academicresearchJournals

Vol. 2(8), pp. 170-177, September 2014
DOI: 10.14662/IJARER2014.037

ISSN: 2360-7866©2014 Academic Research Journals
http://www.academicresearchjournals.org/IJARER/Index.htm

International Journal of Academic Research in Education and Review

Full Length Research

CONTRIBUTION OF INEFFECTIVE TEACHING AND LEARNING OF MATHEMATICS TO REGIONAL DISPARITIES IN SOCIO ECONOMIC DEVELOPMENT IN AFRICAN REGION

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Accepted 8 September 2014

Causes of diversified mathematics curriculum changes in U.S.A, Europe and Russia have basically been technological driven compared to other regions. Yet, mathematics has consistently remained a central and important subject in all school curriculum levels. Its immense relationship with other subject areas has created not only pressure on students' performance in various examinations but also acts as "frustrating belts" for their future careers. Various policy changes, threatening demands for specific entries into the different career training institutions emphasize on mathematical grades. Direct employment requirements and teaching styles for teachers have often used mathematics for selection purposes. Yet, real mathematical knowledge for socioeconomic development is least solicited from individuals. Priorities for alleviating poor results in mathematics have been identified in various African countries such as Kenya, Zimbabwe and Namibia. Nevertheless, the improvement, if any, is minimal while socio-economic development continues to drop. Poor socio-economic development can be linked to poor learning in mathematics. Currently the subject's learning procedures produce few individuals with good grades in mathematics. It is important to note that good grades per se are not sufficient to enhance socioeconomic development in Africa. There are other mathematical issues that are closely related to such development, which the teaching and learning of mathematics must address. Consequently, this paper addresses such issues including problem solving and equity for mathematical education. Others are issues relating to poverty, politics and forming a wider learning environment for mathematics education in schools. Unless such issues, and the equity in mathematics in particular are fully addressed, the students' endless poor performance will continue to form a strong base for poor socioeconomic performance in Africa. This is the essence of this article.

Keywords: Socioeconomic development, African region, Learning Mathematics, Mathematics Model

Cite This Article as: Rukangu SM (2014). Contribution of ineffective teaching and learning of Mathematics to regional disparities in socio economic development in African region. Inter. J. Acad. Res. Educ. Rev. 2(8): 170-177.

INTRODUCTION

Mathematics is a core subject in school curricula. The importance and the demand for the subject's knowledge has remained constantly high and a master of many human operations. Hence, its role in socioeconomic development cannot be overemphasized. Despite these appealing descriptions of mathematics, there are as many disparities in socioeconomic development as there are human operations. This paper addresses some disparities in socioeconomic development that are likely to result from ineffective teaching and learning of mathematics in some African countries, with special focus on Kenya.

Rationale

Active human life revolves around logical reasoning, mental representation of social issues in mathematical world through environmental manipulation for self-actualization. In school contexts, abstract mathematical concepts are taught with the intention of developing learners' reasoning ability for socioeconomic development.

The basics for socioecomic development revolve around individual's vision. An individual visualizes and focuses on personal goals to be achieved in life. Such achievement would require strategic planning, implementation of such strategies and self-evaluation. These characteristics are reflected in a mathematical process model shown in Figure 1.

From Figure 1, three issues tie the entire process: vision, socioeconomic impact of the developed mathematical ability and self-evaluation. Self-evaluation is particularly important because one has to ascertain the beginning of a plan and its final result, all inherent of a mathematical activity. The extent to which individual's mathematical ability is developed through such a process can be adjudged through his/her interaction with mathematical world while solving social problems in real world situations. That such ability is not adequately developed among some individuals who have learnt mathematics can be depicted from some of their individual expressions. Such expressions are commonly found in daily newspapers either as an advertisement or feature that have hidden mathematical implications as illustrated by the following examples:

1. American Green Card Lottery in Kenya

> "Study, live, work and enjoy life in the United States. 55000 green cards will be issued. US citizenship possible" (House Doc, 2003).

