
# EFFECTS OF DIFFERENT TEACHING AND LEARNING METHODS

**SHAIK MOULALI**

**TABLE OF CONTENTS.**


## 1. INTRODUCTION

1.1. Geographical situation of Tanzania
1.2. Educational system in the country
1.3. Present method of teaching
1.4. Introduction of computers
1.5. Micro based Learning (MBL)

## 2. EDUCATION IN TANZANIA – A PERSPECTIVE.

2.1. Historical Background
2.2. Education During the First Phase Government of Tanzania.
2.2.1 The Presidential Commission of Education.
2.3 Education During the Second Phase Government of Tanzania
2.3.1 Outcomes of UPE
2.4 Education During the Third Phase Government of Tanzania
2.5. The Tanzania Education and Training Policy.
2.5.1 Formal Education and Training System
2.5.2 Vocational Education and Training
5.5.3 Non-formal Education and Training
2.6 Primary Education Development Plan
2.6.1 Enrolment Expansion
2.6.2 Quality Improvement
2.6.3 Capacity Building
2.6.4 PEDP Institutional Arrangement
2.7 Secondary Education Development Plan
2.7.1 Access Improvement
2.7.2 Quality Improvement
2.7.3 Management Reforms
2.8 Higher Education in Tanzania
2.8.1 Brief Description of the Higher Education System in Tanzania
2.8.2 Financing Higher Education in Tanzania

## 3. EXISTING USE OF COMPUTERS IN TANZANIA

3.1 Deployment of ICT in Tanzania
3.2 Status of ICT in Tanzania
  3.2.1 The National ICT Programmes and Projects
3.3 The Overall ICT Environment in Tanzania
  3.3.1 Access to ICT Facilities
  3.3.2 ICT and Education
3.4 ICT and Society

## 4. AIM OF STUDY AND RESEARCH APPROACH

4.1. Science Teaching
4.2. Computer studies in Secondary schools.
4.3 .Status of Teaching Maths in Tanzania
4.4 . Research Approach .

## 5. THEORITICAL FRAME WORK

5.1 A brief overview of computers in classroom
5.2 How to use computers as a tool in teaching
5.3 Types activities in the classroom
5.4 What are the benefits for teachers and students ?
5.5 Potential of using ICT while teaching maths/science

## 6. DESIGNING THE RESEARCH WORK

6.1. Selection of target group and controlled group
6.2. Lesson preparation and presentation using computer and without using computer
6.3. Assessment at end of the chapter
6.4. Results
6.6. Analysis
6.7. Inference

## 7. EFFECTS OF USING COMPUTER IN THE CLASSROOM

7.1. What did the teacher learn ?
7.2. What did the student learn?
7.3. What are the effects on class management ?
7.4. Students as independent learners

**8. CONCLUSION**

8.1. Rationale for the study and design
8.2. Reflections on the outcomes
8.3. Reflections on the Research Methodology
8.4. How does the study help Tanzanian teachers/researchers in the field of ICT in Education
8.5. Recommendations

**REFERENCES**

## CHAPTER I

# INTRODUCTION:

***1.1 Geographical situation of Tanzania***
***1.2 Educational system in the country***
***1.3 Present method of Teaching***
***1.4 Introduction of computers***
1.5 ***MBL; how it works in Tanzania***

## 1.1 GEOGRAPHICAL SITUATION OF TANZANIA.

**SITUATION.**

1.1 **Tanzania is situated in the eastern part of Africa**. It shares boundaries with eight surrounding countries via: Kenya, Uganda, Rwanda, Burundi, Congo, Zambia, Malawi and Mozambique. The United republic of Tanzania includes the islands of Zanzibar, Pemba and Mafia. It gained its independence in 1961. It has an area of 945,087 sq km. 2001 estimates of the population was 32.8 millions which gives a population density of 29. per sq km. Tanzania has Mount Kilimanjaro, which is the highest peak in Africa (5895m)

1.2 **A brief on education system in Tanzania**: The existing structure of the formal Education system is 7 years of Primary, 4 years of Secondary, 2 years of Secondary at Advance level and 3 years of university education. Primary education is compulsory to all, there are kindergarten/Nursery schools and some day care centers found mostly in urban centers.

Primary Education – Standard 1 to 7 – Examination for Primary Education – Secondary Education – form I to IV – "o" level Secondary Examination – Advance level Secondary Education – form V to VI – Advance level Secondary Examination – Tertiary Education – University Courses

In addition to above there are technical and vocational schools and Teacher training colleges which provide young people with skills for self reliance and teaching occupations. The Ministry of Education and Culture (MOEC) is responsible for formatting, monitoring and improving the education system. The University of Dar es Salaam is the first University in Tanzania which takes of care of graduate and undergraduate courses in Art, Science, Management, Engineering and Medical faculties.

The National Examination Council of Tanzania (NECTA) is responsible to conduct exams and publish results of Primary, Secondary and Teachers Colleges. The Tanzania Institute of Education (TIE) is another important institute, which is responsible to develop curriculum for Primary, Secondary and Teacher Education.

## 1.3 TEACHING AND LEARNING AT SECONDARY LEVEL.

Many schools in Tanzania still follow the traditional teacher centred lecture method. The skills and knowledge are transformed to students. The best learner is the one who can reproduce by memorization. There is very little interaction between the teacher and taught. The teacher rarely provokes students into asking questions, through this method of teaching has pedagogical merits such as imparting solid information, this is not always the reason behind the teacher's choice. It may be quite often a choice because it is a familiar method and gives importance to teacher.

## 1.4 INTRODUCTION OF COMPUTERS IN SECONDARY SCHOOL.

Introduction of computer literary and computer science in Secondary school curriculum has been seen as an important step forward by the MOEC; as the demand for ICT Professionals in the country is very high. Computers play a very important role in education, computer as a tool for study, computer science as a discipline or a profession, computer as a medium for instruction. Computer as a medium for teaching and learning necessitates changes in curriculum. The ultimate goal is to enable students, to learn explore, and increase the ability to facilities for acquiring and processing information (Tilya 2003)

Through the idea of introducing computers sounds great, very little has been done in terms of planning and implementation of computer courses in public schools. Majority of teachers are still computer illiterate. However, the MOEC asked the heads of public schools to allocate and prepare a computer labs in their schools, very few schools received computers. The situation in private schools is rather different, private schools preferred to recruit trained and qualified computer teachers. Most private schools have their computer labs and children in such school are exposed to computers right from grade I.

IICD (International Information Institute for Computer Development) had initiated through their round table in 2003, some projects in education: one of the projects "Professional Development of Teacher using ICT" was taken up by an NGO called "BRIGHT EDUCATION TRUST FUND" (BETF). BETF aimed at training teachers in Secondary schools and Teachers colleges: They prepared their own syllabus and manual to train the teachers with required basic computer

skills and their application in their teaching and class management. They already trained 120 teachers so far.. The teachers were very happy to receive the new skills and they felt confident to applying them in classroom to the extent possible.

The few public schools, which have computers were not using them properly due to lack of trained teachers and commitment from the leadership. The decision makers from schools to national level are aware of the situation in Tanzania and would like to have computers in Classrooms for teaching and learning , even though there is little evidence through Research that that this will improve teaching and learning. (Tilya 2003).THERE IS A NEED TO RESEACH INTO THIS QUESTION . "Would computers improve learning and teaching in Secondary schools in Tanzania ?"

## 1.5 **MICRO-BASED LABORATORY (MBL) How it works in Tanzania.**

Micro based leaning constitute a modern approach to teaching science in laboratory. The compute is used as a laboratory instrument, Dr. Frank N. Tilya, a lecture at the University of Dar es salaam Tanzania, has made a tangible contribution regarding the usage of MBL in Tanzanian "A" level schools through his doctoral thesis. Dr. Thilya in his "Conception Frame work" writes Research evidence suggests those ingredients essential in the new paradigm on science learning, which is based on how people learn and includes:

1. Students come to the classroom with preconceptions about how the world works. If initial understanding is not engaged, they may fail to group the new concepts.
2. To develop competencies in an area of inquiry.
3. A meta-congnitive approach to instruction can help students learn to take control of their own learning.

Microcomputer based laboratories (MBL) is a technology, which inherently satisfied the conditions, required by the scientific books, suggested. The MBL software has sub programs for data collection, data processing (smoothing, filtering, spreadsheet) etc; data representation (various graphical representations) and data analysis (mathematical operations). With MBL teachers can structure the learning process such that students actively construct knowledge while engaged in hands-on activity. Some benefits acredited to MBL

are: improve student ability to interpret and produce graphs real – time data collection that makes it possible to repeat experiments, to measure different variables at same time, to use a short or long range to analyze and prepare data graphically and to facilitate group work interactions because of its ability to contribute information during group discussion.

"Teachers can profitably make use of MBL in their classroom only if they acquire a new learning that transform their knowledge and skills pertaining to subject matter, epistemology, their perception about how knowledge is constructed and their view about science" Dr. Tilya's study was divided into two stages i.e. from-end analysis and development, implementation and evaluation. In the study, the outcomes of the front end analysis were used as the bases for designing the exemplary lesson materials that were later used in the in service arrangement and in the development of lesson plans by the teachers. The essence of interactive approach in the development of lesson materials was to improve the quality of material in each cycle. Teachers suggestions were welcomed in the process and some of their ideas were reflected in later exemplary curriculum materials.

In the work shop teachers were seen as initiations of science students in which they were provided with opportunities to 1) Reflect on their personal knowledge and work experiences

2) Participated in interactive, hands on and minds on activities
3) Ask questions, solve problems and use knowledge
4) Communicated and work with others in cooperation team.

In this way the curriculum materials were effectively introduced and teachers strengthened their content and

Pedagogical knowledge and skills. Later teachers were observed teaching their classes using the approach they learned. Formative evaluation was a continuous teacher in all stages of study.

Finally Dr.Tilya asserts that in MBL extensive range of teachers role is required in Tanzania context. The importance of in-service education need not be stressed. Teachers need support in order for then to change their beliefs about students, teaching and learning changes are necessary in national curriculum to reflect inquiry learning. There changes

must also be reflected in final examinations.

## CHAPTER 2

# 2.0 EDUCATION IN TANZANIA—A PERSPECTIVE


*2.1. Historical Background*
*2.2. Education During the First Phase Government of Tanzania.*
*2.2.1 The Presidential Commission of Education.*
*2.3 Education During the Second Phase Government of Tanzania*
*2.3.1 Outcomes of UPE*
*2.4 Education During the Third Phase Government of Tanzania*
*2.5. The Tanzania Education and Training Policy.*
*2.5.1 Formal Education and Training System*
*2.5.2 Vocational Education and Training*
*5.5.3 Non-formal Education and Training*
*2.6 Primary Education Development Plan*
*2.6.1 Enrolment Expansion*
*2.6.2 Quality Improvement*
*2.6.3 Capacity Building*
*2.6.4 PEDP Institutional Arrangement*
*2.7 Secondary Education Development Plan*
*2.7.1 Access Improvement*
*2.7.2 Quality Improvement*
*2.7.3 Management Reforms*
*2.8 Higher Education in Tanzania*
*2.8.1 Brief Description of the Higher Education System in Tanzania*
*2.8.2 Financing Higher Education in Tanzania*

## 2.1 Historical background

In Tanzania traditional education emphasized principles of good citizenship, acquisition of life skills and the perpetuation of valued customs and traditions. During the German and English colonial periods education provided was restricted to a few individuals earmarked to serve the colonial interests. Immediately after independence in 1961, the government passed the education act of 1962 to regulate the provision of education. This act repealed and replaced the 1927 education ordinance and was intended to:

- ⇒ Abolish racial discrimination in the provision of education;
- ⇒ Streamline the curriculum, examination as well as the administration and financing of education to provide for uniformity;
- ⇒ Promote Kiswahili as a traditional language by making Kiswahili and English media of instruction in schools;
- ⇒ Make local authorities and communities responsible for the construction of primary schools and provision of primary education;
- ⇒ Establish a unified teaching service for all teachers

Despite these new policy measures, there was no significant change in the goals and objectives of education until 1967 when the philosophy education for self-reliance was introduced to guide the planning and practice of education.

