



Innovative Approaches in Teaching Chemistry in Digital Era at Secondary School Level in Nigeria: Issues and Prospects

Amina Aminu

Chemistry Department, Federal College of Education, Yola, Nigeria | Email:

aminuamina03@gmail.com

Abstract: *Teaching Chemistry using innovative approaches cum digital devices is one of the most viable strategies, notwithstanding the attendance challenges. This paper examined pedagogical techniques and interactive teaching in the digital era. The paper delved into teaching chemistry where Students are actively involved in laboratory activities, such as experimentations, problem solving and other related Methods. The effectiveness of utilizing equipment, Process Oriented Guided Inquiry Learning Approach (POGILA) in teaching Chemistry were highlighted. Similarly, innovative techniques and key process skills such as ability to think analytically and work effectively as part of collaborative learning were examined. The paper viewed innovative approaches in teaching as improved problem solving skills which allows students to work at their pace and systematically master the concepts. The paper also highlighted the concept of digital era, techniques and devices used in teaching Chemistry. Issues and prospects were equally highlighted as they affect teaching and learning chemistry. The paper recommended among others provision of qualified chemistry teachers and adequate facilities as well as internet resources for teaching of chemistry.*

Keywords: *Approaches, Chemistry, Digital, Innovative, Teaching*

Introduction

The teaching of Chemistry involves innovative approaches which are pedagogically oriented Student-centered. Interactive teaching in Science is based on inclusive approaches' that are research based which provide students with meaningful learning experiences in Chemistry. Chemistry as a science subject offers unique opportunity for leaning about how science works and interact with other learning experiences in life and society (Eilks and Hofstein, 2013). Learning Chemistry using innovative approaches helps in developing general skills, such as problems solving, understanding how Science contributes to society 's sustainable development, thinking in models being sensitive to and aware of dangers and hazards for environmental protection. In this way, chemistry has the potential to contribute to developing general education skills. Some of the skills can be developed with other Science subjects but of these skills are only unique to Chemistry.

It is worth nothing that teaching chemistry as a subject offers Student the opportunity to acquire knowledge about the world around them, enable them to contribute in societal

debate about science and technology related issues. Hence, the need for innovative approaches in teaching Chemistry that brings about desired outcome. Eilks and Hofstein (2013) observed that despite the apparent and conspicuous centrality of Chemistry among the science disciplines, its demanding goals have not been satisfactorily achieved. However, with the emergence and integration of E-learning approaches in science, achievement of the objectives is enhanced. It is against this background that this paper will focus on the following objectives:

- Concept of Chemistry.
- Concept of Digital era.
- Innovative approaches in teaching chemistry.
- Issues in teaching chemistry.
- Prospects in teaching chemistry.
- Suggestions.

Concept of Chemistry

Chemistry is a branch of physical science which deals with structure, properties and changes of matter (Wikipedia, 2011). Chemistry includes topics such as the properties of individual atoms, how atoms form chemical bonds to create chemical compounds, the interactions of substance through intermolecular forces that give matter its general properties, and interactions between substances through chemical reaction to form different substance. Conceptually, the definition of chemistry kept changing over the years due to researches, innovations and new approaches in teaching and learning of the subject. Eilks and Hofstein (2013) noted that the history of chemistry education is a culture of dynamic innovation characterized by new approaches cum knowledge and skills. This of course included new methods, strategies and techniques of teaching. Colgoni and Eyles (2010) Conceptualized science subjects in general and chemistry in particular as broad based interdisciplinary programmes that need a range of integrated approaches. In this context chemistry is regarded as an essential basis for many facts of our everyday lives, and has many unforeseen potential benefits for our future. Proper understanding of chemistry enables us to explain the world around us. This explains the basic necessity to teach and learn chemistry which knowledge and skills remain dynamic in the face of the changing nature of the society. Accordingly, the approaches, methods and techniques of teaching chemistry keep on changing. This calls for the need to explain innovation approaches in teaching chemistry.