Some logical questions can be asked with regard to this advertisement.

- Why should US want more citizenry through lottery while naturally other countries are practising birth control?
- US is a rich country, why should it raise money from possibly poor citizenry from other countries?

From this advertisement, mathematical concepts are abstractly embedded in lottery (random), money and probability. That some people are likely to miss a green card makes the advertisement to be a form of exploitation. This could be avoided if citizenry considered mathematical manipulation processes before paying for the lottery, making them poorer.

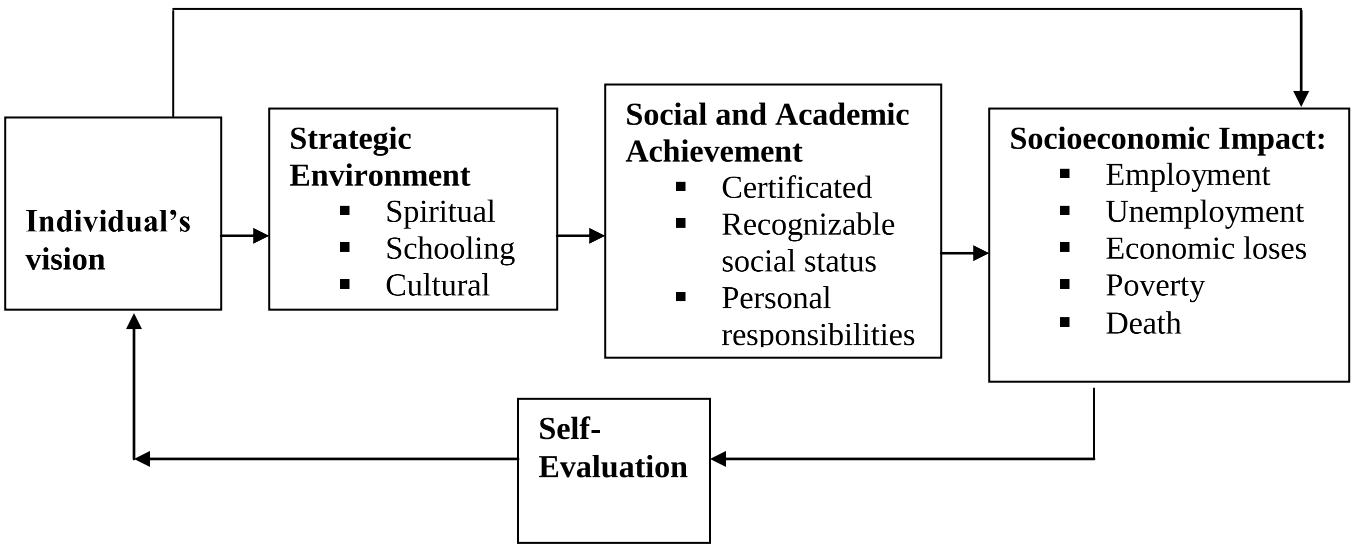
2. "I want to go up to the closest white person and say: you can't understand this, it's a black thing, and then I slap him, just for my mental health" (Daily Nation, 19/8/02:16).

The above statement was released by one of the New York City Council officials while addressing a crowd of black demonstrators demanding reparations from the US government for slavery and decade of discrimination. It is an emotional statement in revenge for blacks' oppression by the whites but with several mathematical concepts implied (the underlined words). Mathematically, closest is for approximation while understanding is for mental manipulation. This is perhaps a negative way of solving a problem by creating another. The implication of this is that didactic teaching might have largely applied in mathematics curriculum implementation, leading to incompetence in critical reasoning (Khalid, 2009) that reduces moody reactions to issues. While ICT would minimize this, particularly in mathematics, has been hindered by challenges such as resources disparities, competence and confidence in integrating it in the teaching of Mathematics (Khalid, 2009). Legislators in Kenya accused Canadian Company, Tromin Resources, of failing to involve local leaders and the people in its mining plans. Thus, "------We are not happy with the deal that has been negotiated between the Canadian firm and our farmers and the sidelining of MPs in that negotiation" (Daily Nation, 13/9/03:32).