The Philosophy of ESR was sequel of the Arusha Declaration and it underscored the weaknesses of the education system then (Tanzania Education and Training Policy, p. (ii), 2004). This philosophy emphasized the need for the curriculum reform in order to integrate theory with the acquisition of practical life skills. It also urged linkage of education plans and practices with national socio-economic development and the world of work. According to Tanzania Education and Training Policy (2004), between 1967 and 1978, the government took several steps and enacted several laws in order to legalize actions taken as a result of Arusha Declaration. These laws and steps included the education acts of 1969 and 1978; the Decentralization Programme of 1972; the National Examination Council Act No. 21 of 1973; Universal Primary Education (UPE) and the Musoma Resolution in 1974; the Institute of Adult Education Act No. 12 of 1975; and the Institute of Education Act No. 13 of 1975. Specifically, the following changes were effected in the education and school system:

- ☺ Reforms in the school curricula in order to meet the national needs

- ☺ More emphasis was given to the provision of primary education by introducing UPE.
- ☺ Teacher training programmes were expanded.
- ☺ Post-Primary Technical Centers (PPTCs) were introduced.
- ☺ Multi-purpose Folk Development Colleges (FDCs) were introduced as part of post-primary training programmes.
- ☺ Abolition of foreign examinations and the introduction national examinations in the formal school system.
- ☺ Formalization of continuous assessment at secondary and teacher education levels in the examinations system.
- ☺ Work was made an integral part of education.
- ☺ Primary and secondary education was made terminal and relevant to the needs of the country.
- ☺ Adult literacy and education were given more prominence and financial support.
- ☺ Voluntary agency schools were nationalized.
- ☺ Local education authorities were formed to run and manage primary schools.
- ☺ A National Advisory Council on Education was established.
- ☺ School Boards and Committees were established for secondary schools/teacher colleges and primary schools respectively.
- ☺ Both public and private schools were required to be registered.
- ☺ All certificated, licensed and non-licensed teachers were required to be registered.
- ☺ Tanzania nationals were appointed to head all secondary schools, except for a few girls' secondary schools.
- ☺ Direct entry for form 6 leavers to tertiary and higher education and training institutions was abolished.

The education act No. 25 of 1978 was passed to legalize education changes that were introduced between 1967 and 1978 following the implementation of ESR. Changes legalized by the act included:

- ☺ The establishment of a centralized administration of schools gave powers to the minister of education to promote National Education; Education Advisory Council was created; the post of the Commissioner of National Education established and every local authority was made a local education authority.
- ☺ Instituting restrictions on the establishment of schools by requiring owners of schools to get approval of the Commissioner of national education and to have all public and private schools registered.

- ☺ The establishment of school categories into: national schools (i.e. all public schools, other than primary schools or adult education centers managed by local authorities; all folk development colleges and colleges of national education), and regional schools (i.e. all primary schools and all adult education centers with former falling under the direct control of the commissioner of national education)
- ☺ Making primary school enrolment and attendance compulsory for children of ages 7 to 13 years.
- ☺ The centralization of school curricula and syllabi.
- ☺ The establishment of school boards and committees.
- ☺ The establishment of inspectorate department in the ministry of national education.
- ☺ Making mandatory the registration and licensing of teachers.
- ☺ The establishment of regional and district appeals boards.
- ☺ Empowering the commissioner of national education to approve fees for public and private schools.
- ☺ Empowering the minister of national education to prohibit the use of certain books in schools.
- ☺ Empowering the minister of national education to make regulations for the better carrying out of the provision and objectives of the act.

## 2.2 Education During the First Phase Government of Tanzania

During the first phase of Tanzania political governance (1961-1985) the Arusha Declaration, focusing on " Ujamaa" (African socialism) and self-reliance was the major philosophy. The nationalization of the production and provision of goods and services by the state and the dominance of ruling party in community mobilization and participation highlighted the "Ujamaa" ideology, which dominated most of the 1967-1985 era. The Education for Self-Reliance (ESR) philosophy authored by the first president of Tanzania Mwalimu Julius K. Nyerere intended to give critique of the education system inherited from the colonial state by showing that it was elitist, theoretical, bookish and alienating. UPE was part of the economic transformation envisaged in the principles and programmes of the Arusha Declaration.

In early 1970s, the first phase government embarked on an enormous national campaign for universal access to primary education, of all children of school going age. It was resolved that the nation should have attained universal primary education by 1977. The ruling party by that time

Tanganyika African National Union (TANU), under the leadership of the former and first president of Tanzania Mwalimu Julius K. Nyerere, directed the government to put in place mechanisms for ensuring that the directive, commonly known as the Musoma Resolution, was implemented. The argument behind that move was essentially that, as much as education was a right to each and every citizen, a government that is committed to the development of an egalitarian socialist society cannot desegregate and discriminate her people in the provision of education, especially at the basic level. For this matter, the process of universal primary education in Tanzania was contemplated and implemented with the full cost borne by the government. After few years enrolment in primary schools across the nation soared and the nation was gravitated in the frenzy to implement the call for education for all in a poor country committed to an equitable and fair provision of education to all citizens. Imbedded in this success story, were internal weakness as well as external factors which were to work towards not only eroding and reversing the achievement of the UPE campaigns in Tanzania, but also compromising the quality of primary education leading to growing disenchantment and despair amongst the populace in general and the elite in particular.

Due to the socialism and self-reliance philosophy in Tanzania at that time, traditional partners in educational provision were either reluctant to come forward to support the efforts Tanzania was putting on the campaign or, most arguably, the government itself was reluctant to call for assistance from such sources. Thus, in the annals of implementation of that phase of UPE, the involvement of international donor agencies and other partners in the development was minimally apparent. It may also be recalled that, in 1967, with the Arusha Declaration, most denominational schools run by Christian missions had been nationalized and de-denationalized by the government. Thus, with a sense of “wait and see” relationship between the traditional partners in educational provision and the Tanzania government, the latter was basically on her own in the fight for universalization of education in the country.

Since not only education was provided free, but also other services, especially health, the government’s readiness, ability and capacity to handle such an enormous task within a short time and limited resources were put into question. And as student enrolment across the country soared, it was increasingly apparent that the government was biting more than it could chew (Ishumi 1984; Malekela 1984; Mgunda 1999)

The government was the only provider of social services with limited support from donors. Efforts to tackle UPE were channeled through centrally

directed, medium-term and long-term development plans resulting into significant access to primary education. Through central instruments the government showed responsibility to facilitate UPE basic requirements including training of teachers en-mass. The government was very strategically placed to affect UPE since it had all the necessary and legitimate organs.

### 2.2.1 The Presidential Commission on Education

In 1981, a Presidential Commission on education was appointed to review the existing system of education and propose necessary changes to be realized by the country towards the year 2000. The Commission submitted its report in March 1982 and the government has implemented most of its recommendation. The most significant ones were:

- ☺ The establishment of the Teachers' Service Commission (TSC).
- ☺ The establishment of the Tanzania Professional Teachers Association.
- ☺ The introduction of new curriculum packages at primary, secondary and teacher education levels.
- ☺ The establishment of the Sokoine University of Agriculture (SUA); the Muhimbili University College of Health Sciences (MUCHS) and the Open University of Tanzania (OUT).
- ☺ The establishment of the Faculty of Education (FoE) at the University of Dar-es-Salaam.
- ☺ The formulation of a National Policy for Science and Technology.
- ☺ The introduction of pre-primary teacher education programme.
- ☺ The expansion of secondary education

## 2. 3 Education During the Second Phase Government of Tanzania

The second phase government of Tanzania spanning from 1985 to 1995, was characterized by new liberal ideas such as free choice, market-oriented schooling and cost efficiency, reduced the government control of the UPE and other social services. The education sector lacked quality teachers as well as teaching/learning materials and infrastructure to address the expansion of the UPE. A vacuum was created while fragmented donor driven projects dominated primary education support. The introduced cost sharing in the provision of social services like education and health hit most the poorest of the poor. This decrease in government support in the provision

of social services including education as well as cost-sharing policies were not taken well, given that most of the incomes were below the poverty line.

In 1990, the government constituted a National Task Force on education to review the existing education system and recommend a suitable education system for the 21st century. The terms of reference (TOR) for the task force were to:

- ☺ Assess the critical problems which are inherent in the education sector;
- ☺ Propose, in terms of policy, planning and administration, an appropriate system which will facilitate increased efficiency and effectiveness;
- ☺ Propose appropriate implementation strategies.

The report of this task force, the Tanzania Education System for the 21st Century, was submitted to the government in November 1992. Recommendations of the report have been taken into consideration in the formulation of the Tanzania Education and Training Policy (TETP).
In spite of the very impressive expansionary education policies and reforms in the 1970s, the goal to achieve UPE, which was once targeted for achievement in 1980, is way out of reach. Similarly, the Jomtien objective to achieve Basic Education for all in 2000 is on the part of Tanzania unrealistic. The participation and access level (shown by enrolment and intake rates) have declined to the point that attainment of UPE is once again an issue in itself. Other developments and trends indicate a decline in the quantitative goals set rather than being closer to them (Cooksey and Reidmiller, 1997; Mbilinyi, 2000). At the same time serious doubt is being raised about school quality and relevance of education provided (Galabawa, Senkoro and Lwaitama, (eds), 2000). The forces against achievement of UPE are many and complex but it is now accepted that holistic approach to provision and financing may be the quickest route. The UPE programme in Tanzania, which was actually built on the philosophy of “ujamaa” (African socialism), and the Education for Self-Reliance (ESR) reforms, had a good chance of succeeding. The ESR philosophy had addressed some relevant novel ideas of relevance of education, egalitarianism, practicality and elimination of elitism. However, the fact that the UPE programme was accompanied by high and rapid growth in enrolment rates for a few years which later leveled off; and then fell need exploration so as to provide a contribution to overall issue of education for all; and, an agenda of the government and development communities/agencies.

The importance of providing Universal Primary Education (UPE) in Tanzania and other less developed countries has never been disputed. It is not merely initial enthusiasm to expansion of primary education and achieving quantity in short run, which matters. Rather, the government must consider the long-run implications of UPE efforts as related to cost-effectiveness of investment as well as the commitment to achieve the institutional arrangements/capacity/competence and development mind-set. And given the limited resources and low/weak institutional capacity available difficult decisions have to be made regarding trade-offs between investments that promote school quality relative to choices that expand school network and enrolments. Thus the achievement of UPE begs for appropriate and strategic investment to allow for a feasible joint pursuit of access and quality in a holistic manner.
In the pursuit of an effective holistic approach to UPE several factors may contribute to the sustainability of UPE achievements. The demands made on the educational system and its institutions are increasingly numerous and complex. On one hand, the resources made available to these institutions and their managers are proportionally fewer. Such resources have usually been secured under conditions of cost effectiveness. Government on the other hand, has to reduce the public expenditure while still pursuing equity goals. Educational management and administration has to play key role in resolving.

### 2.3.1 Outcomes of UPE

According to Galabawa (2001), the UPE describing, analysis and discussing explored three measures in Tanzania: (1) the measure of access to first year of primary education namely, the apparent intake rate. This is based on the total number of new entrants in the first grade regardless of age. This number is in turn expressed as a percentage of the population at the official primary school entrance age and the net intake rate based on the number of new entrants in the first grade who are of the official primary school entrance age expressed as percentage of the population of the corresponding age. (2) The measure of participation, namely, gross enrolment ratio representing the number of children enrolled in primary education, regardless of age, expressed as a percentage of the official primary school-age population; while the net enrolment ratio corresponds to the number of children of the official primary school age enrolled in primary school expressed as a percentage of the corresponding population. (3) The measure

of internal efficiency of the education system, which reflect the dynamics of different operational decision making events over the school cycle like dropouts, promotions and repetitions.

## Access to primary education

The absolute numbers of new entrants to grade one of primary school cycles have grown steadily since 1970s. The number of new entrants increased from around 400,000 in 1975 to 617,000 in 1990 and to 851,743 in 2000, a rise of 212.9 percent in relative terms. The apparent (gross) intake rate was high at around 80% in the 1970s dropping to 70% in 1975 and rise up to 77% in 2000. This level reflects the shortcomings in primary education provision. Tanzania is marked by wide variations in both apparent and net intake rates-between urban and rural districts with former performing higher. Low intake rates in rural areas reflect the fact that many children many children do not enter schools at the official age of seven years.

**Primary Schooling Participation, Access and Internal Efficiency Rates (1970 – 2001)**

| **Year** | **Participation** (Enrolment Rates) Gross (Net) | **Access** (Intake Rates) Gross (Net) | **Internal Efficiency** (Dropouts/Repetition Rates) Gross (Net) |
|---|---|---|---|
| 1970 | 39.1(27.0) | 83(37.0) | 0.9(0.7) |
| 1975 | 54.1(47.1) | 84(34.0) | 1.1(1.1) |
| 1980 | 98.0(68.0) | 78.2(34.0) | 2.0(1.5) |
| 1985 | 85.5(67.8) | 70.3(32.0) | 2.7(2.3) |
| 1990 | 73.5(54.3) | 77.0(21.0) | 4.8(3.9) |
| 1995 | 77.6(55.5) | 72.0(18.0) | 4.8(4.0) |
| 2000 | 77.7(56.6) | 77.0(15.0) | 6.6(4.8) |
| 2001 | 89.0(61.0) | 85.0(27.0) | 6.6(3.3) |

Source: *Prof. Galabawa C.J bases the table on values in the ADEA Biennial Meeting 2001 p. 13 presentation.*

The analysis suggests that a large number of primary school entrants in Tanzania are actually older than the official entrance age. The Education Status Report (2001), Kuleana (1999), The World Bank (1996) and EFA (2000) have cited some of the factors underlying late entry into primary

schooling. These include economic hardship, opportunity cost (paid and unpaid) of child labour, distance from school and access to transportation. Older entrants have resulted from literacy campaigns, school mapping initiatives, mobilization related to the achievement of EFA goals, or demand stimulating attempts like complementary Basic Education and Training (COBET) and Community Education Fund (CEF) arrangements prepare parallel systems to accommodate children who are already passed the official entrance age.

