



Research Article

PROBLEMS AND REMEDIATION IN THE DEVELOPMENT OF MATHEMATICS, SCIENCE AND TECHNOLOGY EDUCATION CURRICULUM FOR SUSTAINABLE DEVELOPMENT IN NIGERIA

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ABSTRACT

Mathematics, Science, and Technology Education (MSTE) has been proved to be an indispensable factor in the economic development of any country and in Nigeria it has a more critical role to play. The report of the commission on the review of Higher Education in Nigeria suggest that the focus of education in this country should be to accustom Nigerians to a productive rather than a consumption culture and this can only be done by effectively programming the educational system with bias towards Mathematics, Science, and Technology Education curriculum. The paper examined the problems and remediation in the development of Mathematics, Science, and Technology Education for enhancing sustainability development beyond oil.

Keywords: Mathematics, Science and Technology, Curriculum, Innovation and Sustainability.

INTRODUCTION

Cure the common Man on the street, and the Nation will be cured of under-development. A fact that is repeated every now and then is that both national and human development depends on a greater extent on the development of science and technology. The report of the commission on the review of Higher education in Nigeria long ago suggest that the focus of education in Nigeria should be to accustom Nigerian to a production rather than a consumption culture, and this can only be done by effectively programming the educational system with bias toward science and technology education for which mathematic is the bed rock. Mathematicians have a central role to play in our economic diversification and technological development, as mathematics is the key to the solution of most human problems. No nation can develop without technology, and mathematics is the bedrock of science which brings technology, so one can say that Nigeria may not effectively realize the goals of economic diversification and technological development without the efficient and effective use of mathematics and mathematicians. Mathematicians are needed in all spheres of our economy such as engineering banking, planning, manufacturing, modeling etc. Fashola (2018) I wanted to be a professional and Law was the only profession I could gain admission to study without having to contend with mathematics, I just didn't like mathematics and was confounded by figures and formulas. In my third year in secondary school, I was moved from science to arts classes and I was happy to see end of mathematics, he say. From my days as governor having to deal with budgets mathematics did not leave me as much as I thought we had parted away. Innovation; means bringing a new idea to market. Several attempts have been made to define technology education. UNESCO define it as, "A comprehensive term referring to the educational processes when it involves, in addition to general education, the study of technologies and related sciences and

acquisition of practical skills and knowledge relating to occupations in various sectors of economic and societal life (UNESCO 2000)". According to Oyeyinka (2010), it is an aspect of education designed for those who are interested and can benefit from learning specific skills in a specific occupation. Okwie (2009) stated that technology education is an educational aspect that prepares individuals for saleable skills and makes one fit into the society to make effective contribution for its development. This implies that practical skills acquisition in various areas lead to economic stimulation in a dynamic society where individuals who are Technology/Vocationally knowledgeable embark on production of saleable items. The focus of technology/vocational education as spelt out in National Policy on Education Revised (2004). According to Ali Muzurai (2005) the technological development of a nation depend on who knows what not who owns what. According to Horuby (2010) defined technology as the mastery and utilization of manufacturing and industrial methods, systematic application of knowledge to practical task in industry, also Olajide (1990) posited technology as an instrument of change evolving through systematic application of collective human rationality to the solution of problem through assertion of control over nature and all kinds of human process. Olivier, (2016) advocate the need to pay greater attention to mathematics and science education, saying it would enhance government agenda on economic diversification. Olivier, who made the call at a press briefing in Lagos on 2016 edition of the Cowbell Pedia Secondary School mathematics T.V quiz competition posited that science, technology, engineering and mathematics (STEM) education is all that Nigeria requires at this time to broaden its economic base from primary commodity driven one to a services oriented economy that the develop world boast other than relying on one commodity ie oil. Economic development in the developed world has occurred at a speed and intensity it has, due to a strong foundation of STEM education, he say STEM courses are pivotal to a nation's technological advancement and mathematics which has historically been seen by students as an unattractive subject, is a key component of STEM education Olivier said. Education would enable individuals to develop their potentials to the

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fullest and contribute most appropriately to sustainable technological and economic development of their society. Such education should be able to equip individual with the necessary skills to make sustainable positive economic and technological impact on the society. Vocational/technology education has enormous contributions to make in this direction. Ali (2009) noted that a significant thrust of the National policy on Education (NPE) is the need for entrepreneurship in scientific/technological education for national empowerment and enrichment. The 2004 edition of the National Policy on Education stipulates: At the early phase of the education system, effort shall be made to inculcate an attitude of respect for and appreciation of the role of mathematics and technology in society. To accomplish this, student shall be made to appreciate the dignity of labour by using their hands in making, repairing and assembling things (FRN,2004).