This is a statement, which mathematically tells lies. This can be demonstrated in the Kenyan context as follows:

ε = {All Coast people}
A = {All Coast farmers}
B = {All Coast people consulted by the firm}
C = {All Coast MPs}

These sets in Figure 2 are presented in Venn diagram below:



Source: Ideas from Simmons (1983 and Rukangu (1987- Master's, 2000-PhD) -Self
Figure 1. Individual's Vision Model for problem solving in Life.

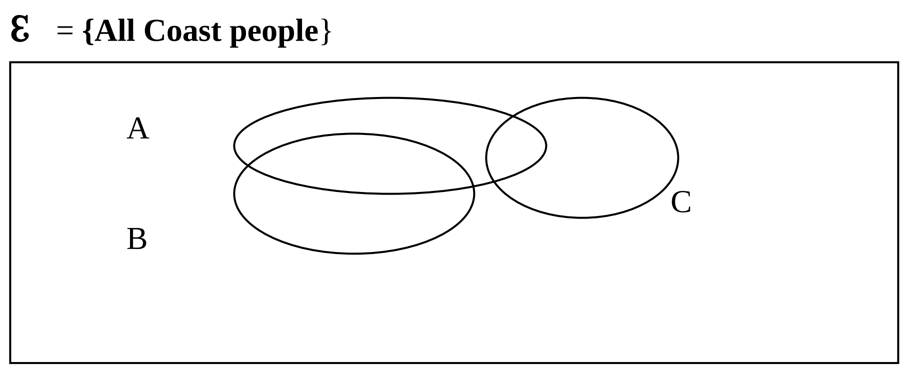


Figure 2. Titanium Mining Consultation Process: Venn Diagram

From the Venn diagram in Figure 2, it can be shown through logical reasoning that **B ∩C = Ø**. However, the statement appears to support **A∩B = Ø**. While Coast legistrators may not have been consulted, it is not true that Coast farmers were not consulted. Therefore, **A ∩B≠ Ø;** meaning that the statement cannot be taken to be the truth.

Such statements can be useful in teaching algebra especially at tertiary level where proof by negation is taught. By using such information, learners would be practically sensitized to avoid either confrontation in problem- solving practices, or deliberately causing confrontation by telling lies. Such contexts have led to socioeconomic disparities and challenges especially to African countries as discussed in the next section.

Socioeconomic Disparities in Africa

Disparities in Africa's socioeconomic contexts are of great diverse. "No continent has been more mistreated, misunderstood, exploited and misreported than Africa" (Lamb, 1985). The struggle began with the scramble for Africa, followed by the fight for independence and then *coup detats,* which have led to educational, political and economic sabotages for selfish motives. The roots of such practices are embedded in inadequate problem solving skills, whose principles are taught in school mathematics perhaps with inadequate application in real lfe situations. Napier and Gershenfeld (1999) and Rukangu (2000) have shown that such principles are embedded in f perceptions, compounded with mental manipulation.

Perception is the basic and core concept in the process of learning mathematics. If the concept is not fully developed in mathematical lessons, one may not be able to apply the skills in real life situations. The perception skills are enhanced by increase in access to formal education and relevant mathematical education. The importance of mathematical and scientific skills has been described by Gwimbi (1996) who considered priorities for innovation in science teacher education in Zimbabwe; and Mkandawire (1996) in analyzing academic achievements among secondary school students in Namibia. All these perceptions were meant to equip students with necessary skills for use in real life situations.

Other woes of Africa can be associated with inadequate logical reasoning among some of her people, especially in causing poverty, entrenching, corruption and ethnicity in society. How mathematics learning can be associated to this can be explained by using the following statements. Some tourists had booked a flight to Zaire (now Democratic Republic of Congo using Air Zaire) and there was a delay in their flight.

