

THE ROLE OF SCIENCE TEACHERS ASSOCIATIONS IN CAPACITY BUILDING OF STEM EDUCATORS

By

Pollyn, Ibifiri Blessing
Integrated Science Education Department
School of Science Education
Federal College of Education (Technical),
P.M.B. 11, Omoku, Rivers State, Nigeria
Phone No: +234 8131229705
email: ibifiripollyn@yahoo.com

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ABSTRACT

The paper discusses the role of Science Teachers Associations (STAs) in capacity building of science educators. By definition, capacity building for STEM educators is the building up of their innate capabilities to perform efficiently and effectively in the building up the innate capabilities of their products who are expected to become professionals in their different fields of studies and occupations in turn. This is mainly for the promotion of sustainable development in a nation. The undertone of every educational development in a nation is sustainable development and the undertone of every sustainable development in a nation is STEM education. The paper defines capacity, building and also describes STEM educators as OCEAN BRAINS who can fast track sustainable development and advancement in their own nation through effective teaching and learning of Science, Technology, Engineering and Mathematics (STEM) in schools. Implications for effective teaching and learning of STEM are implicit and explicit in the goals of science teachers associations which exist locally, nationally and internationally in the globe. It is in this direction that STEM educators are expected to be innovative and creative enough while implementing any curriculum or delivering their routine lessons. This paper proposes an initiative which can be used to drive effective teaching and learning of STEM and thus bringing about sustainable development into any nation. The initiative is described as PICO Games[®] STEME-P-SHEEP3S networking and OCEAN BRAINS Projects. This initiative optimistically would be capable of increasing the membership of Science Teachers Association of Nigeria (STAN) and their full participation in the production of Positive, Innovative, Dynamic and Appropriate Instructional Materials (PIDAIMs) for effective and creative teaching and learning STEM in Nigeria.

Introduction

Capacity according to Microsoft Encarta Dictionary (DVD, 2009), is a measure of the amount that can be held or contained by something, in this case, the brains of human being have capacity which can be built up through education. Also, capacity means the maximum amount that can be held or taken in, or, it is, the legal ability or qualification to do something. For teachers, capacity means the legal ability or qualification obtained to do something well, i.e. teaching effectively based on training and enthusiasm in the profession. It is in this direction that there is need for capacity building of STEM educators nationwide and the globe in general.

Building, on the other hand, means making large structures, i.e. the business or task of constructing houses, factories, bridges, and other large structures; this has to do with the capacities of both teachers and learners, being built up through education. Actually, buildings are handled by construction engineers, but for teachers, capacity building means, training giving to teachers and their learners to activate and increase their innate capabilities to function well in their societies. Capacity building for STEM educators therefore is necessary and can be conceived as the building up of their innate abilities to perform efficiently and effectively,

whereby they would in turn be able to build up the innate capabilities of their products for them to increase and become professionals in their different fields of studies and occupations.

STEM educators are indeed OCEAN BRAINS and professionals imbued by training, with the knowledge of constructing the minds of people to make them total human beings and humane personalities in their societies; unlike the professional engineers who are imbued with the knowledge of constructing fiscal structures. By this function, STEM educators construct the learning experiences of their learners, and prepare them for future responsibilities. In this direction, capacity building efforts of STEM educators can be likened to the making of solid foundations through placing of one adequate block after the other and sealing them up with mortar in a well planned excavated land and scaffolding to form a formidable foundation and building. Such efforts can also be likened to the application of oil to an engine, which will help to grease it to function effectively and efficiently at all times. Capacity building efforts of STEM educators is both ways, individual science educators empower both themselves and their learners through education on one hand, while the government of any nation on the other hand, can make provisions to empower educators in order to bringing about sustainable national development into the nation, through the education system and science teachers associations.

Science is a key to capacity building of STEM educators. Akpan (2010) opines that “science is a key and the springboard that contributes to the quality of life in so many areas: health, nutrition, agriculture, transportation, material and energy production, and industrial development. Studying science through the education system and science teachers associations can never be out dated. It helps to expanding the capacities of science teachers and draws their attentions to current issues of life. This is for the fact that, “Science ensures that the air we breathe, and the water we drink, are life sustaining and not vectors of disease and decay.” That means science, and by extension science education, is the key to capacity building of both teachers and learners alike. In this direction, science educators can be considered as the constructors and manufacturers of the keys (learning experiences) that can be used to open several doors for sustainable development to take place in any nation. As one hand or leg alone cannot accomplish much without the help of the other, Science and technology education make up a bunch of keys that can be placed in the hands of science teachers and learners to become competent operators to drive sustainable national development in their nations. With this bunch of right keys correctly manufactured and handed over to the learners by science educators through effective teaching and learning, learners and graduates would be able to unlock the locked doors of socio-economic development and kick start sustainable development in their nation, and eventually bring such a nation to a world power.