What is Technology?;

Hornby (2005), quoted by Oyeyinka (2010) defined technology as the mastery and utilization of manufacturing and industrial methods, systematic application of knowledge to practical task in industry. Olajide (2013), posited technology as an instrument of change evolving through systematic application of collective human rationality to the solution of problems through the assertion of control over nature and all kinds of human process. As Ekhagueere (2010) put it; "A nation's economy, on the one hand and its science and technology is on the other hand are conjoint twins, sharing common heart called Mathematics; destroying the heart you destroyed the twins; fatly injure one of the twins you fatly injure the other as well as the heart. There is therefore a fundamental responsibility on the nation to keep the heart in a healthy state at all time". Our country is not unaware of the importance of mathematics and its problems. Efforts have been made in the past to improve teaching and learning of mathematics and technology at all levels. This lead to the establishment of National Mathematical Centre in Nigeria. The centre is now championing the course for the improvement of teaching and learning of mathematical sciences at all levels. But much is still expected from this tower of mathematical science to redeem the image of mathematics in Nigeria.

Mathematics for economic diversification and technological development

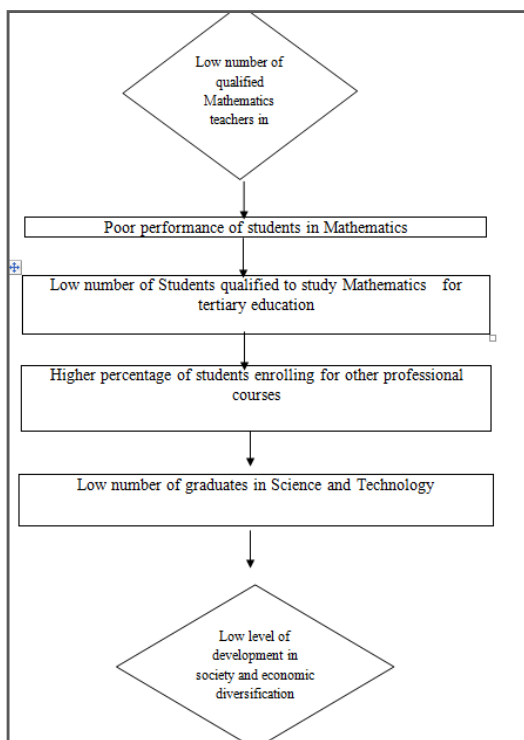
According to Audu (2003) Mathematics is an indispensable medium by which and within which science expresses, formulate and communicate itself. Mathematics not only specifies, clarifies and makes rigorously workable concepts and laws of science, but also at certain crucial instances became an indispensable constituent of their creation and emergence as well. Mathematics is incorporated into the language of physical sciences, technology and social sciences. Mathematical models (description of real world events that use mathematical language.) from the basis of econometrics and health policy analysis. For example, the survival analysis examines statistical and mathematical methods used to provide a realistic analysis for problem in medical research, reliability theory, actuarial computations and demographic studies. Mathematical analysis contributes substantially to decisions about economic and health policies, which in turn have enormous financial and social consequences. All major professions in life today require the knowledge of mathematics to practice. These professions include Engineering, Accountancy, Medicine, Economics, Banking and

