Human Capital Development: Efforts at Enhancing the Teaching and Learning of Science and Mathematics in Nigeria

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Doi:10.5901/mjss.2012.v3n15p42

Abstract

This paper reviewed the Human Capital Development in Science and Mathematics in Nigeria. The teacher has been identified as the most important factor in meeting the Human Capital Needs of Nigeria in Mathematics, Science and Technology (MST). Thus the country's goal of becoming one of the 20 greatest countries of the world by the year 2020 must adequately focus on the teacher. The Teaching Profession is at the peak of all professions - it is the profession that creates other professions. All the efforts of the Federal Government of Nigeria, STAN, MAN, and other organisations have not eradicated the acute shortage of mathematics and science teachers. It is recommended that putting back the Teaching Profession at the pinnacle it used to be in Nigeria (The Teaching Profession is at the pinnacle and has always been at the pinnacle in other parts of the world), will check the exodus of trained teachers. This way, the leakages being experienced in the profession would be eliminated and the Human Capital Needs of Nigeria in Mathematics, Science and Technology met with minimal efforts.

Introduction

There can be no scientific success without mathematics (Ale, 2007). This was the declaration of Sam Ale, Director of the National Mathematical Centre in Abuja, during the 5th meeting of Nigeria's International Mathematics and Sciences Olympiads Committee in 2007, which focused on demystifying mathematics for both teachers and students. Ale emphasized that the Nigerian government must invest heavily in mathematics education if the country is to become scientifically literate. He said the country needs to spend US $31 million over 13 years if it is to achieve its goal of being in the top 20 world economies by the year 2020.

According to the International Mathematical Union (IMU), Nigeria currently ranks as one of the least mathematically literate nations of the world and Reuben Ayeni, President of the Mathematical Society of Nigeria, told SciDev.Net (2007) that the investment proposed by Sam Ale could be used to fund scholarships for students to study mathematics at the tertiary level. He further suggested that the investment could fund teacher-, and student-driven researches into effective methods of teaching mathematics. The foundation of science and technology is mathematics. As Adeyegbe (1987) observed, anyone who neglects mathematics may not be able to go far in science, technology and in fact other things of the world.

Science and technology are very crucial factors for the development of any nation. There is no doubt that what distinguishes the developed nations from the developing nations of the world is the degree of science and technology prevalent in these nations, and mathematics is the fulcrum on which science and technology rotate. In other words, it is the level of mathematical appreciation of a nation that propels the level of science and technology in that nation. While science is the bedrock that provides the springboard for the growth of technology, mathematics is the gate and

key to the sciences. Thus, the development of human capital in science and technology is a function of developed human capacity in mathematics.

The development of human capacity in Mathematics, Science and Technology (MST) has been on the agenda of almost all developing countries over the past few decades to mitigate the "bad foundation" in science and mathematics. This is in response to the widespread evidence from the developed countries, and more recently, from the experiences of the East Asian Tiger economies, of the positive relationship between MST and development (Caillods, et al., 1996). Another reason is the current information and communication revolution with its subsequent globalisation effects. Nigeria is one example of a developing country that is committed to MST human capacity development. Her roles since independence in 1960 are quite commendable, except that despite all her efforts, there still exists a dearth of human capital in MST in the country. It is necessary here to bring to focus the various efforts of government, associations, and people of Nigeria towards human capacity development in the area of teaching and learning of Mathematics, Science and Technology.

Human Capital Development

The theory of human capital development emerged from decades of efforts by economists to distinguish between factors that contribute to national growth and development (Enaohwo, 2009). In these efforts, economists thought that the gap between economy of consumption and economy in investment would become narrower if the relationship between investment in human capital and investment in physical capital is made distinct. According to Enaohwo (2009), human capital development is capacity building, enhancing the knowledge and skills of people for national growth and development. Marthis and Jackson (1982) opined that development focuses on improving the conceptual skills and intellectual abilities of individuals needed to handle complex situations better in an organisation. An organisation is made up of four major resources: man, material, money and machine – the 4'm in management. Of these four factors, only the human resource is active to the extent that except it puts together the other three resources (material, money and machine), they remain inactive and of no use. The argument has been that if there are heavy investments in physical capital, then there should be heavier investments in human capital (without which the physical capitals remain docile).

According to Williams and Anekwe (2011), investments in human capital (like investment in physical capitals) make a lot of economic sense to the extent that value of additional future benefits exceeds the extra costs of training (development). In this light, education has come to be regarded as the major factor of investment in human capital development and the teacher as the central factor in education.