By way of emphasis, the brains or minds of the science teachers and learners (which contain capacities) need to be built up and opened up with the right keys placed in their hands (i.e. science and technology education given them as a bunch of keys). Such brains can also be likened to spring wells containing enough water (such as knowledge, skills, attitudes and value systems). During the teaching and learning process, when the appropriate materials are employed by the teacher to teach them, these learners containing spring wells or rooms full of wealth would be able to unlock and release such wealth of experience in them into action. It is in this direction that STAs have very important roles to play in promoting the capacity building of both

science educators and their products. Examples of such roles being performed by STAs in Nigeria and Swizerland are recorded in Akapn (2010) as follow:

In Swaziland, Slimming (1976) reports that the impetus for that country's Integrated Science project came when in 1971, the *Swaziland Science Teachers Association (SSTA)* brought to the attention of the Ministry of Education's Science Teaching Panel their dissatisfaction with the existing Junior certificate syllabuses in Introductory Science and Biology. There was concern that the new course should encourage the study of science with an emphasis on individual experimentation and on understanding and constructive thinking; and it was strongly stressed that full account should be taken of the cultural and physical environment of the country. A set of proposals was put forward and the ministry of Education invited all science teachers to a meeting to consider these. After a lively debate the proposals were unanimously accepted and the Swaziland Integrated Science project (SWISP) thus came into being in March 1972. Similarly in Nigeria, the Nigerian Integrated Science Project (NISP) (now renamed Nigerian Basic Science Project, NBSP) earlier reported on is the brainchild of STAN.

Effective Science and technology education does not exist in isolation from English and Mathematics; hence the right bunch of keys to be obtained first by teachers, and to be handed over to the learners in this millennium, has recently been galvanized and described as STEM education. STEM means Science, Technology, Engineering and Mathematics, and education is live wire being used to transmit concise knowledge of these courses or subjects to learners. To me, the "E" in this acronym should represent English to cover all areas of knowledge in STEM. This should be based on the fact that no science or technology subject or course is done without English Language in most parts of the globe.

Educating learners in STEM is to enable them operate competently in their societies to bring about sustainable national development and this is imperative in the fast changing millennium of ours. Any shift away from 'teaching the textbook information', 'teaching to the examination' and towards 'assessment for learning' (formative assessment) will be heavily enhanced by the setting up of multiple professional fora for enhancing the development of teacher's PCK (pedagogical content knowledge). This is the view of (Akpan 2010) and indeed the main goal for which all STAs exist in local, national and international fora.

Note that, when the constructors (STEM educators) of the bunch of keys (STEM education) which can be used to unlock closed doors of wealth, health and sustainable national development in any nation do not have the expected capacity to produce the right keys, no matter the well stated goals in a National Policy of Education (NPE, 2013) or in STAs, achievements of such goals would be very far. It is in this direction that this paper has formulated the following significant questions for consideration as follow:

- 1 (a). What would happen to the doors that are locked up if the holder(s) of the keys to open such locked doors are not having the capacity to do so?
- 1 (b): Can we as scientists use the eclipses of the moon and sun to demonstrate and give plausible answer the above questions?

- 2 (a). What if the key or bunch of keys produced and given to the holders are counterfeit in the hands of the holders, what would they do with such key or bunch of keys?
- 2 (b): Can we use the level of examination malpractice going in our education system to discuss and give plausible answers to question 2a?
- 3 (a). When a nation is controlled by those holding a bunch of fake keys to operate the affairs of the people in the nation, what do you think would happen to that nation in future?
- 3 (b): Can we use the level of corruption in any nation to discuss and give plausible answer to question 3a?

Giving plausible answers to the above questions calls for active participation in the science teachers associations and thus STEM education nationwide and in the nations of the globe. STAN for instance, has been a frontier of STEM education in Nigeria and her focus from inception is based on capacity building of STEM educators who would in turn impact their learners. Since her inception, STAN has been organizing conferences, workshops and seminars to build up capacities of STEM educators in the nation and by so doing, driving quality STEM education into many of her members nationwide. At present, the membership of this association stands at a little above Ten Thousand participants considering an account given in “an over view” of STAN (2010); who she is and what she does. But this number is quite minimal considering the population of the nation which is well over one Hundred and Fifty (150m) million people. The questions therefore are:

1. What are the functions of STAN in Nigeria and abroad?
2. How can STAN increase her number to cover all STEM educators nationwide?

