be used in any job or employment sectors. They are what makes you employable. As a general rule, employers are willing to teach someone the job-specific requirement, such as how to operate particular pieces of machinery, or use

particular computer packages that are very specific to the role or company. However, they usually want to see that you already have the other 'basic knowledge' before hiring, because they are much harder to teach.

Good collaboration with others: the knowledge requires to-work well with other people are known as interpersonal skills. Good interpersonal skills allow you to participate effectively as a member of a team, satisfy your expectations, negotiate, make decisions and solve problems with other people, and generally work effectively with others. Interpersonal knowledge includes: Good Communication knowledge (verbal and non-verbal), listening, emotional intelligence, team-working, negotiation, persuasion and influencing skills, conflict resolution and mediation, problem-solving and decision making.

Being reliable and dependable: this basically means doing what you say that you will do. It also, however, means being able to look around and see what needs doing-and do it. It requires a wide range of ideas, mostly personal than interpersonal. You have to be organized by managing your time effectively. You have to be trustworthy and conscientious. You have to be self-motivated and a creative thinker.

Willingness to acquire new knowledge: it means being open to new ideas and experiences, and always looking to improve your already existing knowledge. Most times is referring to as personal development. There are, inevitably, a wide range of knowledge that could be useful in chemistry. Each of us has our own personal range of ability levels, and we therefore can each make a unique contribution according to our individual knowledge level. Learning to recognize and use your understanding appropriately is essential. An open mind and willingness to embrace new ideas, is probably one of the most useful attributes that you can possess as a good chemistry tutor or learner (Ogunbiyi, Ugodulunwa, Eze, Uwaleke, Igu, Ogba and Ekechukwu, 2019).

Need for Innovative method of tutoring in chemistry

One of the objectives of chemistry programme is to build and produce competent individuals who can apply what they have learned in form of ideas to national development. The Nigeria's work environment is progressively changing, especially with globalization and the influx of advanced technology existing today in the commercial setting. Employers express dissatisfaction with the kind of competence shown by science and chemistry graduates in particular (Eze, 2010). While collaboration, analytical skills, manipulative skills and good communication which involve the appropriate use of both oral, written and information and communication technology were recommended for chemistry, Udosen, (2015) and Ajaero and Okoroafor (2018) explained that most of this knowledge especially the information and communication technology (ICT) part in mostly essential for sustainable human capital development.

Ajaero and Okoroafor (2018) further pointed out some basics required by a good chemistry students or graduate in other to meet up with the expected challenges usually seen in the larger society. They include: the ability to effectively manage and resolve conflict, understand team dynamics and appropriate response, teamwork and interpersonal knowledge, assume leadership role where/when necessary, negotiate acceptable solutions in a professional manner, organize and monitor performance, be productive with innovations, recognize and respect similarities in a team, team work and interpersonal relationships and collaborate with others when necessary.

Others are problem solving, analytical and critical appraisal skills, which enables students to: solve problems which solutions are clearly obvious; make timely decisions using available information; demonstrate the capacity for inquiry, logical thinking, inductive and deductive reasoning and critical examination; apply different problem-solving strategy in a constructive way and identify and solve unfamiliar problems that require analytical skill and originality (Okeke, 2015). According to Yaminu (2025) and Ajaero and Okoroafor, (2018). There is basic competence needed by every science graduate for their future survival, they include: productive competence, entrepreneurial competence, critical thinking competence, analytical background and innovative knowledge to identify a problem (Terwase et**.** all**,** 2019).

The above substantiates the views of Osisioma (2012) and Uwaleke and Okoli (2019) who stated that the basic objective of offering science and technology education courses in Nigerian tertiary institutions is for graduates to have sound understanding that are in highly required in diverse sector. These include ideas and knowledge relating to numeracy, problem solving, team-work, good organization conduct, project and time management, data analysis and communication of complex ideas. Graduates can work in industries including education, defense, health care, pharmaceutical companies and nature conservation. They can also work as secondary school teachers, research scientists, higher education lecturers, chemists, nature conservation officers, research scientists, production managers, quality control officers/analyst, health promotion specialists, and science writers. If a chemistry graduate undergoes proper tutoring, all that he or she received in school before graduation can prepare the person for other careers (Uwaleke, Okoli and Uwaleke 2019).