Technology. Mathematics is very useful in various designs. Now the design on clothes, houses, parks, furniture, and electronics all have some mathematical backgrounds. In offices, industries and other human establishments, mathematics is needed for analysis, organization and evaluation of the information needed in order to make new decisions. For mathematics to take up its vital role in the realization of economic and technological development in Nigeria some improvements have to be made at all levels. Mathematics has to be relevant to our goals of technological development part of which is to transform the country technologically. Development may be defined as the collective of activities by any human society directed at reducing the totality of perceptible obstacle to a higher standard of living, thus maximizing the quality of life of citizen (Ikeku, 2012). Development is widely conceived as a "participatory process of social changes in the society, intended to bring both social and material advancement (including greater equality, freedom and other valued qualities) for the majority of people through their gaining control over the environment" (Ambali,2012). Some of the elements of development include high standard of living, high agricultural productivity, high technological productivity, adequate exploration and exploitation of the natural and mineral resources of the society, less dependence on imported materials, presence of many industries, high literacy and numeracy rate of the citizens, appropriate health care delivery and low unemployment. Every society aspires to develop and achieve a better standard of living for her citizens and thus is only possible with the presence of well trained technologies, which can help to transform the society. Therefore, the underdevelopment of Nigeria could be traced to her lack of economic independence which in turn arises from her backwardness in science and technology. The world summit on sustainable Development (2010), report that sustainable development operates at three domains, they are Economic domain aim at reducing and seeking to eradicate poverty, achieving higher level of prosperity and enabling continued gain in economic welfare, Social domain aim at reducing and seeking to eradicate other dimensions of poverty, improving the quality of education, health, housing and other aspects of welfare of individual, communities and enhancing the quality of social interaction, engagement and empowerment, Environment domain aim at reducing pollution and other negative impacts on environment, mitigating the effect of industrialization and human activities, and seeking to achieve sustainable use of resources in the interest of future generations.

The teacher and the curriculum

The meaningful implementation and success of any STME curriculum for self reliance rest heavily on the availability of sufficient number and right caliber of teachers, (Wasagu, 2011). Nigeria has great human resource potential, for all sectors, and many of them could be encouraged to embrace education/teaching field, trained and equipped with practical skills and resource materials, that would facilitate youth development training in various communities. Such are positive ways to begin imparting the spirit of self reliance and nationalism among the citizens. Furthermore, since the teacher is the translator, interpreter and trusted executor of the school curriculum in the classroom. Then Nigerian STME teachers are the central figures in the meaningful realization of the program as enshrined in the public school curriculum. This is because the teacher as the implementer of the curriculum, mediate between the curriculum aims and objective, content and materials and the learner (Nwachukwu, 2010). The actualization of the goals and benefit of STME for self

reliance is a heavy task highly demanding on the teacher and the school system. The teacher is responsible for selecting the contents, materials and pedagogies, preparation and presentation of the content to learners, evaluation and feedback. In addition the teacher is faced with the task of constantly motivating and reinforcing the learner, as well as provision of socio-emotional atmosphere that is conducive for learning in order to achieve the desired goal. For the effective and efficient execution of this laudable tasks by the teacher, Morrison (2009) advised that the teacher be properly trained and must acquire a mastery of vast arrays of skills and competences. Examples of such skills are knowledge of the subject content, practical competence, minds-on and hand-on, pedagogical competences, etc. Furthermore, teachers should view the learners as beginners hence, they need to adopt practical approaches such as use of concrete examples and improvisations. Since the acquisition of skills necessary for self reliance are all embracing practical activities should be extended to simulation, games, etc. since no educational system or curriculum could rise above the quality of its teachers, it is pertinent that teachers should be trained with variety of pedagogical approach which will facilitate acquisition of skills needed for self employment and the corresponding effect would be self reliance. For the general development of any nation like Nigeria mathematics has central role to play. The effective teaching and learning of mathematics cannot be achieved without adequate number of qualified and motivated teachers in the school system. Irrespective of the provision of classrooms, instructional materials, facilities and general administration in any school, the effective teaching of mathematics cannot be achieved without sufficient number of qualified and motivated mathematics teachers. Therefore, one sure strategies for ensuring a sustainable development in any nation is to sincerely address to problems of the production and retention of qualified mathematics teachers in any society. As many students go for other professional courses that are considered more lucrative and avoid studying mathematics and mathematics education, the problem of the shortage of mathematics teachers and the consequences can be illustrated in the flowchart below;



