



Challenges of Mathematics in Economic Development in the Twenty-First Century: Implications for Tertiary Education

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

This paper examines the vital importance and significance of Mathematics to the culture of the modern Technological world with particular reference to the role of Mathematics for the achievements of the Economic Goals in the twenty-first century. It takes account of the curriculum, pedagogy of teaching, enrolment and teaching facilities. Besides, suggestions for the improvement of the situation to enable mathematics and mathematicians meet up the challenges of our economic goals are made. It concludes by stressing for a more relevant Mathematics and a greater exposure of Mathematics students to the application of the discipline such that they can contribute more meaningfully to the development of our-nation. Nigeria like all other nations aspires towards technological advancement and economic prosperity in order to attain sustainable development in the twenty-first century. Such aspiration can only materialize when the right education is made available to lay the foundation for the manpower that will steer the country forward.

Keywords: Economic development; tertiary education; Nigeria; human resources.

1. INTRODUCTION

Education plays a prominent role in positive national development. A comprehensive

qualitative education of a nation's citizens will be essential for advancement in science and technology and all other spheres of human life. Awo in Enoch [1] sees education as, an

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investment in human resources which is expected to make a good contribution to human formation. It is a systematic course of instruction that gives intellectual and moral training to an individual. Our human resource in Nigeria is considerably dependent on its educational system for human development. Thus, any programme that is not centered on appropriate and effective human development strategies will achieve very little positive results.

The main reason for studying Mathematics in Europe in the 17th century was to acquire knowledge and put self in position to make inventions. That is why within that century, as reported by Smith [2] in his book, *The Nature of Mathematics* that “All mathematicians” were philosophers and all philosophers were mathematicians”. Mathematical experience is inevitable for survival and most especially economic survival. Thus mathematical research has to imagine the future and forecast products and services that will help develop the nation into the new millennium. Hence, industry and government have sound business reasons for investing in research in mathematical sciences.

The achievement of economic strength is clearly dependent on other related variables, particularly political stability and a sound educational system. In this case, however, Tertiary Mathematics Education is the relevant educational component for the achievement of the economic goals of this country. As we aspire to achieve national self-reliance, economic viability and political stability, the knowledge of Mathematics is inevitable in the realization of these goals.

The twenty-first century is expected to experience more investments in science and technology. It is a pity that Nigeria and perhaps Africa in general is far behind the levels of developed nations. Fafunwa [3] states that “Many of the first fruits of ‘technological progress have not arrived in Africa and the new advances which have superseded the old’ are even further from ‘Africa’s reach’, appears to still hold up to this moment.

The foundation of scientific, technological and economic development is mathematics. Due to its importance in this area, the policy makers on education have rightly emphasized its role in education at primary and secondary levels. But the training of the dispensers of mathematical knowledge at secondary and primary levels lies

with the tertiary institutions. It is therefore imperative that the dispensers of mathematical knowledge to the future implementers of this knowledge be properly trained so that they can be effective in their training of our citizenry.

This paper thus discusses the challenges of tertiary mathematics as it affects the economic development of Nigeria.

1.1 The Prevailing State of Mathematics in Tertiary Education

In Nigeria today, mathematics is studied in Colleges of Education, polytechnics and Universities. In some cases Mathematics is combined with computer science, statistics or education. The students are exposed to curriculum which is more theoretical than practical.

The teaching of mathematics at the pre-tertiary levels is far from adequate. There are various problems such as lack of qualified mathematics teachers, poor infrastructural facilities such as under-sized classrooms, lack of mathematical laboratories that will enhance students imbibing of mathematical concepts, etc. Such problems leave students to cram just in order to get good results for admission into tertiary institutions. The end result is that students do not understand fundamental ideas of basic mathematical concepts. The effect of this can be devastating in the capacity the students would develop.

It is noteworthy that teachers at pre-tertiary level tend to spoon feed the students to some extent. At the tertiary level, these same set of new entrants are often likely to lack the autonomous capacity in their studies. They are still not used to independent studies. They now have to face abstract topics in real analysis, Algebra, Geometry, Trigonometry, etc which will pose drastic challenges upon them. For example, Okafor and Anaduaka [4] noted earlier that “there is a wide gap in knowledge of fundamental ideas between secondary and tertiary mathematics.” To date, this gap needs to be bridged, and that cannot be done without effective and adequate instructional facilities and strategies that would strengthen the students at the tertiary level. In effect the state of tertiary mathematics education is undermined by low-level preparation before tertiary education. Any attempt to improve it shall be preceded by serious improvements in post-primary education which should lay the foundation for tertiary education.

1.2 Teaching Strategies

Looking at the teaching technique employed in tertiary mathematics, the lecture method is conventionally the method of instruction in all countries, Nigeria inclusive. Robinson [5] gives vivid illustration of this method which he described as "more or less oral presentation of information by lecturers." Ukeje in Enoh [6] has criticized the method for being teacher centered, monotonous and failing to permit active learning. They opined that the low quality of the teaching personnel constitutes a serious problem in the quest for social reconstruction. Students cannot acquire the necessary skills that are needed in transforming Nigeria in terms of technology without sound and educated teachers.

