

# APPLICATION OF PSYCHOLOGY TO TEACHING AND LEARNING OF THE SCIENCES: A MOTIVATIONAL AND COGNITIVE APPROACH

*R.O. Nnachi (Ph. D)*

## **Abstract**

The declining rate in achievement in the sciences among secondary school students in Nigeria has become a matter of great concern. The paper considers science as a vital instrument for building nations without which human civilization would be drastically relegated. Thus, the paper views the declining rate in science achievement among Nigerian students as an issue that requires urgent attention. It then discusses the concept of science and the teaching of the sciences. It highlights how the teaching of the sciences would be improved using different methods of teaching. The paper considers psychological approaches to the teaching of the sciences and views motivational and cognitive dimensions as effective means of enhancing science teaching and learning. The paper makes some recommendations for the application of psychology to the teaching and learning of the sciences for better achievement among learners.

## **Introduction**

The issue of high failure rates in the sciences in the Senior School Certificate Examinations (SSCE) for West African Examinations Council (WAEC) and National Examinations Council (NECO) candidates has become a worrying phenomenon. The same event seems pervasive for similar examinations conducted by reputable bodies in Nigeria, for instance, the National Business and Technical Examinations Board (NABTEB). The achievements of the learners in the basic sciences have been generally poor at the Senior School Certificate Examinations (Nnachi, 2002).

A number of researches have been carried out to investigate the extent of performance of the learners at the SSCE. For instance, Ali and Anaekwe (1997), carried out a study on the extent of the achievement of senior secondary school students in chemistry at the SSCE and found that performance in chemistry has been poor year after year. The study covered three years (1988, 1989 and 1990). According to the study, out of 34, 508 students that took chemistry in 1988 at the Senior Secondary School Certificate Examinations (SSCE), only 20.7% were successful at the credit level-Out of 35,705 that took the examination in 1989, only 10.8% were successful at credit level. Out of 80, 059 that took the examination in 1990, only 4.1% were successful at credit level. More recent studies indicate that the trend has been the same as years pass by. For instance, Nnachi (2002), has shown that the dwindling trend in performance of the candidates in the sciences at the SSCE has been the case from year to year and the situation seems to be worse as the years passby.

If the situation is left unchecked, without immediate remediation and subsequent normalization, a quantum phobia might be accumulated by both the learners and teachers of sciences. It should be borne in mind that science, in association with technology, builds the world. Thus, in the absence of science, the world would only appear as a vacuum occupied by ordinary animals and plants. Emergence of science has significantly differentiated man from ordinary animals and has catapulted the position of human organisms from mere mortals to super organismic entities.

Since science has been the backbone of man's integrity and hierarchical elevation, the importance of science to man cannot be over emphasized. The inquisitiveness of human organisms to probe nature, explore and exploit their immediate and extended environments has drastically improved the cosmos and has built the spirit for scientific enquiries. Therefore, the world devoid of science is synonymous with the world devoid of progress, development and achievement.

## **Concept of Science**

Science is simply defined as the study of nature. It is, however, the body of knowledge derived from the study of nature. The word *science* is derived from a Latin word *scientia*, meaning *knowledge*. It is, then, considered as a body of knowledge derived from systematic observation and verification of facts. Science also refers to the organized body of knowledge concerning the physical world which consists of animate and inanimate objects. In his own consideration, Conant (1959:25), defines science as "an interconnected series of concepts and conceptual schemes that have developed as a result of experimentation and observation." Science is also considered as cumulative and endless series of empirical observations-which result in the formulation of concepts, laws and theories with both laws and theories being subject to further empirical observations (Abdullahi, 1976). From every indication,

then, science is both the body of knowledge and the process of acquiring and refining knowledge. In its broadest sense, science refers to all human activities involving organized knowledge of natural phenomena.

It is by means of science that man continues to accumulate extra-ordinary knowledge of the universe as well as the events of nature. Science has, then, revealed the secret of nature and has then simplified complex cosmological forces and their subsequent operations.

It has become crystally clear that no nation can make a headway for progress and development without sound scientific background. Therefore, its teaching and learning constitute an indispensable factor of progress for the individual and the nation, especially in this technological age. Achievement in science by the learners becomes a solid hope for the nation at large; especially in the development and progress in certain vital dimensions- Such dimensions include transportation, medical services, engineering, agriculture, architectural works, telecommunication, geological operations, food preservation and a variety of industrial events. The importance of science in national and international developments cannot be over emphasized.

For this, adequate measures must be taken to ensure adequate performance among the learners. Thus the effective approaches in the teaching and learning of science call to mind.

