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UTILIZATION OF 5Es' CONSTRUCTIVIST APPROACH FOR ENHANCING THE TEACHING OF DIFFICULT CONCEPTS IN BIOLOGY

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ABSTRACT

Studies show that students perform poorly at the secondary school level in biology. The concepts considered as difficult contribute more to the poor performance. The fact remains that the topics related to these concepts are found to be difficult by the teachers teaching them. The undesirable trend has been attributed among other reasons to ineffective pedagogy among teachers of biology. This problem led to an upsurge of research into innovative approaches that can alleviate the situation. One such emerging approach advocated here is the use of 5Es' constructivist approach. The approach advocates problem solving learning atmosphere where learners are effectively guided to take responsibility for their learning, the effective utilization of which can enhance biology teaching and learning. This paper focused on how this approach could be applied in teaching one of the identified difficult concepts in biology namely; respiration. Some empirical studies on the effectiveness of the constructivist-based methods when compared with other approaches were reviewed. A sample of note of lesson using the 5Es' approach and guide was designed. It was recommended among others that government as well as professional associations should organize training for biology teachers on the use of 5Es' learning cycle as effective teaching approach.

KEYWORDS: Utilization, 5Es Constructivist approach, difficult concepts, Biology.

INTRODUCTION

The contribution of the science of biology towards the quality of human life cannot be overemphasized. This justifies its pride of place in Science curricula of schools in Nigeria. Despite the relevance of Biology, research report is replete on high level of failure in the subject at the secondary school level. The failure rate is more obvious in the areas often tagged as difficult in biology (Eshiet, 2007; Samba & Eriba, 2012). Samba and Eriba (2012) had specifically identified respiration as one of the difficult concepts as determined by teachers, the implication of which the authors emphasized that topics related to this concept is found to be difficult by the teachers who teach them. Eshiet (2007) asserted that when a certain concept is perceived as difficult to teach, subject teachers have a tendency of avoiding teaching the concept. This invariably means that: Students lack understanding of such concept; avoid answering questions set from such topic in the examination paper, and candidates as a consequence record high rate of failure time over. The implication is that the life enhancing potentials of biology cannot be realized unless the students understand biology concepts. Poor pedagogical approach which the teachers utilize in teaching biology concepts has been attributed to these problems among other reasons. Ajowole (2003) noted that teacher-centred traditional

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approaches have persisted in biology classrooms which run contrary to modern science teaching. The traditional approaches are predominantly transmissive, make the learning of biological concepts irrelevant and relatively difficult.

In view of this trend, a number of innovative approaches to science teaching have been introduced in secondary schools with the curriculum revised to give meaningful biology education to students. One of the much heralded of the paradigm shift from teacher-centred to student-centred approach to biology teaching is the Constructivism. Constructivist theory is one of the contemporary learning theories that emerged from the philosophical basis that the teacher's role should be trainer, facilitator of learning processes and creator of educational environment. This is for the students to: build their knowledge by themselves through direct interaction with the learning and the use of all their accumulated concepts and previous experiences and to be the centre of the educational process (Zayton, 2007) while the role of the learner is characterized by activity, positive innovation, leading to discovery of knowledge, self-understanding, through discussion with others, and keeping away from memorization (Abu-Safar 2014).

Constructivism is therefore a theory that gives hope to the development of the deep understanding of the science concepts. In constructivist approach students construct their knowledge by making link between their ideas and new concepts through experience they acquire in school or daily life (Kila-vuz 2005). This suggest that the new concept information and principles to be learned can only make sense when they are related to the previous one.

Alshehri (2006) confirmed that constructivist-based models have proven in its different stages successful, resulting in proper conceptual understanding of the cognitive structure. Such learning model includes but is not limited to cooperative learning, concept mapping, problem-based learning and learning cycle. These emerging models from constructivist theory are successful strategies for teaching any topic, and they all focus on the activity and effective student role, emphasizing that students are the producers of their knowledge. The 5Es cycle has been shown to be an extremely effective approach to learning. 5Es model developed by Robert Bybee derives its name from the number of its phases and the initials. The five phases are Engage, Explore, Explain, Extend and Evaluate. As a constructivist-based teaching and learning model, 5Es model consist of active research skills that are necessary for knowledge construction and comprehension (Ergin, Unsal and Tan 2006); targets at discovery and the connection with previous knowledge of new concepts by students (Tuna and Kacar, 2013).