There are various weaknesses and strength which can be summarized from the work of Gregory [7]. Among the weaknesses he identified are: not being able to cater for individual differences of learners, little or no active participation by the students and development of few high intellectual skills. The advantages include; coverage of more materials, transmission of uniform information, economic use of instructor's time and usefulness with large audience, and generally inhibits feedback and promotes covert rather than overt engagement of students in learning tasks.

This lecture method is widely used in tertiary mathematics instruction. Most lecturers at tertiary level used this method because it is the method used in institutions. The feeling is that since they were taught that way and had succeeded, their own students too must succeed if taught in the same way.

The prevailing problem is that most of the time, students do not understand or imbibe the concepts lecturers think they are being taught. Morgan [8] expressed concern about the general poor level of Mathematical competence of engineering students in tertiary education. According to him, the development of mathematical ability is not being achieved since students cannot generate solutions to basic problems.

This picture of tertiary Mathematics teaching prevails in Nigeria today. In an attempt to "Cover the Syllabus", students are presented with too many factual materials, with lecturing done at a fast pace. This indiscipline pace and the

sequential nature of Mathematics make many of the students get lost, and the longer the lecture lasts, the more serious the students' incapability to absorb what is being taught becomes. This may result in students' missing crucial statements, or may copy down incorrect and incomplete statements; thus creating a problem of comprehension. It is true that lecturing in mathematics provides a fast way of reaching a large audience, but how effective is the individual learner being reached? Thus, Alagbe [9] commented that "Where the lecture method is a good method for the person to transmit information to many, it is a very poor method for the individual to receive the learning." A good mathematics instructor, at any level of the educational system, must not just be a transmitter of knowledge, but a manager of knowledge as well, as a developer of skills.

In most tertiary institutions, teaching is supplemented with tutorials organized for the students. The problem is how effective are these tutorials organized so that it can help to improve the low achievers in mathematics? Experience has it that in Nigerian Universities post graduate students often handle under graduate tutorials. In most of these tutorials, post graduate students or high achievers among these students solve some problems on the board. This therefore leads to poor attendance at these tutorials. If the lecturers just give out tutorial questions to these students to practice without making effort to assist them in sorting out the solutions, the effort will be rather unprogressive. Unguided tutorial activities thus become problems in themselves as they become unrewarding.

1.3 Assessment Techniques

In most institutions, continuous assessment scores exist as a percentage of the cumulative final score. The usual way is to give one or two tests to students. Where no feedback is provided in time, students are not given opportunities for corrective measures. They may be informed about their scores but are often not given the correct solution to the problems. More often than not students use the scripts of high achievers as the Model solutions. In situations where students discover that examination questions are often drawn on the solutions of the clever students, all students strive to copy the works of those skilful colleagues. There is hardly any possibility to promote appreciation and understanding of mathematics' skills.

1.4 Tertiary Mathematics in National Economic Development

It is worth noting that no nation can develop without developing her science and technology and mathematics is then ucleus of science and technology. The role of mathematics innational economy is far more than a symbolic one. The dwindling national economy cannot be far from the failures to involve the mathematicians a lot more in the planning and management of the economy. The issue of funding by the government and other relevant authorities has beena major challenge to mathematics education. The yearly budgetary allocation to the education sector has been grossly inadequate as compared to funding from both developed and some developing countries. In Nigeria, education sector has not received top-most priority in budgetary allocation as it deserves over the years.

Considering that the products of tertiary education mathematics are the crucial targets, it will be important to make certain suggestions regarding mathematics in tertiary education. In the same vein, what the public needs to know about the mathematicians will be given so that maximum use can be made ofthe mathematics potentials in the society. In this paper, some observations are made, suggestions on improvements are proffered. This concludes a curriculum position in tertiary mathematics, the creation of public consciousness on the functions of mathematicians in the economy, and the professional training of mathematics lecturers in tertiary education.

2. CURRICULUM REVIEW IN MATHEMATICS

Curriculum as sighted by Azuka et al. [10] is an important instrument in educational system. Because education is central to the society, so is curriculum which is the heart and life-wire of education. The existing curriculum of mathematics needs to be reviewed to enable mathematics students acquire more knowledge of the applications of mathematics relevant to societal needs. The curriculum should be such that mathematics graduates do not endup only as teachers but should be able to render other services to man and the community.

The proposed curriculum should be such that it can expose mathematics students to, at least, one of the following fields, Computer, Quantity Survey, Arts and Design, Actuarial Science, Accounting and Financial Studies, Planning, etc. Besides, the curriculum should be reviewed in such a way that students' projects should combine mathematics and at least one of itsapp lications. This may involve students staying longer duration in the institutions. The effective combination of mathematics with the applications will:

- a. Make mathematicians more relevant and acceptable to the needs of the society.
- b. Attract more students to study mathematics in tertiary institutions instead of rushing to other professional courses.
- c. Enable mathematicians to be self-employed and be self-reliant after graduation.
- d. Improve the job prospects of mathematics graduates besidesteaching and lecturing.
- e. Improve the standard of living of mathematics graduates through their productivity in the society and better conditions of service.
- f. Enhance the economic and technological growth of our nation.