The fundamental knowledge required by chemistry students or graduates are so enormous hence its worth cannot be overemphasized. This corroborate the view of Eze (2010) that science and technology education graduates with various knowledge would be required by employers because they would help in bringing required ideas to achieve success in the work place. Therefore, the need to introduce, enhance and sustain good innovative method of tutoring in our schools especially in a developing country like Nigeria becomes very vital.

Innovative Method of Tutoring (IMT) in Improving Quality Knowledge in Chemistry

Innovative method in teaching whose aim is to make students become part of the teaching and learning process is very fundamental in actualizing the objective of any planned lesson. The concept of innovative tutoring according to Ajaero and Okoroafor (2018) was propounded in 1905 by Hayward and further expounded by Deway in 1956. IMT is a better method than the conventional concept of learning where the teacher solely dispenses knowledge to the students. IMT is an innovative teaching method that grants students the opportunity to be active during teaching and learning. It is a modern teaching method that allows the teacher to be the director or facilitator while ensuring that the students comprehend and become involved in achieving the objective of the teaching and learning process. IMT holds the students accountable for learning rather than the content of what the teacher is teaching, this is because knowledge cannot only be passed from teacher to students but also from student though their background experience and knowledge to bear on what they learnt so that they can have a better understanding of their learning task (Ajaero and Okoroafor, 2018; Stanbarg, 2007).

Ajaero and Okoroafor (2018) stated that all known active or collaborative learning has been found to bring about better understanding in learner than the conventional or passive method of learning, which makes the teacher the focus of the lesson rather than the students. Effective use and application of problem-solving activities during teaching and learning helps the learner in areas such as, stimulations, case studies, group activities, role playing as learning method enables students have experiential knowledge and understanding, as well as develop good knowledge such as problem-solving ability, good communication, teamwork, presentation and research (Eison, 2010; Palanissamy, Syed and Kumar, 2017).

IMT is also based on Bruner's (1966) constructivist theory of learning which states that learning is an active process in which learners construct/acquire new knowledge/ideas based upon the current or past knowledge. The constructivist believes that effective learning takes place when students actively engage in the learning process by collaborating rather than learning on their own. It is through group interaction that learners relate what was taught to what they already know, reflect and hence construct knowledge. Bruner also states that meaningful learning is a cognitive process in which learners make senses of the world in relation to the knowledge which they already acquired or have constructed. Bruner is a strong proponent of innovative learning which has to do with the acquisition and enhancing of quality knowledge. Hence, Brunner's constructive learning theory provides the theoretical base for this paper which focused on developing the adeptness of chemistry education programme through Innovative Method of Tutoring (IMT).

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Types of IMT

Innovative methods of tutoring, such as the flipped schoolroom model, Ramification, and inquiry-based learning IBL, offer energizing and mutual alternatives that could transmute the informatory experience. These methods not only made learning more gratifying but also catered to different learning styles, thereby improving boiler suit academic executing and fostering a womb to tomb concern in chemistry.

Despite the proven benefits of innovative method of tutoring, many schools continue to rely heavily on traditional lecture-based methods. These conventional approaches present several limitations that hinder effective learning in chemistry:

• Passive Learning: Traditional lectures often position students as passive recipients of information, limiting their active involvement in the learning process. This passivity can lead to disengagement and a lack of motivation, which are detrimental to the learning experience.

• Lack of Practical Application: Chemistry is a discipline that thrives on experimentation and practical application. Traditional methods frequently emphasize theoretical knowledge at the expense of hands-on experiences, depriving students of opportunities to apply concepts in real-world scenarios.

• Limited Interaction: Lectures typically offer limited opportunities for student-teacher interaction and peer collaboration. This isolation can impede the development of critical thinking and problem-solving skills, which are essential in the study of chemistry.

• Difficulty in Conceptual Understanding: Abstract concepts in chemistry, such as molecular structures and chemical reactions, can be challenging to visualize and comprehend through lectures alone. Innovative methods that incorporate visual aids, simulations, and interactive activities can significantly enhance conceptual understanding.

