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Mathematics Education for National Competitiveness and Prestige

Uveruveh, F. O.
Department of Mathematics
College of Education, Warri
Delta State, Nigeria

&

Perekeme, P.
Department of Mathematics
College of Education, Warri
Delta State, Nigeria

Abstract

Mathematics education has always been a key factor in improving a country's productivity and competitiveness. Proficiency in mathematics education implies a high-level of cognitive skills among the labour force, in other words, a high quality of human capital, which leads to technological innovation and productivity gains. This paper discusses some examples of application areas where mathematics education is emerging as vital components with great opportunities for inter discipline research. It is recommended that the current interaction between mathematics education and other disciplines will be further strengthened by ensuring

t hat adequate time is devoted to classes and to eliminate the belief that mathematics is not important in their lives.

Introduction

The word "mathematics" comes from the Greek, Mathema, meaning 'science, knowledge, or learning' and Mathematiko's meaning 'fond of learning' (Simonson and Gouvea, 2007). Explaining this, Agwagah (2008) noted that mathematics is often defined as the study of topics such as quantity, structure, space, and change. These topics provide the major subdivisions of mathematics into: Arithmetic, Algebra, Geometry and Analysis. These major disciplines within mathematics arose out of the need to do calculations in commerce among others. According to Thomaskutty and George (2007), mathematics cannot be considered as a classroom discipline only. Reflecting on this, James (2005) stated that not only an Academician, a Scientist, an as engineer, but a shopkeeper, a grocer, a housewife, a sportsman, an employee need mathematics, and who does not need it? A common man can get on sometimes very well without learning how to count and calculate (Agwagah, 2008). Mathematics education has been vital to the development of civilization. From ancient to modern times mathematics has been fundamental to advances in science, engineering and philosophy.

Developments in modern mathematics have been driven by a number of motivations that can be categorized into the solutions of a difficult problem and the creation of new theory enlarging the fields of applications of mathematics. Very often the solution of a concrete difficult problem is based on the creation of new mathematical theory. While on the other hand creation of new mathematical theory may lead to the solution of old classical problem, (Monastyrsky, 2001). In the 18th and 19th centuries, mathematical language was vague and did not allow much interaction among mathematicians of different fields. The period 1950s to1970s Mathematicians concentrated around problems of algebraic topology, algebraic geometry and complex analysis and they developed new concepts and new methods. New powerful mathematical tools were developed and the language of mathematics became highly developed and very powerful. As evidenced by the discoveries of the last half of the 20th century, mathematics can enrich not only physics and the other physical sciences, but also medicine, and the biomedical sciences and engineering. It can also play a role in such practical matters as how to speed the flow of traffic on the internet or sharpen the transmission of digitized images, how to better understand and predict patterns in the stock market, how to gain insights into human behaviour, and even how to enrich the entertainment world through contributions to digital technology.

Through mathematical modelling, numerical experiments, analytical studies and other mathematical techniques, mathematics can make enormous contributions to many fields. Mathematics has to do with human genes, the world of finance and geometric motions. For example, science now has a huge body of genetic information, and researchers need mathematical methods and algorithms to search the data as well as clustering methods and computer models (among others) to interpret the data. Finance is very mathematical; it has to do with derivatives, risk management, portfolio management and stock options. All these are modelled mathematically, and consequently mathematicians are having a real impact on how those businesses are evolving. Disciplines that hitherto hardly use mathematics in their curricula are demanding substantial doses of knowledge of and skills in mathematics. For example, the pre-requisites for mathematical knowledge and skills for entry into biological and other life sciences as well as the mathematics content in the university curricula of these programmes is becoming quite substantial. Curricula for the social sciences programmes now include sophisticated mathematics over and above the traditional descriptive statistics curricula of some universities in the developed countries have inter-disciplinary programmes where mathematics students and students from other sciences (including social sciences) work jointly on projects. The aim is to prepare graduates for the new approaches and practices in their fields and careers. According to Odili (2006), the utilitarian aspect of mathematics in preparing students for useful living include counting, notations, addition, subtraction, multiplication, division, weighing, measuring selling and buying. Every student, on finishing secondary education, should have clear idea of numbers and a comprehension of both the very large and the very small numbers. Students should understand the way number is applied to measure lengths, volume, weight, area, density, temperature, speed, acceleration and pressure. Estimation and approximation helps them to check economic waste in everyday life. Odili (2006) further highlighted that economy of modern living and the technology of modern selling requires a house wife to be able to estimate quickly which of two different prices offers, sizes or measures is the better buy and to be able to see through many of the tricks of the trade. This presentation shows daily usage of mathematics, which in turn makes mathematics education to be nationally competitive and prestigious.