Concept of Digital Era

Digital era can be conceptualized in terms of information age within a period in human history characterized by the shift from traditional to industrial revolution. It is worth nothing that the definition of digital era continuous to change over time. In this context the concept of digital era refers to e-learning. Digital learning, therefore, refers to any type of learning that is facilitated by teaching or by instructional practice that make use of technology. Digital learning occurs in all learning areas or domains. According to Victoria (2017) it encompasses the application of a wide spectrum of practices which include:

- Blended and digital learning

- Game based learning
- Assessing digital context
- Collaborating locally and globally
- Assessing and reporting on time

Active participation in online communities

Using technology to connect Collaborate, curate and create

Innovative Approaches in Teaching Chemistry in Digital Era

The concept of innovative approaches has to do with new methods techniques, strategies and skills in teaching. Nicolaides (2012) conceptualized innovative approaches in terms of multimedia technologies that are available for developers. This view represents multimedia devices that are interactive and resourceful in teaching. Similarly, Ogbondahi (2008) conceptualized multimedia devices in terms of three categories: visual, audio-visual and aural devices. These devices provide avenues digitalization in teaching and learning process.

The above views represent mainly the concept of teaching materials which are basically features and constituent of techniques and skills of teaching and learning process. Degereji (2006) referred to approach as any viable practical method of teaching that brings about a desired outcome. This view represents innovative approaches as any pedagogical and interactive teaching techniques that activity involved learners. Similarly, Kabutu and Degereji (2006) noted discovery and problem solving as viable approaches in teaching broad base science which allows students to actively participate in their own observations.

Eilks *et al.* (2013) referred to innovative approaches in teaching chemistry as meaningful contexts to motivate the learning of chemistry. This usually stem from the structure of the discipline or history of chemistry, via everyday life contexts, industrial applications, or environmental issues and socio scientific issues. They further maintained that general orientations offer textual approaches to start the lesson, but the orientations can be used as guiding principles for structuring the whole chemistry curriculum. These orientations of approaches are;

- History of science (chemistry) orientation;
- Structure of the discipline orientation;
- Everyday orientation;
- Environmental orientation;
- Technology and industry orientation;
- Socio-scientific issues orientation.

The above orientation textual approaches can be used within the context based chemistry curriculum. Innovative approaches are eminent due to growing awareness about the problem in traditional chemistry teaching. Eilks *et al.* (2013) noted that orientation on contexts means topics are chosen as the basis from which to start chemistry teaching and learning. In innovative approaches, contexts are thought to engage the students and provoke questions in this regards, connection to basic concepts ensures that the chemistry knowledge students gained within an individual context is detached from the specific context. The de-

contextualization and networking leads to cumulative learning of the basic concepts such as context on “food” provokes questions which answer lead to certain chemical knowledge. This knowledge is elaborated upon in a variety of ways until the questions are answered. For example, the elaboration of a context on burning will use some of this knowledge and produce some more. Using innovative approaches methods and techniques more knowledge is built up and whenever elements of a basic concept emerge, they are reflected and used for systematic organizing of the acquired knowledge.

Schwartz *et al.* (2013) noted in using innovative approaches in teaching chemistry. A teacher may ask the following questions: What do I want my students to understand? Or; What are they supposed to be able to do as a result of learning? In an attempt to answer these questions in the event of teaching and learning process, chemistry students should be engaged in active learning using variety of methods and techniques. Colgoni and Eyles (2010) and Eilks and Hofstein (2013) maintained that Innovative approaches such as process oriented guided inquiry learning, laboratory technique, electronic learning, mattering chemistry and smart work among others are innovative research- based online environment designed for both effective teaching and learning, similarly, concept simulations tutorials, visual experiences and problems based home, improve student learning and performance in chemistry. Students should be exposed to laboratory activities so that they learn about chemistry methods and experimentation. These classroom and laboratory techniques help in teaching content and key process skills such as ability to think analytically and work effectively as part of collaborative and interactive learning.

