THE NEED FOR SCIENCE AND TECHNOLOGY ENTREPRENEURSHIP CURRICULUM AT THE SECONDARY SCHOOL LEVEL IN NIGERIA

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Abstract

This paper justifies the need for science and technology based entrepreneurship curriculum provisions that will lead to acquisition of entrepreneurial skills and competencies required for self-employment. The relationship between science and technology entrepreneurial education and economic development were stressed. Science and technology entrepreneurship education at secondary school level was reviewed and a model science and technology entrepreneurship curriculum in which entrepreneurial contents are integrated into the curriculum and teaching that can help provide entrepreneurial education at the secondary school was discussed. Constraints to effective implementation of S&T entrepreneurship curriculum were highlighted and implementable suggestions that will help in effective implementation were given. The suggestions were based on teaching, curriculum, material and teacher considerations.

Introduction

The high rate of school leavers and graduates unemployment in Nigeria calls for educational relevance and functionality. One of the goals of education in Nigeria is for individuals to acquire physical and intellectual skills and competencies that will make the individual self-reliant and apply such skills and competencies to contribute to the overall development of the society (Federal Government of Nigeria, FGN, 2004). The emergence of the 6-3-3-4 educational structure in 1981 was to make the nation's educational system more practical oriented towards self-reliance. Decades after this introduction, the country is yet to transform into technologically advanced country. The nation economy is still comatose, and school leavers and university graduates are without skills for self-reliance (Nwangwu, 2007). The educational system has also been described as devoid of entrepreneurial education (Ndibe, 2011;Olorundare & Kayode, 2012; Okoli,2004). The new junior secondary science and technology curricula are relatively of low entrepreneurial content (Mustapha, 2011) and the level of acquisition of entrepreneurial skill by science and technology students is very poor (Okoli, 2004). Consequently, what the educational system produces are school leavers and university graduates that have little or no basic skills for vocational and entrepreneurial relevance (Olorundare & Kayode, 2012).There is the need therefore, for a re-orientation of our educational system through entrepreneurial curriculum that can produce students with skills in job creation.

In the context of Nigeria's educational reforms, Government directed that entrepreneurial education or programmes be incorporated into the nation education curricula from basic education to the tertiary levels. The policy directive was meant to use education to promote education for self reliance. Science and technology education have important roles to play in the context of the nation's socio-economic development though science and technology (S&T) education that is entrepreneurially oriented (Obong, 2002). Researchers have revealed that there is a relationship between science and technology and entrepreneurship (Wadhwa, 2008) in Olagunju and Akanbi (2009). Science as a field of inquiry helps to develop an enquiry mind, technology helps in creativity and innovation (Mustapha, 2011) and accordingly enquiry, creative and innovative minds are needed

in entrepreneurship (Olagunju and Akanbi, 2009). Indeed, the attitude of inquiry, creativity and self-reliant all are related to entrepreneurship (Olumide & Ovigueraye,2011). Generally, entrepreneur education fosters self-reliant, economic growth and economic emancipation while science and technology drive the economy of a nation. Thus, entrepreneur S&T education is critical to national economic development. This paper is centered on this premise and canvass for a secondary school (SS) science and technology entrepreneurial based- education that will equip students with the desired skills, competences and the disposition for world of work.

Entrepreneurship education (EE) at secondary school level will essentially serve as foundation for acquisition of basic skills that can be vocationally and entrepreneurially relevant either at the end of secondary education or for entry in to tertiary education. The essence is to provide students at SS level with knowledge, skills, motivation and attitudes to be engaged in entrepreneurial studies for self-employment after schooling. Although, science and technology are entrepreneurial in nature and students are expected to develop skills and competences necessary for self- survival, this has not been achieved as an outcome of our science and technology education (Aderogba, 2011). The introduction of entrepreneurship within science and technology curriculum therefore becomes imperative.

Concept of Science, Technology and Entrepreneurship Education

Science is an investigatory activity or what is often described as a process of inquiry into the nature of the universe. This investigatory nature of science leads to uncovering of the secret of nature that is organized into systematic body of knowledge. Thus, science is described as a systematically organized body of knowledge of the universe. This body of knowledge is called the product of science. From the perspectives of science a process and as a product, science could better be defined as a body of knowledge, a method of investigation and of reasoning in the pursuit of the understanding of nature (Mustapha, 2004, & 2009).