Examples of Key Fields Where Mathematics Is Emerging Vital Mathematics in Materials Sciences

Materials sciences is concerned with the synthesis and manufacture of new materials, the modification of materials, the understanding and prediction of material properties, and the evolution and control of these properties over a time period. Until recently, material science was primarily an empirical study in metallurgy, ceramics and plastics. Today it is a vast growing body of knowledge based on physical sciences, engineering and mathematics. For example, mathematical models are emerging quite reliable in the synthesis and manufacture of polymers. Some of these models are based on statistics or statistical mechanics and others are based on a diffusion equation in finite or infinite dimensional spaces. Simpler but more phenomenological models of polymers are based on continuum mechanics with added terms to account for 'memory'. Stability and singularity of solutions are important issues for materials scientists. The mathematics is still lacking even for these simpler models.

Another example is the study of composites. Motor companies, for example, are working with composites of aluminium and silicon-carbon grains, which provides lightweight alternative to steel. Fluid with magnetic particles or electrically charged particles will enhance the effects of brake fluid and shock absorbers in the car. Over the last decades, mathematicians have developed new tools in functional analysis, PDE, and numerical analysis, by which they have been able to estimate or compute the effective properties of composites. But the list of new composites is ever increasing and new materials are constantly been developed. These will continue to need mathematical input.

Another example is the study of the formation of cracks in materials. When a uniform elastic body is subjected to high pressure, cracks will form. Where and how the cracks initiate, how they evolve, and when they branch out into several cracks are questions that are still being researched.

Mathematics in Biology

Mathematical models are also emerging in the biological and medical sciences. For example in physiology, consider the kidney. Over million tiny tubes around the kidney, called nephrons, have the task of absorbing salt from the body into the kidney. They do it through contact with blood vessels by a transport process in which osmotic pressure and filtration plays a role.

Biologists have identified the body tissues and substances, which are involved in this process, but the precise rules of the process, are only barely understood. A simple mathematical model of the renal process shed some light on the formation of urine and on decisions made by the kidneyon whether, for example, to excrete a large volume of diluted urine or a small volume of concentrated urine. A more complete model may include PDE, stochastic equations, fluid dynamics, elasticity theory, filtering theory, and control theory, and perhaps other tools.

Other topics in physiology where recent mathematical studies have already made some progress include heart dynamics, calcium dynamics, the auditory process, cell adhesion and motility (vital for physiological processes such as inflammation and wound healing)and biofluid.

Other areas where mathematics is poised to make important progress include the growth process in general and embryology in particular, cell signalling, immunology, emerging and re-emerging infectious diseases, and ecological issues such as global phenomena in vegetation, modelling animal grouping and the human brain.

Mathematics in Digital Technology

The mathematics of multimedia encompasses a wide range of research areas, which include computer vision, image processing, speech recognition and language understanding, computer aided design, and new modes of networking. The mathematical tools in multimedia may include stochastic processes, Markov fields, statistical patterns, decision theory, PDE, numerical analysis, graph theory, graphic algorithms, image analysis and wavelets, and many others. Computer aided design is becoming a powerful tool in many industries. This technology is a potential area for research mathematicians. The future of the World Wide Web (WWW) will depend on the development of many new mathematical ideas and algorithms, and mathematicians will have to develop ever more secure cryptographic schemes and thus new developments from number theory, discrete mathematics, algebraic geometry, and dynamical systems, as well as other fields. However, from the above we can say that mathematics education have a large positive impact on a country's long-run economic growth and well-being.

Conclusion

It is pertinent to note that the importance of mathematics education in promoting national competiveness can't be undetermined, since it is difficult to imagine how such fields as accountancy, engineering, natural and applied sciences , land surveying, quantity surveying, modern cooperate management, education, medicine, banking, finance, actual science, architecture, fine and industrial arts etc could get along in their services to humanity without mathematics.

Many graduates with degrees in other fields do not find jobs after graduation simply because there is no demand for their skills, which thus aggravates the problem of unemployment. We would argue that if some of these people had graduated from mathematics department, they would have had a greater chance of getting hired. For example, consider two recent graduates with different backgrounds, say one with a bachelor's degree in mathematics and the other with a degree in business administration, if both were to apply for the same position[requiring some degree of analytical thinking] in a commercial bank, the former would have a greater advantage when the employer was making his decision .

This is exactly what is in many countries, were job applicants with mathematics and other related backgrounds such as statistics, physics or computer science, have significant advantages over other graduates.

Recommendations

According to Osofechinti in Odili (2006), the importance of mathematics to individuals in their daily undertaking is so enormous that the knowledge of mathematics is an indispensable tool for a successful and balanced human existence on earth. Based on this and other pivotal reasons, we hereby make the following recommendations:

There should be a synergy with education partners to strengthen the mathematics curriculum to strike the right balance between developing mathematical skills, procedural thinking, conceptual understanding, and problem solving techniques.

There should also be increase in federally funded research focused on mathematics teaching and learning to cultivate the most effective teaching methods.

Establishing a mathematics education advisory committee to provide a forum where educators can share ideas on how to improve the quality of mathematics education and learning. Recruit, train and retain qualified mathematics teachers to meet the demand. Attract mathematics teachers via scholarships, students loan forgiveness, bonuses and tax incentives.

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