## Participation in Primary Education

The regression in the gross and net primary school enrolment ratios; the exceptionally low intake at secondary and vocational levels; and, the general low internal efficiency of the education sector have combined to create a UPE crisis in Tanzania's education system (Education Status Report, 2001). There were 3,161,079 primary pupils in Tanzania in 1985 and, in the subsequent decade primary enrolment rose dramatically by 30% to 4,112,167 in 1999. These absolute increases were not translated into gross/net enrolment rates, which actually experienced a decline threatening the sustainability of quantitative gains. The gross enrolment rate, which were 35.1% in late 1960's and early 1970s', grew appreciably to 98.0% in 1980 when the net enrolment rate was 68%. This is mainly because the general will to achieve UPE was at its highest in 1970s' partly due to the ruling party's (TANU) ideology and the committed mass mobilization effort led by Mwl. J. K. Nyerere. This period also experienced an increasing allocation of government recurrent expenditure to education, which averaged 17% of the total education expenditure relative to the country GNP which was also high at around 4.9% (as high compared to the Africa South of Sahara average of 3.3%). The period of 1980 to 1990 experienced decline in both gross and net enrolment rates while the period 1995 to 2001 experienced both higher gross and net enrolment rates in line with the basic education investment strategy (EDSDP – Primary Education Development Plan, 2001). The expansion of the sector in the 1970s led to a crisis of distortion in terms of priorities. There were problems of sustainability, payment of fees and general decline of the system's efficiency and effectiveness. The burden of the government solely providing for primary education remained appreciably high as the resources continued to be scarce because of low revenue and low tax take relative to GDP.

**Grade-Specific Enrolment Rates in Primary Schools in Tanzania 1992-1999(%).**

| Grade/Year | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|
| 1 | 82.7 | 80.5 | 77.9 | 79.7 | 78.5 | 77.1 | 71.3 | 70.7 |
| 2 | 74.4 | 76.8 | 74.4 | 72.7 | 76.7 | 74.6 | 72.6 | 68.3 |
| 3 | 70.1 | 71.5 | 72.1 | 70.7 | 68.7 | 71.3 | 71.3 | 69.3 |
| 4 | 75.5 | 75.8 | 76.6 | 71.1 | 74.2 | 70.0 | 67.1 | 75.9 |
| 5 | 62.5 | 63.0 | 61.1 | 67.8 | 57.8 | 64.5 | 56.2 | 59.3 |
| 6 | 61.0 | 59.8 | 61.4 | 57.0 | 62.2 | 53.9 | 61.0 | 52.2 |
| 7 | 58.0 | 59.9 | 55.8 | 56.9 | 54.2 | 59.0 | 49.1 | 48.0 |

*Source: Prof. Galabawa C.J bases the table on values in the ADEA Biennial Meeting 2001 p. 13 presentation.*

## Internal Efficiency in Primary Education

The input/output ratio shows that it takes an average of 9.4 years (instead of planned 7 years) for a pupil to complete primary education. The extra years are due to starting late, drop-outs, repetition and high failure rate which is pronounced at standard four where a competency/mastery examination is administered (ESDP, 1999, p.84). The drive towards UPE has been hampered by high wastage rates. It should be noted that with average and under age children and those repeating grades, a country's gross enrolment rate could be more than 100%. The rates for Tanzania have been quite below the 100% mark. This situation is quite alarming since it shows that in quantitative terms the difference in education opportunity are widening over time and across schooling level. Indeed, for the whole period 1985 – 1999 the Tanzania primary education system was at risk because the available data suggest that learners are not performing effectively and completing each cycle of the education system. The primary school expectance, which was 6.60 and 6.23 in 1980 and 1985 respectively, dropped to 5.48 in 1990 and slightly improved to 5.66 in 1998. This means that the total number of years of schooling, which a Tanzania child of age 7 can expected to receive in future, is 5.66. Dropout rates in Tanzania primary school system tend to be associated with age, gender and socio-economic status. With the exception of the coastal districts and gender insensitive areas, dropout rates are higher among boys than among girls (Galabawa, 2001). They tend to be high at grades one, four and six because of possible disinterest in schooling

and the dry-curriculum offered. The general lack of careful school monitoring of learning, achievement and quality is another determinant of dropout. It is therefore important that social mobilization campaigns, collective national efforts and other interventions pursue policies, which could curb children from dropping out of school or being excluded from schools.

## 2.4 Education During the Third Phase Government of Tanzania

The third phase government spanning the period from 1995 to date, intends to address both income and non-income poverty so as to generate capacity for provision and consumption of better social services. In order to address these income and non-income poverty the government formed a development plan known as Tanzania Vision 2025. Vision 2025 targets at high quality livelihood for all Tanzanians through the realization of universal primary education, the eradication of illiteracy and the attainment of a level of tertiary education and training commensurate with a critical mass of high quality human resources required to effectively respond to the developmental challenges at all level. Since 1995, the government has initiated a series of policies and reforms in the education sector with the aim of ensuring that all children have equitable access to a good quality primary education. In this case, all children must have the opportunity to participate in education regardless of their poverty, gender, disability, and ability to pay fees and other contributions. In order to revitalize the whole education system the government established the Education Sector Development Programme (ESDP) in this period. Within the ESDP, there two education development plans already in implementation, namely: (a) The Primary Education Development Plan (PEDP); and (b) The Secondary Education Development Plan (SEDP)

## 2.5 The Tanzania Education and Training Policy

Tanzania's development policy has always aimed at combating poverty, ignorance and disease. Right from independence, it was realized that the elimination of these bottlenecks of development would lead to improve living conditions and standards and hence social and economic development of the whole nation. However, since 1970s, the country has experienced serious economic problems, which led to the deterioration of the economy at the turn of the 1980s. In addressing these economic problems, the

government re-examined its development plans and policies of the 1960s. The current socio-economic development and its strategies of Economic Recovery Programmes (ERP) first introduced 1986 are a result of institutional changes that have been introduced in order to resuscitate the national economy. Given its limited domestic resource base, the government advocated:

- ☺ Increased role of the private sector, thereby broadening the participation in the economy;
- ☺ Continued liberalization of trade and other systems;
- ☺ Provision of essential resources to priority areas;
- ☺ Increased investment in infrastructure and social development sectors, especially health and education;
- ☺ The reduction of subsidies, and the introduction of cost recovery and cost sharing measures where applicable.

Most of these policies reflect a shift from the policy emphasis of the 1960s to the early 1980s, which placed strong reliance on government control of the economy and the public sector. It is this shift of emphasis, which has also influenced the form, and direction of the education and training policies. The educational policies for ministries, which deal with formal and non-formal education and training, have been accommodated. From the foregoing shift of emphasis, the broad policies of education and training are as follows:

- ☺ Enhancement of partnership in the provision of education and training, through the deliberate efforts of encouraging private agencies to participate in the provision of education, to establish and manage schools and other educational institutions at all levels.
- ☺ Identification of critical priority areas to concentrate on, for the purpose of creating an enabling environment for private agencies to participate in the provision of education such as, the training of more and better teachers.
- ☺ Broadening of the financial base foe education and training, through more effective control of government spending, cost sharing and liberalization strategies.
- ☺ Streamlining of the management structure of education, placing more authority and responsibility on schools, local communities, districts and regions.
- ☺ Emphasizing the provision of quality education, through curriculum review, improved teacher management and introduction and use of appropriate performance and assessment strategies.

- ☺ Strengthening the integration of formal and non-formal education relationship, by instituting point's knowledge comparability and inter-mobility within two sub-sectors of education.
- ☺ Increasing access to education, by focusing on the equity issue with respect to women, disadvantaged groups and areas in the country.
- ☺ Facilitating the growth of the culture of education for-job-creation and self-employment through increased availability of opportunities for vocational education and training.

### 2.5.1 Formal Education and Training system

This system is predominantly academic, ranging from pre-primary to university level.

The structure of the formal education and training system now is 2-7-4-2-3+ (i.e. 2 years of pre-primary education, 7 years of primary education, 4 years of secondary ordinary level, 2 years of secondary advanced level and a minimum of 3 years of university education)

**Pre-primary education**

This is a two years education cycle, for the children of ages 5 –6 years. This cycle lasts for two years with no examinations for promotion purpose.

**Primary education**

This is a seven years education cycle for children of ages 7 –13 years. This cycle is compulsory in enrolment and attendance and it ends with primary education leaving examinations. At the end of this education cycle, pupils can go on with secondary education, vocational training or enter the world of work.

**Secondary education**

Secondary education is sub-divided into ordinary level (Forms 1 to 4) and advanced level (Forms 5 and 6). The ordinary level lasts for four years while advanced level lasts for two years. Students who complete ordinary level secondary education can go to the advanced level secondary education, vocational training, professional training or the world of work, while those who complete advanced level join tertiary and higher education or the world of work.

### 2.5.2 Vocational education and training

This type of education and training is associated with acquisition of skills for wage employment, self-employment or further vocational and professional

advancement. The most predominant vocational and training institutions include National Vocational Training Centers, Folk Development Colleges, Technical Secondary Schools and private vocational schools and centers.

**Trade schools**
Due to great need for craft level skills to cater for the expanding production and service industry and as a means creating job opportunities for employment and self-employment, trade schools were re-introduced in the education system. These post-primary schools offers crafts courses such as, tailoring, masonry, painting, carpentry, etc., which lasts for four years ending with an award of Trade Test Certificate Grade I. Successful students can join the world of work or continue with further professional training.

**Polytechnics**
In order to have enough manpower required for industrial and economic growth, training for technicians and professional cadre is needed. A shift from the single skills focus to a multi-skill (polytechnic) approach is cost-effective and more responsive to national needs. These polytechnics provides further training for secondary school leavers and others with prerequisite entry qualifications.

### 2.5.3 Non-formal education and training
Non-formal education can be generalized as out-of-school education as distinguished from formal education, which is in school education. The non-formal education and training caters for the informal and adult education. The latter includes literacy, post-literacy, continuing education and Open University. In non-formal education, it is the student who sets the pace for his/her studies and there is no stipulation of the duration for promotion and completion. The results of examinations taken at various stages are used for promotion from one stage to another.

## 2.6 Primary Education Development Plan
The primary education development plan (PEDP) is a five year plan that articulates the vision of universal primary education within the wider Tanzanian policy frameworks of the education and training policy and the education sector development programme (ESDP), the local government reform programme, the over-arching poverty reduction strategy paper and

vision 2025. The PEDP consists of four main components: (a) expanding enrolment;
(b) improving the quality of teaching and learning processes; (c) building the capacity within the education system and other public and private sectors with a stake in education provision; and (d) strengthening the institutional arrangements that support the planning and delivery of education services (Primary Education Development Plan, p. v).
In order to achieve the objective of enrolling all children 7-10 years old by 2005, the PEDP focuses on issues of enrolment and access, teacher's recruitment and deployment, and classroom rehabilitation and construction. It also includes interim plans for expanding non-formal education programmes for out-of-school children and youth. This PEDP is a start-up plan for achieving the education targets in the vision 2025 (Primary Education Development Plan, p. v).The objective of improving educational quality the areas to be strengthened were human resources, teaching and learning resources, and pre-service teacher training. In human resources, the primary focus was on the in-service professional development of the teacher, with complementary efforts focused on head teachers, school committees, and training college tutors. With regards to teaching and learning resources, the emphasis was on textbooks and materials, the quality and relevance of the curriculum, and the school environment. Finally, pre-service teacher training will be rationalized and improved in order to increase its capacity to produce the large number of newly trained teachers demanded by enrolment expansion, as well as to improve the quality and relevance of the training that new teachers undergo.
The Primary Education Development has four strategic priorities; enrolment expansion, quality improvement, capacity building, and optimizing human, material and financial resource utilization.

### 2.6.1 Enrolment Expansion

The highest priority for primary education is to increase overall gross and net enrolment of boys and girls. According to the Primary Education Development Plan (2002), this will be done through a combination of strategies: (a) increase enrolment rates of all groups of children; (b) to use existing teachers and classrooms more effectively; (c) to recruit new teachers and to construct new classrooms; and (d) to expand complementary education programmes for out-of-school children and youth. The government's target was to expand enrolment starting with 1.5 million in the year 2002 and continuing up to 2006 as shown in the table below.

| Year | New Admission Targets |
|---|---|
| 2002 | 1,500,000 |
| 2003 | 1,600,000 |
| 2004 | 1,640,000 |
| 2005 | 1,041,000 |
| 2006 | 1,065,000 |

Source: *The table is based on values in the* Primary Education Development Plan p.5

In order to make sure that all children who are 7 – 12 years old are enrolled into standard one, the government abolished school fees and all other mandatory parental contributions from January 2002. Also the government established scholarships from National Education Fund (NEF) to pay for the education of disadvantaged children, including AIDS orphans. Furthermore, the government increased the school capacity by increasing the use of teachers and classrooms available through double-shifts and multi-grade teaching.

