

# PROCESSES OF SCIENCE SKILLS ACQUISITION: COMPETENCES REQUIRED OF SCIENCE TEACHERS FOR IMPARTING THEM

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## **Abstract**

The major purpose of this paper was to discuss the provision in the National Policy on Education for teachers' acquisition of competences required for teaching the processes of science and to relate them with science teacher's practices in the field. It was found that the competences practiced by science teachers in the field run short of the provisions in the National Policy on Education for imparting skills of processes of science to students. It was concluded that urgent steps should be taken by government and science teachers to reposition the teaching and learning of science in line with international standards through reviewing the existing teacher education policies particularly in the area of admission requirements, improving the state of infrastructure for teaching and learning science and retraining of all science teachers through seminars, conferences and workshops.

## **Introduction**

Many educational reform efforts in United States and Korea have called for a shift in the emphasis of science education from memorization of facts and procedures to a deeper understanding of the subject matter through the application of the processes of science (American Association for the Advancement of Science (AAAS), 1993; National Research Council (NRC), 1996; National Research Council (NRC), 2005). In the same vein, the National Science Education Standards was released, calling for inquiry (a method that enforces the acquisition of the processes of science) as a way in which "students actively develop their understanding of science by combining scientific knowledge with reasoning and thinking skills" (NRC, 1996:2). Effective teaching of science, which

Culminates in its effective learning, is hinged on the application of the process of science in instruction.

The processes of science include; observation, classification, experimentation, measurement., communication, counting numbers, inference, formulating hypotheses, manipulating instruments, understanding ' space/time relationships, recording, controlling variables, interpreting data, formulating mental models, raising questions, making operational definitions and making conclusions.

The practice of these processes by scientists result in their acquisition of scientific attitudes. The scientific attitudes include; patience, curiosity, originality, cooperation, honesty, punctuality, empiricism, regularity, ' carefulness, reliance on evidence, disinterestedness on outcome, concern for accuracy, concern for others, inquisitiveness, respect for data or evidence, diligence, resourcefulness, and courage to explore.

The provisions of the National Policy on Education (Federal Republic of Nigeria, 2004) for teacher education include the purpose of teacher education, institutions of training for professional teachers and their entry qualifications, curriculum of Teacher's Colleges, and Professionalization of teaching. Since the implementation of the teacher education policy, it has been seriously criticized and argued that sufficient provisions were not made for the teaching profession.

While the policy stipulates a minimum qualification of NCE for the professional teacher in the future, government went ahead and approved Teachers' Grade II Certificate as the minimum qualification for a professional teacher. It is surprising to note at this point that 27 years

after the adoption of the National Policy on Education, Grade II teachers are still employed by the various governments to teach in primary schools. This suggests that the provisions in the National Policy on Education are not followed with all amounts of dedications. The contents of the curriculum of teachers' colleges were restructured to enable academic and professional training of teachers to take place such that graduates of these colleges can proceed to Colleges of Education and Universities for higher qualifications in education (Ivowi, 1997). Continuing, Ivowi, noted that the retention of Grade II certificate as the minimum qualification for teaching and the mere restructuring of the curriculum of the teachers colleges to enable academic and professional training to be imparted on students, and to enable the graduates proceed to either colleges of education or universities for further training were some of the aspects the teacher education that were not adequately provided for in the National Policy on Education.

The 6-3-3-4 system of education laid emphasis on the teaching and learning of science to acquire essential scientific skills and attitudes as a preparation for technological development. This was to lay the foundation for functional education through appropriate development of cognitive, affective and psychomotor skills as a basis for the development of the country. For this objective to be attained, both teaching and learning of science at the secondary level of education need to be improved. The secondary school science education needs special attention and direction. This therefore implies that effective science learning at the secondary level of education needs effective teaching of the processes of science. For a teacher to be able to do this, he must be very knowledgeable in the skills of teaching science.

The secondary school structure which has two levels; junior and senior has different science curricula requiring varying teacher

competencies. In this paper, attempt will be made to discuss the competencies or requirements as stated in the National Policy on Education, practiced competencies of teachers in the field and factors militating against science skills development in Nigeria.

