

**INNOVATIVE TEACHING METHODS IN SCIENCE EDUCATION FOR
JUNIOR SECONDARY SCHOOL BASIC SCIENCE STUDENTS.**

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Abstract

The paper innovative teaching methods in science education, reviewed different innovative teaching methods. Theoretical background of the study is the constructivist theory that advocates active student participation unlike the “talk and chalk method of teaching where learners are spoon-fed information instead of discovering for themselves. Concepts such as innovative and teaching methods were explained. Conventional teaching methods were discussed. Innovative teaching methods were suggested. Some advantages of the innovative methods include; creating a sense of responsibility in students as they become more involved in their learning, building a team spirit in students, etc. Some disadvantages are; it’s time consuming and maybe expensive. Notwithstanding the disadvantages, they offer better teaching and learning option in that they are more learner-centered than the traditional methods. Teachers are therefore encouraged to fully adopt these methods or incorporate them into the traditional teaching methods they use.

Keywords: Innovative, Teaching method, Science, Education

<p>Education is important in every clime and thus the right to education is seen as a fundamental human right which should not be violated. The aim is not only to make a student literate but for him to be</p>	<p>self-sufficient, knowledgeable and think rationally, (Damodharan and Rengarajan, 1997). Access to education is gotten not only from informal settings like the home and the society in general but also from</p>
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formal settings where learners are called students and are taught by teachers. In order for the teacher to pass across the message to the student in a formal setting, different methods and means are devised for this purpose. The conventional or traditional approach of learning has always been the face-to-face method of talking and writing on boards also called the “talk and chalk method”, In other words, the teacher delivers the lecture content and the students listen to the lecture. Thus, the learning mode tends to be passive and the learners play little part in their learning process.

According to research, the conventional lecture approach in classroom is of limited effectiveness in both teaching and learning, because students assume a purely passive role and their concentration fades off after 15-20 minutes, (Damodharan and Rengarajan, 1997). Effective concentration leads to improved learning outcome. Thus there is need for the use of alternative and innovative teaching method that will entail active involvement of students in teaching and learning process, removing the element of passivity. The method should also be able to effectively pass across the message and ensure that the objective is achieved.

This review therefore aims at; briefly discussing conventional teaching methods in use currently, its advantages and disadvantages, enumerating various innovative teaching strategies available for the use of science educators in Nigeria. This will further discuss the edge it has over conventional methods if any.

Conceptual Framework

Some concepts of interest in this study are;

Innovative

The word innovative is the adjective of innovation. Thus in trying to explain the word innovative, one should first of all know the meaning of innovation. Several definitions have been given such as; the act or process of innovating; something newly introduced, new method, custom, device, etc; change in the way of doing things; renew, alter, (Webster, 1982). Thus the basic idea behind the term is that it defines a new or novel way of doing things. In aiming for innovation in teaching, teaching strategies employed should be different from what has been formerly obtainable, (Amidon, 1995). The teacher has to think differently from what he is used to in order to come up with innovative teaching methods.

Teaching methods

Teaching method also called teaching strategy or instructional strategy, has variously been defined by several authors. Some of the definitions include that of Kizlik, (2016), who defined teaching methods as processes that are primarily descriptions of the learning objective-oriented activities and flow of information between teachers and students. More than one teaching method may be employed by the teacher in a particular lesson, and some teaching methods are class specific. For instance, methods for teaching primary school students may seem high while that for

nursery pupils may be very low for primary pupils. The essence of adopting an effective teaching method is to increase students' engagement and understanding of the topic thereby improving learning outcome.

Theoretical Background

The theoretical basis of this study is the Constructivist theory propounded by Jean Piaget, 1896-1980. This is a learning theory that explains how students can acquire knowledge or learn and describes how learning happens. Constructivism encourages active learning or learning by doing, active participation of the learner is advocated unlike formerly when the learner is allowed a passive stance during learning. The theory suggests that humans construct knowledge and meaning from their experiences. Constructivists teaching in which students direct the great majority of their activities and engage in what Bereiter & Bird (1985) referred to as *collective knowledge building* through inquiry is the focus of this review.

This method of instruction is founded on the behavioral learning perspective where learning outcome is dependent on what a learner does in the course of learning. A major feature of constructivism is that it is student-driven rather than teacher-driven. Students take part in hands-on, collaborative and/or project-based learning. In science education, this is often called inquiry-based learning. This is an important part of many contemporary science curricula, in which students explore science

concepts for themselves through carefully set-up experiments.

Conventional Teaching Methods

These are some of the traditional teaching methods that teachers prefer to use in their teaching. The essence of good teaching method is to make class sessions more effective and to realize the stated lesson objectives. According to American Association for the Advancement of Science, (1990a); McDermott and Shaffer (1994); Mazur, (1996), some universal principles guiding effective teaching methods are;

- Teaching scientific ways of thinking, actively involving students in their own learning.
- Helping students to develop a conceptual framework as well as to develop problem solving skills.
- Promoting student discussion and group activities.
- Helping students experience science in varied, interesting, and enjoyable ways.
- Assessing student understanding at frequent intervals throughout the learning process.

