

# MEASUREMENT AND EVALUATION IN SCIENCE TEACHING

*Pius O. Nwani*

## **Abstract**

Science and learning sustainability through measurement and evaluation is a tactical approach which when fully applied by educational instructors would go a long way to improve the standard of science education in Nigeria. This study aims at revealing the purpose of measurement and evaluation in teaching and learning science and as such illustrating various measures that could be adopted in order to sustain science teaching and learning. In line with the above subject matter the researcher recommended among other things that, teachers should, check learner's progress and guide accordingly through feedback, be flexible and innovative in their instruction, make sure that learning objectives clearly identified and to make sure that test given to students should be a representative sample of what have been taught.

## **Introduction**

Science and learning sustainability is an innovation which aims to sustain learning outcome among students through effective measurement and Evaluation. Measurement and Evaluation in education is not the same thing. Measurement is the process of assigning numerals to objects, or events according to certain rule (Kerlinger, 2000). Gay (1980), in Bade Adegoke (1998) defines Measurement as the process of quantifying the degree to which someone possesses a certain trait such as quality, characteristics, or feature. For instance, instead of saying that Ojo is more intelligent than Chukwu, we can merely say that Ojo has a measured intelligence Quotient (IQ) of 125, while Chukwu has a measured intelligence quotient (IQ) of 80. Measurement, per se is not restricted to administration of test" because data could also be collected via other processes such as observation analysis and the rating of a product (e.g. performance or manipulation during an experiment with pendulum in physics laboratory). It is a quantification of the degree to which students possess skills or manifest certain behaviours which can directly be observed or indirectly ascertained by the analyses and rating of responses. It also involves first obtaining or anticipating data or responses and then attaching numbers to rating or analyzing these data or responses. In fact, the nature and type of data or responses determine the instrument(s) used to collect the data or responses. The instruments may include paper – pencil tests (teacher - made tests), Observatory tools (Checklists and rating scales), interviews, questionnaires, standardized tests, personality tests, and interest inventories.

Evaluation on the other hand, is the process of making value judgments or decision making G.C. IIOgu (1998). Usually it begins with the data collected and ends up with conclusions and generalizations. In order to reach worthwhile conclusions and generalizations, some analyses of the data collected are done carefully and accurately. Cooley and Lohnes (1998), sees Evaluation as "a process by which relevant data are collected and transformed into information for

decision – making. It is a process rather than a product. It is successful in so far as the information it generates becomes part of the decision – making process.

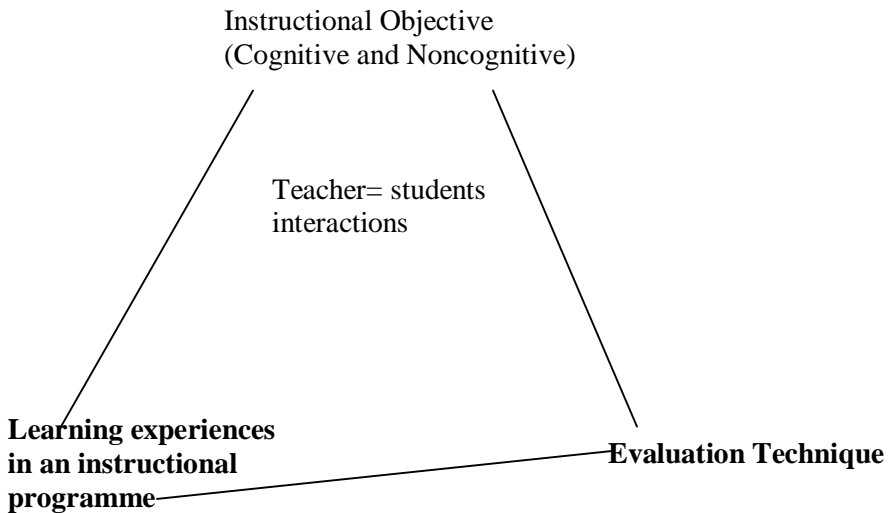
Evaluation is a measurement of the extent to which objectives set for a particular event have been achieved Ola Busari (1998).

### **Purposes of Evaluation**

The major purposes of evaluation are to:

1. Diagnose learner’s difficulties in curricular programmes
2. Appraise teacher’s instruction and
3. Checking learner’s progress and guide accordingly through feed back.
4. Assess instructional programmes. Evaluation attends what measure, how to measure and how good the measurement is.

