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*Review*

# Human capital development in science, technology and mathematics education: implications for sustainable development in Africa

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**This paper harped on human capital development in science, technology and mathematics education with special reference to its implications for sustainable development in Africa. The usefulness and relevance of science, technology and mathematics education to sustainable development in African Nations are no longer in doubt. Therefore any nation that plays with these indices plays with her own development. America is a super power today because she has been able to transfer her science into technology. This could also be done in Africa through effective and efficient development of STM human capital. This paper discussed the rational for human capital development in STM education, the economic implications of human capital development in STM education and the attendant suggestions to improve human capital development in the STM programme in Africa.**

**Keywords:** Human Capital, Science, Technology, Mathematics, Sustainable Development.

## INTRODUCTION

Science, technology and mathematics are components of the triangle of knowledge that exude sustainable development in advanced nations of the world. Therefore, the usefulness of science, technology and mathematics education to sustainable development are no longer in doubt. The pursuit of this triangle of knowledge as an imperative effort for achieving sustainable development is conspicuous in many National Development plans. Invariably STM education is regarded as the pivot upon which technological advancement revolves. Gbamanja (1986) posited that a general trend in this pursuit has been to produce scientifically and technologically literate citizens. Supporting this view, Gimba (1997) remarked that the achievement of a sustainable development through STM education cannot only be realized by just producing or providing the necessary infrastructural facilities, rather effort should be geared at producing the individuals in order to effect positive change of attitude

and orientation concerning their physical environment and natural existence.

Hence, human capital development in science, technology and mathematics education connotes the development of teachers, technicians, and personnel involved in the teaching-learning process. However, the human capital development that hinges on the teacher is perhaps the most crucial in that the development of science and technology culture has its origin in the classroom. The extent to which this is achieved depends on the qualification and training of the teacher and on the attitude of the teacher in the teaching environment. Thus the success of STM education and achievement of sustainable development in Africa depends critically on the availability of technically trained manpower. Furthermore, Fafunwa (1969) had earlier asserted that sustainable development will be achieved when the emphasis on development is on people rather than

things. He stressed that although factories, schools, hospitals, steel mills are built over night, they will stand idle or be unused, unless the masses of people for whom they are built have been scientifically and technologically prepared for them.

Therefore the need for emphasis on people when considering the indices of development is underscored by the fact that people are the subjects and objects of development; they are the wealth of a Nation. This is hinged on the fact that when the people are developed, they will develop all the acknowledged indices of sustainable development. Therefore, human capital development is tantamount to the development of the spirit and skill of innovation needed to manage our natural resources in order to meet our technological needs. This will make Africa to be self-reliant, thus ensuring sustainable development.

### **The Rationale for Human Capital Development in STM Education**

The fact that science, technology and mathematics education is a verital tool for sustainable development of any Nation is n longer in doubt. Sustainable development according to Ogban-Iyam (1983) is that development which is self-regenerating, self-sustaining and dependent mainly on internal inputs and initiatives. In continuation, he added that this type of development is needed to maximize the output of consumer and capital goods, reduce the problem arising from foreign trade and promote social economic development. In line with this, Badejo (1998) noted that sustainable development can only be meaningful when most of the inhabitants of a country have rudimentary knowledge of science, technology and mathematics. The extent to which this objective is achieved depends on the attention given to the training, welfare, remuneration, and ego-boasting environment of the resource personnel in the system.

This calls for human capital development as this refers to the totality of the effort made at equipping the individuals with the necessary scientific and technological skills, knowledge, abilities and environmental conditions necessary for them to achieve their full potentials. These enable them to make full use of their hands, brain and energy, thus being self-reliant. The need for emphasis on human capital development in STM when considering the indices of sustainable development is underscored by the fact that people are the object and subject of development. On this note, Akale (1990) pointed out that the development of science and technological culture in any nation begins in the classroom and the teacher is the key factor. This implies that the implementation of the STM curricular objectives in Africa depends on a strong army of science, technology and mathematics based teachers who can interpret the curricular objectives and use new educational materials effectively. It should be

noted that no matter how attractive, detailed and supportive new educational materials are, they cannot be effective unless science and technology personnel are adequately developed to put them to use.

Unarguably, human capital development is the key to successful and lasting STM education vis-a-viz sustainable development. Without the right kind of teachers, the innate potentials of the populace cannot be tapped. The science teacher is a vital factor in motivating and maintaining students' interest in achieving the curricular objectives. Furthermore, the role of the STM teacher is a very important one in the scheme of things in any nation's vision for development. Effective STM teaching is not just a professional necessity but paramount to the basic need in the country for socio-economic development and to improve the quality of human life. Without well-trained and competent STM personnel, African Nations will continue to depend on other more advanced nations. Therefore a nation cannot be dreaming of sustainable development so long as foreigners continue to man her technology.

A closer look at the educational practices in the Nigerian nation in particular and Africa in general depicts that the teaching style of the average STM teacher still sees the learner as a vessel in which to pour knowledge, thus relegating the potentials for self-directed learning to the background. In this approach, the emphasis is on the imparting and regurgitation of facts, which makes students more on-lookers learning about science and not learning science. The type of result expected from such a system is far from what can be relied on for sustainable development. Hamlyn (1967) had earlier noted that such a learner is put in a situation in which he will need to perpetually rely on external sources of knowledge even when he has innate capabilities to source for knowledge. Akale (1990) also noted that without the right kind of teachers the STM education is pushed in a precarious position and there are indications that the educational policies coupled with the present economic constraints may bring the STM education to the brink of disaster.