### **Teaching of The Sciences**

What might be considered nowadays as the sciences are different branches of science which, over the years, gained their independence and assumed their rightful positions in the committee of disciplines. The branches include biology, chemistry, mathematics and physics as well as applied-sciences such as agriculture, medicine, psychology, engineering, architecture and so on. Each of these branches of science is now called a *science*.

The first set of the sciences such as biology, chemistry and physics are referred to as the *core sciences*. They lay the foundation for other branches of science. Because each branch of science has achieved its discipline status and can now operate on its own accord within the general scientific framework, it is a science. Thus, we have a plural of science, referring to branches of science. When we talk of sciences, we mainly refer to core sciences such as Biology, Chemistry and Physics as well, as core science-related fields. -

All the sciences have related procedure for teaching. Because all the sciences are systematic in approach, use experimentation, make use of observation and employ the classification of phenomena, the teaching of all the sciences takes a similar pattern. The teaching of all the sciences employs different methods that are used depending on the prevailing circumstances. The methods of the teaching of the sciences include:

1. Lecture method
2. Discussion method
- 3.- Demonstration method "
4. Discovery method
5. Laboratory method
6. Project method
7. Field trips
8. Individualized instructional method

#### ❖ **Lecture Method**

This method is referred to as *didactic* method of instruction (Maduabum,1984). The teacher is at the centre of the activity and is the main repository of knowledge. The students listen to the teacher who does most of the talking and asking of questions.

Lecture method is also referred to as chalk and talk method. While the teacher talks and writes on the board, the students listen and take down notes.

#### ❖ **Discussion Method**

In this method, the teacher initiates a discussion and would want the learners to air their views. He directs the questions to the students and would expect answers from them.

#### ❖ **Demonstration Method**

In this kind of method the teacher carries out the display or exhibition of phenomena or event while the learners watch. It involves presentation, showing and--displaying the equipment, apparatus and the ways the instruments or materials work.

❖ ***Discovery Method***

This is a method that involves the teacher to give to the learners certain assignments that would require them to find answers. Discovery method could be guided or unguided.

❖ ***Laboratory Method***

This is a method of science teaching whereby the learners are quartered in a room or a particular environment to carry out some exercises of finding out facts. It could be exercise or experimental work.

❖ ***Project Method***

This is a method of science teaching that requires the assignment of a task or tasks to an individual or group of individuals for a particular period of time in order to discover or prove some facts. The teacher only guides and gives the learners the free hand to carry out the tasks. \*:\* *Field Trips*

This is a method of science teaching that involves taking the learners to the environment under consideration to see or observe things by themselves. They are taken to the field or industry or a place where a particular thing under study could be found. Through this, they gain first hand experience.

❖ ***Individualized Instructional Method***

This is a new approach whereby the individual (the learner) learns on his own under the guidance of the teacher. The learner learns at his own rate.

**Is Performance In The Sciences Really Dwindling Among the Nigerian Students?**

Increasing evidences indicate the dwindling performances in sciences among Nigerian students (WAEC, 1992; Ali and Anaekwe, 1997; Nnachi, 2005). Taking into consideration the tremendous importance of science and the need for every society to be scientifically literate, one would expect progressive and increasing achievements in the sciences. Also, taking into consideration the effort of the Nigerian governments (Federal and States) to give greater attention to the production of science teachers, one would expect brighter days for the learners in terms of performance.

Unfortunately, the reverse seems to be the case. Instead of appreciable increase in performance, what seems to be a deterioration of performance has been the case (Nnachi, 2005). In common cases, there has been what appears to be a decreasing trend in performance among the science learners. Instead of the students to progress in the mastery of sciences due to the production of more science teachers in schools now than before, students' results in the sciences continue to show some decline.

Indications have not shown any improvement on the part of the learners. This is a serious threat to the Nigerian bid for scientific and technological breakthrough in this modern age of science and technology. Some factors responsible for this include the non serious attitude of the learners to their studies due to some hope in examination malpractice, the negative portrayal of image of science as that of power and complexity (Webster, 1991), the non challant attitude of the teachers to the teaching of their subjects due to dissatisfaction With the –condition of service and the non application of the right approaches in teaching and learning of science. If the government would look into the causes of the perennial dwindling of the learners performance, a lot would be achieved for now and in future.

**Psychology in Science Teaching And Learning**

One of the most impressive innovations in science teaching and learning is the employment of psychology to the approaches of science teaching and learning. Psychology is defined as the scientific study of behaviour and mental processes (Feldman, 2000). No wonder psychology studies the behaviours of the teacher and the learner and formulates approaches in tackling the problems that confront them. Thus it formulates the procedures and sequences of handling matters in respect of teaching and learning. Psychology constitutes the bedrock for teaching and learning and has become a veritable base for teaching and learning of science (Nnachi, 2004).