Vocational education and appropriate technology in development

The ultimate aim of any form of technological innovation is to raise the standard of living of the people. Thus the first step in any program for massive technological development or innovation is the formulation of a relevant and realistic theory of effort towards the selection and invention of the appropriate means to the end in view. The development of technology must include knowledge of how to design, fabricate, produce modern tools of production and finance their distribution. This is where we are faced in this country with serious political and moral issues or, in fact a vicious circle because there is no indigenous technology and we cannot really succeed with borrowed technology. At present we are borrowing ideas, skills, machinery, and personnel, but the concept of technological transfer is a myth, couple with the other problems in the effective dimension of education is it any wonder that the products from most of our local industries do not compare favorably with products from the same manufacturers based in the metropolitans country. The industrialized nations naturally do not want competitions, they want customers and consumers. The solution is clearly on the creation of indigenous technology or a new orientation to technological innovation and education. Vocational and technical Education; A tool for poverty alleviation, Economy diversification and sustainable development, it is an obvious fact that the level of technological development and acquisition has become the basis for determining social, economic and industrial development of a nation. The wealth and economic self-reliance of any nation is directly proportional to its level of scientific and technological development. In order to solve the problems of poverty, low technical base, and low quantity of life index, most developing countries have recently turned attention to completing these strategies that will lead to national development and diversification of economy. The importance of technological development in Nigeria calls for technical education, technical colleges, vocational centre's, polytechnics, colleges of technology and colleges of education (technical) to pursue and implement strategies stated in the National Policy on Science and Technology below:

- a. Evolving programs for the recognition, encourage development and promotion of scientific and technological talent at all level.
- b. Making it possible for the average child to have early contacts with the concepts and materials related to science and technology even before entering the primary school age;
- c. Orienting science and technology curricula of polytechnic, college of technology and technical colleges to be theoretical and prove practical base.

In order achieve the set goals in National Policy on Science and Technology, many nations have introduced and implement vocational and technical education. An example is the USA, one of the most industrialized nation today has invested heavily on vocational technical education, similarly USSR, who has about 70% illiteracy at the beginning of the 20th century quickly began massive build- up of man power of all categories especially engineering and technology cadre. For Nigeria to develop technologically, mathematic, vocational and technical education is the answer.

Problems militating against the development of mathematics and appropriate technology for sustainable development

- **Leadership; As the Roman historian Plutarch(46120AD)** had noted. "The mine is not a vessel to be filled, but a fire to be candle". Given their corrupt and greedy lifestyle Nigerian's leaders do not, seem to care about integrity or moral values of their citizens. They are good at predicting the future without creating it. As peter Druckers has observed " If you want to predict the future, create it". The leaders must recognize the relevance of mathematics, vocational and technology education in national development and adopt what works in developed nations. The leaders could salvage Nigerian image by re-branding their mentality and do the right things. Nigeria can become an economic power house and realize its vision only if proper attention is given to education and technological development, promote and reward creativity and channel its materials and human resources to productive use.
- **Curriculum Review;** The existing curriculum of mathematics and technology education should be reviewed to enable students acquire more knowledge of applications of mathematics and technology relevance to the societal needs, curriculum should be such that prepares students for "useful living" which could be synonymous with the concept of "self reliance"
- **Difficulties of Adjustment to Technology:** Industrial mass production or technology requires not only skills of hand dexterity but also social skills. It requires habits which may be sported or impeded by attitude, tradition, morals, convention and mode of feeling and behavior. Sticking to standards or the attitude of 'anything goes' is more cultural than cognitive. Our traditional obligation to members of an indigenous group which engenders nepotism clearly militates against productivity. Too often in our present circumstances, people are employed to post not necessary because of their qualification, experience or efficiency but because of their connections.
- **The Problem of Human Resource and Development;** It is a fact that one of the greatest issues in technological innovation is the control of human resources. Indeed proper development and effective utilization of human resources is the most important idea in technology development. The general issue includes questions as to: How shall we be educated?, what type of education shall be provided?, for how long shall the education last? And who shall work and under what condition?. Technology cannot be isolated from the general social life and make-up of the people. Economically the application of technology may be wasteful where its use and maintenance are in the hands of untrained with wrong attitudes. It is not sufficient to learn how to design and produce machines or how to operate them, it is also vital to know how to care for and maintain them. Here is where we require proper education of technological workers. Thus in our bid for an appropriate technology, we must also pay attention to the sociological as well as the psychological technology innovation.
- **Wrong Educational Policies and System:** By far, the greatest problem to technology advancement in Nigeria is the adaptation of wrong educational system or policy implementation. Little attention is paid to the study of the various educational systems that have given rise to sustained technological greatness in the past. Alternatively the expressed design to train a certain number of personnel and to create a certain number of institutions is mistaken for a produce people unsuited to the technological environment and who merely from added links in the chain of underdevelopment.
- **Lack of Technological Awareness:** A rapid technological advancement in any country demands the participation of the majority of the population in providing an environment for such rapid development. Given a considerable length of time and sustained effort, it is possible to create technological awareness, environment for advancement by training a small proportion of technological engineers etc.
- **Use of Innovation Processes:** Basic to the idea of innovative processes in the acquisition and absorption of technology is the exposition of trainees to a localized technological environment provided either in a unit workshop attached to the educational institution, in industrial complexes or full fledged industrial establishments. During industrial training fund (ITF), the student is required to work for a minimum length of time in an industry during his studies following a specified and agreed programmed or industrial training. Most of the innovative processes neglect the grassroots approach and cannot be expected to lead to a rapid technological transition.
- **The Use of Wrong Type of Personnel Management:** One important factor in the absorption of any adapted technology is the management of such technology referred to as techno-management. Where as in the developed countries all managers in the private and public sectors are trained techno-managers. In Nigeria they are essentially managers who have grown without any technical background. In any instances great efforts are made to prevent technical personnel from taking part in management and management decisions, contrary to the practice in the developed world. According to Akpale (2011), one of the major constraints in the Nigerian education system is the strong bias toward vocational and technical subjects. Hence, vocational and technical education has not been adequately developed resulting in the dearth of men with technical know-how needed for effective implementation as stated in the National Policy on Education.
- **Inadequate Funding Which Leads to Inadequate Physical Facilities and Equipment:** Visitation to most of our institutions shows that the students' enrolment has increased but there is no significant change in adequacy of equipment for the past years, also obsolete equipment and tools are still being used to train students who will require training.