The Teacher as the Central Factor in Education

The teacher is the central component in the teaching and learning situation and consequently human capital development. In every human endeavour, the teacher is central – be it trade, sports, academia, religion, military, etc. Given this scenario, appropriate teacher quality and relevance are very important in human capital development. According to Nampota (2007), for the MST human capacity development, this calls for the provision of adequate teaching and learning resources. Such teaching and learning resources centrally include the teacher. The teacher is the key leverage point in achieving the desirable quantity and quality of MST human capacity for the country.

In defining the variables of the teaching and learning situation, three interrelated factors have largely been of value in the past. These are the teacher, the learner and the context. However, in recent times, these factors have been broadened to include the teacher, goals, contents, teaching methods, learners and general conditions (Rhemtula and Rollnick, 2006). According to Rhemtula and Rollnick (2006), teaching involves a transformation, by the teacher, of the subject matter (content) into forms that are accessible to learners. For example, although the content and consequently, goals for the course are already predetermined by curriculum developers in the syllabi or course outlines, the teacher selects teaching methods and transforms these into deliverable forms for the learners. During the teaching and learning process, the teacher's knowledge manifests in various representations including metaphors and illustrations; curricula saliency (e.g. depth of coverage, what to leave out and what to include); nature of interactions with students and topic specific instructional strategies (Nampota, 2007). The implication of this is that the teacher has a reasonable degree of control over most factors influencing the teaching and learning situation. This is why the teacher is regarded as the key leverage point in every teaching and learning situation. What this suggests is that adequate provision of appropriately trained teachers is of paramount importance if the development of human capacity in MST is to be achieved.

The Trend of Human Capital Development in MST in Nigeria

This paper seeks to discuss the efforts and programmes towards meeting Nigeria's human capital needs in science and mathematics and how effective these efforts have been. In other words, the paper shall discuss whether the shortage in science and mathematics teachers have been checked by the programmes of government and other bodies, and whether the poor academic performance of students in science and mathematics (Akubuiro and Joshua, 2004) has any bearing with the shortage of qualified science and mathematics teachers.

The dearth of science and mathematics teachers became very obvious when the expatriates left the country after independence in 1960. The Federal Government declared a state of emergency in the area of science and mathematics teachers and positioned to tackle the problem. Several discussions, conferences, workshops and study groups were held to proffer suggestions to combat the crisis. From the workshops and conferences it became very obvious that the shortage of indigenous science and mathematics teachers had its roots in insufficient enrolment and sustainability of students in science and mathematics. With poor enrolment in the subjects at the secondary level, the number of students who entered tertiary institutions to offer the subjects was adversely affected. And with very low enrolment in tertiary institutions for science and mathematics, there were very few graduates in these subjects, and fewer still with such background to venture into the teaching profession. Thus a vicious cycle evolved with poor enrolment at one level affecting the output at subsequent levels. Arising from these observations, government promulgated a number of national education policies to address the shortage of science and mathematics teachers. Such policies are outlined below:

1. Regional Crash programme for Junior Science Masters in the West

As observed by Bajah (1993), the training produced enthusiastic junior science and mathematics teachers who:

i. Were competent in science and mathematics at the junior secondary school level;

ii. Punctuated their teaching with practical hands-on activities that developed them even further;
iii. Had very strong academic background in English, science and mathematics - subjects they could offer at the University entrance examination.

As was later on found, the third factor formed a major incentive for teachers who desired to take up the course offered to junior science masters. Thus the Junior Science Masters programme did not only produce a sound crop of science and mathematics teachers, it also offered them great hope that they were not pursuing a dead end in their career. The programme thus improved both the quantity and quality of junior science/mathematics teachers. This regional experience gave the drive for the creation of the Emergency Science School at the national level.

2. Establishment of a National Emergency Science School

The success recorded by the Junior Science Masters Programme in the Western Region informed the Federal Government of a need to expand the programme thus giving rise to the establishment of the Special Emergency Science School to tackle not only the problem of shortage of science and mathematics teachers at the national level, but to also meet the short supply of applicants with appropriate background qualification to fill university places in science and mathematics.

Bajah (1993) reported that the success recorded by the Emergency Science School was resounding in the country. The number of students who qualified to enter the universities for science/mathematics courses increased. The Emergency Science School produced more successful science/mathematics A-level candidates than all the then existing sixth-form schools put together. The result, like the regional experiment, was improved quality and quantity of science/mathematics teachers. But this was very short-lived with the introduction of the Universal Primary Education in 1976.