Nsofor (2002) posited that the healthy growth of STM in Africa depends critically on the availability of technically and scientifically trained manpower. The above pictures if not put on check will constitute a vicious circle for when the teacher is not well developed all that depend on him for training will not be developed and so science, technology and mathematics become a powerless tool in their hand. On this note the paper puts in that human capital development in STM is a "sine-qua-non" for sustainable development in Africa.

### **Problems of Sustainable Development in the STM Education**

The role played by science, technology and mathematics education is an indication that education is the foundation

of all development. Thus, sustainable development of any nation is dependent upon the educational system. In Africa, a number of factors have been identified to militate against her development. These include:

i) **Poor Quality Education:** The implication of poor quality education for sustainable development is not far fetched; hence once the educational practices are faulty, the products of such a system are bound to be faulty also. Such is the situation in Africa in general where the teacher education programmes in most African countries do not implement their programme, which emphasized practical work for the teacher trainee. It is only when the teacher is grounded on the practical and innovative work can he on graduation apply such knowledge to expose the students to learning through creativity. It is said that a blind man cannot lead a blind man; hence poorly trained personnel will invariably have a rippling effect on the system. Poor quality education leads to sterile knowledge, which is not viable for sustainable development

Furthermore, it has been reported in many profiles of teachers that most of their interactions with their students is the lecture method and note copying, the result being that students are only oriented towards remembering what is taught to them which is also easily forgotten. The result is that students cannot think enough to create something. Closely tied to this is lack of basic training on methodology of science instruction. Abdullahi (1982) revealed that most of the teachers who taught primary science in most part of the country had no training whatsoever in the area of science. It is therefore unlikely to expect these ill-equipped teachers to teach science in any imaginative way that will lay foundation for the development of creative thinking, vis-a-viz sustainable development.

ii) **Dearth of STM Teachers:** This is also a problem staring sustainable development in the face. There are few qualified STM teachers coupled with rapidly expanding number of schools. To this effect, STM teachers are drafted to teach other STM subjects other than the ones they specialized in. These groups of teachers cannot contribute meaningfully towards achieving sustainable development in Africa.

iii) **Ego-Boasting Environment of STM Teachers:** Government and the general society at large have not accorded STM teachers their rightful respect and honour needed as a take-off for better service. Teachers are not regularly paid their due wages, and they are held at very low ebb. These attitudes have generated a lot of provocative set back in the role the teachers can play to ensure sustainable development

iv) **Poor Funding:** African educational institutions at various levels are poorly funded; this manifests itself in poor infrastructural and educational materials. Students are supposed to do science and not learn about science, but the situation in African schools is such that science is taught with a simple wave of hands and textbook

regurgitations. This does not promote creativity in students and therefore not lead to sustainable development.

### **Economic Implications for Human Capital Development in the STM Education**

Human capital development in STM education has far-reaching economic implications for sustainable development in Africa. According to the Ministry of National Planning (1980), human capital development entails the development of man, the unfolding and realization of his creative potentials enabling him to improve his material conditions of living through the use of resources available to him. These are sine-qua-non for mobilizing and empowering nation's citizens for effective participation in technological development. It is also a foundation for transmitting the values inherent in STM to technological advancement hence ensuring sustainable development.

To support this, Akuimade (1997) asserted that human capital development is very important in the scheme of things in any nation's vision for development. In continuation, he explained that human capital development nurtures individual's potentials, boosts one's knowledge, skills, attitudes, promotes motivation and ensure that they are all integrated to bring about the overall technology that is functional and people-oriented. This is the foundation for sustainable development.

It should be noted that human capital development is tantamount to the development of the spirit and the skill of innovation; the knowledge and attitude which make people self-reliant and self conscious instruments of change. It is a truism that the cost of developing human capital in STM is high because it calls for attention into the training, welfare remuneration and ego-boosting environment of the teachers in the system. But no amount of money spent in developing human capital should be considered too much, as humans are the wealth of a nation. When African Nations have enough effective STM human capital they will contribute immensely in training and turning out efficient personnel who effectively will manage the nation's natural resources. In order words they will make Africa to be self-reliant thus ensuring sustainable economic development.

### **Suggestions for Human Capital Development in STM Education**

As a check on the problems enumerated above, the following suggestions are put forward:

- African National governments should provide enough funds to build more infrastructures and purchase science teaching materials in all levels of education. This will make STM education activity-oriented and innovation

conscious.

- The problem of low motivation on teachers may be solved if there is the standardization of teacher's condition of service. This will accord teachers their desirable high social esteem and status and thus motivate them to put in their best to ensure sustainable development.

- The STM education programmes in teacher trainee institutions should be grounded on practical works. The programme should be technique-dominated, industry-oriented and innovation conscious.

All these should be geared towards achieving the much-desired sustainable development in African Nations.

- Finally, governments of the African Nations should sponsor STM teachers to seminars, conferences, workshops and encourage full in-service training. These will enable them be up to date in their knowledge of current events and new developments from advanced nations of the world.

## CONCLUSION

Science, technology and mathematics education provide the overall avenue for a nation's development. Human capital development holds the key to the training of qualified teachers which is paramount to the STM education programme. There is therefore the need to start a comprehensive science teacher education

programme in all African Nations that will arrest the deplorable conditions of science teaching in Africa. STM teachers should be encouraged through innovative training and be able to improve and infer alternative opportunities in the development of science, technology and mathematics. In spite of the attendant cost implications, human capital development in STM education is the bedrock for sustainable development in Africa.

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