### **Science Teachers Competencies as Stated in the National Policy on Education.**

A major provision for teacher education in the National Policy on Education is the prescription that all teachers in all educational institutions should be professionally trained.

The contents of the science curricula used in the junior and senior secondary schools require teachers with varying competencies to guide learning activities of students. To this end, the minimum qualification of NCE is stipulated for teachers teaching at the junior secondary level a first degree for those teaching at the -senior secondary level.

Federal Republic of Nigeria (2004) in the National Policy on Education also made -provision for more opportunities to be given to science teachers for on the job training. NCE science teachers are given the opportunity to update their knowledge in their subject areas to degree level through study leaves. Laboratory facilities in teacher training schools are to be expanded to enable the appropriate training in science process skills to be given to trainees. The need for expansion of laboratory facilities was to motivate teachers and provide adequately for their initial experiences in their field. All these are aimed at improving the science teachers' competences in the following areas:-

- (i) proper knowledge of contents of subject matters;
- (ii) knowledge of how to present content materials to students;
- (iii) knowledge of process skills required by science students and how to inculcate them;

- (iv) resourcefulness in improvisation of instructional materials, and maintenance/repair of laboratory equipment;
- (v) behaviour motivation of students through being seen as a role model; and
- (vi) accurate evaluation and interpretation of learning outcomes of students through well constructed tests, and accurate assessment.

Federal Republic of Nigeria (2004) in the National Policy on Education also stipulates that the best method for teaching science should be inquiry/discovery approach. This is to be achieved by employing the following teaching methods: Cooperative learning, discussion, questioning, experimentation, project, role-playing and stimulation in order to acquire skills in science. This approach to instruction demand a very cordial teacher-student interaction dominated by the student. The role of the teacher is that of a facilitator rather than a dispenser of knowledge.

The policy also made provisions for regular training and retraining of science teachers to make them conversant with changes in science teaching and learning. This is to be achieved through conferences, workshops and seminars. There is also provision for regular provision of equipment, facilities and materials for teaching and learning of science. All these provisions in the National Policy on Education has the propensity of improving science teachers competences in causing learning to take place among science students.

### **Competencies Practiced by Today Science Teachers**

What teachers do in science classrooms is a function of their competencies. The teacher's competence is a function of what they do in the science classrooms. Although the National Policy on Education was launched in 1982 and by 1985 all states have joined in the implementation

of the programme, most research findings on the implementation of the policy indicate that most of the provisions in the policy are not adhered to. Ivowi (1997) noted that there are differences in the knowledge of the concept of implementation amongst teachers, planners and administrators. The following classroom activities are not in line with the recommendations in the National Policy of Education on Science teaching and learning:

- (i) Research results (Oludotun & Oguniyi, 1981; Abijo, 1981; Aminu, 1980; Jegede, 1982, Ajaja, 1998; Ajaja, 2005; Ajaja, 2009) have shown that teachers continue to teach science using the lecture method despite the suggested-guided discovery method because of its effectiveness in enhancing learning. The teacher's inability to use guided discovery approach in teaching science is as a result of some teething problems. The first is the lack of laboratories equipped with appropriate facilities for the use of the method. Another is the large class size of science students with few teachers to match makes the use of the method impossible. Again is the lack of well skilled science teachers resulting from poor training. Although most science teachers may be incompetent in their subject areas and ability to select appropriate methods to use in teaching, the need to cover student's schemes of work within a given time makes teachers to always resort to the lecture method. There are now research evidences that suggest that student's performances in science is as a result of method of instruction used by the teacher. For example Ajaja (1998) found that biology students taught with guided discovery and invention methods retained biology knowledge longer than those taught with lecture method. This shows how the knowledge of the appropriate method of teaching can influence learning outcome,
- (ii) The exhibition of professional qualities in terms of activities and behaviour need re-examination. It was observed that most of the teaching skills the teachers acquired before

certification are not put into practice in the field. Most teachers in the field do not plan and write lesson notes to guide effective delivery of lessons to students. Ajaja (2009) identified the following non-professional behaviour of science teachers in the field: (i) non-coverage of contents in scheme of work; (ii) non-giving and marking of assignments; (iii) non-supervision of instruction; (iv) non-organization of practical lessons; (v) non-organization of extra lessons to cover lost grounds; and (vi) non-assessment of learning outcomes regularly. The knowledge and skill acquired in micro-teaching and media construction in instructional material improvisation is hardly put into use in science teaching. Taking students to short field studies to show and illustrate with organisms in the natural environments are hardly done by science teachers.