To address these challenges, it is imperative to explore and implement innovative teaching methods that actively engage students, provide practical learning experiences, and foster a collaborative and interactive educational environment. This paper delves into various innovative approaches, evaluating their effectiveness in enhancing chemistry education and advocating for their broader adoption to overcome the limitations of traditional teaching methods. (Yamini, 2024)

Flipped Classroom Model:

• Concept and Implementation: The flipped schoolroom model redefines formal pedagogy by having students initially engaged with new capacity at home finished video lectures as well as readings, or on line, resources. This pre class expression allows students to acquaint themselves with the corporeal at their own pace. During class time, alternatively of listening to lectures, students participated in mutual activities such as discussions, problem solving sessions, and active experiments. This excited learning environs enables students to apply concepts as well as ask questions, and collaborated with peers under the way of the instructor.

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Benefits: The flipped schoolroom model offers single meaningful advantages. First, it increases activeness by the learner by shifting the focus from inactive listening to excited engagement. Students are more involved in their learning process, which enhances and motivates them. Second, it improves the understanding of compound concepts. By allowing students to study materials advanced, they come to class prepared to delve deeper into the correction liaison finished hardnosed coating and discussion. This commercial helps solidified their grasp of dirty topics. Third, it enhances problem solving skills. The mutual class activities encouraged students to think critically and work finished problems collaboratively, fostering base deductive and teamwork skills that are important in the study of chemistry.

Case Studies:

Research and case studies concentrate the strength of the flipped schoolroom model in alchemy education. For instance, a study at Harvard University found that students in a flipped alchemy class performed meliorate on assessments and demonstrated a deeper understanding of chemic principles compared to those in formal lecture-based classes. Another case study at the University of British Columbia reported that students in flipped classrooms showed increased employ and high attending rates. Additionally, as well as a study conducted among high crop alchemy teachers who implemented the flipped model revealed that 80% observed improved bowman executing and increased schoolroom participation. The flipped schoolroom model offers an energizing and efficacious admittance to alchemy education. By promoting excited learning and hard-nosed application, it enhances bowman participation, inclusion of compound concepts, and problem-solving abilities, as evidenced by single hunt findings and case studies.

Gamification in Chemistry Education:

• Definition and Techniques: Gamification involves the coating of game design elements in non gamed contexts to heighten learning and engagement. In alchemy education, Ramification could transmute formal schoolroom activities by incorporating techniques such as point scoring, leaderboards, and rewards. Point scoring rewards students for completing tasks, solving problems, and participating in discussions as well as fostering a sense of achievement. Leaderboards make a competitor environs by displaying top performers, encouraging students to meliorate their standings. Rewards, which could range from badges and certificates to realistic prizes, allow incentives for students to draft more thick with the material.

Engagement and Motivation:

Ramification importantly boosts bowman motivating and employ by making learning more mutual and enjoyable. The competitor unreliable of leaderboards and the pull of earning rewards drive students to record actively in class activities. This increased employ helps students stay focused and invested in their learning process. Additionally, the prompt feedback provided by point scoring and other game elements helps students learn their advance and areas needing improvement, which

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fosters a growing mind set and encourages successive learning. The cooperative aspects of some Ramified activities also promoted teamwork and communicating skills as well as hike enhancing the learning experience.

• **Examples and Outcomes:**
Several examples illustrated the succeeder of Ramification in alchemy education. At a high crop in California, a Ramified alchemy family saw students earn points for completing assignments, participating in class, and achieving high mount on quizzes. This admittance led to a 30% increased in prep culmination rates and a meaningful betterment in quiz scores. Another case study from a university alchemy family involved using an appendage choline that incorporated Ramification elements like badges and leaderboards. The results showed a 25% increased in bowman employ and a marked betterment in boilersuit family grades. Additionally, a study published in the Journal of Chemical Education reported that students in a Ramified alchemy class exhibited high motivating and meliorate storage of corporeal compared to those in a formal class setting. Ramification in alchemy pedagogy harnesses the power of game design elements to heighten bowman motivating and engagement. By making learning more mutual and competitive, Ramification could lead to improved academic executing and a more gratifying informatory experience.