It is now vehement to point out that psychology considers the nature of the science teacher -his predispositions, his emotional qualities, intellectual standing as well as affective and psychomotor dispositions. According to Nkemak9lam (1995), \_the major contribution of psychology to education lies in its capability of providing a scientific foundation for educational practices. Psychology evolves and critically evaluates theories of human motivation, instruction and learning. The teacher is assisted,

through the knowledge of psychology in the principles of teaching and learning.

As a scientific discipline, psychology uses scientific procedure to collect data on individuals and groups and uses the same scientific procedure to analyse and predict behaviour. It thus designs ways and strategies of handling human cases relating to behaviour in school and out of school situations.

With the help of psychology, the principles of teaching and learning are x-rayed. More understanding is created. Since it is a scientific discipline by its own merit, it assists the science teacher in the development of analytical culture for the cross examination of issues to validate their authenticity (Nnachi, 2004). It has then come to be known that psychology has tremendous role to play in different facets of teaching and learning and is becoming an indispensable tool for effective science teaching and learning.

### **Towards The Improvement of Performance in The Sciences: A Motivational Perspective**

The central point in the bid to forge sciences ahead in Nigeria is motivation. The motivation could be in terms of the learner or in terms of the teacher. Following psychological approaches, there is the assurance of hope in the transformation of the dented image of science. An outline is therefore made for the salvaging of the situation:

- 1. Use of Incentives:** The teacher should encourage the learners to work hard and should disabuse their minds of examination malpractice. The teacher could also use incentives to awaken the morale of the learners. The teacher should, from time to time, give incentives to hardworking students. This will help the learners to understand and appreciate the need for hard work. The class teacher could use a number of ways to create incentives.
- 2. Application of Science Taught to life Situations;** What is taught in the class by the classroom teacher should be related to circumstances of real life situations to create reality for science teaching and learning. What the teacher teaches should be related to the immediate circumstances and should have practical background. This will concretize what might seem to be quite abstract in science dimensions.
- 3. Raising of The Integrity of The Teacher:** The integrity of the science teacher and that of the other teachers should be raised. One of the psychological reasons for the dwindling seriousness of the learners is that many of them see nothing serious in the teachers that teach them. When a teacher continues to wear a pair of shoes for a whole week and a particular dress for the same week, the students would start to downgrade the teacher, the work of teaching and the business of learning. They would neither value the teacher nor what he says or teaches. The teacher should be enhanced, elevated and dignified to facilitate the learners' recognition of him (her) and all that he (she) teaches. To this end, there should be some positive amendments in the salary of the teachers. Science teachers should receive commendable science practical allowances.
- 4. Making Each Science Topic Interesting:** The classroom teacher should endeavour to ensure that every topic is made interesting either by the way of presentation or by the way of conception. The teacher should ensure that he/she uses a suitable method to teach a topic as the case may be to make the topic as interesting as possible.
- 5. Making the Objectives of Each Science Topic Clear:** The teacher should make clear to the learners the objectives of teaching a particular topic in science. He (she) should encourage the learners to bear in mind the objectives of a particular topic.
- 6. Use of Teaching Aids:** The teacher should endeavour to teach with teaching aids to illustrate and make more explicit his classroom work. The teacher should always try to use charts and other aids that could be of assistance to his teaching.
- 7. Creating Conducive Classroom Atmosphere:** The science teacher should ensure peace and tranquility in the class to engender harmony and receptiveness in the class. He (she) should be environmentally friendly and should ensure that the classroom is likeable.
- 8. Teacher Being friendly with Learners:** The science teacher should not be antagonistic to the

learners. He (she) should always be friendly with every learner. He (she) should always be of assistance to the learners. The science teacher should always be friendly with staff and students of the school.

### **Enhancing Cognitive Development of the Science Learner**

The most aching problem of science teaching and learning is the view of science as a story telling affair whereby the teacher conceives of the learner as a tape recorder that has the responsibility of pouring down what he has taught. Many a times rote memorization is encouraged. When this approach is difficult for some people, there is the problem of coping. It is believed that the most effective approach the teacher adopts is the motivational approach which has just been highlighted. The learner has his (her) role to play which will concretize the effectiveness of the teacher's approach. The learner is guided by the teacher to adopt the following cognitive strategies for effective learning of sciences. The strategies include:

1. Insightful approach to learning
2. Perceptual organization of the learners' perceptual field and

Development of the Cognitive Map of the Learner.