This new project threw the gates of existing primary schools open for the enrolment of all children of primary school age. The primary school enrolment was overwhelming and the effect was an acute shortage of primary school teachers and inadequate infrastructural facilities to service the huge number of children of primary school age. In tacking the problem of shortage of teachers, Government went all out to recruit staff from outside the country. The implication was that the country went back to the era before independence of huge shortage of indigenous science/mathematics teachers.

3. UPE Teacher Training Institutions

The Federal Government noted this gap and set up in the various states, UPE Teacher Training Institutions for the up-grading and up-dating of teachers for the UPE schools. These institutions received direct government subsidy and those admitted into them were given certain incentives like no tuition fees, generous financial allowance and supply of necessary books, and materials. With particular reference to science, there was an almost open door policy of admitting students from the secondary schools. Those who have literally failed to obtain the basic five credits to qualify to apply for university entrance examination and those who did take science but failed to obtain enough credits to meet the minimum entrance requirements of the universities qualified to be admitted to the UPE Teacher Training Institutions. Some of the would-be science-trained primary school teachers from the programme were those who failed science at the school certificate level

(O-level). This became the greatest undoing for the Teaching Profession in Nigeria - it is regarded as a place for the never-do-wells. Yet the never-do-wells produce the great, the high and the low.

There were great expectations from this project and as expected an appreciable number of teachers were trained. However, the impact in combating the shortage of science and mathematics teachers was very minimal. Then other programmes followed in quick succession. They include:

1. Sandwich Programmes in Institutes of Education of Universities for the up-grading of Grade II teachers to Grade I.
2. Special Science Schools in the States intended to replicate the success of the National Emergency Science School. This experiment responded positively to the issue of shortage of students and there was phenomenal increase of science and mathematics students, and correspondingly increase in the number of those who trained as science and mathematics teachers. But unfortunately most of those that studied science and mathematics education did not go to the classrooms after graduation. They rather went to the oil companies, banks and other well-paying establishments leaving the shortage of science and mathematics teachers to persist.
3. Remedial Science Programme in Universities: The Federal Government through the National Universities Commission (NUC) gave special incentives to the Federal Universities for meeting the 60:40 (science : non-science) admission quota. Some universities with low applications for admission into their science programmes embarked on a special remedial programme for those who plan to seek admission into their science programme.
4. In-Service programme for Science and Mathematics Teachers organised by state ministries of education and Professional Science and Mathematics Associations [Science Teachers Association of Nigeria (STAN) and the Mathematical Association of Nigeria (MAN)] to up-date science and mathematics teachers.
5. Incentives for promoting science and mathematics among students and teachers: It is one thing to set up programmes for attracting more students to science and mathematics, but it is completely a different issue retaining such graduates in the teaching profession against the fierce competition with scientific industries. Some incentives are offered as sweeteners to keep them:

(a) Post-secondary scholarship, to would-be science and mathematic students.
(b) Preferential admission policy for science and mathematics students: 60:40 ratio of science to arts subjects.
(c) Special science teachers allowance paid to science and mathematics teachers.
(d) Special additional allowance and promotion prospects for science and mathematics teachers in rural areas of the country.

Why is there Continued Shortage of Science and Mathematics Teachers at all levels of Education in Nigeria in spite of the efforts of the Federal Government, Science Teachers Association of Nigeria, Mathematical Association of Nigeria and other Organisations and Agencies to address the Country's MST Human Capital Needs?

The demand for secondary MST teachers in Nigeria has always been high, and is probably increasing every year. The reasons for this are two fold. The first is that perhaps as a result of the commitment to MST human capacity development as stipulated in policy documents, science and mathematics are core subjects in the centrally controlled secondary school curriculum.

The second reason is that the number of primary schools, secondary schools and universities (public and private) is rapidly increasing due to increased demand for education in recent years. The increased demand for education might partly be as a result of the Government's Policy on Universal Primary Education, which was introduced in 1976 and led to increased enrolment in primary schools and consequently secondary schools and universities. In addition, it may be as a result of increased awareness on the importance of education by parents and guardians as a consequence of a varied number of sensitization campaigns currently in place. Whatever the reason, it is now widely accepted that there is an increase in demand for primary, secondary and tertiary education which has in turn resulted in an increase in number of primary schools, secondary schools and universities.

Given the above, the high demand for MST teachers in the primary schools, secondary schools and universities in Nigeria is not in doubt. The question that needs urgent attention is "why have all the efforts of government and other bodies in Nigeria not been able to address the country's MST human capacity needs? In trying to answer this question, one may start by looking at the existing opportunities for training the required number of MST teachers.