The delay in the flight was explained as follows:

> [----President had flown off to Europe with the airline's Boeing 747. His wife had taken the DC-10. No matter that Air Zaire flights QC 011 and QC 073 failed to show up days for the scheduled stops in Nairobi, Brussels, Paris and Bujumbura – the country went broke and planes were repossessed (Lamb, 1985:23)].

The above statement is an indication of probably inappropriate teaching styles in which learners either did not understand or did not properly apply some mathematical concepts such as:

- Commercial arithmetic: Profit and loss.
- Linear programming in order to optimize the available resources.
- Use of sets.
- Functions.

What lacked in this context were among others, time management, optimizing use of resources, sense of human touch and accountability. When such concepts are not effectively used, even making a simple logical statement in form of mathematics language may be difficult. Lack of proper communication due to illogical statements that are not easily understood can lead to poor time management. A worker who cannot follow logical arguments, and there are some in public service in Kenya, cannot effectively serve the public. That this is possible is demonstrated by the following conversation:

> "Hello, I want to report that there is a body lying on the highway, just beyond Riverside Drive".
> How many are there? The police dispatcher asked.
> How many what?
> How many bodies are there?
> "One. There is one dead man on the road who was run over".
> "Is he carrying identification?"
> "Look, I don't know anything, that I have stopped up the road at the petrol station to call you".
> "I see. And this man, how long has he been dead?"
> How many did you say they were?"
> (Lamb, 1985: 229).

This argument shows serious mathematical gaps in:

- Association and mapping
- Death rate
- Decision-making
- Road safety
- Time management
- Relations

It is not easy to explain this scenario. Perhaps the police dispatcher wanted information only in his memory. In this case, understanding the context being described was difficult. Whatever the situation, there is evidence to show why various regions have disparities in socioeconomic development. Visionary thinking by individuals takes a form of mapping in Mathematics. Logical reasoning perfects the outcome of the reasoning. Since most of reasoning is practised in learning mathematics, there are as many variations as there are people learning mathematics. Hence, the socioeconomic disparities that are experienced in various regions of the world. Comparing socioeconomic activities in Africa and developed world reflects these disparities during the second half of the 20th century. However, there is no reprieve for such trends that occurred more than forty years ago as internally displaced persons are found in some independent African countries. Such disparities are presented in the typography shown in Figure 3.

It is possible that if mathematical concepts were effectively taught, individual citizenry would be more responsible and accountable to their future activities than they are today. Such disparities in the mathematics classroom contexts are discussed in the next section.

Disparities in Curriculum Contexts

The fact that mathematics is a core subject in all curricula causes pressure on both teachers and learners in classroom contexts. Teachers would like learners to

Africa	**Developed Countries**
1. Struggle for independence in 1950's and completed 1980's (noble activity). 2. 1960's – 1990's: -*Coup detas* and counter coups -Curriculum transfer from developing countries to Africa. -Ethnic clashes. -Busy changing citizenship. -Looting economy.	1. Had scrambled for Africa and were now consolidating their wealth. 2. Space explorations led to math curriculum changes for specific need in such explorations. 3. Technological advancement. 4. Bosnia attack: war on super power struggle. 5. Making money from green cards. 6. Protecting flow of funds to developing countries.

Figure 3. Source: Adapted from Posamentier & Stepelman (1999).

understand certain concepts within a specific period while the learners are obliged to do well in their examinations. Nevertheless, mathematics curriculum has remained more dynamic compared to those of other subjects in various countries. Changes in USA, Europe and Russia have basically been issue specific of technological in nature compared to other regions. Changes in mathematics curriculum in some African countries have occurred due to leaders' perceptions about the subject rather than systematic research in need-specific (James and Brown 2005, Rukangu, 2000 PhD Thesis).