**Teacher Recruitment and Deployment**

The government assisted the local government authorities to recruit, train and deploy adequate number of primary school teachers in order to accommodate the big increase in pupils' enrolment, and the increase in staff attrition rates as a result of various factors, including AIDS-related deaths. The plan of the government was to train new teachers as shown in the table below

| Year | New Teachers Recruitment Targets |
|---|---|
| 2002 | 9,047 |
| 2003 | 11,651 |
| 2004 | 10,563 |
| 2005 | 7,286 |
| 2006 | 7,249 |

*Source: The table is based on values in the Primary Education Development Plan p.6*

In order to have a standard teacher-to-pupil ratios and enough teacher-to-pupil contact time that effectively accommodate enrolment increases, the government decided to emphasize on high quality and good teachers' career prospects and terms of service.
In addition, some school especially in urban areas are functioning with morning sessions and afternoon sessions. Also some teachers are supposed to teach several grades in one classroom for a limited time.

## Construction

The government initiated a classroom construction programme that intended to provide enough classrooms and sanitary facilities for the extended enrolment. This programme also, intended to build teacher houses especially in rural and remote areas of the country.
In order to improve the quality of infrastructure in primary schools, the government established the investment grant through which the local government authorities and school communities could implement the construction programme. The new classroom construction targets that was planned in order to cope with the anticipated large increase in the enrolment is shown below

| **Year** | **New Classroom Construction Targets** |
|---|---|
| 2002 | 13,868 |
| 2003 | 13,396 |
| 2004 | 14,203 |
| 2005 | 6,794 |
| 2006 | 5,832 |

Source: *The table is based on values in the* Primary Education Development Plan p.7

### 2.6.2 Quality Improvement

According to the Primary Education Development Plan, the second primary education policy priority is to improve the quality of primary education, focusing on three main components: (a) improving teachers' teaching style and methods in the classroom, (b) ensuring the availability of good quality learning and teaching materials, and (c) ensuring the necessary support for maintaining educational standards. The aim of this is to improve the overall achievement of all pupils in the primary education system.

**Human Resources**
Since teachers' are the main instruments for bringing qualitative improvement in learning, during the PEDP period, professional development of teachers, tutors and other educational leaders is to be emphasized. In this case, teachers' were to be enabled to acquire and develop appropriate pedagogical skills through various cost-effective pre-service and in-service training programmes.

**Teaching and Learning Resources**
The quality of education process is enhanced by the availability of teaching and learning materials like textbooks and curriculum. As schools becomes more adept at producing their own whole school development plans, the PEDP Capitation Grant should become a key mechanism for acquiring textbooks and other materials that will stimulate teaching and learning process. In order to introduce a reliable income stream for essential non-salary expenses at school level, the government established a Capitation Grant equivalent to US $ 10 per enrolled child nationwide as of January 2002. Of this, US $ 4 to be sent to the district to enable schools to acquire textbooks and other teaching and learning materials. The remaining US $ 6 to be distributed to schools through the district council, and school committees to decide how best to use the funds.

## 2.6.3 Capacity Building
The third primary education policy strategy is to strengthen the institutional capacity and competence of the central, local government authorities and school levels(Primary Education Development Plan, p. 11). This is consistent with the government's policies of achieving greater efficiency, reforming the civil service and local government, decentralizing government functions, and absorbing the principles of participation and empowerment into public service.

**Pre-service Teacher training**
The plan of the government is to train a large number of new teachers during the PEDP period and providing them with appropriate qualifications and adequate pedagogical skills. In order to achieve this, the curriculum, the duration and timing of teacher training courses and the resources in the teacher training colleges were to be reviewed in line with this objective. The government's strategies in line with capacity building are: (a)to revise the

teachers' training curriculum; (b) to increase the number of new teacher trainees; (c) to conduct in-service professional development of tutors and recruit new tutors; and (d) to review and rationalize the timing, duration and overall operation of pre-service training(Primary Education Development Plan, p. 12).

.

**Governance and Management**

The head teachers, school committees, ward education co-coordinators, inspectors and local government authority staff are to enabled about the whole school development plan, district education development plan and national education plan. Issues that planning is taking account of, include the impact of HIV/AIDS on the education system, ensuring gender-equity, and governance. The overall aim if to improve management, accountability and efficiency throughout the system so that children receive a better education.

**Financial Management**

The PEDP requires new financial mechanism in order to devolve financial management to school level. Head teachers, ward education co-coordinators, and district, regional and national staff were to be trained in the new financial management modalities. The emphasis of training is on the ability of each level in the system to adhere to financial regulations and to render financial accountability in the use of the Capitation and Investment Grants, and of the capacity building fund.

The 1990 Jomtien "World Conference on Education for All" (EFA) was instrumental in identifying internationally agreed targets for the provision of education as a basic human right. It is the UPE campaign, which remains at the core of Tanzania's determination to achieve EFA. Its principles of access, equity and quality for all children underpin many of the policies incorporated into this plan for developing primary education.

## 2.6.4 PEDP Institutional Arrangements

The fourth strategic priority for primary education is to optimize the use of human, material and financial resources within the existing institutions that compromise the education system. To meet the human, material and financial aspects of this goal, the government increased the overall budget allocation to primary education and encouraged greater community participation and enhanced donor financial inputs.

**Administrative Arrangements**

The policy development and monitoring will continue to be centralized in the ministries during the PEDP period. But, some authoritative tasks, like management of education provision and development were delegated to local government and schools. In the PEDP the roles and responsibilities of local government bodies at village (school committees), ward (ward education co-coordinator), district (district education officer), and regional (regional secretariat and regional education officer) levels were defined and extended.

At national level, there are two ministries, which are responsible, the ministry of education and culture (MOEC) and the president's office-regional administration and local government (PO-RALG).

**MOEC**

The roles and function of MOEC include collaborative planning, monitoring and evaluation, and determining policy, regulations, and quality assurance standards. The permanent secretary is providing overall strategic leadership for the PEDP implementation and development within MOEC. In implementing its tasks, MOEC is supported by the core institutions like, Tanzania institute of education, national examination council of Tanzania, institute of adult education, Tanzania libraries services, and the university of Dar-es-Salaam. The PEDP programme co-coordinator is responsible for co-coordinating MOEC directors, and consultations with NGOs, donors and other stakeholders.

**PO-RALG**

The role of PO-RALG is to oversee the decentralization of government functions to local levels, including the delivery of primary education by district authorities. It provides technical support to, and guidance to the regional secretariats and local government authorities. At national level it monitors, evaluates, and co-ordinates regional education development plans in collaboration with MOEC. The PEDP programme co-coordinator from the PO-RALG education team is responsible to direct and oversee the implementation of PEDP.

The plan is now on ground with visible success outcomes. The first boosted grade one intake is in grade four now. Last year in grade three, there were 1,486,628 pupils, which was double of what existed before the drive. In 2003 the country made some achievement, because, the gross enrolment

ratio was 105.3% and the net enrolment ratio was 88.5%, while gender parity was 49.9% of girls in primary schools

## 2.7 Secondary Education Development Plan (SEDP)

The Secondary Education Development Plan (SEDP) was developed within the context of the broad Education Sector Development Programme (ESDP) and the Secondary Education Master Plan (SEMP). The overall goal of Secondary Education Development Plan is to increase the proportion of Tanzania youths who complete secondary education at lower and upper levels with acceptable learning achievements. In order to realize this goal, plan has five strategic priorities, namely: (a) access improvement; (b) equity improvement; (c) management reforms; and (d) education management system improvement.

### 2.7.1 Access Improvement

The main objectives here is to increase the transition rate from primary to lower secondary education so as to avail greater opportunities for those completing primary education to pursue secondary education. In order to achieve this objective the government planned to optimize utilization of teachers and existing facilities, construct new schools, and expand open and distance learning. The government targets are to increase transition from primary to lower secondary education from 21% in 2002 to 50% by 2009 and transition rate from lower to upper secondary education from 15% in 2002 to 25% in 2009 through:

**(i) Completion of existing schools**

The government will increase the capacity of existing two streams school to four streams as follows:

| Items | 2004/05 | 2005/06 | 2006/07 | 2007/08 | 2008/09 |
|---|---|---|---|---|---|
| Classrooms | 427 | 427 | 427 | 427 | 0 |
| Staff houses | 427 | 427 | 427 | 427 | 0 |
| Chairs | 17,507 | 17,507 | 17,507 | 17,507 | 0 |
| Tables | 17,507 | 17,507 | 17,507 | 17,507 | 0 |
| Libraries | 214 | 0 | 0 | 0 | 0 |
| Supply of water | 53 | 0 | 0 | 0 | 0 |
| Supply of electric power | 53 | 0 | 0 | 0 | 0 |
| Laboratories | 320 | 0 | 0 | 0 | 0 |

*Source: The table is based on values in the Education Sector Development Programme – Secondary Education Development Plan (SEDP) p. 7.*

## (ii) Rehabilitation of 100 old government secondary schools:

| Items | 2004/05 | 2005/06 | 2006/07 | 2007/08 | 2008/09 |
|---|---|---|---|---|---|
| Schools (normal) | 20 | 20 | 20 | 20 | 0 |
| Schools (Disabled)* | 8 | 0 | 0 | 0 | 0 |
| Infrastructure of urban schools with double shift | 63 | 0 | 0 | 0 | 0 |

*Source: The table is based on values in the Education Sector Development Programme – Secondary Education Development Plan (SEDP) p. 7.*

* one toilet, one classroom and one special room shall be rehabilitated in each school of the disabled.

### (iii) Construction of new lower secondary schools in underserved areas:

| Items | 2004/05 | 2005/06 | 2006/07 | 2007/08 | 2008/09 |
|---|---|---|---|---|---|
| Classrooms | 458 | 1,251 | 2,361 | 3,015 | 5,633 |
| Laboratories | 362 | 596 | 1,039 | 1,773 | 3,470 |
| Libraries | 121 | 199 | 346 | 591 | 1,157 |
| Administration blocks | 121 | 199 | 346 | 591 | 1,157 |
| Assembly halls | 121 | 199 | 346 | 591 | 1,157 |
| Toilet halls | 121 | 199 | 346 | 591 | 1,157 |
| Staff houses | 1,206 | 1,987 | 3,463 | 5,910 | 11,566 |
| Supply of water | 121 | 199 | 346 | 591 | 1,157 |
| Supply of electric power | 121 | 199 | 346 | 591 | 1,157 |
| Chairs | 146,103 | 180,283 | 244,890 | 351,818 | 758,700 |
| Tables | 146,103 | 180,283 | 244,890 | 351,818 | 758,700 |
| Hostels for girls | 2 | 5 | 5 | 3 | 2 |

*Source: The table is based on values in the Education Sector Development Programme – Secondary Education Development Plan (SEDP) p. 7.*

### (iv) Construction of requisite facilities in 14 lower secondary schools being up-graded to upper secondary schools

| Items | 2004/05 | 2005/06 | 2006/07 | 2007/08 |
|---|---|---|---|---|
| 'O' level schools converted to 'A' level | 7 | 7 | 0 | |

| | | | | |
|---|---|---|---|---|
| Lecture halls | 4 | 3 | 0 | |
| Assembly halls | 3 | 4 | 0 | |
| Hostels | 7 | 7 | 0 | |
| Ablution blocks | 7 | 7 | 0 | |
| Expansion of 64 'A' schools – classrooms | 128 | 128 | 128 | 128 |
| Hostels | 48 | 48 | 48 | 48 |
| Ablution blocks | 16 | 16 | 16 | 16 |

S*ource: The table is based on values in the Education Sector Development Programme – Secondary Education Development Plan (SEDP) p. 8*.

**(v) Expand open and Distance learning:**

In order to expand open and distance learning, the government's target is to enroll 50,000 out of school youth and adults participants in secondary education through non-formal methods by 2009. Also the government intends to reduce drop-out rates from 6% in 2003 to 2% in 2009, as well as reducing the failure rate at form two from 31.2% to less that 25% in 2009.

Equity Improvement

The main objective is to ensure equal participation across geographical, gender, different disadvantaged groups, and income level so as to achieve balanced and harmonious development. In this case, the government will construct schools in underserved areas, provide scholarship to children from poor families, improve education facilities for disadvantaged groups, and improve the performance and retention of girls. The government's target here is to increase the number of children getting scholarship from 6,000 to 12,000, improve facilities in 8 school with disabled students, as well as constructing hostels in girls' secondary schools, especially in nomadic areas by 2009.

## 2.7.2 Quality Improvement

The main objective of this quality improvement is to have a market responsive curriculum, with an efficient and effective delivery system. In this context the government's strategies are: (a) to review science and mathematics subjects, based on learning abilities; (b) to focus on creating compulsory subjects in form 1 and 2, which include: Kiswahili, English, mathematics, civics, history, biology, physics and chemistry; (c) to train adequate number of teachers; (d) to provide adequate financing for the provision of teaching and learning materials; (e) to provide appropriate in-service training to both teachers and tutors; and (f) to establish online teacher training system in all diploma colleges. The government's targets

here are: to have a reviewed curriculum by 2006, to develop the national curriculum and examination framework by 2005, to make the student-book ratio 1:1 by 2009, to establish on-line teacher training system in 14 diploma colleges, and to provide adequate qualified teachers for all subjects in all schools and colleges by 2009 (SEDP, p.9)

**Improving Students Learning Time**
Since, students in most of day schools do not spend enough time to learn and study, the main objective here is to maximize time-on-task and provide incentives for students to learn.
In this case, the government's strategy is to provide lunch by the use of the capitation grant and parental contribution. And therefore, the target is to provide lunch in all day schools by 2005.