**Insightful Approach to Learning:** The Nigerian science learner should be encouraged to be insightful through the means of constant reflection of facts. The learner should be encouraged to survey the problem situation, think deeply about the problem in question and carry out the task of solution. There should then be constant development of insight in the science learner. Insightful learning can be developed in the learner through constant giving of assignments by the teacher.

### **Perceptual Organization of the Learner's Perceptual Field**

Learning is said to be -a relatively permanent change in behavior due to experience. By perceptual organization, the learner is encouraged to learn facts repeatedly to create better understanding and proper organization of facts in the mental system. The classroom teacher should encourage a thorough study of facts to cause effective organization of facts in the mental system of the learner.

**Development of the Effective Cognitive Map of the Learner:** The Classroom teacher should endeavour to help the learner develop effective cognitive map of the scientific facts. This the teacher does by ensuring that every presentation is not hastily carried-out. The learner should take some time to observe, listen to or smell something as the case may be. The teacher should not always be in a hurry in presenting and teaching scientific facts so as to help the learners develop the cognitive map of the facts.

### **Summary / Conclusion**

The high rate of failures in Nigerian external examinations calls for a redress on the part of the teacher, the learner and the nation. The worst hit disciplines are the sciences. Performances in the sciences dwindle year after year, causing embarrassment to the teacher, the learner and the general public.

Since science is the backbone of national and international development, no nation can be sure to survive the course of development without science. The nation cannot fold her arms watching when her survival is at stake. This calls for the consideration of the use of psychological approaches to solving the problems of teaching and learning of sciences. A good number of psychological strategies have been highlighted for the teaching and learning of sciences. It is believed that if the strategies are applied effectively positive change would be the case in the teaching and learning of sciences.

### **Recommendations**

For the improvement of teaching and learning of the sciences, the following recommendations are made so that the learners' academic achievement in the sciences could be enhanced:

1. The government should constantly motivate the teachers by giving to them all their rightful incentives, ensuring that teachers are paid in time, ensuring that teachers' science allowances are paid and encouraging teachers to attend workshops, seminars and conferences to improve on their science teaching methods.
2. The teacher, on his/her own part should employ motivational techniques such as the use of incentives, making science topics taught very interesting, relating science topic to life situations and so on
3. The teacher should always create a conducive psychological atmosphere for the learners of

science.

' 4. The teacher should constantly employ' cognitive strategies to enhance the cognitive development of the learners' cognitive field through insightful approach to learning, perceptual organization of the learner's perceptual field and development by the cognitive map of the learner.

### References

Abdullahi, A. (1976). Towards a philosophical basis for teaching in Nigerian Schools. *Journal of the Science Teachers Association of Nigeria*, 15(1), 6-10.

All, A. & Anaeke, M. C. (1997). Science and technology for national *development*: The Effects of Students' interaction Patterns on cognitive achievement in chemistry. In A. AH (Ed.) *Perspectives on Crucial Issues on Nigerian and African Education, Vol. I. A publication of Institute of Education, University of Nigeria, Nsukka*.

Conant, J. B. (1959). *Science and Common Sense*. New Haven; Yale University Press Ltd.

Feldman, R. S. (2000). *Essentials of Understanding Psychology*. Boston: McGrawHill Higher Education.

Maduabum, M. A. (1987), *Teaching Biology Effectively*, Jos: Jos University Press Ltd.

Nkemakolam, E. O. (1995). Education, growth and development: An over view. In E. O. Nkemakolam (Ed) *Education and Human Development; A Psychological Approach, Benin: Barloz Publishers, Inc.*

Nnachi, R. O. (2002). Relationship of achievement, gender and science self concept to *students attitude to Science within South Eastern States of Nigeria*. *The Nigerian Educational Psychologist: Journal of The Nigerian Society for Educational Psychologists*, 1(1), 79-91.

Nnachi, R. O. (2004). Psychological strategies for applying science taught in school to life situations. *Nigerian Journal of Curriculum Studies: Journal of Curriculum Organisation of Nigeria*, 1(2),-183- 188.

Nnachi, R. O. (2005). Psychosocial Strategies for changing the image of science for greater comprehensibility in Nigerian Schools -*Nigerian Journal of Curriculum Studies: Journal of Curriculum Organization of Nigeria*, 12(1), 30-33.

Webster, A. (1991). *Science, Technology And Society*. Houndmills: Macmillan Press Ltd. West

African Examination Council (1992). *Statistics of entries and performance in*

West African/Senior School Examinations. Yaba: WAEC.