Causes of diversified curriculum Recent changes have however, been effected to deal with equity issues (Silver, Smith and Nelson, 1995). This is meant to encourage girls and under-privileged children to equally participate in mathematical activities. Hence the "Quantitative Understanding: Amplifying Student Achievement and Reasoning" (QUASAR) project that developed mathematics education in a way that served all students well and provided avenues for them to develop their intellectual potential in USA (Silver, Smith and Nelson 1995:11). The project assisted students to construct their knowledge without condemning them to be mathematically bankrupt; a view from deficit – model. QUASAR helps students to use their brains well rather than simply involve them in didactics teaching.

Another program meant to provide alternative education for mentally talented students has been developed at the University of Minnesota (Keynes, 1995). It provides intense academic environment and a different culture of mathematics using need-specific mathematics courses. It is interesting to note that the University of Minnesota Talented Youth Mathematics Program (UMPTP) targets youth in high schools. The staff design intervention and support material to address equity demands while maintaining intellectual thrust. This is an idea, which staff in African Universities should actively endear themselves to instead of playing a wait-and-see role.

In another development, Posamentier and Stepelman (1999) have shown that mathematics education for the twenty first century in USA started in 1986 with the establishment of a "commission on standards for school mathematics while addressing the role of the teacher.

1. To develop quantitative thinking skills which are necessary for technological development.
2. Mastering these skills should guarantee success in constructivism.
3. Teachers' performance affects students' success on tests real life situations.

Similar standards monitoring project has been in operation in Britain as Assessment Performance Unit. What is then happening in Africa?

It would appear that since El-Tom's research in Mathematics Education in 1986, little has apparently been specifically done on these areas. Some works have been recorded in Zimbabwe (Gwimbi, 1996) on priorities and innovations in science teacher education in order to improve the quality of education and students' performance. Mkandawire (1996) surveyed academic achievement for secondary schools in Namibia. In Kenya, Strengthening Mathematics and Science for Secondary Education (SMASSE) project has not covered all schools in the country, its objectives, and especially of providing initial equipment to SMASSE centers is a very welcome idea.

From the above regional comparisons, it would appear that while mathematics educators in developed world are working towards improving technological skills, those in Africa are struggling to improve their students' examination performance in mathematics. There is therefore need for teacher-training institutions including universities to establish a center for monitoring mathematics standards in order to prepare teachers for proper classroom communication and effective technological skills for learning mathematics.

The fact that learners are not finding it easy to learn mathematics in secondary schools cannot be

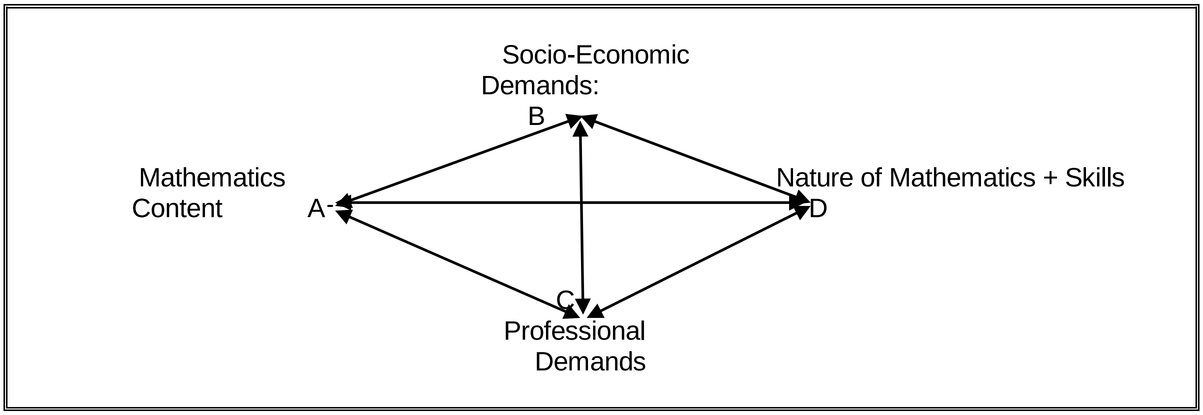


Figure 4. Future mathematical model
Source: Adapted from Rukangu (2000- PhD Thesis).