**Girls Retention and Achievement**
The main objective is to improve the retention and achievement of girls in secondary schools. In this context, the strategies of the government are: (a) to provide remedial classes to girls who are under performing; (b) to improve guidance and counseling services and facilities for girls, privacy in schools; and (c) to provide user friendly materials in science and mathematics. The government's targets are: (a) to establish remedial classes for all under performing girls in all schools by 2005; (b) to firmly establish guidance and counseling services in all schools by 2007; (c) to provide adequate facilities for girls privacy in all schools by 2009; and (d) to provide user friendly materials by 2006 (SEDP, p.11)
.

## 2.7.3 Management Reforms

The main objective of management reforms is to improve the operational effectiveness and efficiency of secondary education by reducing bureaucracy in decision making and encouraging community participation. The government strategies here are: (a) to devolve authority of financial/operational management of schools to school boards; (b) to promote accountability of heads of schools; (c) to develop school plans of execution; and (d) to train school heads, board members and management team. The targets of the plan are: (a) to devolve authorities and responsibilities to lower levels by 2006; (SEDP, p.11&12)

## 2.8 Higher Education in Tanzania

### 2.8.1 Brief Description of the Higher Education System in Tanzania

Tanzania has a dual system of post-secondary education with a clear distinction between what is categorized as tertiary education and higher education. Tertiary education institutions train, prepare, and produce middle level professionals in different occupations-usually not requiring a university degree as a basic entry qualification. Higher education institutions, usually universities, university colleges, and institutes train high-level manpower for occupations requiring a university degree or equivalent as a basic entry qualification in a profession.
Higher education in Tanzania can be differentiated into a *university sector*, including both public and private institutions, and a *non-university sector*, the latter comprised largely of government-owned institutes and colleges.

There are currently four public universities and 19 private universities and colleges. With the exception of one private university that has existed as a Catholic owned higher education institution for the past thirty years, private higher education is a recent phenomenon in Tanzania.

Beginning in 1997, private universities were granted permission to begin operations (Luhanga, 2000). By 1999, 19 private institutions were undergoing accreditation reviews by the Higher Education Accreditation Council (HEAC), and twelve of these admitted students in 1999-00 academic year, offering Bachelor's degrees as well as advanced diplomas in different fields. There is only one accredited private university so far, which offers Bachelor's and Master's degrees and postgraduate diplomas in medicine and nursing.

The non-university sector is comprised of institutes and colleges offering a multitude of technical, vocational, and professional courses in accounting, computer science, business administration, journalism and mass communication, engineering, teacher education, clinical medicine, agriculture, community development and social welfare (ESAURP, 1994). The sector enrolls more than 14,000 students annually.

Admission to public universities is very competitive, and is based on pass mark achievement on the Advanced Certificate of Education Examinations (ACEE). A limited number of non-traditional students enter public universities through Mature Age Entry Examinations and through distance learning conducted by the Open University of Tanzania that operates in all 25 regions of Tanzania Mainland. Higher education is also offered through the World Bank sponsored African Virtual University through its Dar es Salaam based campus.
Higher education access and participation in Tanzania is influenced by socioeconomic status, ethnic origin, religion and gender. The major ethnic groups that had the initial advantage of getting Christian missionary education continue to dominate higher education institutions and positions of power and influence. Moslems are underrepresented in higher education and in positions of power (Ishengoma, J. M. & Deborah, Youngman, 1999).
In the 1999-2000 academic year, a mere 0.3 percent of students completing primary education gained admission to universities. The university age cohort participation rate in higher education is 0.27 percent in Tanzania, compared to 1.47 percent in Kenya, 1.33 percent in Uganda, 4.66 percent in Namibia, 0.33 percent in Mozambique, 0.44 percent in Angola, and 1.05 percent in Zimbabwe (CVCPT, 1999). In the 1999-2000 academic year, total enrollment in public universities was 12,665 students, with women comprising 23.8 percent. There were 873 students enrolled in private colleges and universities in the same academic year (MSTHE, 2000).

University degrees, especially those from public universities, are highly valued by society despite high levels of unemployment among university graduates. For example, out of an annual average of 832 university graduates in a recent year, only 20 percent were found to be gainfully employed.

All public higher education institutions, though semi-autonomous, are regulated and controlled by the government through the Ministry of Science, Technology, and Higher Education and other relevant governmental ministries. The government allocates funds and approves budgets for universities and other higher education institutions, and appoints (and at times fires) the heads of these institutions.

### 2.8.2 Financing Higher Education in Tanzania

Sharing of higher education costs is not a new phenomenon in Tanzania. The practice existed in various guises from before independence through 1974 when the government took over all responsibility for paying for higher education in exchange for a student's working for two years in the public sector. Formal cost sharing in higher education was re-introduced in the late 1980's due to economic crisis during this period that reduced the government's financial support to the sector and as part of wide-ranging economic and social reforms under the IMF/World Bank sponsored structural adjustment programs (SAPS). The government first formally adopted cost sharing in higher education in 1988, but for political reasons, made its formal announcement in January 1992, two years after the general elections.

Due to the fact that higher education in Tanzania was "free" for more than 25 years, the government decided that the implementation of cost sharing should be in three successive phases.

The first phase became operational during the 1992/93 academic year. In this phase, students and their parents were required to pay their own fares to and from their respective places of domicile to universities. Prior to the introduction of this new measure, students were entitled to travel free in second-class coaches. Students were also entitled a 50% discount on domestic air travel.

The second phase of the cost sharing policy was implemented during the 1993/94 academic year. In this phase, students were required to pay for food and accommodation, student union fees, and caution money. The so-called higher education allowance was eliminated during this phase. The government retained responsibility for covering tuition fees, examination fees, book and stationery allowances, special faculty requirements, registration fees, and field allowances.

During this phase the government also introduced loans that are available to all students to cover on- or off-campus accommodation costs and meals sold in university cafeterias that have been privatized. Currently, the government pays every student 3,100 shillings ($US3.68) per day to cover accommodation and meals. The government wanted to reduce this amount to 2,500 shillings ($US2.97) per day beginning in the 2001-2002 academic year, but students resisted. Parents/guardians are co-signatories for these loans.

The third phase is envisaged to involve partial payments by parents and students of the following costs: tuition fees; examination, books, and stationery allowances; special faculty requirements; and field practice allowances.

In October 1998, the MSTHE released a comprehensive *Report of the Task Force on Financial Sustainability of Higher Education in Tanzania*. This report recommended several funding options for higher education and different ways of improving and/or modifying the implementation of cost sharing. Among the recommendations to be implemented by the central government is the introduction of a means-testing system to ensure that those who have the ability to pay do not get government loans and grants. It is proposed that means-testing system should also include the so-called "*democratic public confirmation of the ability to pay of such candidates directly involving the community*." At present, local leadership confirms the ability or inability of the candidates to pay higher education costs—and as expected, this "means testing system" has been grossly abused.

**The Task Force proposed the following distribution of financial responsibility.**

Table 1
Contribution to Higher Education by Stake Holder

| Source / Stakeholder | % Contribution |
|---|---|
| **Central government, local governments & communities** | **82** |
| **Students, parents, &households** | **12** |
| **Higher educations institutions & donors** | **4** |
| **Other sources plus faculty** | **2** |

*Source: This table is based on the figures given in the Task Force Report on p.xvii*

The major concern of many parents, students, and higher education practitioners has been how loans will be repaid in the situation where university graduates are not guaranteed jobs and graduate unemployment is rampant. At present, students have to pay these loans when they finish their studies whether they have a job or not. Other than the general expectation that loans will be repaid over the period of 16 years after graduation, no recovery mechanism is yet in place, although the first loans have now become overdue (MSTHE, 1998). Some 11.85 Tanzanian billion shillings

had been given out as loans to students between 1994-1999 according to anecdotal evidence.

**CHAPTER 3**

# 3. EXISTING USE OF COMPUTERS IN TANZANIA


***3.1 Deployment of ICT in Tanzania***
***3.2 Status of ICT in Tanzania***
***3.2.1 The National ICT Programmes and Projects***
***3.3 The Overall ICT Environment in Tanzania***
***3.3.1 Access to ICT Facilities***
***3.3.2 ICT and Education***
***3.4 ICT and Society***


## 3.1 Deployment of ICT in Tanzania

Rapid global technological changes have made services enabled by ICT a prerequisite for socio-economic development because it enables people to share and exchange information, knowledge and experience, and thus empowers them to address the challenges they encounter in every day life more easily. ICT is vital for good governance including gender balance, poverty reduction, health, social and education services improvement, and for opening new opportunities for creating wealth.

Tanzania embarked on the development of ICT only few years ago. Initiatives to develop ICT came from individual, public and private entities. Although these initiatives recorded commendable achievements, the lack of an overall policy and poor harmonization have led to random adoption to different systems standards as well as wasteful duplication. Recognizing the development potential of ICT and the need to address the issue of

coordination and harmonization, in 2001, the government appointed the Ministry of Communication and Transport as the national ICT coordinator and a focal point of all ICT related issues. The main tasks of the ministry communication and transport were to formulate and prepare the national ICT policy document that will guide the provision of ICT services in Tanzania, and to recommend a suitable and sustainable institutional setup which will be responsible for the facilitation of ict services to all sectors of the economy. The ministry is also required to create a conducive environment that encourages growth of public-private partnership in ict development. Over the years Tanzania has achieved notable progress in deploying ict. The achievement was a result of various adjustments since early nineties in policy, regulatory and commercial facets, both macroeconomic and within ICT's converging sector. The private sector has certainly contributed to these achievements by investing in among others, support facilities, training centers and sales outlets. These efforts have enabled government departments, institutions of learning, non-governmental organizations (NGOs), as well as other private entrepreneurs, to acquire ict solutions that address their individual problems more appropriately. The plan is to integrate ict into Tanzania’s national development plan aiming at improving the living standard and quality of life of Tanzanians and creating a more informed society.

### 3.2 Status Of ICT In Tanzania

Tanzania has made remarkable progress in deploying ict. This progress has been well received by the citizens and service providers who striving to address unmet demand and competition in newly liberalized markets. This chapter summarizes the current status of ict in Tanzania and highlights the

gaps that need to be addressed to position the country appropriately for the new knowledge-based society.

### 3.2.1 The National ICT Programmes and Projects

Main focus of the ongoing initiatives and projects is on Internet connectivity and information dissemination through the Internet or public databases. Target groups for these activities are often rural population, women and youth. There are also ongoing projects to facilitate the transformation of University and its administration towards IT. Few projects have the goal to give direct support in private sector development, and the role of the private sector as an engine in transformation of the society is very little discussed. So is the need of professionals to make the technology work. The use of Internet and information dissemination through Internet is easy for the user and demands little training. But this ease of use does not mean that the technology itself is easy and uncomplicated. On the contrary, a successful implementation of IT in every day use requires people who are able to manage computers, networks, software and contents.

In the plan to improve the use of ICT in the country the Tanzania Commission for Science and Technology (COSTECH) in collaboration with the International Institute for Communication and Development (IICD), established programmes and projects in 2002/2003 to foster the deployment and use ICT equipments. These projects includes: Tanzania National ICT Policy, Capacity Building of the National ICT Coordination office, Strengthening of ICT Policies in Africa – A Case of Tanzania, ICT Infrastructure and e –Readiness Assessment for Tanzania, eThink Tank Tanzania, etc.

## Tanzania National ICT Policy

The main objective of this project was to have the national ICT policy in place with Mission and Vision.

The ministry of communication and transport coordinated this project, since, it is the national coordinator and a focal point of all ICT related activities. The ministry formed a task force of 15 members to do that task with support from the government of Sweden.

Capacity Building of the National ICT Coordination office

The objectives of this project were to:

- Strengthen the capacity of the national ICT coordination office staff for effective and efficient delivery of ICT services to user
- Renovation of the coordination office
- Provide the coordination office with working equipments for improved performance
- Strengthening office documentation system

The ministry of communication and transport coordinated even this project. The ministry formed a 17 members national ICT task force led by Prof. Mathew Luhanga, Vice Chancellor of the University of Dar-es-Salaam. The task force was charged with tasks of working out modalities and strategies for the establishment and deployment of ICT in Tanzania. This included formulation of a suitable ICT policy and recommend for an efficient national

ICT institution that will carry out the role of coordinating, planning, management, monitoring and evaluation of the implementation of national ICT project activities.

**Strengthening of ICT policies in Africa- a case of Tanzania**

The main objective of this study was to strengthen the national information and communication technology (ICT) policy for the purpose of providing an enabling environment for effective development of ICTs for sustainable development in Tanzania. This study, intended to identify national governance, equity and institutional issues, basic regulatory principles and suggest some guidelines for reviewing public telecommunication policy as well as ICT policy that will provide an enabling environment for the sector to move forward.

**ICT Infrastructure and e-Readiness Assessment for Tanzania**

The main objective of this project was to measure the capacity of Tanzania to participate in the digital economy.

The project had a national scope and was expected to cover top leadership in all government ministries, 15 administrative regions, 18 districts, 46 public institutions and public sector. The assessment also covered about 1000 people randomly picked from all walks of life, paper clipping from selected daily/weekly newspapers, and other secondary sources.