The objectives, the instruction and methods of evaluation are closely interrelated. This is shown schematically below.



### **Learning Experiences And Evaluation Techniques**

The learning experiences and evaluation techniques help to classify the objectives. This does show that a teacher that states in his performance objective in interpret data and for actual instruction; facts are contained in the lesson and he now calls for measurement of only cooperativeness (affective outcome) in his test, has provided conflicts in the relationship shown above. Evaluation must be a measurement of specific objectives set for series of lessons. When evaluation is done appropriately learning is sustained. Evaluation is carried out with the use of test and examinations in school. Examinations and test are similar in nature. While test attends to a particular discipline at particular time examination covers 2

series of tests in each and or different disciplines at a final stage, which is either for selection or promotion or prediction in the school.

### **Types of Evaluation**

There are two forms of evaluation:- formative evaluation (e.g. continuous assessment) Summative evaluation (e.g. terminal examination) Formative evaluation is a periodic or developmental evaluation for the purpose of diagnosis, trial testing and remedial actions.

An example of this type of evaluation is continuous assessment. Continuous assessment is a part of evaluation used to determine what student has learned from learning activities and experiences in terms of knowledge, thinking, character development and industry (manual on continuous assessment 1981).

It requires that the results of this assessment form part of the final assessment of the individual. The characteristics of Continuous assessment include:- Its being systematic, comprehensive and cumulative; requiring the use of a variety of evaluation and is also guidance – oriented.

It is systematic in the sense that the assessment is made gradual and implemented at intervals. The skills, knowledge and attitudes of students are measured which are subsequently gathered and added to the terminal scores. This latter part of continuous assessment makes it cumulative.

Most items used for continuous assessment in science teaching in secondary schools are basically factual – oriented. The scientific skills and attitudes are most often neglected. Thus the scientific facts become the central focus of examination preparation of students.

Among the reasons put forward in support of continuous assessment in science teaching include to:

- (1) Give the science teaching a greater involvement in the overall performances of science students.
- (2) Provide a more valid assessment of students' overall knowledge skills and attitude.
- (3) Enable teachers to be more flexible and innovative in their instruction.
- (4) Provide a basis for more effective guidance of students.
- (5) Provide a basis for the teacher to improve his or her assessment tools.

The summative evaluation is a terminal assessment of students' performances in science. Each form of evaluation employs certain tests for its purpose. Test is used to assess casually terminal and non-terminal examinations.

Test and examinations form an important part of evaluation. Teachers should identify different ways of constructing good test and work towards its purposes. In order to sustain science teaching and learning, the science teachers should note that students are often misdirected in their preparation for internal and public examination by the impression created by the kinds of items often given to them.

Note that if questions center mainly on specifics, definitely students will tend to memories and regurgitate the facts as given to them. However, if there are variations in the assessment instruments especially items that demand great thinking and reasoning as well as demonstration of practical skills, the students will responsively react and respond by analyzing concepts and applying principles.

For sustainability of science learning, the science teachers should use the following as guides whenever tests are to be undertaken:

1. The meaning of various scientific facts laws and theories .
2. The Inter – relatedness of certain concepts in science (e.g. the laws of thermodynamics and diffusion in Biology, Chemistry and physics).
3. The acquisition of practical skills.
4. Extrapolation of graphs analysis and interpretation of data and solution.
5. The phases used in attending to problems, trial and error or scientific approach. .
6. Assessment given should be valid enough to service not only as an evaluative tool but a diagnostic tool.
7. Inference making from scientific statements or observations.
8. Instruments having predictive value future knowledge skill and attitudes of students.
9. The essential of feedback of every test and the improvement of teachers methodology in science teaching.

Many Science Students are anxious and nervous to sit for a test or examination. Anxiety in students puts them in an abnormal condition when writing a test or examinations. It is a consensus among many science teachers that students be informed before a test is given. Regardless of whether students are informed or not a science teacher should avoid using a test as the sole determinant of students grades. Every minute in science classroom should be considered as meaningful period to testing the students whether orally written or practical. By so doing science teaching and learning would be sustained. It is important to note the vast variations in students ability, style, interest and perception. Thus, it becomes imperative for teachers to ascertain for students confidence in the science subjects rather than narrowing the objectives of science teaching to the mastery of scientific facts. It is also imperative that science teachers interact with students, monitor their performances and counsel them from time to time and make reports available on each student. This is the only way the science teacher can ascertain his capability, efficiency and methodology.