Kneller G.F. (1971) group science into three classes,

i) Pure or basic science. These groups are the natural sciences such as biology, chemistry and physics. They are made up of organized body of knowledge and processes which includes the laws and theories that explain the fundamental working of the universe.
ii) Fundamental applied science. This includes such scientific fields as bio-chemistry, micro-biology, medicine, agriculture etc. They are concerned with scientific knowledge which may eventually be put into practical use.
iii) Applied science. This basically involves studying phenomena with the intention of producing knowledge immediately applicable to solution of technical problems. This is the field of technology and engineering disciplines.

The basic sciences have greatly increased the knowledge of the world in which we live, while the applied sciences have contributed to the application of science in solving societal problems and in the upliftment of human's general well-being. This has greater implication to technological and socio-economic development.

The applied science relates to technology, which is the use of knowledge primarily derived from systematic knowledge of the forces of nature to satisfy human needs (National Policy on Science and Technology, NPST, 1987 p7). Technology forms the cornerstone of progress and upon which all nations depend to attain self – reliance and self-sustaining development. In other words, science and technology are intricately related and both form the basis of development and have continued to influence (hu) man's thinking and working process. Any nation of the world that guest for

technological and invariable socio-economic development must provide functional scientific knowledge and skills that can equip learners for self development and national development.

S & T education on the other hand involves:

(i) Learning S&T subjects which involve the study of knowledge, processes and skills of science of biology, chemistry, physics and mathematics and the applied science subject involving technology and engineering base subject
(ii) Learning about. S&T. This involves understanding of the nature and methods/processes of S&T and the knowledge of their potential application to human needs including economic needs; and
(iii) Doing science. This involves learning S & T to get expertise inquiry and problem solving.

These various dimensions of S&T education are essential for entrepreneurship education and thus for promotion of economic development. Science and technology entrepreneur education is about developing entrepreneurship skills and competencies through the teaching of S & T. subjects. It is about using the contents of S & T subjects to develop in students the orientation and sense of entrepreneurship.

Entrepreneurship Science and Technology Education at Secondary School Level in Nigeria

Secondary education is the education received after primary education by students between the age 12-18 before tertiary level (FGN,2004).The broad aim of education at this level is to prepare individuals for useful living and for higher education(FGN ,2004). Specifically, one of the goals of Nigeria education is to equip students with both physical and intellectual skills to be self-reliant (FGN, 2004).The education is expected to provide students with the necessary survival skills and competences that will enable them be useful to themselves and to contribute to the development of the society even if secondary education is the terminal education they receive. All these are related to entrepreneurial education which is to provide students with knowledge, skills and motivation for entrepreneurial success in a variety of setting (Wikipedia, 2007).

In the context of the national educational goals, the National Economic Empowerment and Development Strategies (NEEDS) and the pursuit of the Millennium Development Goals (MDGs), several reforms have been initiated in many aspects of the curriculum of Nigerian education. In response to the Federal Government directive that entrepreneurship be introduced at all level of education in Nigeria, Nigerian Educational Development and Research Council (NERDC, 2008) introduced 35 vocational trade subjects as elective at secondary school level for students to select one as a field of entrepreneurial study. This is a model geared towards learning a trade to meet entrepreneurial needs. Nevertheless, there is the need to explore the entrepreneurial aspects of secondary school curriculum in order to enhance the acquisition of relevant entrepreneurial skills and competences. Although, the provision for learning of a trade is a laudable one, it falls short of desired re orientation of the educational system that is needed to develop creative and innovative individuals for job creation and become entrepreneurs based on their specialization. Integrating entrepreneurship in to subject curriculum will give a better insight and orientation towards entrepreneurship. This is with a view to make the graduate of the educational system to be more inclined and have the mindset towards entrepreneurship than just learning a vocational trade. The best way to achieving entrepreneurship is to refine the entrepreneur education in the context to create and enhance the spirit of entrepreneurship in students through educational programmes that integrate entrepreneurship (Adejimola & Olufunmilayo, 2009; Garba, 2010).

Entrepreneurship is defined as the willingness and ability of an individual to seek out investment opportunities in an environment and be able to establish and run an enterprise successfully based on the identified opportunities (Nwagwu, 2007), Entrepreneurship education on the other hand is the type of education that prepares the individual to be equipped with relevant skills, knowledge, disposition and positive attitudes for self-employment (North, 2002; Olorundare, 2012). It teaches individuals to identify business opportunities and to act on them to generate wealth for self-reliant. It is concerned with training young people to become job creators rather them job seekers and therefore seeks to provide students with the relevant knowledge, skills and motivation to encourage entrepreneur success in a variety of setting (North, 2002).

