
ROLES OF INTEGRATED SCIENCE TEACHER EDUCATORS IN PREPARING NEW INTEGRATED SCIENCE TEACHERS IN NIGERIA

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ABSTRACT

Nigeria is currently facing a shortage of quality teacher especially in the areas of sciences. This placed enormous task on all stakeholders; government agencies, private partners and most importantly on science teacher educators in Nigeria. This paper articulate radical change needed to succumb this major challenge in the areas of individual Integrated Science Teacher, learning environment and methodology within the realm of general teacher education program. The models of science education that widely persist in Nigeria schools across all levels are inadequate and ineffective for developing students with deep understandings of science and capable of applying the knowledge to real life and into new settings. We focus on expert knowledge and skills needed to prepare exemplary integrated science teachers. Well prepared integrated science teachers require specialized integrated science teacher preparation programme focused on individual teacher, methodology, environment and general science curriculum. The study suggest among others, the need for the integrated science educator to tune to national issues and debates, prepare to take actions for change, and accept leadership, responsibility in establishing exemplary programmes and utilizing innovative methods.

INTRODUCTION

The success of any education system depends largely on the quality of teachers. Mbachu (2011) puts it that the teacher is seen as an agent of innovation and the Fulcrum on which the success or failure of any education rotates. If we believe in the quality of education system that would result in rapid and directed social, economic scientific and technological development; we should be concerned with who teaches in our schools, because no education system can rise above the quality of its teachers (Akinwumi 2007).

Unfortunately it is no longer secret that Nigeria is currently facing a shortage of quality teachers especially in the area sciences. This shortage is particularly severe among educationally

disadvantage states of northern Nigeria and equally noticeable within many rural and urban communities where the number of pupils enrolment is on a geometrical ratio. The political, economic and logistical pressures this shortage places on school systems, government and parents alike is enormous. This is coming at a time when Nigeria Certificate in Education (NCE) is the officially recognized minimum teaching requirement in Nigeria (FGN, 2004).

The challenge of a common trainer is to transfer, certain skills and knowledge content to the trainee, but when the task of the trainer is to train another trainer, then, the challenge of the first trainer becomes doubled, first, playing the role of a common trainer and secondly training the will-be trainer by sharing the techniques of training of trainees. These

are the challenges of all teacher educators and by extension teacher training institutions all over the world.

What is the role of the Integrated Science teacher educator? To put it straight, the integrated science teacher educator should be a catalyst and facilitator for change in concept and culture of integrated science student-teachers towards teaching and learning. The changes must empower individual student-teacher to transcend typical over used ways of thinking and traditions in Science education. He should facilitate transformation of mental models of the roles and goals of integrated science teachers within the learning environment; and to translate new innovative understandings about inquiry and science process skills into actual habits of practice. Those over use methods such as lecture method, talk-and-chalk method, demonstration method, rote learning etc largely failed to truly engage most students in the learning process. Their consequences on students' outcomes are disastrous. The students are left with shallow understanding, weak connections between big ideas and inability to apply knowledge in new settings. As a result, students do not develop the ability to become self-regulating learners or inquirers. (Johnson, 2004)

Integrated science teacher educator therefore, must facilitate a departure by their students (pre-service and in-service teachers) from traditional models of teaching and learning of science especially models and methods that are no longer valid in a society confronted with exponential advancement in information and technology into a learning community we dream to establish as teachers (Isiago-Abanihe, Ifeoma, Longjohn & Tandi, 2010). Equally important, is the need for Integrated Science teacher educator to help pre-professional and professional student teachers understand how a teacher's personal values

affect the type of community their students establish in the classroom. (Dhinsa & Salleh, 2009)

Yager (1991) opined that prospective and practicing science teachers must adopt radically new ways of viewing the teaching and learning of science education. Unfortunately, this typically requires the rejection and abandonment of models of pedagogy that are all too familiar and all too easy to mimic.

The science teacher educator must understand that the process of changing deeply and long term held mental models and methods and perhaps, their subsequent abandonment is extremely difficult and can result in a great deal of anxiety (Craven & Penick 2001). Thus, it is imperative that the Integrated Science teacher educator establish a learning environment conducive to the safe expression and exploration of ideas and thoughts.