Remediation of the problems

With the current rapid growth of science and technology, developing societies like Nigeria do not require students that can only store information. The students required are those that can use new scientific information intelligently. There is need for proper reorganization and reorientation of education system to make it morally sound, relevant and responsive to the needs of a technological culture. Present administration agenda: The Nigerian government declared a state of emergency in the Education sector and is in the process of undertaking a major review and development of its higher education policy, and other levels. Whereas previous new policies focused on access and quality, this time there is a major opportunity and indeed imperative to address not only these issues,

but also other important reforms in the context of the massification of higher education, burgeoning private provision of education, rapid technological change and the internationalization of education and to meet the needs of rapidly changing labour markets and industrial needs, among other things.

Others include

- ✓ Addressing the cascading effect of poor early education outcomes on later education;
- ✓ Recognizing the lack of employability of graduates, the need for better teaching training and for prioritizing quality in the system as a whole through mandatory accreditation and other methods;
- ✓ Promoting more broad-based curricula to emphasize softer skills;
- ✓ Addressing governance problems at the system level and institutionally (for example, hiring practices of vice-chancellors and academic freedom) as well as regulatory issues;
- ✓ Recognizing the need to foster linkages between research and industry and to put greater emphasis on vocational education and integration of vocational and higher education;
- ✓ Addressing disparities in access and provision of higher education (and earlier education) for females, minority groups and different regions;
- ✓ Accelerating deployment of new technology for pedagogy and online delivery of courses;
- ✓ Promoting greater internationalization of the tertiary education system, including allowing selected foreign universities from the top 200 in the world to establish a base in Nigeria in collaboration with Nigerian universities; and Exploring financing models, including more public-private partnerships and alumni funding, as well as support to help students get greater access to loans.