The model is found to motivate students to be involved into a topic, to explore and to obtain more detailed information about their learning and to evaluate it. Learning cycle as a constructivist model motivates research-based learning, brainstorming, creative thinking complex for overcoming problems and difficulties and therefore can facilitate teaching and learning of difficult concepts in biology.

Studies on Impact and Effectiveness of Constructivist-based teaching Approaches

Skamp and Peers (2012) reported a case study of insights from teachers' feedback on the impact of 5Es learning model at the primary school level. The study used a qualitative content analysis of more than 3000 comments from over 200 teachers. The report revealed among a range of outcomes that the approach has had very real and positive influence on science learning at primary school level. More so, that less teacher talk and direction (than their usual practice) allowed students to be more autonomous in their learning, increase their engagement, interest in science and improves the learning outcome.

Oludipe and Oludipe (2010) examined the effectiveness of constructivist-based teaching strategy on academic performance in integrated science. The study used quasi experimental research design with a sample of 120 Junior Secondary School III Students in Ijebu-ode L.G.A of Ogun State in South West Nigeria. Paired t-test and independent group t-test were used in analyzing the data. The findings revealed that the constructivist instructed students had higher scores on integrated science.

Folashade and Akimbobola (2009) investigated the effect of constructivist problem based learning technique on the academic achievement of physics students with low ability levels in Nigeria. Pre test - Post test control group quasi experimental research was adopted. A sample of 105 SS II physics students from Taraba State was used. T-test was used for data analysis. Result of the study showed that the physics students with low ability level taught with

the constructivist problem-based learning technique outperformed those taught in the traditional classroom.

Several empirical studies on effectiveness of 5Es cycle: example Lee (2003), Whilder and Shuttle Worth (2004), Nuhoglu and Yalcin (2006), Pulat (2009) and Ajaja (2013) respectively found that students' achievement improved after the instructions using 5Es model. Lee (2003) specifically reported that students acquire knowledge about plants and animals in daily life easier and understood the concepts better when taught with 5E cycle.

Some of the research evidence on the success and effectiveness of constructivist-based models have been reviewed. Obviously, the research findings above are clear on the effectiveness of the innovative approach. However, the successful implementation of the new pedagogy as it was intended would be dependent upon the teacher's clear understanding of the theory-base underpinning the model as well as the technical skills in developing lesson plan based on the model, and teach a lesson using the model. It is against this background that this paper, in response to the above research concerns seeks to provide a blueprint for classroom delivery of concept of 'respiration' using the Constructivist-based 5Es cycle.

A Sample Lesson Guide for Teaching Respiration Concepts Effectively Using the Constructivist-Based 5Es Approach

Topic: Cellular Respiration

Specific Objectives: At the end of the lesson, the students should be able to:

i) Define the term cellular respiration
ii) Mention and describe the two types of cellular respiration
iii) Distinguish between the types of cellular respiration
iv) Explain what happens to some of the energy released in the process of respiration.
v) State the use of anaerobic respiration in everyday life

Instructional Materials: Chalkboard, Charts showing two chemical equations: one of aerobic respiration and the other of anaerobic respiration, polysaccharides, white anhydrous copper (II) sulphate crystals and lime water.

Entry behaviour: It is assumed that students are familiar with the characteristics of living things

Step I. Engage Phase:
The teacher sets up problems to stimulate and focus students' attention on the task that will follow. The problem must have connections to students previous experience, and also to the objectives of the actual experience thus; students are asked to:

i) List the characteristics of living things (MR NIGER)
ii) What will happen if a living thing ceases to carry out exchange of O_2 and CO_2 gases?

The students are told the objectives of the lesson. Based on the students past experiences, the teacher poses specific questions on the upcoming lesson for students to explore in the next phase of the cycle

i) What is the meaning of the term cellular respiration?
ii) Mention two types of cellular respiration and describe each type
iii) Distinguish between the two types of cellular respiration
iv) What happens to some of the energy released during the process of cellular respiration?

A chart showing two chemical equations; aerobic and anaerobic respiration are shown to students for observation and data gathering, but there is no lecturing, teacher avoids defining and making explanations about the concept.