This environment according to Dhinsa and Salleh, (2009) must be nested within a broader program one that also values inquiry and thinking, and one that presents a coherent and consistent experience for the learners and one that seek to be self-improving through process of retrospection, feedback and critical inquiry. Consequently, Integrated Science teacher educators must help their students understand the role of teacher as leader and professional change agent within the broader school community. In this paper we explore what the Integrated Science teacher educator can do to actualize the change at each of these levels: we begin with the qualities of a model integrated science teachers, then move on to strategies (methodology) of bringing about the required changes. We now outline the processes of establishing an engaging learning environment and finally cap it up with the need to have a basic science programme (curriculum) which is coherent, purposeful and aligned with the general goals of science for all.

QUALITIES OF A MODEL INTEGRATED SCIENCE TEACHER

Integrated Science teacher educator should have a comprehensive understanding of the type of science teacher he is finally expected to produce as the product of science teacher training faculty or department. The specific objectives of the National Science, technology and mathematics programmes include:

1. To cultivate inquiring, knowing and rational mind for the conduct of a good life (i.e. scientific literacy) (FGN, 2004).

In line with the above specific objective, there is the need for the science teacher-educators to inculcate into the student-teachers the qualities and characteristics of scientifically literate school graduates.

In the constructivist perspective, children are theory builders who construct knowledge through a dynamic and interactive process. Teacher is the facilitator of learning rather than a mere transmitter. Although the teacher loses some control in certain respects, she still has control and responsibility for a greater part of the child's educational experiences. In such classroom, he has numerous roles as identified by Challe and Britian (2003):

1. **An Observer:** A science teacher should be a constant observer in both formal and informal ways. Observation provides the teacher with clues to understanding of individual children and to helping them appropriately.
2. **A documentor:** A science teacher as a documenter, need to observe and takes down Information of what the children learn and what they are interested in. Teacher need to collect all the information as evidence, so as to implement curriculum and share with the parents.

3. **A question asker and problem poser:** When a teacher asks children with open ended/loose questions, it enables children to learn from each other by sharing ideas and points of views. Teacher act as a question asker and problem poser, children are encouraged to think about the solution and problem solving. It is advisable to ask questions starting with why it happened this way, what, how, when...
4. **A public relations manager:** A science teacher as an effective public relations manager must be able to explain to the parents, colleagues and administrators of how children can benefit in constructivist classroom with confidence, clarity and enthusiasm. Use formal and informal ways to handle the task of explaining goals and philosophy such as orientations with video tapes of children, documentation with digital pictures and newsletter with articles from books and journals. It is good to invite parents to be involve in the children's activities in school as well as home.
5. **A contributor to classroom culture:** A science teacher is a contributor to classroom culture because from the types of questions that she has asks and the type of physical environment set up, to the tone of the teacher's voice, the teacher creates the culture in the classroom.
6. **An environment organizer:** It is important for the children to learn in a well-planned self-explanatory, self-direction environment with interaction with their peers, materials and environment. It is an extension of a science teacher's role as it can eliminate unnecessary intervention. Besides, the environment has to be

planned carefully, observed, evaluated and altered as necessary.

7. **A presenter:** Teachers not only present to a group of children but also need to present options, for individual child. They needs to present ideas to children engaged in ongoing activities. It is important that teacher present activities or ideas in an opened-ended manner allows for multiple possibilities of responses from the children. Teacher must observe and listen to the children, response to their ideas and allow different ideas and possibilities.
8. **A theory builder:** Teacher should allow time and energy for own professional and personal development so as to full fill all other roles effectively and enthusiastically. The science teacher must have courage to experiment, be reflective, seek relationships between different variables in the classroom and consider different perspectives. Basic science teacher plays these important roles throughout the day in constructivist classroom. Hence it is important that a constructivist teacher recognize that he is actually a facilitator of children's knowledge construction. Evidence continues to emerge suggesting that a teacher's views of the world, teaching and learning, as well as his/her beliefs about knowledge and intelligence have direct impact on the way they teach (Kennedy, 1998).

