TEACHING PHYSICS IN NIGERIAN SECONDARY SCHOOLS: LECTURE METHOD VERSUS GUIDED INQUIRY APPROACH

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Abstract

In this age of information revolution, with the world conglomerating into a global village due to science and technology innovations, science teaching in schools has become indispensable. This paper looks at guided inquiry approach as a strategy for teaching Physics in Nigerian secondary schools as against the lecture method. Advantages and disadvantages of lecture method were x-rayed. The paper also delved into the philosophical and psychological bases of lecture and inquiry methods, and the advantages and challenges of teaching Physics using guided inquiry approach. The advantages of teaching Physics using guided inquiry approach include active participation of students in learning Physics concepts and processes; and increase in the ability of students to deal effectively with structured situations within and outside the classroom. Challenges such as lack of materials needed for guided inquiry investigations and difficulty in developing materials locally for students' investigations in the guided inquiry class were identified. Some implications of teaching physics by guided inquiry approach for Physics teacher education in Nigeria were also explored. For instance, the Physics teacher-in-training must be taught how to select and implement Physics programmes which have a strong and constant emphasis on the guided inquiry approach. Recommendations were proffered which, when implemented, would aid in overcoming the challenges that face the teaching of science as guided inquiry in Nigerian secondary schools.

Introduction

In this age of information revolution, with the world becoming a global village, science teaching has become far more significant than ever before. The

strategies for teaching science at the secondary school level have evolved from the didactic "chalk and talk" method (otherwise called the lecture method) to the inquiry approach over time. In an attempt to meet the demand of the age, the Nigerian government recommended practical, exploratory and experimental methods of teaching Physics in secondary schools so as to lay a sound basis for scientific and reflective thinking; and to prepare the child for useful living in the society (Federal Republic of Nigeria, [FRN] (2014). The general objectives of Physics teaching, which Nigerian Educational Research and Development Council, NERDC (2008) enumerated, are to: provide basic literacy in physics for functional living in the society, acquire basic concepts and principles of physics as a preparation for further studies, acquire essential scientific skills and attitudes as a preparation for technological application of physics, and stimulate and enhance creativity.

The teaching and learning styles at the secondary school levels laid too much emphasis on teacher's authority (Ajaja & Eravwoke, 2010). The styles were teacher-centered. This kind of teaching style is the "chalk and talk" method of teaching. This old traditional approach used over the time in teaching Physics in secondary schools has continued to produce unfavourable attitudes and results for Physics from the learners as evidenced from outcome of certificated examinations such as the West Africa Senior Secondary Certificate Examinations (WASSCE) organized by West Africa Examinations Council (WAEC). Lending credence Rinmak, Bakalyil, Dangpe and Mark (2006) acknowledge that the performance of both teachers and science students (Physics students inclusive) is on a continuous decline.

Any nation's goal of effective Physics teaching may be achieved through the application of appropriate methods of instruction. In view of the afore-mentioned, this write-up seeks to ascertain the rationale behind the shift in emphasis from the didactic "chalk and talk" method to the guided inquiry and process-oriented approaches. It also seeks to discuss the challenges, if any, that face the teaching of Physics as guided inquiry in Nigerian secondary schools; and attempt to provide solutions to those challenges.

Through its principles, theories and laws, Physics is found in the electricity in homes and industries, in the equipment used for diagnosing diseases of patients in hospitals, and in many other spheres of life. Its importance to national development must not be under-rated. Therefore, a decline in understanding Physics which underpin the understanding of other fields will result to a gradual decline in understanding Physics-related fields such as telecommunication, engineering and medicine. To enhance the study of Physics in schools, the contemporary world is shifting focus from teacher-centered instructional strategies to student-centered strategies. However, in Nigeria, in spite of the huge importance of Physics to the development of a nation, Physics results in

most externally organized examinations such as Senior School Certificate Examination (SSCE) have not been satisfactory (WAEC, 2015). These unsatisfactory results have been attributed to many factors which includes utilization of inappropriate methods of instruction in schools (Boyo, 2010; Mankilik&Josiah, 2013). The 'chalk and talk' method of instruction is still the most frequently employed by Physics teachers in teaching Physics in Nigeria. This method has been reported by Boyo(2010) to be ineffective in the teaching of Physics in schools. Little or no wonder the unsatisfactory results in the above-mentioned examinations over the years.

The Lecture Method of Teaching Physics

The lecture method of teaching is defined by Good and Merkel as cited in Kaur (2011) as a teaching method in which the teacher presents a spoken disclosure on a particular subject matter. The teacher, in this method of teaching, is basically a purveyor of subject matter. His duty, according to Instructional Development and Distance Education (2014) is to organize knowledge into logical units. This content of the subject matter is the core of human culture and so it is a teacher's task to become an expert in dispensing the content of the subject matter. Subjects are taught in the form of notes for students to commit to memory, whether they understand or not and such teaching is textbook-bound and examination-oriented.