### **Construction of Test and Science Learning Sustainability .**

Several factors should be put into consideration before constructing a test as such factors would invariably lead to science learning sustainability. Such factors are:

1. Objectives should be clearly identified

### Measurement And Evaluation In Science Teaching

2. Each objective should be written in terms of observation and or measurable observation.
3. The test should be a representative sample of what has been taught.
4. A table of specification must be developed as a framework for test construction. A table of specification expresses the cognitive objective to be covered and the representative of covered topics in a given subject.

The table of specification below shows the three topics covered in chemistry namely, isotropy and Isotopes, chemical bonding and types of reactions. The cognitive objectives refer to the taxonomy of Educational objectives by Bloom (1956).

**Table 1; A table of specification on three concepts taught in chemistry**

TOPICS	KNOWL EDGE	COMPRE HENSION	APPLI CATION	ANALYSIS	SYNTHESIS	EVALU ATION	TOTAL
Isotopy And Isotopes	2	2	4	3	2	3	16
Chemical bonding	2	3	2	3	3	4	17
Types of reactions	2	2	3	3	4	3	17
Total	6	7	9	9	9	10	50

The table of specifications, shown in the above table guides the teacher in constructing fifty items test on three concepts that have been covered in chemistry.

The table reveals a total of six and seven items on knowledge and comprehension respectively. Knowledge, in these concepts refers to recall of specifics. For instance, the specifics of isotopy and isotopes are namely the definitions of Isotopy and isotopes etc. these also include terminologies like electrovalent covalent, ionization energy etc the comprehension constitutes the ability of students to translate scientific names of isotopes to symbols, and using equations to show formation of various bonds and as such relating chemical reactions with equations.

The application, analysis, synthesis and evaluation are components of higher – order cognitive objectives. The application is the use of concept situation while analysis focuses on the ability to relate theories and principle, processes and products in science. The table specification prevents the overemphasis of some cognitive levels and topics.

### **Conclusion**

For science and learning sustainability to be achieved through measurement and evaluation employers of educational instructors should bear in mind that, for adequate measurement and evaluation of students learning outcome, only educationally qualified teachers that, have taken courses on<sup>5</sup>

measurement and evaluation should be employed at all time to teach science subjects. Furthermore, if the above recommendations are carefully considered and attended to by the teachers in the field science and learning sustainability would be achieved through measurement and evaluation and when these are achieved the problem of lack of man-power as regards to science and technology would be a thing of past.

### **Recommendations**

In order to sustain science teaching learning through measurement and evaluation the paper presents the following recommendations:

1. The teachers should always check. Learner's progress and guide, accordingly through feed back.
2. Teachers should be flexible and innovative in their instruction
3. The teacher should make sure that learning objectives are clearly identified.
4. The teacher should make sure that test given to students should be a representative sample of what has been taught.
5. A table of specification should be prepared to guide in framing up questions and ensuring for fair content coverage.
6. The specific content areas should be listed out, including the corresponding topics.
7. The items in the test must be worded in a clear language to avoid misinterpretation of what is solicited.
8. A consideration of adequate time for answering questions should be the teachers' watchword.
9. A marking Scheme must be prepared by the teacher to assess the limitations of such items and should exhaust all possible answers to the items, though translated in different ways.
10. The teacher should make sure that, any test, to be given to the students, the items must be validated by specialists outside his or her own school environment.

**References**

- Novak J. D. and Godwin D.B (1998). *Learning How to learn* cambridge University Press.
- Busari O.O. Teaching secondary school science Lagos Ayo-Adesisa Publishers .
- Adegoke B. & Busari T. curriculum theory and discipline, Lagos JAS Publishers.
- Shoemaker, D. M. (1975). Towards a framework for achievement testing review of educational research *Winter* 45(1) 127-147.
- Stewart J. (1980). Techniques for assessing and representing information in *Cognitive structure science education* 64(1) 223-235.
- Farrant J.S. (1980). *Principles and practice of education* England, Long-man and Company Limited Schechilcath Tony Printing Press England.
- Bajah S.T. (1975). Preparation of secondary school teachers of physical science of African environment *West African journal of education* Vol. 19 Vol.1 Pp 94-95.
- Owolabi J. B. Evaluation of some Nigeria science teachers, *STAN Journal Vol. 16 No. 3 August 1978*.
- Kekong J. (1984). *Taxonomy in education objective handbook on Formative and summative evaluation students learning*. New York McGraw Hill