In order to do all these, it is important that effective methods are used in teaching, so as to maximize the periods of contact. Some of the traditional methods of teaching are;

1. Lecture Method

This is the traditional "chalk and talk" method or textbook method, where the teacher is almost always the only active person in class. There is evidence

suggesting that oral presentations to large groups of passive students contribute very little to real learning, (Onwukwe, 2010). In physics, standard lectures do not help most students develop conceptual understanding of fundamental processes in electricity and in mechanics (Arons, 1983; McDermott and Shaffer, 1992; McDermott et al., 1994).

Advantages

- It does not take much of the teachers' time.
- The teacher can pass much information across within a short time since it is a one-way flow.

Disadvantages of lecture method

- There is a "one way flow" of information.
- The teachers' continuous talk leads to lack of feedback from the students.
- Teaching and learning are concentrated more on theoretical method rather than practical.
- Students learn from memorization rather than by understanding.

2. Demonstration Method

Demonstration can be explained as when the teacher does what the learners are expected to do at the end of the lesson by showing them how to do it and explaining the step-by-step process to them (Ameh, Daniel and Akus, 2007). Mundi (2006) described it as a display or an exhibition usually done by the teacher while the students watch with keen interest. According to Chamberlain and Kelly

(1981) demonstrations are used to show procedures and to explain techniques. It is effective for illustrating concepts in class but can result in passive learning if careful attention to engage students is not taken. It is more effective as a teaching method if the demonstration has a surprise, challenges or assumptions and otherwise abstract concept or mechanism, (Mundi, 2006).

Advantages

Some of the advantages of this method as outlined by Olaitan (1984) and Mundi (2006) include: -

- It saves time and facilitates material economy.
- Students receive feedback immediately through their own products.
- It gives a real-life situation of course of study as students acquire skills in real-life situations using tools and materials.
- It helps to motivate students when carried out by skilled teachers and it is good in showing the appropriate ways of doing things.

Disadvantages

- It is not suitable for a large classroom as students at the back will not be able to see the demonstration.

Discussion Method

This method is often used in large classes by sectioning the class into small groups to complement the lecture method, (Daluba, 2013). It can also be used concurrently with the lecture method in

the same class. The difference between the two methods is that there is an increased level of student participation in discussion than in lecture method.

Advantages

- Helps in students' problem solving skills as they bring out their own ideas on issues.
- It helps in sharpening critical and quantitative thinking skills.
- Helps students learn how to explain in their own words what they are thinking and doing and not just to memorize terms.
- It motivates students more to prepare for a class in which they are expected to participate actively in.

Disadvantages

- It is more time consuming.
- The teacher needs to be a good facilitator to lead an effective discussion.
- Discussions are likely to become disorganized or irrelevant, if not properly guided.
- Some students may not function effectively in a class where much of the time is devoted to student discussion, due to shyness or other factors.

Types of Innovative Teaching Methods

Some innovative teaching methods that can be in co-operated in the teaching of basic science include;

1. Multimedia Learning Process

Multimedia, is the combination of various digital media types such as text, images, audio and video, into an integrated multi-

sensory interactive application or presentation to convey information to an audience, (Wideman, 2003). Interactive multimedia teaching process involves teaching using game and simulations, through activities that engage the senses. Currently, many institutions are moving towards problem-based learning which is becoming increasingly popular in educational institutions as a tool to address the inadequacies of traditional teaching. Since these traditional approaches do not encourage students to question what they have learnt or to associate with previously acquired knowledge (Teo & Wong, 2000), problem-based learning is seen as an innovative measure to encourage students to "learn how to learn via real-life problems" (Boud & Feletti, 1999). The teacher uses multimedia to modify the contents of the material, using different media elements. These media elements can be converted into digital form, modified and customized for the final presentation. By incorporating digital media elements into the project, the students are able to learn better since they use multiple sensory routes.

The basic difference between the use of multimedia method and the traditional method of teaching is that the traditional strategy gives a one-way flow, meaning that the teacher is the only center of attention. On the other hand, multimedia method offers an interactive learning process that can effectively retain students' attention because of their colorful interface.

Some multimedia tools are; Microsoft PowerPoint which is slide-based and can

be prepared with many of the popular multimedia elements like graphs, sound and video. This is useful in the teaching of the numerate science as it can present graphs and charts in colorful picture that will catch students' attention thus enhancing learning.