The philosophical basis for adopting the lecture method of physics teaching is provided by the realist and idealist philosophers. These philosophers encourage learning by memorization, see the teacher as an organizer and mediator of learning; and see the learner as a receiver of whatever is handed down to him by the teacher, although the onus of learning rests on him. Henry Margenau's philosophical analysis of physical reality advanced in 1950, which conceives of reality as constructed, is a confluence of both the views of the realist and idealist philosophers and becomes very useful in understanding reality (or truth). It therefore serves as a useful basis for effective teaching and learning of Physics, especially when the "chalk and talk" method is employed.

Physics is a process of constructing theories which are sets of abstraction that represent experiences of senses. These abstractions or explanations called theories, laws and principles are developed as a result of sensory stimulation. Therefore, in Margenau's view, science is an attempt at validating knowledge by relating factual primary sensory perceptual plane data (p-plane) to hypothesized abstract conceptual constructs (c-field). Facts are immune to manipulation by reason even though they form the basis of immediate sensory data. This means that facts are facts and cannot be changed but our ideas about those facts can be manipulated. Thus theories or ideas are aimed at explaining such facts.

The lecture method has advantages in the teaching/ learning process. It is known to encourage wide coverage of syllabus within a limited time frame. In using the method, dissemination of unpublished or not readily available material is permitted, and the purchasing of learning materials by students is limited as students depend mostly on the teacher. Furthermore, the method allows for the gradual development of complex or difficult concepts and clarifies learning materials. In using the lecture method to teach, a lot of school time and money are saved since laboratory work and field activities are reduced to the barest minimum (Awolola, 2001 & Kelly, 2010). Although the lecture method is advantageous, there are disadvantages which gingered the call for a shift in emphasis in this method of teaching Physics employed in schools. These disadvantages include:

1. Placing students as passive rather than active learners. Passivity can hinder learning and student's attention may be lost. Little wonder if such students are not capable of logical reasoning or original thinking.
2. Encouraging rote learning as opposed to teaching for development of productive thinking operations (Kaur, 2011). Instructional Development and Distance Education (2014) opined that the use of the "chalk and talk" method of science teaching prevents Nigerian science students from participating in active learning. Active learning develops students' inquiring minds.
3. Considerable amount of unguided student time outside of the classroom is needed in order to achieve understanding and long-term retention of content.
4. Placing responsibility of organizing and synthesizing content upon the teacher.
5. The teacher is required to have or to learn effective writing, speaking and modeling skills.

Guided Inquiry Approach to Physics Teaching

Vasquez as cited in Josiah and Dasbang (2003) opine that the present view of learning places the student's constructive mental activity at the heart of all instructional exchange. This view does not, however, imply that the student is left to discover everything for himself, nor that what he discovers and how he chooses to describe and account for it is left solely to him. Instruction must provide experiences and information from which the student builds new knowledge. Instruction helps to focus those processes so that the resulting knowledge is both valid and powerful. Josiah and Dasbang (2003) and Akinmade (2004) view guided inquiry lessons as lessons that use activity-oriented teaching strategies. This guided inquiry approach, as posited by Almuntasheri, Gillies and Wrights (2016), encourages the students to take primary responsibility for their

own learning by using hands-on and minds-on in their learning in which the teacher has only a guiding and a supportive role.

Fallibilism and the teaching and learning of science, offered by Karl Popper in 1963, yields a philosophical basis for the shift in Physics teaching emphasis from the "chalk and talk" method to inquiry method. Aligning with Popper's fallibilism and the teaching and learning of science view, Di Iorio (2008) opine that students learn through selection and not through transmission. This implies that students can modify or reject some form of scientific knowledge that previously exists. Such knowledge modifications, by Poppers theory, necessarily occur from observed inadequacies of previously held knowledge. This means that a student learning something new in science is simply modifying simple theory or concept he had already held, even though it might have been vague or unarticulated.

The psychological basis for guided inquiry approach stemmed from the constructivism theory of psychologists such as Bruner and Piaget. Bruner, the major proponent of inquiry teaching in 1990, agrees that learning involves the active processing of information that is organized and constructed in a unique way by each student. Students attend selectively to the environment, process and organize the information they take in and integrate this information into their unique models environment. To Bruner, factual knowledge is acquired and stored in the form of active expectancies rather than passive associations, and much learning occurs through inquiry during exploration that is motivated by curiosity.

Piaget's theory in 1972 also emphasizes the concept of learning as active information processing resulting in exploration and inquiry. Stimuli are not external events that control people by eliciting their attention or reinforcing their responses. Instead people act on stimulus. Piaget's explicit recognition that human beings are born as active, exploratory, information processing organisms makes his theory popular with the advocates of inquiry.