Inquiry Based Learning IBL:
• Principles of IBL: Inquiry based learning IBL centers on students exploring questions, problems, and scenarios to make their understanding, earlier than being presented with facts. The core principles acknowledge student driven inquiry, where learners pose questions and investigated them, excited learning, which emphasizes active activities, and reflection, allowing students to think critically about their findings and processes. This admittance encourages curiosity, independence, and a deeper employ with the correction matter.

• **Critical Thinking and Creativity:**
IBL fosters important thinking and creativeness by requiring students to work information, formulated hypotheses, and pattern experiments. As they navigated compound problems and seek solutions, students grow higher order thinking skills and creativity. IBL promotes a deeper understanding of technological concepts, as students actively engaged in the learning process, make connections, and apply their noeses in novel contexts.

Implementation Strategies:
To apply IBL in alchemy classrooms, educators can use project-based learning, where students work on extended projects that need research, experimentation, and presentation. Laboratory investigations are other key strategy, allowing students to run experiments that destination real world problems or test their hypotheses.
Teachers should have provided way and support, facilitating the Inquiry ferment without dictating it, to help students grow liberty and pledge in their technological abilities.
• Technology Integration: Virtual Laboratories:

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• Virtual Labs Overview:
Virtual laboratories are appendage platforms that simulated real world lab environments, allowing students to run experiments and hunt chemic reactions finished computer-based simulations. These realistic labs allow active have by mimicking the procedures, equipment, and reactions found in real labs, thereby enhancing student's hard-nosed skills and understanding of compound concepts.

• Accessibility and Flexibility: Virtual labs importantly increased approachability and traceableness in alchemy education. They make empirical learning approachable to students who may lack approach to well equipped real labs due to geographical, financial, or institutionalized constraints. Virtual labs can be accessed from anyplace at any time, allowing students to learn at their own pace and revisit experiments as needed. This traceableness supports different learning styles and schedules, making it easier for students to draft with the material.

Comparative Studies:
Comparative studies fence that, realistic labs can be as efficacious as formal labs in terms of bowman learning outcomes and engagement. For instance, as well as a study published in the Journal of Science Education and Technology found that students using realistic labs performed as well on assessments as those in formal labs. Additionally, realistic labs often led to high employ levels due to their mutual unreliable and the prompt feedback they provide. However, combining realistic and formal labs often yields the best results, offering both the hard nosed have of real labs and the approachability and traceableness of realistic
ones.

Augmented Reality AR and Virtual Reality VR in Chemistry:
• AR/VR Applications: AR and VR offer innovations solutions in teaching unit structures, chemic reactions, and lab techniques. In AR, students can use changeful devices or habiliment engineering to covering appendage data onto real world objects, allowing them to learn unit structures in 3D and interacted with them in real time. VR, on the other hand, immerses students in realistic environments where they could adopt chemic reactions and manipulated lab equipment as well as providing an active have without the need for real resources.

• **Immersible Learning**:
AR and VR make immersible learning experiences by engaging aggregated senses and providing mutual simulations. By visualizing nonrepresentational concepts like unit structures and chemic reactions in 3D www.ijmrast.com International Journal of Multidisciplinary Research in Arts, Science and Technology (IJMRAST) (14) space, students can meliorate learn the spacial relationships and energizing processes involved. The immersible unreliable of AR and VR captures student's tending and encourages exploration, leading to deeper inclusion and storage of compound concepts.

• **Researched Findings:**
Research on the touch of AR and VR on bowman learning in alchemy had shown promising results. Studies have found that

students who use AR and VR technologies demonstrated improved special reasoning skills, meliorate nonrepresentational understanding of chemic phenomena, and increased motivating and interested in the subject. Additionally, AR and VR had been shown to hold clear cut learning styles and abilities, making them quantitative tools for enhancing exclusivity and approachability in alchemy education. Overall, the immersible and mutual unreliable of AR and VR holds great effectiveness for transforming the way alchemy concepts was taught and learned.