The innovative approaches in teaching science also encapsulate digital techniques chemistry. For example, a teacher can use video project to teach global warming for students to benefit maximally from the knowledge and skills. Lessley (2014) and Eilks *et al.* (2009) noted the importance of the following digital techniques in teaching chemistry: Video games, Team games, Role playing, question games, Puzzles, Discussion, Table top games, lets imagine games and Quizzes, these techniques can be digitalized and enhanced teaching chemistry. Different types of technology can be used in the digital era to teach in the classroom. In this regard, Karehka (2012) noted that use of computer assisted learning in the classroom, smart interactive, white board, online media and online study tools are very effective in teaching various subjects.

Issues in Teaching Chemistry

Chemistry as an academic discipline or subject involves the teachings of theory and practical concepts. In this regard, it requires both human and material resources such as qualified teachers and instructional facilities.

Issues related to teaching of chemistry according to Edomwonyi-Out and Abraham (2011) includes attitudes of both teachers and students, non-professionalism, time constraints, work shop, class size, conditions of service, laboratory adequacy and examination malpractice. These are among critical current issues of teaching chemistry in the digital era. Ouma (2011) examines these issues in terms of factors influencing students’ academic performance in chemistry and emphasized their centrality Vis-a-Vis digitalization of teaching chemistry.

In the light of the above issues in teaching chemistry can feature in two dimension: availability of teaching resources and technical know-how of the teacher in using the resources. This of course does not negate the creativity and resourcefulness of the teacher in making sure that acquiring knowledge based on the digital technology goes hand in hand with the knowledge of the subject matter.

Funding is one of the critical issues affecting the teaching of chemistry, particularly the practical aspects. It is obvious that provision of quality resources determines quality education. Training and retraining of teachers and adequate provision of teaching and learning resources depends on the availability of funds. In Nigeria there are broadly two sources of funding: Government and non-governmental (Famade *et al.*, 2015). In this context, huge amount of money is required for provision and maintenance of digital learning resources. These may be more obvious in subject like chemistry which teaching is not only based on use of available materials but research based instructional technology such as video programmes, video games, and internet resources among others.

The issue of Power supply is also central to the teaching and learning of different concept in chemistry. Use of e- learning resources and other digital devices squarely depend on power supply.

Prospects in Teaching and learning Chemistry

The prospects in teaching and learning chemistry are numerous. Carson (2012) maintained that teaching chemistry using instructional technology helps students to study in their own time and wide range of fields which boost level of self-motivation. E- learning strategies are effective because students can finish learning task in a short time frame, thereby creating time for more things to be learned. Using e- learning devices also enables students assessed all resources of a traditional course which of course helps students to learn where ever they found themselves. Armstrong (2013) noted that instructional technology through the use of digital devices allow students the freedoms to choose the time for study. Equally, it is important to note that digital learning resources enforce self-discipline among students.

Suggestions

This paper puts in place the following suggestions towards improving teaching and learning of chemistry in the digital era:

- Government should ensure that adequate facilities and internet resources are provided to improve teaching and learning chemistry.
- There is need for both government and private sectors to engage adequate qualified teachers who are willing to do the job.
- The present status of power supply is somehow encouraging; however, there is need to improve on the current situation by the government.
- Provision of e-learning resource is capital intensive; thus the government needs to prioritize provision of funds to enable schools used the digital technology effectively.
- There is need for government to ensure that chemistry teachers are professionally trained and re-trained to improve their knowledge and skills in teaching.

- Government should encourage research and implementation of research findings to improve chemistry teaching and learning process.
- Chemistry teachers be encouraging to employ the use of research-based teaching

Conclusion

This paper briefly defined the concept chemistry and examined innovative approaches as well as digital devices in teaching chemistry. The paper described pedagogical techniques within the context of innovative approaches and applicable digital technology in teaching chemistry as interactive teaching laboratory activities, scientific arguments and effective utilization of equipment vis-à-vis innovative skills and key process. Similarly, the paper highlighted some key digital devices. Thus the paper recommended among others the need for government to provide adequate teaching and learning resources in chemistry.

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