Step II. Explore Phase:
Teacher divides students into small groups for the exploration. Teacher specifically assigns each group to investigate each problem. For instance: Group I is asked to define the term cellular respiration and to identify the two types of respiration. Group 2 is asked to describe the two types or cellular respiration and how each occurs in a living cell. Group 3 is asked to distinguish between two types of cellular respiration. Group 4 is asked to discuss what happens to some of the energy released during the process of cellular respiration. Teacher gives each group instructions on what to do, ensures that individual students in each of the groups has a specific role and is active, may want students to make demonstrations or do experiments. Teacher only

guides, not participate entirely in the students' work.

Step III: Explain Phase:

Teacher creates a conducive classroom atmosphere, determines students' ideas before eliciting his/her own. Students explain and interpret the results of their observations through appropriate verbal repertoire with a representative in each group formed in the explore phase. Teacher engages students in discussion by asking them to do the following;

i) Explain your answers to others
ii) Listen attentively to one another's explanations
iii) Question one another's explanations
iv) Listen to the explanation given by the teacher, students share ideas with other students and with the teacher.

In explain phase in 5E model, teacher becomes active, for correcting mistakes and completing the missing parts in students findings before the next phase which is the aim of this phase thus; the teacher introduces the topic: Cellular Respiration, and explains the concept as follows

- Respiration is the process leading to the release of energy in living cells which is extremely important for life.
- It involves gaseous exchange: example in plants O_2 is given off ad CO_2 is taken in.
- In all living cells, the complex food substance (mainly glucose) is oxidized to release the energy which is stored in the form of ATP for powering life processes
- Two types of cellular respiration are aerobic and anaerobic respiration.
- The former uses oxygen to oxidize glucose in the cell to liberate energy, carbon (iv) oxide and water. Goes through 3 stages viz; glycolysis, kreb cycle and electron transfer system.
- In the latter, glucose is broken down inside the cell without oxygen to produce alcohol, carbon (iv) oxide and 2ATP.
- Some of the energy produced in the process of respiration are converted to heat energy.

Step IV: Elaborate Phase:

Students are provided with activities and given opportunity to practice their new knowledge, create new problems, and suggest solutions. This is just to extend what they learnt in the earlier phases of the cycle thus: They work in groups also in this phase, students are asked to

i) find out what is given off when they heat some sugar, and pass the product formed through white anhydrous copper II sulphate crystals and lime water ii) to identify local activities around their community in which anaerobic respiration process is involved, and
iii) State any five uses of anaerobic respiration in everyday life.
Iv) Students are also asked to use what they have observed to answer the following questions:
   - What is the product of respiration?
   - Where does respiration occur?
   - What is the end product of each type of respiration?
   - What are the stages in each type of respiration?

Step V: Evaluate phase:

Students are asked questions to reveal their constructed knowledge. Students may answer to oral questions or make short-written summaries. Teacher asks the following questions;

- Give the meaning of the term 'Cellular respiration'
- Mention the two types of Cellular respiration
- State 3 differences between the two types of cellular respiration.
- Explain what happens to some energy released during the process of respiration
- State 5 uses of anaerobic respiration in everyday life

CONCLUSION

It is worth noting that at all phases of the cycle, the students were not passive but took much responsibility for their learning, generalized it to their situations while the teacher was only the facilitator. It is therefore believed that the

above lesson guide on cellular respiration can be of much help to biology teachers in teaching concepts in biology particularly, making easy those concepts tagged as difficult.

Suggestions for improving teaching and learning of biology

It is the belief of the present research that presenting science concepts in this approach is a critical resource for teaching improvement and better learning outcome. The paper therefore suggests the following;

- Preparation of a teacher guide containing the 5Es step by step activities will equip biology teachers in adoption of the 5Es model.
- Schools administrators should support and encourage biology teachers to embrace the constructivist pedagogical practice in biology classrooms
- Professional bodies such as STAN should endeavour to organize academic workshops, seminars targeted at exchanging views to equip and inform the teacher on new methods adopted in teaching difficult concepts. Biology teachers should endeavour to attend, embrace the change in practice and persist in it to enhance teaching of Biology concepts.

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