Online Learning Platforms:

• MOOCs and E Learning: The rise of Massive Open Aline Courses MOOCs and other on line, learning platforms had revolutionized alchemy pedagogy by providing approachable and conciliatory learning opportunities to a rounded audience. MOOCs offer free or low-priced courses delivered via the Internet, allowing learners to approach high quality informatory capacity from leading institutions worldwide. Additionally, e-learning platforms offer a wide range of resources, including video lectures, mutual simulations, and word forums, catering to different learning preferences.

• Benefits and Challenges:

The benefits of on line as well as learning platforms in alchemy pedagogy are manifold. They allow traceableness for students to learn at their own pace and convenience, accommodating busy schedules and different learning styles. Aline platforms also offered wide approach to informatory resources as well as broke down geographic barriers and providing opportunities for womb to tomb learning. However, as well as challenges such as maintaining bowman engagement, ensuring interactivity, and addressing commercialized issues may have arose. Additionally, the lack of opposite interaction and personalized feedback can be drawbacks for some learners.

• Best Practices: To efficaciously integrated on line, learning platforms into formal curricula, educators should have adopted best practices that leveraging the strengths of both approaches. This includes designing blended learning experiences that aggregated on line, resources with personalized instruction, providing opportunities for mutual activities and peer collaboration. Furthermore, instructors should have offered clear guidelines and concentrate for navigating on line, platforms, aid meaning discussions, and allow well timed feedback to heighten bowman employ and learning outcomes. Additionally, as well as regularly assessing bowman advance and adapting teaching strategies based on feedback could help optimized the strength of on line, learning in alchemy education. www.ijmrast.com International Journal of Multidisciplinary Research in Arts, Science and Technology (IJMRAST) (14) space, students can meliorate learn the spacial relationships and energizing processes involved. The immersible unreliable of AR and VR captures student's tending and encourages exploration, leading to deeper inclusion and storage of compound concepts.

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Merits of IMT

From the literatures reviewed earlier, it has been established that IMT is more helpful than the conventional method of tutoring. The reason is that IMT:

(1) **B**uilds stronger student-teacher relationship;
(2) **T**akes into account students diverse learning needs and interest and increases their retention of both knowledge and skills;
(3) Engages students actively in learning, thereby reducing classroom disturbances;
(4) Improves students' motivation and promotes peer communication;
(5) Instills greater confidence in students since they are responsible for their own learning responsibilities;
(6) Develops characteristics of lifelong learning;
(7) Develops generic skills, such as communication, negotiation, decision making, problem solving and independent skills;
(8) Emphasizes effective communication of knowledge to address emerging and enduring problems in real life context;
(9) Promotes students' innovation and creativity (Hawati, Ruzita, Aisha, Noor, Noor, **and** Muhamas, 2013, cited in Ajaero **and** Okoroafor, 2019).

Challenges Facing IMT in Nigerian Schools

Teaching generally and chemistry teaching in particular is supposed to be result oriented and learner centered, and this can only be achieved when students are willing and the teachers are favorably disposed, using the appropriate resources in tutoring the students. The application of IMT in Nigerian schools is faced with so many challenges. Some of the challenges includes: non-professionalism of people teaching the subject, class size, poor infrastructural facilities, condition of service/teachers' remuneration, lack of adequate workshop/laboratory and overloaded curriculum, to mention but a few.

Other challenges facing MIT in Nigeria as opined by Omiko (2015) is the obsoleteness of equipment and dilapidated laboratories/workshops. Science subjects are experimental and practical subjects and its learning is of most value and effective when the student is involved in the process of scientific investigation.

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Quality teaching/ tutoring is vital in the application of IMT. The problem of lack of teaching materials in schools hinders effective application of IMT (Anyanwu, 2001). Hence teachers in our schools are facing the problem of lack of material resources and the potential knowledge for teaching and learning of chemistry.

Overloaded curriculum/Syllabus and inadequate time: syllabus to be covered is too wide in relation to time allowed for both the theoretical and practical aspect of topics in some subjects like chemistry, biology and physics. It is no doubt that an unwieldy and too demanding syllabus creates a lot of tension in both teachers and students. Therefore, IMT demands huge time and attention, which most teachers in Nigerian schools do not have. Also, the volume of administrative or non-administrative work some teachers have to cope with may hinder them from planning properly for their lessons which may pose a serious setback on the effective application of IMT.