Selection of students into the tertiary institutions (to train science and mathematics teachers) is based on exams and minimum number of credits at the secondary level. For students' enrolment in the Education Science and Mathematics (ES&M) a credit in mathematics is a pre-requisite. Unfortunately, students' performance in the Secondary School Certificate Examinations (SSCE) administered by the West African Examination Council (WAEC), and the National Examination Council (NECO) have continued to deteriorate from year to year, particularly in the areas of Science and Mathematics (Akubuiro and Joshua, 2004). Thus university enrolment of students into ES&M has posed a very big challenge.

The first challenge is that students' university enrolment in Education Science and Mathematics (ES&M), to increase the number of MST teachers, is very low. In addition, of the few students that opt for the programme, most do not meet the cut-off point for selection and are therefore left out. Instead, some students who meet the cut-off point but did not choose to study ES&M are selected into the programme, a process commonly referred to as redirecting.

The process of redirecting students has its own weaknesses. For one thing, the students may not be committed to a profession they did not choose to do, and this in turn will affect their attitude, level of commitment towards studies, and consequently their performance. Obilor (2007) found a significant positive relationship between students' academic self-concept and students' academic performance. It is no doubt therefore that most redirected students may not do well in ES&M leading to low graduation rate in this discipline.

Lastly but very importantly is the problem of defection of trained MST teachers to other professions because they did not choose it ab initio, or for financial gains, or prestige - most Nigerians today prefer other jobs to teaching: an ugly situation created by the democratic administration of Alhaji Shehu Shagari, when teachers' salary was the last to be paid several months after it has been earned and teachers were dehumanized by serving politicians. Hitherto, teachers were very well respected and paid for their unique service of creating others. It was during the said democratic administration that students and pupils were promoted to the next higher classes without studying - the government then, chose this path rather than responding to teachers' demands. The effect has remained until the present day, and more than anything else, students believe that they can always obtain certificates whether or not they qualify for such certificates in character and in learning. The result was disillusionment for teachers and the quest for more rewarding and better paying jobs.

The last reason above has dealt a very devastating blow on the teaching profession. Teachers are ridiculed as poor, lowly, not worthy of respect and honours (titles). Worst still, not many parents want their daughters to marry teachers - recall *Zebrudia of the New Masquerade Play* of the 80's and 90's. The consequence of this is that even those who opt for the teaching profession whole heartedly (not to talk of those who go into it for lack of other courses to study) chart other paths as soon as they graduate.

Thus all the efforts of the Federal Government, Science Teachers Association of Nigeria, Mathematical Association of Nigeria and other Organisations and Agencies to address the Country's MST Human Capacity Needs is like the case of a leaking pot - no mater the effort made at filling the pot with water, it remains either empty or at best half empty. To fill the pot, the cause(s) of leakage must be eliminated or the pot changed in its entirety with another pot that is leakage free. Worse still, the efforts at addressing the MST Human Capacity Needs have stopped - Mathematics, Science and Technology are left at the mercy of unqualified and untrained teachers, especially at the hinterlands.

Conclusion

The teaching profession is at the peak of all professions - the mother of all professions. It is the profession that creates other professions. This fact is known the world over (except in Nigeria) and teachers are paid handsomely and are most respected. But in Nigeria the story is the reverse - teachers are the least respected and the least paid in relation to the services they render. Although before independence and immediately after independence (may be, because expatriate teachers were still here) the status of teachers in Nigeria was the same as their counterparts in other parts of the world - the era when people were proud to be introduced as teachers in Nigeria. Not any more. Thus, to meet the Human Capacity Needs of Nigeria in Mathematics, Science and Technology, teaching must be made the most prestigious job and the mother profession it is. To achieve this, the following are recommended:

- Teachers, the geese that lay the golden eggs, should be paid higher than other employees of government (the teachers created them). This way, the status of teachers will be restored, teaching made attractive and more people would opt for the profession, rather than opt out of it.
- The MST teachers should be paid higher than other teachers – they should be paid like their counterparts in the oil companies and banks to make the oil companies and banks less (or equally) attractive and in addition encourage more people into Education Science and Mathematics (ES&M).
- Admission requirements for ES&M to be relaxed. This is because students may have failed mathematics due to circumstances other than being ill-equipped. This will minimize the redirecting of students and its attendant consequences, and enhance more willing and enthusiastic students being admitted into the ES&M programmes of universities. The result will be increased and committed ES&M graduates.
- Remedial science and mathematics programmes to be made compulsory in all federal and state universities in the country to take care of persons who opt for science and mathematics but have deficiencies.
- Provision of scholarships for ES&M students and also teachers who want to do higher degrees in ES&M.

- Training and retraining of teachers currently teaching science and mathematics in the schools so as to up-date their skills in the latest developments in teaching pedagogy.

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