(iii) The very large class sizes, which exist in schools, have made healthy interactions between students and teachers almost non-existent. Most teachers hardly know their students by their names. The large class size has reduced individual student's attention during practical lesson. Students seeking special attention as a result of lack of clear instruction in practical lessons are hardly attended to. All these culminate in very poor performances of students in test of practical knowledge in final year examinations.

(iv) Another area, which needs thorough examination, is the evaluation of students learning outcomes. Most of the teacher made tests center on lower order questions. Questions are hardly asked to test knowledge of Analysis, Synthesis and Evaluation. Some teachers do not even mark students test scripts. They merely award marks to students without any yardstick for doing so. The consequence of these is that students' mistakes are not identified and corrected during teaching.

### **Reasons why Teacher Competency Problems Still Exist**

(a) Teachers' quantity. The number of science teachers in schools throughout the country are inadequate (Baikie, 2000; Ajaja, 2009). Arising from such situation, the few science teachers are over loaded. This results in

very low output of the science teachers in terms of teaching to cause learning to occur.

(b) Teachers' quality. Whereas the provision in the National Policy on Education stipulate that NCE graduates should not teach beyond JSS III,, the bulk of the science teachers in our schools are NCE holders. Ajaja (2009) in a study conducted in Delta State, an educationally advantaged state found that 47%, 51% and 30% NCE graduates: teach Biology, Chemistry and Physics respectively. The corresponding B.Sc (Ed) graduates who teach the corresponding subjects constitute 27%, 20% and 23% respectively. Also, related to this is the fact that the teaching of science subjects in schools has become for all kinds of graduates. All sorts of teachers with applied sciences knowledge teach science in our schools. The provision that these are not qualified science teachers, and that only trained science graduates in a particular discipline should teach a specific science subject does not hold. This is however, caused by the scarcity in number of qualified science graduates.

(c) Politics and science , teachers employment. A very touchy problem has now emerged arising from playing politics with teachers employment. Politicians are known to share vacancies among themselves all in the name of politics. The worst of science teachers are sort for and employed leaving out the qualified and competent teachers. In most cases the vacant positions allocated to politicians are sold at exorbitant prizes to teaching employment seekers who would be able to pay. What type of competences do you expect from such teachers.

(d) Lack of equipped laboratories. Most secondary schools lack laboratories and those

who have lack equipment materials and reagents. Concepts in science are well and better understood when they are demonstrated in the laboratory. In the absence of practical experiences, concepts are taught and illustrated to students based on the abilities of the science teachers and verbally.

(e) Supervision of Instruction. Most often teachers in the field are not supervised to find out what they do in the science classrooms and where necessary make corrections. Experts and most qualified science teachers are required by law to inspect science teachers' instruction from time to time. This creates room for dialogue between the science teachers and inspectors for better presentation of content materials to students.

(f) Non-participation of teachers in decision-making process. Science teachers are not involved in science programme planning and development; The school science programmes are planned and developed by outsiders called experts. For example the science curriculum currently used in schools was developed by Comparative Education Study and Adaptation Centre (CESAC). The developed programmes are brought to the teachers for implementation without any formal training on the contents in the programmes and inputs on how to implement the new programme, The end result of this is that most often the programme fails because most teachers lack the knowledge and commitment necessary for the programme to succeed.

(g) Science teachers motivation. Science teachers are not given incentives to put in their best. In the 70s, science teachers were paid science allowances to take care of the extra time they spend after normal school periods to conduct practicals. During that time practicals were conducted on regular basis. Since the withdrawal of the allowances by most state governments, the teaching of science practicals after school has suffered a very serious set back.