**eThink Tank Tanzania**

The eThink Tank was formed on 8th February 2000 in the meeting attended by 5 participants, with the aim of creating a clear national direction on ICT matters in Tanzania. eThink Tank is a virtual organization with no formal structure or staff, relying on volunteers and partnerships to achieve its goals. However, specific partnerships have resulted in resources or facilities being provided to achieve specific ends. In this regard a diverse array of partners have included: CATS, Civil Service Department, Costech, Government of Italy, IICD, KPMG, MOCT, Raha.com, SIDA, Tansoft, UNDP, and World Bank. eThinkers are representing Tanzania's interests at the highest level of national and international or global fora. Some of the global for a include the Commonwealth Telecommunications Organization, G8 DOT Force, the UN ICT Task Force and many more including conferences, workshops, etc.

**ICT Learning and Management Improvement in Teachers Colleges**

The main objective of this project was to enable all teachers colleges students to be ICT –literate when finishing their studies and for teacher education to use the benefits of ICT as a teaching and learning tool.

**Distance Learning and Education Services**

The main aim of this project is to use the Internet and other information and communication technology's facilities to improve the quality and access to educational materials to secondary schools children in Tanzania.
Distance Education for secondary schools provides up-country schools with learning material and tutoring on-line from the central information center.
To date, more than 600,000 students have already benefited with the project, while an estimate of 8,500 types of learning materials are expected to be bought by the end users for the period of the project which is five years.

**Teachers' Professional Development**

The objective of this project is to train teachers on how to use ICT to improve teaching and learning process at schools including the teachers' colleges. The main intension is to cover the gap related to lack of textbooks both at teachers' colleges and schools.

**The African Virtual University at UDSM**

The main aim of the project was to increase access to relevant, cost effective and flexible tertiary education and training throughout Africa by leveraging ICTs. The learning center is facilitating the delivery of African Virtual University (AVU) facilitated degrees, diplomas, certificates and short courses in areas: Information and Communication Technology, Journalism, Business Management, Accounting and Languages .

**Tanzania Development Gateway**

The main aim of this project is to bridge the digital divide for Tanzania's knowledge sharing networks, and other relevant partners, enabling a broad

array of stake holders to partner network, share and exchange knowledge and other resources.

This project is an Internet portal that provides and promotes exchange and dissemination of information on development matters. It assists Tanzania to take advantage of the most important aspects of the Internet, and build the ability to capture and disseminate information services consistently across Tanzania. One of the underlying purpose of the gateway is the provision of online resources to promote and support grassroots initiatives by current and potential website owners to work together towards making each other more productive in achieving their respective objectives.

**Tanzania Internet Exchange**

Tanzania Internet Service Providers Association (TISPA) undertook this project with the following objectives:

- To establish internet infrastructure in Tanzania
- To route local traffic locally
- To reduce dependence on international links

Tanzania Internet service providers (ISPs)are all connected to the Internet abroad over slow and expensive links. In order to solve this problem, ISPs in Tanzania are encouraged to exchange traffic between each other on local level and not route it through international gateways.

### 3.3 The overall ict environment in Tanzania.

Despite the rapid improvement, Tanzania's ict environment is still somewhat challenged. Ict is concentrated in Dar-es-salaam, commercial capital with little or no deployment or access in other urban centers or in rural Tanzania. Currently very few educational institutions have computer laboratories and other multi-media facilities and these are more prevalent in private educational institutions than in public. In any event facilities are insufficient to meet demand. In addition while there is an official Secondary school computer studies syllabus for forms I – VI developed in 1996 and issued in 1997, it is severely out of date with respect to the evolution of technology since the early 1990's. Further more the lack of the programme for training teachers on computers and other multi-media utilization has been identified as a major reason for slow take up of computer studies in primary and secondary schools.

In general there is a shortage of well-qualified professionals of ict in Tanzania. There are also no well-established ict professional profile, and a standardized process of evaluation or certification of the different courses by various training centers. Access to online and distance learning is also still limited.

While there are many Tanzanian websites most are in English and are not therefore a dominant medium for society to access information. Many websites are not updated regularly and appear to be an advertising presence on the web. However some are vibrant websites with majority publishing local news on the web, while others demonstrate some convergence by giving access to radio programmes on the Internet. The potential of e-

commerce is constrained by the lack of local digital credit cards and an appropriate legal framework that engenders an environment of trust, security and accountability.

**The ICT service sector**

The it service sector is growing rapidly in number and capacity. During the last years the number of companies offering hardware, software and maintenance services has almost doubled. Most of service providers are still relatively small, the largest companies employing 70-80 people. The demand for ICT services is steady increasing and many established companies are growing at an average of 20-50% per year in terms of staff. The major part of the business is located in Dar-es-salaam, but small enterprises in Arusha and Mwanza regions is growing as well as the presence of Internet cafés. The ICT service sector is still in the beginning of the development curve that in the more mature market is characterized by high specialization and focusing on state-of-art core competence. Apart from the Internet service providers, there are only few companies with distinct specialization. The Tanzanian ICT services providers offer a wide range of services and products, for example, hardware, software, networking, peripherals, accessories and training. Some companies offering hardware/software services also can offer consultancy in systems design, development and implementation.

ICT service providers have difficulties to find trained ICT professionals the labour force of ICT professionals is quite small and the demand is growing very faster than the supply. The country also looses skills abroad since the labour market for well-trained ICT professionals is global. Companies operating in Arusha and Mwanza have the biggest difficulties finding

adequate staff due to the competition both from Dar-es-salaam and foreign countries.

Some of the companies have started and are returning residents with skills and working experience acquired abroad. It is also common- in particular with training providers- employ expatriates. This core competence often provides for in-house training of new staff. But in-house training is not sufficient to provide the business with specialist skills in the area of systems analysis, development and programming and the lack of these skills is becoming a bottleneck in further growth of ICT sector.

**Scope and Coverage of computer training and education**

Major part of the supply is short-term courses at basic level and the target is end-user.

Most of the training providers are small and have limited number of courses and seats available. Apart from the University of Dar-es-Salaam (UDSM), the Dar-es-Salaam Institute of Technology (DIT) and the Institute of Finance Management (IFM) which are public institutions, there are more 6 private IT training providers offering IT career education and advanced further education for IT professionals. These includes:, the African Virtual University (AVU) in collaboration with UDSM and the Open University of Tanzania (OUT), New Horizons, Soft-Tech Consultants, Aptech, Cats, etc. Since there are no international or national general standards for diploma courses, it is very difficult to judge the quality of the existing training programmes, but we doubt that all providers would qualify as career/advanced career education providers. However, some of the providers operate according to high international standards set Microsoft, Owell and

Oracle. They also have ambitious curricula and apply selection criteria for applicants and provide for job practice.

Generally the standard of facilities is good and equipment modern. Some of the providers can also offer radio links for fast Internet connections and have own power supply systems.

Access to candidates with good basic education (Form VI) and higher education (university degree) is very good. Though knowledge in English is essential in all IT training, many appropriate Form IV students disqualify due to lack of adequate skills in English.

The main problems facing the training are lack teachers and lack of job practice. There are hardly any teachers available at professional levels. For career courses and advanced user courses most teachers are expatriate from India with short-term assignments.

Since IT is fully implemented in few working sites, the opportunity to conduct job practice are limited. The education system in general also has a tendency to underestimate the value of job practice to the advantage of lab excises and theoretical studies.

**Current use of IT in industry**

The current estimation of the number of Internet users is put at 20,000 of whom 80% are in Dar-es-salaam. The number of computers in the country is estimated at 180,000, 60% of them are found in Dar-es-salaam.

Tanzania was the late to meet the challenge of being a member of the global information society. In fact, computers were banned in 1974! The ban was never totally implemented, but import and use of computers were controlled and restricted by detailed government guidelines from 1974 – 1991.

This period has without doubt seriously delayed computerization of government administration and enterprises; actually it has just started if the

content of the word computerization is meant to be the following activities conducted by using computers:

- Collect, compile, store, process and analyze information
- Replace manual work with computerized routines
- Have electronic internal and external communication
- Share and exchange data and information within the entire organization
- Develop new products and services

Instead existing computers are often used as advanced typewriters, calculators and mailboxes. Standard package applications are used mainly for accounting. In many companies computers are not linked together in networks and if so, not throughout the entire organization. But there is an awareness of the importance of IT, a major concern of being left behind in the development and a willingness to learn more about IT.
Building up networks has started and many companies plan to install local area networks (LANs) and wide area networks (WANs). Some large enterprises- in particular within the export industry and in industry facing foreign competition – have formed a picture of how IT can be utilized to gain the operations and started to specify needs for databases, software applications and system integration. Since the technical solutions and applications are rare, only a few, large companies have IT departments. One person, not always an IT professional, often manages all IT issues. In case there is IT staff, it consist of trouble-shooters. Development and maintenance of IT solutions is outsourced. The majority of employees are not using computers at all, and there are very few advanced computer users.

Due to lack of own IT skills and knowledge of the utilization of IT, the competence and procurement of IT solutions is low. The buyers are heavily dependent on vendors and the risk of over investment of the operations is obvious.

**Current use of ICT in Government Administration**

The current situation in government administration with regard to computerization and use of computers is even worse than in the private sector. Very few have access to computers and fewer to e-mail and Internet. There is an awareness that existing computers are under-utilized due to computer literacy and that the need of user training and enhanced awareness of the benefits of ICT is extensive.

During the past few years the government administration has also undergone a rationalization process. The staff is dimensioned as if the operations were computerized and subsequently the departments are undermanned due to the absence of computer support and computerized routines. The need and benefits of IT are identified and formulated. The immediate needs are above all networks, databanks and system/standards for performance monitoring, control, policy formulation and formulation/review of regulatory framework.

## 3.3.1 Access to ICT Facilities

**Infrastructure**

Tanzania's teledensity is still low, with the number of fixed and mobile cellular lines currently standing at 11 telephone lines per 1000 people and

number of mobile phones subscribers currently stands at 81 per 10,000 inhabitants. In contrast, the city of Dar-es-Salaam has 5 fixed lines and 10 mobile subscribers per 100 people.

Tanzania's Public Switched Telephone Network (PSTN), using fiber optic, microwave and satellite-based links, is now over 95% digital. This paves the way for allowing new services enabled by ict. However, the coverage of the network infrastructure is still limited to urban areas and thus lack of telecommunications and other infrastructures in rural areas remains a basic impediment to the provision of such new ict services.

**Internet availability**

The Tanzania Communication Commission (TCC) has licensed six companies to provide public data communication services including Internet bandwidth. However, these data operators have isolated initiatives of connecting their Points-of-Presence (PoPs) to the global Internet backbone. As a result, Tanzania lacks cheaper and high capacity connections to the global Internet, and all connections, regardless of the data service provider. There are small capacity international links that connect to the global Internet backbone in different countries. Therefore, the limited international Internet bandwidth is scarce and extremely expensive. The lack of hierarchical and national Internet Exchange Points (IXPs) means that much of Tanzania's local traffic is being expensively routed via international gateways.

There are presently sixteen-licensed Internet Service Providers (ISPs) in Tanzania providing between 10,000 and 15,000 dial-up accounts in the

country with many more users via Company and Government Local Area Networks (LANs) and internet Cafés. Available e-readiness studies suggest that there is a large unsatisfied demand in the country for Internet access.

**Hardware and software**

There is no local manufacturer of ict equipments in Tanzania. Instead, local dealers or agents import computers and related equipments. There are also no standards guiding the imports of both hardware and software. Few local companies are developing application packages. Most of the software used by both public and private sectors are imported at considerable cost. In general, Tanzania has a small emerging skilled capacity to support the ict industry in terms of developing, selling or supporting hardware and software.

### 3.3.2 ICT and Education

**Educational access to ICT**

Currently very few educational institutions have computer laboratories and other multi-media facilities. These facilities are mainly found in private schools, while very few public schools have these facilities and of low quality. At universities and other institutions of higher learning, few computers are available for use by students and academic staff. Internet access bandwidth at these institutions is limited, ranging from 32kbps to 512kbps. Though numerous, cyber cafes do not currently offer conducive environment or pricing structure to make them viable as e-learning centers.

**Enhancing education using ICT**

In order to prepare local ict professionals Tanzania developed an official Secondary School Computers Studies syllabus for forms I – VI in 1996, and issued it, in 1997. However, only few students have taken these course so far, because there are no computer laboratories and trained computer teachers in most of the schools. In this respect, private schools are far better than public schools. Generally, the use of ict enhances effective delivery of education, but this benefit is only evident in schools and colleges in urban areas.

**Developing the ICT workforce**

In general there is a shortage of well-qualified professional of ict in Tanzania. There is also no well-established ict professional profile, and a standardized process of evaluation or certification of the different courses offered by various training centers is lacking. Access to online and distance learning for ict is also still limited. Furthermore, opportunities for training are mostly limited to few urban centers.

## 3.4 ICT and Society

## ICT in Everyday Life

Many ICT users in Tanzania access Internet through Internet cafés. There is also a need to reduce barriers in deploying ICT and in developing the required human capital for sustainable participation of Tanzania society in the ICT industry.