overemphasized. Examples from students' voices in Kenya(Rukangu, 2004) are given below:

1. "Our teacher uses rude language when teaching".
2. "I am uncomfortable with the teacher who gives nonsensical stories during math's lesson".
3. "Some students dub assignment solution from other students".
4. "Some teachers concentrate on students who know mathematics and leave others floating".
5. "We are always taught in hurry in order to cover the syllabus".
6. "When I ask questions in class, the teacher answers me as if I am wasting his time, thus discouraging".
7. "The teacher only checks wok for some specific students".
8. "Given long formulae without guidance on how to understand and use them".
9. "When you fail, the teacher believes you can't make it in math (Rukangu 1999, 2001)".

These learners' voices show that some learners in secondary schools in Kenya graduate from their schools with the skill to cheat, be easily discouraged and have no confidence. They also imply that examinations determine the syllabus rather the syllabus determining the examination. This way, the chance for learners to construct their knowledge for technological development through participatory learning is inadequately developed. Mathematics educators and other leaders should examine the role of examination in developing learners' talents rather than entrenching rote learning. New ways of assessing learners should be developed for every change of mathematics curriculum in Africa and embrace not only technology but also logic for social and economic development. Unless this is done, mathematics educators in Africa will continue to recycle mathematical ideas without social and technological development.

Future Mathematics Curriculum Model

What mathematics model should we adopt in future to enhance socioeconomic development, especially in Africa and other developing countries? The future mathematics should prepare individuals to address social, scientific and technological problems without compromising equity and quality of delivery in classroom contexts. In order to do this, future mathematics should be highly practical with emphasis on technical skills which would positively affect mathematics learning outcomes (James and Brown, 2005). Approaches to teaching the subject should reflect learning importance rather than syllabus coverage. Equity in learning mathematics should therefore be reflected in mathematics classrooms. Such a model as suggested by Rukangu (2000) is represented in Figure 4.

Unless the principles of such a model are followed, the significance of mathematics will not be felt in socioeconomic development despite its emphasis in the school curriculum.

CONCLUSION AND RECOMMENDATIONS

This article has shown that African countries need to develop mathematical education if they have to claim a place in technological advancement. Unless this is done, the continent will always lag behind others pressed under poverty, insecurity scramble for the inadequate resources. Wealth must be created under conducive learning environment for mathematics visualization. In this view, it is recommended that:

The composition of each element in Figure 4 is as explained below:

Explanations:

A. Mathematics Content
Technical skills.
Personal urge (Intrinsic).

. Linear Programming.

. Projects intensified

. Electronics introduced.
Application in subjects other than sciences defined.

B. Socio-Economic demands
.Computers used as devices.
.Industrial needs.
understood through school linkages.

.Use of mathematics in Techno-Agricultural modeling.
. Civil aviation and engineering well defined in schools
. Other extrinsic pressures

C. Professional Demands
. More university graduate teachers produced with proper Mathematical skills.
. Intensive use of library.
.Role of the teacher slightly changed.

Parental involvement (roles) in providing for mathematical needs diversified.
. Technical specialization diversified.

D. Nature of Mathematics
. Abstraction still remains

. Practical aspects Emphasized.
. Humanized approach in schools.

. Classical mathematics still in use.

. Professionalism emphasized.
Skills
. Modeling.
. Problem solving.
Social adaptation.
. Linear-Programming.

1. Mathematics Curriculum developers need to introduce mathematical concepts that embrace practical approach in teaching mathematical concepts for socioeconomic development.
2. Mathematical concepts should be derived from the social and economic environment be taken to classroom lessons.
3. Teachers need to initiate ways of enhancing not only learners' performance but also developing skills to apply mathematics knowledge in real life situations process learning and teaching.
4. Teachers should minimize didactic teaching and humanize mathematics classrooms.

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