Thus, a fundamental role of the Integrated Science teacher educators is to get pre-service and in-service Integrated Science student-teachers to think about their own explicit and tacit thoughts about schools, science education, teaching and learning. One way to accomplish this is to get students to articulate and discuss their understandings, beliefs and prior

science experiences (Prawat & Floden, 1994). Expressing and defending their views on science teaching and learning as they interact with peers, teachers, supervisors, cooperating teachers, and the other partners engaged in the professional development program.

EFFECTIVE SCIENCE INSTRUCTIONAL STRATEGIES

Literature abounds on theories of teaching and learning especially in science class. A Science subject has techniques and methods that are unique to its teaching and learning. The teaching and learning of science in an ideal classroom is expected to be done following the process of science and methods used by scientists. Effective use of the strategies by science teachers leads to the acquisition of science process skills by the students. The National Policy on Education recognized this and spells out clearly that one of the National education objectives is the acquisition of appropriate skills, mental, physical and social abilities and competencies which will equip the individual to live and contribute to the development of the society (FGN, 2004).

Some of the teaching strategies that have been recommended for science teachers to impart science process skill in their students include demonstration, direct observations, field work, laboratory activities, manipulations, modeling, reading and seminar (Ibe and Nwosu 2003). It is therefore, advocated that science should be taught through hands-on method approach were students are placed in problem solving situation and surrounding them with appropriate equipment that will enable them process information to solve scientific problems.

Despite the forgoing, studies have shown that science teachers consistently use the lecture

method of teaching as the major strategy in science classroom teaching (Ibe and Nwose 2003) instead of engaging in innovative activity-based methods where students will be involved in hands-on and minds-on activities like the discovery method, concept mapping approaches and cooperative learning. It is unfortunate to note that science teacher educators may also share in this practice of use of poor teaching methods. This could have far reaching implications on Nigeria's educational system. Most times teachers teach the way they were taught. Johnson (2004) posited that most teachers were not taught using activity based methods since they themselves did not have the opportunity to learn science using activity based method, nor have they conducted scientific inquires themselves.

Osuafor (1999) also ascertained empirically that most science teachers in Nigeria have little knowledge of how to effectively utilize innovative science teaching strategies which includes experimentation, project method, concept mapping and field trips/excursion. These findings raise questions about quality of science teacher education programme in Nigeria and how well science teachers are prepared to handle science teaching with current, innovative and effective strategies. For instance, the teachers who participated in Osuafor's study could not identify- what analogy and concept mapping were all about. The question is how many of the innovative science teaching strategies are listed in the curriculum of science teacher education in Nigeria? Are these strategies/pedagogies taught at faculty of education or at the science education departments?

In a study by Isiugo-Abanihe, Ifeoma, Longjohn and Tandi (2010) they reported that lecture/expository and lecture/demonstration methods are the only teaching methods listed in the curriculum of Bsc. Ed and B.Ed science education programme. Personal project was also listed in the curriculum of both

programmes because it is a requirement for graduation at tertiary level. Discovery/personal inquiry method, guided discovery, laboratory experimentation with lecturer's laboratory manual and questioning methods are listed in the curriculum of B.Ed but not the B.Sc Ed programme while field trip is listed in the curriculum of BSc. Ed but not in the BEd. On the whole only 53.8% of the science teaching strategies investigated in the study were in the science methodology course content of B.Ed and only 30.8% of them are listed in the Bsc. Ed programme. This implies that what a lecturer of methodology course will teach is at the discretion of that lecturer. This may be the reason why lecturers teach strategies that are easy for them, hence concentrating more on lecture method at the expense of innovative, strategies in spite of researches done in these areas showing the efficacy of these innovative methods in enhancing students' academic achievement in sciences.

Teachers prepared with such as curriculum are not likely to imbibe the culture of engaging students in practical activities. This is in line with the observation by UNESCO (1998). The role of the Integrated Science Teacher educator therefore is to identify innovative activity-based strategies of teaching science, regardless of whether they are listed in the curriculum. He should -practice such strategies in the course of training new Integrated Science Teachers so as to serve as model for the new teachers in training.