3. PUBLIC AWARENESS OF THE APPLICATIONS OF MATHEMATICS AND POTENTIALITIES OF MATHEMATICIANS

Most people in Nigeria are not aware of the diverse applications of mathematics in the economy. This may account for the reason why mathematics graduates hardly secure jobs in other establishments outside teaching. Very few job adverts incompanies and government establishments demand form athematicians when in fact mathematicians have wider potentiality to service very many job areas. There should be public and industrial sectors enlightenment on what mathematicians can do in the various fields of human Endeavour's. Such awareness will bring about more acceptability of mathematics and mathematicians and thereby open up their scope of public service. This will ensure proper utilization of mathematics graduates in our economy. The proper utilization ofthe mathematics graduates shall no doubt create a considerable impact in the Nigerian economy. A little public sensitization is all that will be required to make the realization possible.

4. RETRAINING OF MATHEMATICS LECTURERS ON THE PEDAGOGY OF TEACHING

Lassa (1998) observed that, “the Nigerian mathematics teachers were not properly prepared to handle mathematics programme which the teachers are expected to teach”. Poor teaching method has been identified as one of the factors which causes poor performance of mathematics students in tertiary institutions and discourage them from pursuing mathematics in higher degree programmes. Judging from prevailing problems, it will be essential to ensure that some retraining of mathematics lecturers be mandatory for lecturing at the tertiary level. Put another way, mathematicians over the country must have teaching qualification before being employed to lecture in the tertiary institutions.

Retraining of the mathematics lecturers and ensuring that they have teaching qualifications will be indispensable as this will generate a lot of improvement in the status including the following:

- a. Better teaching method in the tertiary institutions as the training will help the lecturers to teach better.
- b. Better performance of the students arising from teacher qualities.
- c. Arousing and sustaining the interest of students and lecturers in mathematics due to innovating teaching skills.
- d. Encouraging students to study mathematics for their higher degree thus minimizing the shortage of mathematicians in the economy.
- e. Exposing lecturers to the teaching of the applications of the mathematics topics especially as these relate to show the connection between mathematics and other aspects of human life.
- f. Improving the testing and scoring methods by the lecturers so as to render mathematics teachers more competent and accurate in their assessment of students.

5. PROVISION OF ADEQUATE TEACHING FACILITIES AND MATHEMATICS TEXTBOOKS

This is another area that needs to be properly addressed. There is acute shortage of teaching facilities and textbooks in mathematics

departments in tertiary institutions. Many lecturers only depend on few textbooks, chalkboards and chalk while the students depend only on the lecture notes given to them by lecturers and few textbooks.

To produce mathematicians for the twenty-first century, better facilities and textbooks should be made available for the lecturers and students. The textbooks should expose students to the application of the topics covered and should be such that can sustain the interest of the readers.

All these will cumulate to the population of mathematicians with better knowledge of mathematics and its applications that can contribute meaningfully towards the development of the economy and the society in general.

6. CONCLUSION AND RECOMMENDATIONS

Our major aim in the 21st century is to transform Nigeria from a developing country to a developed country. Hence mathematics in tertiary institutions must act as a catalyst for the development of skills for the economic market place and professional world.

The method of teaching the subject must be rational to enable tertiary institutions to train civic leaders who will serve others.

If the economy of Nigeria is to turn around for good, there should be massive investments, as stated by Derr [11] who opines that “true prosperity comes from investment and trade and not just aids”. Tertiary institutions therefore are encouraged to start thinking of ways of investment instead of just depending on subventions.

Teachers of tertiary mathematics need to constantly update their knowledge in order not to develop what Bajah [12] called “Acquired Date Deficiency Syndrome (ADDs).” This disease results from teachers not upgrading their knowledge after graduation since they assume they know it all. The end result is that the teachers suffer data retrogression, omit some difficult topics and become anti-questions or unreceptive to students questions.

Based on that, government should sponsor teachers to workshops and increase salaries and

journal allowances in order to enhance teachers updating their knowledge.

All tertiary institutions must include students' work experience in industries, construction companies, banks etc, in their curriculum. Moreover, researchers in tertiary institutions must be encouraged to visit and interact with workers in industries and assist in improving the means of productivity.

Mathematics is indispensable for the achievement of any meaningful development at the present Science, Technology and Information age. Thus the economic goals of the twenty-first century may not be realized without adequate attention given to the teaching and learning of mathematics at all levels of the schools system and with particular reference to tertiary education. Mathematicians would be able to apply their knowledge of mathematics in the production of goods and services needed by Nigerians, thus it will help to realize our economic growth. The challenges are stupendous but the needs are urgent. There are small ways of doing great things.

CONSENT

As per international standard or university standard, students' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Author has declared that no competing interests exist.

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