The 21st century concern of Physics teaching at the secondary school level is the improvement of Physics education for students. Assisting Physics teachers in this level to teach for thinking and productivity as opposed to the mere teaching for memory comprehension is one foci of concern. Physics students must be taught from self-investigation, where they can learn.

Some scientific processes that the Physics student can use in learning science during inquiry are observation, classification, measurement, counting, communication, using space relationships, experimenting, making a hypothesis, inferring, interpreting data and predicting. The primary objective of using these processes is to develop scientific skills in students so that they can learn Physics concepts effectively.

Advantages of Guided Inquiry Approach in Teaching Physics

There are clear benefits to be derived from using the guided inquiry approach in teaching Physics at the secondary school level of education. These include:

1. The students are actively involved in doing things and learning Physics concepts and processes from the guided inquiry approach.
2. Students' minds are developed and used to solve problems. This is because the guided inquiry approach has a claim on knowledge gained by self-effort. When knowledge is gained by guided inquiry, it is better assimilated and recalled than when it is learned by rote.
3. Teachers provide clearly-produced step-by-step materials or guides of solving problems in Physics to students.
4. Students increase their ability to deal effectively with unstructured situations in and outside school.

Challenges of using the Guided Inquiry Approach in Teaching Physics

The challenges that face the teaching of Physics using guided inquiry in secondary schools are numerous, amongst which are:

1. Lack of needed materials for guided inquiry investigations: Familiar instructional materials, especially foreign, such as textbooks, written problems sets, and reference books cannot be relied on to provide the needed materials for investigations.
2. Developing materials locally for student investigations in the guided inquiry class is not an easy task. The guided inquiry approach can only work where there are good supplies of well-indexed resource materials, since the use of improvised materials do not give precise scientific answers.
3. Teachers are faced with the type of assessment necessary to demonstrate that learning has taken place in a guided inquiry lesson.
4. The teacher finds it difficult to effectively supervise the students as science classes are usually crowded. A situation where teacher-student ratio is 1:80 poses a challenge to the use of guided inquiry approach.
5. Due to the little amount of time allocated to science teaching on the school timetable (not more than 40 to 45 minutes per lesson) in Nigerian secondary schools, only small amount of knowledge may be attained. This does not encourage effective teaching and learning when using the guided inquiry approach.

Implications of Teaching Physics using Guided Inquiry Approach

Many implications of teaching Physics by guided inquiry approach for the Physics teacher-in-training in Nigeria can be identified, amongst which are: The Physics teacher-in-training should

1. learn the operational knowledge of and ability to use the guided inquiry approach.
2. be taught how to select and implement Physics programmes which have a strong and constant emphasis on the guided inquiry approach.
3. be taught how to keep students maximally involved in hands-on activities during an guided inquiry lesson.
4. be taught how to constantly evaluate his students' master y of process skills (learning outcomes).

Conclusion

For Physics teaching to be effective, it must not only promote Physics as a product but must strive to simulate interest in Physics and stimulate the learner to apply his knowledge and skills to solve societal problems. Therefore, Physics teachers must create time and be innovative on the use of the guided inquiry approach. They must work hard to make Physics learning relevant and meaningful by integrating and interrelating learning with societal problems and concerns.

Recommendations

To overcome the challenges that face the teaching of Physics as guided inquiry in Nigerian secondary schools, the following suggestions are proffered:

1. If the Physics teacher is to develop a guided inquiry approach to his teaching methods, he must review the materials and resources available to him. This will help in providing needed materials for guided inquiry investigation.
2. To develop materials for student investigations, Physics teachers should gather materials via creative collaboration with other colleagues. By using the internet many teachers will find they are able to develop lessons from materials taken from the World Wide Web (www) sites and then turn around and share these lessons with others via the internet. The beauty of this lies in the fact that teachers are able to take some other teacher's lesson and adapt to their own learning environment. This method of sharing is becoming one of the fastest growing means teachers have to bring innovative ideas and experiences into their classrooms.
3. Assessment of learning can be done through the likes of exhibition, investigations, demonstrations, and written or oral responses; and should be done continuously (continuous assessment).

4. If the large science class-size is drastically reduced the Physics teacher would effectively supervise the learners during Physics lessons. For effective teacher supervision, the recommended teacher-student ratio of 1:30 (Federal Republic of Nigeria, 2004) should be maintained. The teacher is encouraged to use modern technologies such as ICT, interactive board and laboratory kits.
5. Students need to spend some time exploring a topic/concept and posing questions. Therefore, enough time should be allocated to Physics teaching in Nigerian secondary schools so that sufficient knowledge can be attained.

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