THE NATURE OF INTEGRATED SCIENCE LEARNING ENVIRONMENT

The most important factor affecting opportunities to learn is the nature of the learning environment (Alasia, 2003). Most of what people come to know and understand results from complex social dynamics. The totality of internal and external influences surrounding a school constitutes its

environment (Alabi, Oduwaiye & Fasasi, 2009). The appropriateness of such a learning environment is vital both to safety and to effective learning and development (DFES, 2006). Creating and maintaining stimulating, learning environment can be achieved through adequate provision of relevant resources, effective classroom organization, interactive and whole school displays and a climate of innovation. (Dhindsa, & Salleh 2009).

The structure and nature of the learning environment do indeed have powerful influences on the learning outcomes of students. For example, Johnson and Johnson (1991) found that when students work individually, they often believe that their achievement is unrelated to and/or isolated from the achievement of the other students in the class. The researchers report that such beliefs have adverse effects upon the students' socialization and on healthy social as well as cognitive development. In contrast, they report that in classroom where there is a high degree of student-to- student interaction (such as those that emphasize cooperative learning) several positive outcomes occur including increase (1) positive interdependence, (2) face - to - face promotive interaction (encouragement and support), (3) individual accountability, and (4) interpersonal and small group skills.

Yager (1991) proposed that in the best constructivist classrooms, student ideas and questions should be encouraged, accepted, and used for curriculum planning. He also urged that high value and emphasis should be placed on open ended questions, cooperative learning, reflection, and analysis of concepts. Constructivist classrooms are purposefully designed to promote the transformation and internalization of new information by the learner (John, 2011). Taylor, Dawson and Fraser (1995) provide us with a detailed description of the constructivist learning environment. That description includes one

where in:

1. Students are given the opportunity to communicate their understandings with other students, to generate possible explanations for phenomena, to test, evaluate and defend their explanations among their peers, and actively engage in the social construction of knowledge all of which are reflections of the nature of science.
2. Students are provided frequent opportunity to identify their own learning goals, to share control of the learning environment and to develop and employ assessment criteria within the learning environment.
3. The environment of the classroom is conducive to inquiry. That spirit of inquiry includes the freedom for students to question the operations of their class.
4. Students must have the opportunity to experience the tentativeness of scientific knowledge. That is, students must understand that scientific knowledge is theory-laden; socially and culturally constructed. The science teacher educator, therefore, must help pre-service and in-service teachers learn how to create learning environment that are intellectually fertile, conducive to inquiry, and centered around student to - student interaction for as Marton (1988) remind us, what is learned and where it is learned are two inseparable aspects of learning. The findings of the studies discussed above provide clear guidelines for the Integrated Science Teacher educator's role in establishing an inquiry based learning environment within the teacher education programme. That is, he must create and model:
 - a. A classroom environment that predisposes

students to accommodate an antiquity and flexibility.

- b. A learning environment that values collaboration over competition and cooperation over opposition.
- c. Authority structures within the classroom consistent with student - centered approaches towards learning. In these classrooms, the class negotiates criteria for assessment, classroom ethics, and paths of inquiry collectively. Teacher determine the criteria and grades are de-emphasized peer observation and evaluation as well as self-assessments are useful approaches towards changing the typical authority structure of the classroom.
- d. A classroom environment reflecting the importance placed on students roles responsibilities, and learning. Students work therefore, is displayed and highly visible throughout the classroom.
- e. A classroom environment extending beyond the classroom walls. There is evidence within students that content and concepts of the curriculum have direct links to and context within, the outside world.

THE NEED FOR DYNAMISM OF SCIENCE TEACHER EDUCATION PROGRAM (CURRICULUM) IN NIGERIA

Controversy regarding the constitution of an ideal teacher preparation programme still remains. Without doubt, theoretical, philosophical differences and different cultural values have created a wide variety of both orientations and curricula within science education programmes (Ryan, 2001). Outside social and political force vying to influence programme design and content only add to the confusion. Ryan ultimately concluded that the foundation of a viable programme in science education is grounded on

consistent perspectives and clearly articulated goals.