Implications/Recommendation

First, there does not appear to be a comprehensive roadmap to an end goal – for example, what are the absolute and immediate ‘must have’ reforms upon which other reforms will be based? Certainly the proposed reforms have a ‘wish list’ feel to them and, of course, in casting the net far and wide there is some inevitability in this. Secondly, they represent an institution-heavy response to Nigerian’s higher education needs which run the risk of inflicting more bureaucracy onto an already top heavy system. More and more advisory boards, committees, commissions and specialist bodies seem to be the underlying message – an Education Commission to assist in identifying new knowledge, a new Central Educational Statistics Agency, a new Teacher Education University, an expert committee to study accreditation abroad and a taskforce of experts to study recruitment, promotion and retention of academics, are just some of many examples. At a time when new technologies ought to be leading to more devolution, accountability and distribution of responsibilities, this seems more than a little contrary. Thirdly, the linkages between research and industry, while flagged, do not appear to be accompanied by many ideas of how to make them happen. Greater two-way mobility of personnel between higher education institutions and industry, including much less restrictive hiring practices, should be part of this, as should developing strongly functioning eco-systems with key linkages between government,

higher education, vocational/Technology education, industry, research and the financial sectors. It is instructive that, while there is some notion of creating ‘pace-setting’ institutions to be academic incubators, linking with industry this academic incubator should be the centre for entrepreneurship, innovation and creativity. Having a much stronger, explicit and overarching eco-systems approach is critical and a key challenge. Further, while the suggestions above call for better linkage between higher education and society, this could perhaps be better fashioned around ensuring that higher education meets the specific challenges or missions confronting Nigerian society.

Access and internationalization

Some other issues are worthy of mention. Nigeria has certainly embraced MOOCs – massive open online courses – and online delivery of courses, but ensuring quality remains a major challenge. In addition, there is an opportunity for Nigeria to become a ‘massification-segmentation’ provider of tertiary education, in which new information and communications technology can be deployed not only to provide access for large numbers of students, but also to tailor education solutions to particular student needs. While the documents speak of internationalization of higher education, there is little by way of strategies to attract more international students – apart from the laudable aims of making Nigerian’s curricula comparable to the world’s best and developing Nigerian cultural studies – to strengthen the global flow of ideas. Perhaps this is a pipe dream given capacity and other constraints in Nigeria. The approach to internationalization is focused more on institutions – attracting them to Nigeria and encouraging Nigeria institutions to locate abroad. Further, one of the problematic cornerstones of the Nigerian higher education system is its affiliation system in which colleges that are tied to universities have limited, if any, autonomy at all, with a consequent impact on accountability, motivation and capability. This could be a lost opportunity for some much needed fundamental reform. Nigerian higher education is at a crossroads. Its future direction, as exemplified in the documents, points to some tentative positive steps to address the massive challenges faced by the sector. However, there is an uneasy sense that more could be done to address more fundamental issues despite the various political constraints that come with proposing reform.

Conclusion

With good leadership, realistic curricula review, public awareness on the potentialities of STEM teachers. Incentive packages, retraining of STEM teachers and provisions of teaching facilities for STEM at both secondary and tertiary level, the STEM we teach and learn in our schools will be more relevant to the goals of our economic and Technological Development. These will improve our economy diversification and the common man has something doing.

REFERENCES

- Ali, A. 2010. Entrepreneurship practice in education, Umumnze Federal College of Education. Conference proceeding.
- Ali, M. 2005. The technology of any country depend on who knows what not who owns what. Tvdocumentary program.
- Ambali, S. F. 2012. Vocational and Technology education culture of Development; National conference organized by the school of

- vocational and technical education, Taisolarin college of education (TASCE) Ijebu-ode.
- Audu, M. S. 2003. Application of Mathematics; paper presented during the UNESCO assisted workshop for mathematics Teachers held at NMC Abuja from 10th to 14th Mach.
- Akpale, 2011. "Singaporean Teachers perception of activities useful for fostering creativity"
- Ekhagneere I. *et al.* 2010. "New evidence on college Remediation" the journal of higher education vol.77' Federal Republic of Nigeria (2016).National policy on Education 7th edition.
- Ikeku, E.O. (2012. Technology, Development and poverty alleviation in the Next century.Held in proceeding of the 2012 Annual Conference of Nigeria Association of Technology. Held in Lagos
- Olajide, P.D. 2013. Appropriate Technology; Technology with human face.The Macmillanpresslimited. New York.
- Oyeyinka, 2010. STEM Education the way forward. Keynote address deliver at Nationalconference of STAN in Abuja
- Olvier, thiry, 2016. Advocate the need to pay greater attention to mathematics and scienceeducation,press briefing in Lagos on}