On the other hand, there is already a significant improvement in the penetration of fixed and mobile telephone lines and public pay phones in

urban centers. However, the available e-readiness evidence shows that there is a need to increase the availability of ICT as a result of the high current demand and burgeoning awareness.

### ICT in Workplace

There is sufficient evidence that several large organizations and companies make extensive use of networked computers, some with Internet access. The banking sector makes heavy use of ict to provide improved customer services with some banks using Very Small Aperture Technology (VSAT) or public leased lines to interconnect their branches and cash dispensing Automatic Teller Machines (ATMs).

However, anecdotal evidence suggests that smaller companies, and many institutions outside Dar-es-Salaam, make marginal use of ict in their daily operations. The greatest obstacle of effective use of ict in the workplace according to SIDA (Swedish International Development Agency) survey and the e-readiness report in low capacity of human capital in the use and maintenance of ict.

## 3.5 ICT and the Economy

### ICT Employment Opportunities

The supply of ICT professionals is considerably less than the current demand, especially in the areas of higher skills and experience. Furthermore,

job mobility in the ICT sector is very high. Therefore, there is a need for increasing emphasis on the human capital development aspects to address this situation.

## E-Commerce

Only few websites recently began offering limited e-business services. However, these services are constrained by lack of national payment system, local credit cards and a legislative framework appropriate for e-business. These are constraints that need to be addressed urgently. Consequently, financial institutions are not able to set up provisions for their own and each other's clients.

## E-Governme**nt**

Various arms of the government have made significant progress in deploying ict in e-government solutions. These solutions can be categorized into both government and e-governance solutions. In the category of e-government, several departments are transforming their operations by deploying ict. However, there is no mechanism to ensure that these major initiatives are coordinated or developed within a holistic strategic government plan. To make further progress and reap additional rewards, government needs to develop a comprehensive and holistic e-government strategy for urgent implementation. Not only will this enhance government productivity, but it will also enable the government, as a "model user" of ict, to become a driving force for sustainable progress in the national ict arena. The possibility to provide e-governance services depends up on the existence of an effective e-government infrastructure through which the

public service can communicate internally and with the intended beneficiaries of its services.

## 3.6 Problems and Constraints in Implementing ICT

### Deficiencies in Infrastructure and Investment Climate

Tanzanian companies are operating under some restraints that seriously impedes their opportunities to reallocate resources from basic investments into investments in information and communication technology. These are:

- Unreliable power and water supply
- Poor condition of the roads
- Uncompleted networks for data- and telecommunication

This circumstances force the companies to invest in expensive equipments such as generators, wells, water reservoir, expensive transport equipments, and satellite and radio communications.

In addition there is a number of constraints that strongly affect the corporate performance and put the Tanzanian enterprises to a disadvantage compared to their foreign competitors in terms of cost and quality of products and services.

- High costs of energy and telecommunications
- High import taxes and cumbersome procedures for import clearance
- Complexity of tax structure
- Inefficient administrative procedures for starting and running enterprises
- Corruption

The infrastructure deficiencies also constitute a barrier in realizing new business ideas based on e-commerce, which in turn requires reliable access to web based applications and high efficiency in the delivery chain.

**Under-developed Financial Market**

Investment in ICT are often costly and the lack of credit supply facilities and investment capital is an obstacle in the process of ICT implementation. Interest rate are also high which prevents companies from borrowing even in cases where credits are available. In the long run the lack of instruments for financing participation in training courses can also turn into a barrier in recruiting students in training programmes.

**Lack of Adoption Hardware and Software**

Modern hardware and software is developed for the needs of companies and organizations operating under working conditions and physical environment of the industrialized world. In the tropical climate of many developing countries computers are exposed too much harder stress than usually in the industrialized countries. Extreme heat, humidity, dust and frequent breaks in power supply are a reality on many working sites in tropical Africa. These diverging circumstances cause difficulties in implementing existing hardware, software and applications.

**Lack of Motivation to Replace Existing Production systems with Modern ICT**

The decision makers lack sufficient knowledge to evaluate the benefits of ICT and further implication of computerization. The use of new technologies

becomes a question of cost rather than investment in future income. In this perspective the cost appears to be higher than it would be if the investment appraisal had included both cost and income.

The Tanzanian industry has no tradition of co-operation and linking up with sub-suppliers, one of the main reasons to invest in electronic communication and exchange of information and documents.

**Lack of Competence and Awareness**

The owners and management lack understanding for ICT and sufficient knowledge to evaluate benefits. There is also a lack of commitment, which shows in unrealistic funding plans and time schedules of implementation projects.

# CHAPTER 4

## 4. *AIM OF STUDY AND RESEARCH APPROACH*

***4.1. Science Teaching***
***4.2. Computer studies in Secondary schools.***
***4.3 .Status of Teaching Maths in Tanzania***
***4.4 . Research Approach .***

***Aim of the study: The aim of the study is to find out whether pupils in secondary school learn better by using computer as a tool while teaching. This study is confined to specific subject, math at grade 10 level in Tanzanian secondary schools***.

### 4.1. SCIENCE TEACHING:

Problems in teaching and learning in Tanzanian secondary schools.

The outcome of any teaching is to bring about changes in knowledge level
behaviour, skills and confidence.

The method the teacher applies to bring about these changes in pupils is important. Traditionally teachers adopted lecture method where by teacher transferred a lot of knowledge as specified in the curriculum. The teacher centered lecture method is the predominant approach in Tanzanian.

Secondary schools as well as in most of sub – Saharan countries ( Chonjo, O Saki, Possi &Mrutus; de Feiter, Vonk & Van den Akkar 1995 ), in this method, the pupils remain passive, taking down the notes, to memorize and pass the examination.

There is little chance to think logically and ask questions related to topic.

There is hardly any time for the teacher to promote the students to participate and allow interaction between the teacher and students; students and students.

A study done regarding the situation in science teaching in Tanzania revealed that "Teachers were seen to be authoritative dogmatic and inflexible" ( Chonjo at all 1996 ). Their teaching mainly aimed at conveying the content. The problem is complicated further by the cultural belief that teachers are elders

and are to be respected without challenging with questions. In another study by Osaki ( 1999 ) it was found that pupils depend mainly on the notes given by teachers instead of relevant textbooks.
Teachers also, gave hardly any questions that make students refer textbook or other reference books from library. Most of the time science was taught as rigid formulated facts , rather than a knowledge related to nature and its behaviour. Thus student had only superficial knowledge rather than the specific concept.

Osaki ( 1999 ) also found that teachers teaching science lack skills, such as observations, generation and testing of hypotheses through analysis of data and writing reports of observations and experiments. In another study by ( Chonjo etal 1996 ) reveals that science teaching was in a poor state with respect to books, laboratory supplies, good teachers, classroom presentation, teacher pupils' relation and professional development of teachers.

**Curriculum review**: The most recent curriculum review took place in 1996:
The intervention of the new curriculum is to meet the new demand in Job market. The changes involved all the academic subjects: However the curriculum documents remained students centered.
A more pragmatic change is required in science and math subjects so that students love to learn new things and connect them to the dynamic daily life. People from industries where they use young students should be able to contribute to the curriculum changes.

## 4.2 COMPUTER SYUDIES IN SECONDARY SCHOOLS

The computer studies syllabus is divided into two distinct subjects to be taught at two different levels of secondary schools education.

**Computer literacy to form one two:** It covers general knowledge of the computer history, structure, and the principles of operation. The subject

culminates into developing skills of three computers applications namely, word processing, database and spreadsheet.
At the end of the course pupils are expected to:

- Manage files using computers operating system
- Understanding the division and role of the hardware and software.
- Demonstrate word processing skills and producing a hand copy ( print out ) of a document from a computer.
- Demonstrate skills of database, simple statistical calculation by spreadsheet.

**COMPUTER SCIENCE ( BASIC LANGUAGE )**

This is an optional subject for students of form three and four ( grades 10 and 11 ). The subject is designed to develop skills of logical problem solving and teach the skills of computer programming in BASIC language.

**METHODS OF TEACHING AND LEARNING:**

A computer studies teacher is advised to employ activity teaching methods and "problem solving approach". The teacher will be free to use any other teaching method ( e.g.: exposure teaching method ). Considered effective according to certain circumstances in promoting learning.(From computer studies syllabus form 1 to 6)

## 4.3 The Status of Teaching and Learning Mathematics in Tanzania Secondary Schools

The process of teaching and learning mathematics is in a transition stage: "The School environment and the curriculum need to be dynamic to meet the needs of rapidly changing world."
"Various evidences on the current Status of teaching and learning mathematics in this country have indicated that the performance on the subject by Pupils/Students is not encouraging. Results of form IV or grade ll Students as analyzed by the National of Examination Council of Tanzania (NECTA) for five recent consecutive years (1998-2002) reveal that 202,052 Secondary school candidates equivalent to 74.5% of all candidates who sat of certificate of secondary Examination CSEE got an F grade. This means that these candidate scored between 0 and 20 out of 100 in mathematics. There must be a reasons for this poor performance. Various research –based documents on the possible causes of a such a poor performance are

available. These are such as: educationists, documents, school inspectors subject report, research report by the inspectorate, math academicians journals,, the Science education in secondary school (SESS), and the mathematics association of Tanzania (MAT) just to mention a few . Possible constraints that need a special attention are as follows:

1. **Lack of logic among students when doing mathematics problems solving.**

   The majority of learners in Secondary School level, have not acquired enough knowledge and skills of making connections in mathematics (concept map).They are unable to understand how mathematical ideas inter connect and build on one another to produce a coherent whole by lacking skills of inquiry as an ability and culture to be learned and practiced . Algebraic operation skills which are fundamental to the wider knowledge of understanding mathematics from primary to higher levels of learning is less emphasized in to day's classroom interaction.

2. **Teacher Centered classroom instruction**

   The reports have identified this aspect as another serious problem to effective Teaching and learning mathematics in the classroom. Teachers need to activate the students during classroom interaction so as to motivate the lesson for positive outcomes in the end. The school inspector's report (2002/2003) have indicated that lecture method prevails in classroom instruction by an average of 68% at all levels. This method implies students learn through memorizing taught concept, copying material in notebooks and are heavily tested through factual questions there by making the subject at very boring to them. As a result majority of children from a very early stage of learning hate mathematics even though in real life they will use ideas in a variety of ways.

3. **Lack of Pupils/Students motivation on the subject**

   It was further found that students were not well exposed to environment of Learning mathematics from the experience. Learning experience refers to the Operation as activities through which the learner will acquire knowledge, Skills and attitudes that they are intended to acquire.

4. **Lack/Shortage of Aids and other instructional materials.**

This is another constraint that affects teaching and learning of mathematics in the Country.

According to "Madalla" et.al" (1990), the memory retention in learning by

- Reading 10%
- Hearing 20%
- Seeing 30%
- Seeing and hearing 70%
- Saying and doing 90% (practice)

This is called the Cone of Experience. This problem is affecting 70% of all the institution.

5. **Evaluation on the Pupils/Students mathematics progress not adequate:**

During an individual lesson teachers should evaluate to find out if the learners are understanding and learning the concepts or skills they are teaching. They should also evaluate to discover specific problem, learners may have in skill development and find ways of rectifying the problems noted .In addition evaluation may help the teachers to determine which learners are in the top, middle, or lower part of the class. The evaluation will help the teacher to plan better for the teaching and learning of the subject. Inspection report show that majority of teachers are not evaluating students' progress on the subject.

## HOW CAN MATHS EDUCATION BE PROMOTED?

"We need to discuss critically what transformation is needed in the current curriculum
of mathematics in terms of its enrichment. A good mathematics curriculum need to specify explicitly what is it taught and how is it taught in the class interactions. Indeed they are important issues if we want to transform our to-day's generation from being an admirer of what is going on in terms of

Scientific and technological developments that are occurring to day and are likely to occur tomorrow in this world!

It is this aspect that makes teachers of mathematics think of computer literacy and its application in teaching and learning mathematics. Using of computers in class may also help in:

(a) Student centered instruction
(b) Students motivation on the subject
(c) Solving enough exercises
(d) Evaluating progress of the student instantly
(e) Good exam setting.

## 4.4 Research Approach

Research is viewed as a careful study or investigation under taken in order to discover or produce new knowledge or information that will lead to the development. In this case researches are performed in order to produce new knowledge or new products, sometimes, researches are performed in order to improve the existing knowledge and products. Therefore the main aim of any research is development. Richey and nelson (1996) described development research in education as the production of knowledge with the aim of improving the process, design, development, and evaluation of educational products. Further more research and development in education is described as a scientific search for new and improved knowledge, skills and information that helps the society to improve the quality and standard of its education.

In this study, teachers from three selected schools, who were expected to participate in the new technological teaching approach, were first trained, how to use computers effectively in teaching, and how to prepare and administer valid, reliable and fair tests. Since most of the student who participated in this study were completely computer illiterate, again these students were taught, how to start a computer and open Microsoft Excel, how to enter the data in the worksheet and find results in cells which contain formulas. In this study two classes of the same level or grade were taught the same lesson/topic by the same teacher ( i.e. the same subject matter) using two different approaches (i.e. one class by using the new technological approach and another class by using the traditional approach), assignments and tests were given, and then the results were compared to evaluate the level of student' achievement between the two classes. Students were given assignment at the end of each lesson, and a test was given at the end of the

topic to measure the level of student achievement. All tests and assignment were administered in the same way each time and had the same format. The effect of the new instructional method was evaluated from the comparison of the students' test scores between classes where computers were used and classes where computers were not used. Formal hypothesis tests were used to analyze the data.