Movie based multimedia tools using Windows Movie Maker. This can be used in the teaching of life sciences through making movies of important life processes such as germination of plants, reproduction etc. These topics can be taught better by engaging students to find out already produced movies of relevant topics from the internet and present in class. The interest generated from the project will help learning to take place even before the teacher has done anything. Teachers using this method reported a high level of professional and personal satisfaction derived from teaching in what they found to be a more meaningful and effective manner, and from seeing the positive impact their work was having on students, (Wideman, 2003).

2. Activity- Based Teaching on Science Principles

This method is important as science should not be done theoretically but needs to also be practicalized. This is the practical based study of the theories in the course. Thus it is important that all science subjects be taught practically as well as theoretically. Activity-based teaching can be done using resources such as

Indoor laboratory or Field laboratory – this can be set up in schools with very minimal resources especially for the life sciences. Use of this teaching

strategy encourages cooperation in small groups and participation in doing science. Examples of some of these resources are; small sized aquariums, different collections of sample animals and bones, also for basic field experiments like ecological studies of animals in their habitats, weather monitoring

3. Role Playing and Scenario Based Teaching

Role-plays according to Onwukwe (2010) are activities designed to allow the participants (students) assume characters that help them perform certain roles in an imaginary social set up. In this method, the students do not just read, watch or tell about a topic but act it out as in a play. Role-plays and simulations have been effectively used as teaching tools in disciplines like social psychology, law enforcement, legal practices, political science, just to mention but few (Owen, 1997).

In a study on role playing in teaching of Chemistry, titled "Combined effects of play-simulations and teaching with analogy on secondary school students' achievement in Chemistry", (Onwukwe, 2010). The study investigated the effects of Play- Simulations and Teaching-With-Analogy (P STWA) on achievements in Chemistry among secondary school students in Owerri Education Zone of Imo State. The results revealed that students taught chemistry using PSTWA method achieved significantly higher than those in the control groups. Role-playing therefore, helps to transform information into experience. By engaging in role-playing, students acquire new experience that helps

them to view the information they have (their basic knowledge) in a new, realistic light.

4. Z to A Approach

In this method, the teacher takes the approach of attempting to explain the application part of a particular concept first before explaining the concept itself. The teacher should explain the application of a particular concept first and explain the effects of such applications. For instance, explaining Galileo's "leaning tower of Pisa experiment" of two different objects falling at the same rate using traditional method and Z-A approach. Traditional way of teaching method will be explaining the theorem first and followed by its application. But Z-A approach goes opposite in a manner that the proof or application is explained first and later the theory.

Advantages of the Innovative Methods over the Traditional Methods

- a. Good for students with low attention span as it effectively retains students' attention because of the colorful interface.
- b. They are more student-centered than traditional methods as the students do most of the work while the teacher more or less supervises.
- c. Helps to create a sense of responsibility, accomplishment and maturity in students as they are solely responsible for every decision they take in the course of their projects and assignments.

d. Enables students to see the practical applications of the concepts they have been taught as they try their hands on what they were taught.

e. Creates long lasting memory/correlation of a concept.

f. Facilitates collaborative work among students. In collaborating during assignments, peer tutoring was often possible among students' where knowledge is passed on from one person to another.

g. Students tend to perform better, i.e. research showed that student taught chemistry using role playing performed better than those taught using conventional methods, (Onwukwe, 2010).

Disadvantages

a. Expensive to implement as resources are needed for these methods to be effective unlike in the traditional methods.

b. The method can be time consuming to set up and execute.

c. Multimedia using ICT introduced new modalities of students' work and presentation that are increasingly difficult to assess.

d. There is need for the teacher who acts more as a facilitator to be knowledgeable in the use of ICT.

Conclusion

From this review, it can be seen that there are so many methods of teaching at the disposal of the science educator, who does not necessarily have to rely only on the "talk and chalk" method.

All the mentioned teaching methods and more all have advantages and disadvantages meaning that none is a perfect method. The essence of teaching being to expose students to knowledge, it is therefore important that they are made to be actively involved in the process. Traditional methods do not allow for active participation of students, thus the need for innovative teaching methods which do. This is therefore where the mentioned innovative teaching methods of; role playing, Z-A approach, multimedia learning process and activity-based teaching through practical comes into play. They are necessary to modern day teaching and learning because they have removed the old passivity of the learners replacing it with activity. Teachers are no longer required to bear the full burden of the students learning but are seen more as guide, facilitator and role models that direct and steer the students towards their learning needs. There is therefore need for urgent application of some of these methods in teaching basic science. In cases where it's not possible, a combination of traditional and modern methods should be combined for a more fulfilling teaching and learning experience.

The Way Forward

To ensure the implementation of these innovative methods in teaching, it is necessary that;

i. Professional development should be made an integral part of schools culture to help develop the teachers' skills.

ii. Government should endeavor to provide enabling environment for the maximum functioning of the teacher through provision of necessary resources in schools.

iii. Parents in the form of school PTA's should (in situations where there are lapses) step in to ensure the provision of basic equipment for these teaching methods.

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