The role of Science Teachers Associations (STAs) in the globe

The role of science teachers associations based on the foregoing, is well defined in Akpan (2010). Science teachers associations are the platforms whereby teachers are given additional but adequate training in the areas of current issues bothering on teaching and learning, i.e. STEM education. Here, teachers participate to become well trained and empowered to produce formidable workforce for any nation through the education systems and organizations as they are in nations of the globe. There would be no developed nation without the presence of science educators and their associations such as science teachers associations. These associations and their membership form the engine room of any nation’s economy and sustainable development. Several science teachers associations exist across the globe for the purpose of capacity building of STEM educators in order to bring about sustainable development into human beings and their nations. Among such science teachers associations (STAs) are the following, to mention but few:

1. The National Science Teachers Association (NSTA) in USA.
2. The Association of Science Education (ASE) in United Kingdom.

3. Ghana Association of Science Teachers (GAST).
4. Science Teachers Association of Nigeria (STAN).
5. Lesotho Science and Mathematics Teachers Association (LSMTA).
6. Swaziland Science Teachers Association (SSTA), etc.

According to Akpan (2010), in his “Innovations in Science and Technology Education through Science Teacher Associations,” there are three types of science teacher associations: local, national, and international. A good example of national STAs in the globe as mentioned above is the Science Teachers Association of Nigeria (STAN). Akpan (2010) states that, STAN as a professional association has the following aims which lead to the important roles she play in the nation:

- To promote co-operation among science teachers in Nigeria with a view to raising the standard of science education in the country.
- To provide a forum for discussion by science teachers on matters of common interest.
- To help science teachers keep in touch with developments in science and its applications to industry and commerce.
- To popularize science.
- To co-operate with and affiliate to other societies and bodies with related interest.

According to Akpan (2010), the major functions of the Association (Silber as cited in King 1991:47) include the following:

- Communications - Journals, conferences, publications.
- Representation - To teachers and government, liaison with other groups and participation in international activities.
- Services - continuing education, employment, low cost equipment and out-of-school activities.
- Leadership - Curriculum development, teacher benefit, guidance on new development in science education.

Continuing, Akpan (2010) pointed out that, in Africa, STAN has tremendous influence on STM education not only in its country but also in foreign nations. He said: “In August 2002, the STAN conference provided a spring board for the launching of the African Branch of the Commonwealth Association of Science, Technology and Mathematics Educators CASTME.” On the international scene, STAs have come together under one umbrella which is the International Council of Associations of Science Educators (ICASE), while at local levels there are branches of STAs in the different states of the globe.

From the foregoing, promotion of capacity building of science educators is the common goal of all science teachers associations (STAs), whether locally, nationally or internationally. This common role is played by all STAs based on the importance placed on teaching and learning of STEM in schools. As important as mathematics, so is English. Rather than engineering which is already a part of technology education, the letter E in the acronym STEM should be English Language in order to make the STEM education an inclusive knowledge drive concept. By her well defined activities which also includes educating the girl child, STAN can foster the inclusion of English language into STEM education.

Based on her activities, membership of STAN can conveniently be described as OCEAN BRAINS. This acronym meaning Our Consortium of Educators and Active Nobles;

Brilliant/Brave, Responsible/Reliable, Amiable, Intelligent and Noble Scholars can be used to summarize both the activities and nature of STAs in the globe.

How can STAN and by extension STAs increase her number to include all STEM educators nationwide?

In addition to her numerous activities based on her goals, STAN in order to increase her membership to include all science educators nationwide should put up a network of OCEAN BRAINS which will take the form of an initiative I refer to as PICO Games[®] STEME-SHEEP3S Networking and OCEAN BRAINS Projects. Through this initiative, every science educator and learner would become invaluable in the nation through the activities they would perform. Through such networking and projects, it would be reasonable to expect that teachers possess the very knowledge, skills, and dispositions that society expects their students to learn (AAPT, 2009).

Implication of PICO Games[®] STEME-SHEEP3S networking and OCEAN BRAINS Projects

The need of a generation of teachers who aim to develop learners instead of teaching them, who help their pupils to become independent (learning to learn), who provide students with motivation and interest for life-long learning and urge them to become autonomous learners, is essential in the education of the future (Sens Publication 2009/10). Also, effective curriculum implementation strategies which are innovations in (teaching and learning) transmitting STEM education to the learners in any nation are imperative. PICO Games[®] STEME-SHEEP3S Networking and OCEAN BRAINS Projects are innovations that can be used to bring meaning into STEM Education in schools across any nation. Through this initiative, STEM educators and learners can interact to increase their capacities and function as professionals and OCEAN BRAINS alike. For instance:

Production and use of PICO Games[®] in capacity building of both teachers and learners