EE is multidirectional and diversified. Thus, entrepreneurship can be incorporated in to any subject curriculum. It is now known that entrepreneurship can be practiced, developed and learnt and therefore all students should be expose to entrepreneurship education (Akpomi, 2009).

The main goals of entrepreneurial education therefore, are to provide entrepreneurial orientation and skills, stimulate the development of entrepreneur mind set of students and to encourage innovative strategies (Inegbenebor, 2009; Ndibe, 2011). Accordingly, EE aims at developing the required entrepreneurial skills and competences and the dispositions that predisposes individual to be a driving force in going in to business (Agu, 2006).These goals of EE cannot be achieved with our present science and technology curricula that are devoid of entrepreneurship. Thus, there is the need to integrate entrepreneurship into science and technology curricula for the purpose of achieving the goals of entrepreneurship education. Integrating entrepreneurship in to S&T education is to integrate skills and learning experiences that are suitable for entrepreneurial endeavor in to appropriate contents of S&T subjects.

There is significant relationship between entrepreneurship and S & T education and economic development of a nation (Mueller, 2004) and accordingly, global economic development is based on STM education (Ubong, 2002; Wasagu, 2007). Therefore, any nation aspiring to eradicate poverty, reduce unemployment and to promote economic development must take entrepreneurship education serious. Essentially, science and technology education should help provide learners with appropriate knowledge, skills, competencies and attributes that will enhance individual self actualization, self-enhancement, independence and possible self- employment (Akale, 2004). Entrepreneurship in S&T requires science and technology curricula that is not only entrepreneur inclined but also focus on promoting creativity, innovation, problem-solving, life coping skills along with those entrepreneur skills and competencies that are essential for attainment of self-reliant and self-employment (Mustapha, 2011). Therefore an entrepreneurship S&T curriculum that is centered on creativity and creative thought processes and nurtures the spirit of innovation in students will help the nation to produce creative and innovative individuals, scientists and technologists needed to enhance scientific and technological and the overall socio-economic development for self- reliance.

Model of Entrepreneurial Science and Technology Curriculum

Science and technology entrepreneurial education demands a unique curriculum in which entrepreneur content element are parts of its features and that links school science and technology subjects with productivity industry and economic processes. Such curriculum is about integrating entrepreneur skills and competencies into the curriculum and teaching of relevant S & T subjects or having alternative entrepreneur science - technology curriculum for all science and technology students. The curriculum should contain carefully planned learning experiences and activities that can lead to application of scientific and technological principles and skills to productivity, create awareness of entrepreneurship and self-employment. Equally, the content of such entrepreneur

S & T curriculum should include indigenous knowledge and technology in various traditional endeavor, agriculture, food processing and preservation, metallurgy, medicine etc.

The areas of S & T contents that have potential for economic values and through which students can integrate scientific knowledge, principles and skills into development of entrepreneurship at secondary school level biology, chemistry, physics, basic science and technology should be identified to specifically form the basis for the S&T entrepreneur curriculum.

The following are examples of entrepreneur inclined content areas of S&T subjects at secondary school level:
Apiculture: bee keeping
Aquaculture: fish farming, sea weed culture
Floriculture: growing flowers and other ornamental plants
Horticulture: practice of growing fruits and vegetables production
Animal husbandry: raising goats, sheep, pigs, rabbits, snails and even mice and rats for researchers, poultry and aviculture
Colour: Textile processes; dye and print etc
Water purification/ processing: water packaging e.g. sachet water, bottled water, distilled water etc
Nutrition: Food processing; catering, juice production, food condiments and flavours
Saponification: soap, detergents, cream production
Animal products: milk and cheese making
Plant products: seeds and leaves of economic and medicinal values, gum production
Light ; decoration devices
Electrical/Electronics: devices, maintenance and repairs of electronic materials or gadget and related electrical works, wiring, computer word processing and using ICT devices for production of educational instruction materials; charts, models, audio lessons etc.

In essence through S & T education with relevant entrepreneur inclined curriculum content students can be trained in the principles of entrepreneur education to have entrepreneur mind set and skills for self- employment.

Constraints to Effective Implementation of S&T Entrepreneurship Curriculum

Literature has revealed several constraints to effective implementation of S&T education curriculum which would also affect the effective implementation of S& T entrepreneurial curriculum. These constraints include;

(i) The implementation of S&T curricula are examination driven. The general desire in Nigeria is to pass examination. This has a stronghold on what goes on in the classroom and the outcomes of learning. In spite, the general emphasis that teaching S&T subjects should be practical oriented and be made relevant to Nigeria socio-economic and cultural needs, the S&T students and teachers at all levels of education focus more on performances in examination rather than acquiring knowledge, skills and principle required to solving social and economic problem.