Most chemistry teachers do not have a functional understanding of the changing nature, scope and development in chemistry. Some chemistry teachers do not have current information because they do not belong to any science or chemistry professional body like the Science Teachers Association of Nigeria (STAN) or attend conference and workshops. Such teachers find it more convenient in staying away from current books and journals: so they go ahead to churn on outdated and a recycled notebook or lesson note thereby producing students that can only appreciate the benefit of science from only material infrastructural development in society. This invariably affects the students' involvement and active participation during teaching and learning.

Non-professionalism is another major challenge facing the application of IMT in Nigerian schools. Some teachers are teaching courses they do not specialize on, this will make them not to impact the knowledge appropriately and students will automatically become passive which is against the tenets of IMT. Poor remuneration and poor staff welfare have destroyed the morale of most teachers in Nigerian schools. From the forgoing, it is obvious that the factors examined will go a long way in determining effective application of IMT in Nigeria schools especially at secondary level.

Conclusion

Secondary level of education is part of the main foundations for educational development in Nigeria, therefore is amongst the levels of education saddled with the responsibility of inculcating its citizens with the requisite knowledge that will make them resourceful. Improving the teaching of chemistry in Nigerian schools through the use of IMT is highly required. This paper has proved that IMT is more of great necessity towards developing necessary competence for the holistic development of our students, especially for chemistry students/ graduates. Sound knowledge and background for chemistry were pointed out with emphasis on meeting the needs of the current realities in Nigerian economic system. Students play a major role in IMT. They are active participants in the learning process. It is

observed that if Nigerian schools are encouraged with the necessary resources for the effective application and implementation of IMT, our students and graduates will be better equipped to be self-reliant and employers of labor.

Implication of the Study

This study has provided evidence for the use of IMT in improving a good background for chemistry students. The findings of this study have relevant educational implications to students, teachers and education sectors of State and Federal Government of Nigeria. The use of IMT makes the students to be actively involved during learning which is among the major principles of learning. This method gives the student the opportunity to be self-reliant, thus enhancing their problem-solving skills. Students learn better when they are actively involved in a lesson. The study has also proved that students find it difficult to learn effectively when conventional lecture method is used. This is because when conventional lecture method is used, students become only listeners, observers and note copiers thereby become inactive during teaching and learning.

The implication of this study to educational sectors of State and Federal Government of Nigeria, is that it will serve as an eye opener to our schools offering science subjects especially chemistry to redirect them towards incorporating IMT as part of the instructional strategies that students' teachers would be trained on during their preparation processes as prospective chemistry teachers.

Recommendations

It is therefore recommended among others that:

(i) Innovative/activity-oriented lessons should be embarked upon by chemistry teachers so as to fully engage their students in a bid to maximally explore their potentials thereby enhancing their knowledge.

(ii) Conscientiously the teacher must of necessity, provide enabling environment and other resources necessary for implementation of IMT. To achieve IMT in Nigerian schools requires the use of various innovative method with which the teacher should be acquainted.

(iii) Government should provide well equipped chemistry laboratories in all secondary school; this will help to facilitate learning especially where IMT is to be applied.

REFERENCES

Ajaero, O. and Okoroafor, S. (2018) Enhancing Employability of Accounting Graduates through student-centred learning. *Effective Teaching and Learning: A handbook for Educators in Nigerian Universities.* Funai Press, Federal University Ndufu-Alike, Ikwo, Ebonyi State.159-166

Anyanwu, S.U. (2001). *Principles and methods for classroom teaching.* Owerri, Jeo Mankpa's Publishers.

Bodner, G. M., & Domin, D. S. (2000). Molecular modeling: An essential component of modern chemical education. Journal of Chemical Education, 77(7), 870-874.

Bruner, J. (1966). *Toward a theory of instruction.* Cambridge, MA: Harvard University Press.