It has been observed that the type of curriculum designed for Nigerian science education programme did to properly position the constructivism approach which provides that children should learn by discovering things for themselves (Adikwu, 2008). In his view, Adikwu (2008) opined that world's declaration of education for all was not simply to make school available to all but to promote the type of quality education that provides the tools, knowledge, skills and values required by human beings to be able to survive. Such quality of education has the ability of developing the full potentials of learners to live and work in dignity, participate fully in community efforts to improve the quality of their lives, make informed decisions and to continue to learn. This implies that curriculum content of the tertiary institutions need to have in them specific skills, values, knowledge and social values to be acquired by its graduates as well as the right attitudes of mind required to function in the society in order to live meaningfully and contribute to the development of the learners and the society they live in.

Babalola and Jaiyeoba (2008) made similar observation about curriculum of science education in Nigeria. That science education curriculum in Nigeria higher institutions of learning has remained unchanged. This view was also substantiated by the former executive secretary of National University Commission (NUC) as reported by Okebukola (2002), that no matter how good the curriculum mounted by the commission, there was compel evidence that universities in Nigeria were not implementing the initiated syllabuses as expected. In the view of Adikwu (2008), the teacher education programmes in Nigeria are outdated, hence calls for a review specifically the science curricula in order to make them relevant. He declared that there is urgent need for curriculum development, especially in the area of science to be in

line with the Millennium Development Goals, if Nigeria is not to be left behind in the globalization process.

CONCLUSION

Teacher training institutions have dual roles of teaching subject contents and preparing new teachers to teach effectively. Teacher educators are found often calling secondary and primary school systems to change while they are equally notorious to systematize. Yet to remain effective and responsive, mechanism for improvement must exist. It is paramount for Integrated Science Teacher educators to first understand the nature of the individual science teacher he is expected to produce at the end, in terms of concepts, values and culture. He equally needs to consistently keep to trends of changing Science teaching and learning methodologies. What is learned and where it was learnt are two inseparable components of every education system. The constructivist learning environment is advocated for the effective teaching and learning of integrated science. Therefore, there is the need for the integrated science teacher educator to participate in critical assessment and evaluation of the integrated science education component and, importantly of the institution of teacher preparation programme as a whole.

SUGGESTIONS FOR FURTHER STUDIES

Integrated Science teacher educator must tune to the national issues and debates, prepare to take actions for change, and accept leadership, responsibilities in establishing exemplary programmes and utilizing innovative methods using the lessons learned. Thus, for pragmatic changes, the role of the Integrated science educator is to consider and act upon (not in any particular order) the following suggestions as identified by Craven and Penick (2001):

1. **Collaboration:** Facilitate a dialogue across the campus (all faculty and staff playing a role in

the education of the teacher should understand their roles.

2. **Goals:** Coordinate an articulation of the goals and philosophy among key partners of the educational programmes. The roles of all the partners within the programme including teachers and students should foster the achievement of the goal(s).
3. **Coherence:** Connections between all course field, practical, and student teaching components are to be articulated for example, the Integrated Science teacher educators ensures that field work supervisor, teaching practice supervisors alike and supporting staff, e.g. laboratory technicians understand what approaches to teaching, learning and classroom environments should be expected and observed.
4. **Pedagogy and assessment:** Ensure that the methods of assessment and instruction are consistent with the goals across the programmes. The Integrated science teacher educator should provide leadership and vision towards establishing inquiry based learning community.
5. **Research experience:** Ensure that graduates of the programme experience authentic research in science as well as teaching and learning.
6. **Feedback:** Mechanisms are established that provide feedback on the outcomes of the programme (e.g. the abilities, knowledge, and habits of practice of the graduates). The feedback is used to inform practice, modify the programme and improve education.
7. **Inclusion:** The broader community including business, informal science, centers, and local government agencies participate in appropriate ways to the preparation of

integrated science teachers.

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