(ii) The S&T curricular to a greater extent are devoid of contents of commercial values of the S&T subjects. Consequently, S&T teachers see no relevance nor find it necessary to incorporate in their lessons the scientific principles and processes and the commercial values in the content of S&T subjects being taught in schools.

(iii) The number of hours provided S&T on the school timetable provides only limited time for practical work and for interested and resourceful S&T teachers to promote productivity,

school-industry link or to relate school to traditional technology and economic ventures in the community.

(iv) Lack of a good number of S&T teachers in schools who know what to teach and the methodology for teaching entrepreneurship or of linking school S&T to industrial processes and techniques. Also most teachers do not have interest, initiatives and resourcefulness to promote science for economic benefits, and to relate science to world of work. Again, many of the teachers lack the skills to link school science and entrepreneurship, school science and economic development and business ventures. Such teachers will find it difficult to effectively implement entrepreneurship S&T curriculum.

(v) Poor funding of S&T education makes it difficult for schools, colleges and universities to commit their scarce resources to promoting school science-industry link and provisions for entrepreneurship training facilities

Implementing Science and Technology Entrepreneurial Based Curriculum

For successful implementation of S&T entrepreneurial based curriculum, the method of teaching of S&T in schools, the training of S&T teachers and provision of material resources are important. Teaching methods which emphasize practical work, field studies, projects and problem solving that can lead students develop skills should be used. Teaching should be inclined to and emphasis productivity through the application of S&T knowledge and principles. Equally, the relevance of and the commercial or economic value of S&T topics should be pointed out during teaching.

Teachers who are capable of integrating entrepreneurship and have entrepreneurial mind set are required to bring entrepreneurship are to be trained. The pre-service teacher education programme should provide training opportunities for acquiring practical knowledge and experience in industries necessary to acquire entrepreneurial mind set. Thus, the industrial training experience should become a component of S&T teacher education, as it is the teaching practice. In this context, teacher education institutions should collaborate with industries, (rural or urban) that are relevant to the needs of the teachers that will implement entrepreneurial based curriculum.

The point being made is that we need to refocus our S&T curriculum, reform science teaching and the professional and academic training of S&T teachers towards entrepreneurship. Nigeria can to use education to eradicate poverty and to reduce youth unemployment through appropriate S&T curriculum.

Conclusion

This paper attempts to justify that S&T education is pre-requisite for scientific and technological development of a nation. Science and technology in turn form the foundation for industrialization and economic growth. The submission is that we need to incline S&T education towards entrepreneurship to reduce unemployment and poverty to the minimum and to help improve the overall economic development of the nation. There is established correlation between science and technology and entrepreneurship and between entrepreneurship and economic growth and overall economic development of a nation. The critical concern is to make S&T curriculum entrepreneurially inclined at the secondary school level to produce school leavers who will have entrepreneurial skill and competences. For S&T education to be responsive to the nation's economic growth, and to serve as means to producing school leavers that can be self-reliant, the following are suggested:

(i) Greater emphasis should be given to scientific principles and applications to industrial processes and small scale ventures in S&T curricula and teaching.

(ii) Students should be allowed to experience field visit to small scale industries, technology incubation/ entrepreneurial centres, and research institutes to complement knowledge learnt

in class with practical applications. Similarly, industrial scientists and entrepreneurs be invited to schools to provide up-to-date knowledge on processes involved in making products, and to provide guidance and career talks to stimulate students interest in S&T entrepreneurship.

(iii) Students' industrial / apprenticeship training should be introduced at the secondary school level. This will help them acquire skills, enable integration of theory with practical and promoting sense of entrepreneurship in students.

(iv) Raising S&T teachers' competences and interest in relating S&T to industry, entrepreneurship and economic development through pre-service and in-service training programmes.

(v) Makin Provision for S&T teachers to spend part of their holiday period in industries relevant to their field of specialization to further widen their horizon in the application of science and technology for economic development.

(vi) Making S&T teaching less examination oriented but to be more practical and inquiry oriented.

(vii) Better funding of S&T education by government to improve provision of teaching and learning facilities and materials for practical work.

(viii) Nigerian Educational Research and Development Council should evolve a science and technology curriculum that is entrepreneurially inclined at the secondary school level.

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