Eison, J. (2010). Using Active Learning Instructional Strategies to Create Excitement and Enhance Learning. Retrieved from

https://www.cte.cornell.edu/documents/resentations/Eisen-handout.pdf

Colburn, A., & Keene, K. (2018). Augmented reality in chemistry: Preliminary investigation of a new tool for student learning. Journal of Chemical Education, 95(10), 1682-1688.

Eze, C.C. (2010). Repositioning chemistry education in Nigeria colleges of education for economic empowerment. *51st Annual Conference Proceedings of STAN* 287-292

Hawati, J., Ruzite, A. R., Aisyah, A. R., Noor, A. A., Noor, A. H., and Muhamad, Z. Y. (2013). Integrating Student-Centered learning in Finance Courses: The Case of a Malaysian Research University. *International Education Studies, 6* (6).108-123

Hornby, A.S. (2010). Oxford advanced learners dictionary (international students edition) 8th ed. Newyork; *Oxford University Press.*

Egolum, E.O., Njelita, C.B. and Ezeokeke K.N.C. (2014). Identification of production skill possessed by the chemistry teacher and those acquired by students for wealth creation. *International Journal of Engineering and Science 3, (*3).15-23

Ogunbiyi J.A., Ugodulunwa C.A., Eze A., Uwaleke C.C., Igu C.N.N., Ogba F.N. **and** Ekechukwu L.E. (2019). Effect of persuasive communication on students' mathematics test anxiety, attitude and achievement in Nigerian air force secondary schools. *American-Eurasian Journal of Agricultural & Environmental Sciences (AEJAES), 19* (4): 269-262 IDOSI publications.

Okeke, M.I. (2015). *Production focus for skill acquisition and entrepreneurship development.* Spp Syfey prints.

Omiko, A. (2015). Laboratory teaching: implication on students' achievement in chemistry in secondary schools in Ebonyi state of Nigeria. *Journal of Education and Practice:* Available Online using www.Iiste.Org Issn 2222-

1735 (Paper) Issn 2222-288x (Online) 6, **(206-213)**

Osisioma, I. (2012). Re-Imagining the Nigerian science and technology child with skills and competencies to succeed in the competitive global community. *IJERD. International Journal of Education Research and Development 4*, (1) 13-21

Palanissamy, A., Syed, R. T., **and** Kumar, P. (2017). *Benefits' of Implementing a Student-centred Learning Approach-A Study*. Quality Management & Enhancement in Higher Education. OQNHE Conference, Muscat, 21-22

Sternberg, R.J. (2007). *Wisdom, production skill, intelligence, and creativity synthesized.* New York: Cambridge University Press.

Stains, M., Harshman, J., Barker, M. K., Chasteen, S. V., Cole, R., DeChenne-Peters, S. E., ... & Young, A. M. (2018). Anatomy of STEM teaching in North American universities. Science, 359(6383), 1468-1470.

Terwase, T.N., Ugodulunwa C.A., Bulus, C.H., Ekechukwu, L.E., Uwaleke, C.C., Ogba F.N., Igu, C.N.N., & Eze, A. (2019). Diagnostic assessment of students' achievement in automobile electric works in technical colleges in a developing country. *American-Eurasian Journal of Agricultural & Environmental Sciences (AEJAES), 19* (4) 233-241. IDOSI publications

Udosen, E.D (2015). *Concepts in environmental chemistry*. Kalaba, Anikzo Global Ventures

Uwaleke, C.C. and Okoli J.N. (2019). Impact of Laboratory Approach on Acquisition of Production Skills in Bleach Making by Secondary School Chemistry Students in Okigwe Education Zone of Imo State, Nigeria. *Journal of Science, Mathematics and Technology Education Research (JOSMATER)* 1,*.(1)* 64-78. *Published by PSTAN. The Plateau State Science Teachers Association of Nigeria.*

Uwaleke, C.C., Okoli, J.N. and Uwaleke O.E (2019). Approaches for Improving the Acquisition of Production Skills among Secondary School Students in Okigwe Education Zone of Imo State, Nigeria. *AE-FUNAI Journal of Education (AE-FUNAI JOE).*1,*(2)*563-573. *ISSN: 2705-1560. Published by AE-FUNAI PRESS. Alex Ekwueme Federal University Ndufu Alike, Ebonyi State, Nigeria.*

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