## **Solutions to Science Teachers Competency Problems**

The provisions in the National Policy on Education has solutions to competencies problems particularly in the areas of education, subject matter and students evaluation. The real problem is that of training of the teachers to acquire the necessary skills to enable them exhibit the appropriate competencies in their subject areas.

Two approaches are recommended to solve the problem at hand. These include; (i) Revisit of the teacher education programme; and (ii) Re-training of all science teachers.

Ivowi (1997) noted that the gap between the expected and practiced competences of teachers at the secondary schools can be bridged by means of teacher education programmes. All the teacher education programmes in Nigeria are filled with young people who exhibit behaviours that portray them as unprepared and uninterested in the profession they are being trained for. They neither show signs of resourcefulness nor portray themselves, as would be dedicated teachers on graduation. Most of them openly express regrets for studying education and show willingness to change to other faculties when given the opportunity. With these kinds of behaviours being expressed by would be teachers, one would ask; what type of competences would you expect from such teachers on graduation.

The reasons why the teacher trainees show such behaviours are due to many factors which are not far fetched. The first and most significant factor among others is the conditions or requirements accepted for admitting students into education programmes. Education courses have the most liberal and weakest requirements for admission. The implication of this is that most of the students studying education courses at the end are students rejected from non-education courses. Most of the students studying education courses do so because of the shame of

going home on rejection or remaining at home without admission.

The second factor is the weak and less rigorous stands employed in training of teachers. The teaching practice which should have been the last point for processing the teachers for the job of teaching is not taken seriously by both the students and the teacher certificate awarding institutions. As at this very moment no clear-cut provision has been put in place on how long teaching practice students have to remain in their schools of practice. The duration varies from one institution to another.

With these obvious lapses in the teacher education programmes, what quality of teachers do you expect from the programmes? This situation therefore calls for changes in the policies on how to admit students into teacher education programmes. It is suggested that only fairly matured candidates who show interest by choosing teaching as their first course of study among others should be admitted into teacher education programmes. The idea of lowering admission requirements for courses in education should be discontinued. The requirements for admission into all teacher education programmes should be as tough as other non-education programmes. This will indeed remove teaching from all corners field were standards and professional ethics are not adhered to.

Retraining of all caliber of science teachers in the secondary schools will strengthen their growth and skill development. An innovation is bound to lead to personal growth and skill development. Ehiamezor (1984) for example noted that the Science Association of Great Britain attached great importance to the development of effective in-service education programme for science teachers to implement new science programmes.

The professional development of science teachers should be of great importance for the successful implementation of the National Policy on Education. Such in-service training should

lead to skill development. The Science Teachers Association of Nigeria (STAN) and the various institutes of education are in better position to develop and formulate policies on the in-service training of science teachers on the effective utilization of science teaching strategies and equipments in schools. STAN should find a way of being at the centre among those who formulate policies on science education for Nigeria.

The Science Teacher Association of Nigeria has developed several textbooks on Integrated Science, Biology, Chemistry, Physics, and Primary Science to improve on the teaching and learning of science. Yearly they organize conferences and workshops to retrain science teachers on strategies for teaching and learning science. It is sad to note that the percentage of teachers who attend is very low. The STAN still has a lot to do in the area of sensitizing the; various state ministries of education on the: relevance and need to sponsor their science teachers to attend such conferences and workshops. For the successful implementation of science education programmes in Nigeria, it should be made the responsibilities of government and STAN,

### **Conclusion**

Effective science teaching demands a firm and thorough knowledge of how to present subject matter and content materials to students. Although the National Policy on Education clearly made provisions on how science teachers can acquire the required competencies for effective science teaching particularly on how to present content materials to students, what is practiced in schools is far short of the specifications. This has resulted in our inability to take science teaching far and above what it was before the introduction of the policy. This situation therefore calls for urgent steps to be taken by government and science teachers to reposition the teaching and learning of science in

line with international standards. This can be achieved through reviewing the existing teacher education policies particularly in the area of admission requirements and improving the state of infrastructure for teaching and learning science. Also required is the retraining of all science teacher's in secondary schools through in-service programmes jointly coordinated by state ministries of education and STAN but financed by the various arms of government.

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