PICO Games[®] are materials or learning packages containing bits of information that systematically explain concepts and sub-concepts in a particular topic or lesson or subject to the learners in particular. They are also described as digests or PIDAIMECTAL (Positive, Innovative, Dynamic and Appropriate Materials for Effective and Creative Teaching and Learning). They can be prepared based on the curricula or minimum standards recommended for effective teaching and learning process in the schools. These games can be used to initiate classroom, laboratory, individualized, minds-on-hands-on, cooperative as well as lifelong learning activities between teacher and pupils/students, peer groups, parents and children or wards at one time or the other. They can also be used to initiate effective and creative teaching and learning process which can be guided with the philosophies of 3RTLL (Right Teaching, Right Learning and Right Living) in the society; and RIDE ON (exhibiting Responsibility, Integrity, Discipline and Empathy for One's Nation or Neighbours). The acronym PICO means Power in Intelligent and Competent Operations. If this power is inculcated into learners through active learning, then we can be sure that competent operations by learners and graduates in the society will

become the order of activities would these yield good fruits of goods and services to bring about sustainable development into any nation.

STEME-P-SHEEP3S Networking is a mechanism or linkage through which PICO Games[®] can be effectively prepare, produced and utilized by teachers, pupils/students, peer groups, parents and children both at school and home in order to increase their capacities to function well in their nations. The acronym STEME-P-SHEEP3S means Science, Technology, Engineering/English and Mathematics Education-Promoter of Safety, Health, Environment, Empowerment and Peace; Security, Standards and Scholarships. Science, Technology, Engineering/English and Mathematics (STEM) education provide the media through which, knowledge, skills and attitudes are taught and imparted to all learners from the schools. The acronym SHEEP3S which is the fruit of STEM education collectively means knowledge of Safety, Health, Environment, Empowerment and Peace; Security, Standards and Scholarships. These are specific areas that learners are expected to acquire knowledge and function well during and after their learning process and graduation. Through networking between STEM educators and their learners in STEM education, knowledge, skills and attitudes can be inculcated into the learners which will enable them to become functional in their nation. Meanwhile, in their schools these learners can acquire such knowledge, skills and attitudes from different clubs where they can be guided to work in specific knowledge areas and become future employees or employers of labour in their nations.

OCEAN BRAINS Projects

These are also various ventures through which learners' capacities can be developed to empower them with STEM education to bring about rapid and sustainable development into their nations. OCEAN BRAINS means Our Consortium of Educated and Active Nobles; Brilliant/Bright, Reliable/Responsible, Amiable/Adorable Nobles and Scholars in a nation. In their schools, learners working in different clubs (forming a scientific community) where they are carrying out different Projects while being guided by their teachers and the philosophies of 3RTLL (meaning Right Teaching, Right Learning and Right Living in the school or the society) and eRIDE ON (meaning exhibiting Responsibility, Integrity, Discipline and Empathy) in One's own Nation or toward One's own Neighbours, can also be referred to as OCEAN BRAINS. In this direction, OCEAN BRAINS can be teachers and their learners (pupils/students) performing their academic duties rightly together in the education system or in the society. Hence, OCEAN BRAINS can be groups of professionals guided by the philosophies and rules in performing their duties rightly in their societies. Through these means, meaningful projects can be proposed and carried out by both teachers and learners to facilitate sustainable national development in their own nations.

Conclusion and recommendations

The role of Science Teachers Associations (STAs) in capacity building of STEM Educators in any nation can never be over emphasized; this role should be encouraged by the government of any nation in which STAs are operating. To register their commitment, Science Teachers Associations are involved in organizing conferences, workshops and seminars from the local to the international levels; thereby build up the capacities of STEM educators. Very importantly,

STAs help STEM educators to become abreast with current global issues that bother on effective and creative STEM teaching and learning strategies. The aim is play down on the conventional method of teaching and learning which produces graduates who are deficient of practical skills, scientific attitudes and proactive ways of solving personal and societal problems. If all STEM educators in a nation are encouraged to participate fully in different fora organized by STAs, the dwindling educational foundations and economy in any nation would be revamped and sustainable national development would be the reverse. It is in this direction that it becomes imperative for every STEM educator to belong to STAs at the three levels where they exist, i.e. locally, nationally and internationally. An initiative such as PICO Games[®] STEME-P-SHEEP3S networking and OCEAN BRAINS Projects should be welcomed and encouraged by STAs and STEM educators for the purpose of promoting sustainable individual and national development in a nation. Suffice it to say that, this is a panacea for ill education, examination malpractice, corruption, insurgencies, vices, restiveness, poverty, diseases and under development challenges which are common in the globe. The platforms where these issues, problems challenges can be adequately tackled are the classrooms and STAs fora which can be described as functional scientific communities across the globe.

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