# CHAPTER 5

# 5. THEORETICAL FRAME WORK


***5.1 A brief overview of computers in classroom***
***5.2 How to use computers as a tool in teaching***
***5.3 Types activities in the classroom***
***5.4 What are the benefits for teachers and students ?***
***5.5 Potential of using ICT while teaching maths/science***


## 5.1 A Brief Overview Of Computers In Classroom

This section provides a short description of how computers can be used in a classroom to enhance teaching and learning. Researchers who have tried to evaluate whether the use of ICT in education has a significant and reliable impact on student achievement, realized that ICT can not be treated as a single independent variable, and that student achievement is not only measured by how well students perform on standardized tests but also by students' ability to use higher-order thinking skills (such as thinking critically, analysing, making inferences, and solving problems). Judging the impact of any particular technology requires an understanding of how it is used in the classroom and what learning goals are held by the educator involved, knowledge about the type of assessment that are used to evaluate the improvement in students achievement, and an awareness of the complex nature of change in the school environment. Evidence indicates that when used effectively, "technology applications can support higher-order thinking by engaging students in authentic, complex tasks within collaborative learning context" (Means, Blando, Olson, Middleton, Morocco, Remz&Zorfass, 1993). The education

system (educators) must use the knowledge regarding the circumstances under which technology supports the students achievement to make choices about what technologies will best meet the particular needs of the curriculum and also ensure that teachers, students, parents, and community members understand the role of that technology application in the curriculum and how its impact is being evaluated.

The ICT qualifications such as processing and handling of information are becoming as important as the traditional basic qualifications (i.e. reading, writing and arithmetic), this makes necessary for students to understand how to use computers and other ICT equipments to process data and handle information in their learning process. In this case students have to be ICT users because they are prepared to become ICT users at work, and at the sometime teachers have to be able to master ICT tools themselves in order to use them effectively in their teaching process as well as keeping of records.

Taylor (1980) suggested that there are three basic ways of using computers in schools. These are:

1. **The computer as a tutor**

   Here tutoring systems present subject material, to which the learner responds. This type of material is programmed by specialists and includes drill and practice exercises and tutorials. This kind of programme varies widely from the simply repetitive to sophisticated tutorials, which keep check of progress and suggest areas for remediation.

2. **The computer as a tool.**

   Tools or technologies include software like word processing package, spreadsheets, data bases, presentation software, desk top publishing, CD-ROM based encyclopedias, HTML editors, the world wide web, etc. These are generally curriculum or content free, in that they can be applied to a wide variety of educational and other activities.

3. **The computer as a tutee.**

Tutee systems are regarded as the most powerful in that they allow the student to control the computer. It includes the use of programming languages like LOGO, Visual Basic and the like.

Using computers in classroom has the following advantages to both teachers and students: -

It provides access to high quality learning resources, extends teaching resources and improves efficiency.

It promote the ability to access, use and evaluate information from different sources in order to enhance learning

It helps learners to become more independent and effective information seekers and critical users.

It helps teachers to manage their classes easily during the teaching process.

It helps students and teacher develop the information culture that generates critical thinking and awareness about knowledge production.

To use ICT in school helps to enhance more effective teaching in classroom such as using art and design software for young learners, data logging in science subjects such biology, chemistry, physics and geography or using digital cameras in technology classes to record each stage of design and development. In this case subject teachers will have to acquire ICT skills that will help them to easily prepare their lessons and master the ICT tools. Therefore the teachers are to be educated concurrently with the increase in ICT use

## 5.2 How to use computers as a tool in teaching.

This section describes how a computer can be used as a tool that can help to develop educational standards for student achievement. Rapid advances in ICT have led educators and researcher to plan and investigate how the technology can be used to develop the standards of education for students' achievement by supporting meaningful and engaged learning. Instead of focusing merely on isolated, skill-based uses of technology (such as integrated learning systems), educational technologists are promoting the use of various technologies (ranging from word processor to modeling software to internet-based research) that is integrated across the curriculum (Means & Olson, 1995; Panel on Educational Technology, 1997; Eisenberg & Johnson, 1996).

The choice of the technology (tool) to be used in teaching is determined by the impact that tool in meeting the objectives of what students should learn and the ability of students to understand complex phenomena, analyze and synthesize multiple sources of information, and build representations of their own knowledge.

## 5.2.1 Types of Computer-based Tools (or Technology).

The educators must become aware that there are different types of computer-based tools or technologies that can be used to support and enhance learning. Various technologies deliver different kinds of content and serve different purposes in the classroom.
For example, word processing and e-mail promote communication skills, database and spreadsheet programs promote organizational skills, and modeling software promotes the understanding of science and math concepts. It is important to consider how these computer-based technologies differ and what characteristics make them important as vehicles for education (Becker, 1994). Technologies available in classroom today range from simple tool-based applications (such as word processors) to online repositories of scientific data and primary historical documents, to closed-circuit television channels and two- way distance learning classroom. Each one is likely to play a different role in students` learning. Rather than trying to describe the impact of all educational technologies as if they were the same, we needs to think about what kind of technologies are being used in the classroom and for what purposes.
The computer-based technology can be defined on the basis of its application-- how it is used for learning. For example, Means (1994) described four major functions of technology used to support learning. These are:

1. Educational technology can be used as a tutor (examples are drill-and – practice software, tutoring systems, instructional television, computer- assisted instruction, and intelligent computer-assisted instruction):
2. It can be used a means to explore (examples are CD-ROM encyclopedias, simulations, hypermedia stacks, network search tools, and microcomputer-based laboratories):
3. It can be used as a tool to create, compose store, and analyze data (examples are world processing and spreadsheet software, database management programs, graphic software, desktop publishing

systems, hypermedia, network search tools, and videotape recording and editing equipment):

4. And it can be used as a means to communicate with others (examples are e-mail, interactive distance learning through satellite systems, computer and modem, and cable links).

My own experience reflects that, most of the mathematics and science teachers in Tanzania are using lecture method and teacher-centered approach, as the classroom instruction delivery approach, this is one of the problems that hinders the effective teaching and learning of mathematics in the classroom. In this case the education system needs to improve the instruction delivery approaches and focus on using the new technological approach, instead of continuing with traditional methods of presenting information or knowledge that is possessed by the teacher (i.e. teachers are believed to be the only learning resources). The computer provides children/learners with the opportunity to move away from old curricula rote learning and teacher-centered lessons by giving more control to learners to do their own learning by using a computer as a tool in learning. In computers and other ICT tools there are so many educational software (tools), which provide the opportunity for students to learn independently such as: spreadsheets software for mathematical problem solving and investigations database software for data manipulation and analysis. These present a useful environment for learner to work collaboratively in a problem-solving mode. For example, in this study we have used spreadsheet as a tool that will help students to solve quadratic equations easily and quickly, our emphasis was on using the perfect square method to solve quadratic equations. In this case we intend to investigate and evaluate whether spreadsheet is a tool, which can be used to solve the quadratic equations easily and quickly so as to enhance the learning. The student are supposed to solve quadratic equations, deduce the relationship $b^2 = 4ac$ from each quadratic equation of the form $ax^2 + bx + c = 0$ (where $a \neq 0$) and then think, analyze, and make inference that will lead to the generalization of this relationship as a basic condition for a quadratic equation to be a perfect square. Our objective is to investigate and evaluate whether the spreadsheet is an appropriate tool that can support student's higher-order thinking ability.

## 5.3 Activities in the classroom

The arrangement of learning space has a significant impact on operatives that can be provided for teaching and leaning.
The following are some arrangements of computer-based technologies.

- Fully integrated classroom promote maxim use of computer at times when they are needed by individuals/or group of students
- Special computer rooms or computer laboratories give students access to computers within a set time frame.
- Computer based resources are rapidly replacing print-based materials (i.e. Internet is used as a library).

The process of up-taking the computer-based technology in education involves five stages: the first stage involves the process of learning the new skills about how to use a computer and its applications. The second stage is how to make the exact copy or replicate the established practical, that is, adoption. The third stage involves the process of learners to use or integrate the technology acquired into their own practice. The fourth stage is the process of using that technology in cooperative and multidisciplinary work, and the last stage involves the process of devising new uses of the technology as a tool for teaching and learning.
Learning mathematical ideas is difficult for students. Teacher often struggles to find ways to help their students understand very abstract notions.
As a teacher face this challenges he/she must think about how best to help the students/learners form understanding of mathematical abstractions. The job of the teacher is to help learners to construct internal representations (i.e. cognitive abstraction of mathematical concepts) that are developed through experience embodied in external representations (i.e. physical objects), such as graphs, tables, diagrams, and charts.

### 5.3.1 Presenting the concept of a quadratic equation.

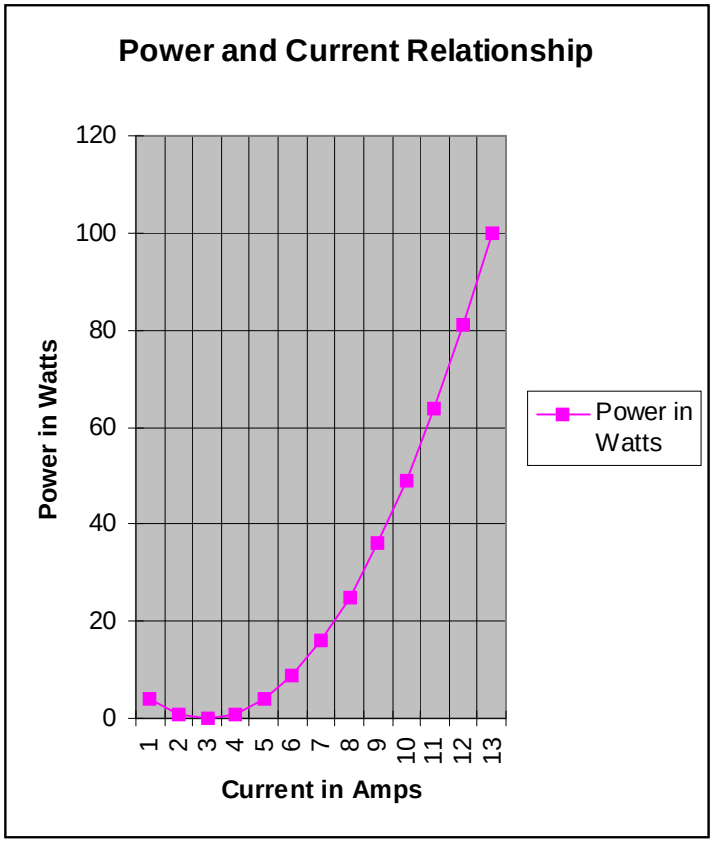
Let` s examine the concept of a quadratic equation (prefer square) as an example. In the power -current curve the steepness of the curve is an

indication of how power increases or decrease depending in the current supplied to the system.
This study focuses on the relationship between the current flowing into the system and the power given out by that system. The internal representation is how the change in current affects the power and the external representation is the curve showing the relationship between the current and power. The relationship between the power and the current is represented in a quadratic equation
$y = x^2 – 6x + 9$, in which the initial conditions are stated, such that at a certain value of current (e.g. when the current is 3 amperes) the power given out becomes zero. The chart below shows the relationship between the current and power.

| ***Current in Amps*** | ***Power in Watts*** |
|---|---|
| ***1*** | ***4*** |
| ***2*** | ***1*** |
| ***3*** | ***0*** |
| ***4*** | ***1*** |
| ***5*** | ***4*** |
| ***6*** | ***9*** |
| ***7*** | ***16*** |
| ***8*** | ***25*** |
| ***9*** | ***36*** |
| ***10*** | ***49*** |
| ***11*** | ***64*** |
| ***12*** | ***81*** |
| ***13*** | ***100*** |

Table 1. The relationship between current and power

The teacher must grapple with how to help students understand the concept of the rate of change of one quantity (current) in relation to another( power).



Graph 1. The relationship between the current and power

That is, the teacher must help students form accurate internal representation of an abstract mathematical concept embodied in the graph. Representations have been classified in many ways. For example, Bruner (1996, as cited in Janvier, Girardon and Morand, 1993) developed one important approach. In this scheme, representations are categorized as enactive, iconic or symbolic. Enactive representations refer to the activity basis of a concept (e. g. how the change in current affects the power ) Iconic representations refer to the images that embody the concept (e. g the curve), and symbolic representations refer to the characters that mathematicians have agreed upon to represent the mathematical concept (e.g. the quadratic equation that relates the power and current). From the table and graph shown above the main concept is that, there is only a single value of current for which the power is zero and the general knowledge is that, quadratic equations must have two solution, it means that, such quadratic equations have repeated roots, which is a definition of perfect squares.

## 5.3.2 Using Technology to Enhance Experience.

How might the teacher provide this experience? One suggestion is through the use of technology. For example, in this study the spreadsheet which is formatted with formulas in some fields to solve quadratic equations of the form $y = ax^2 + bx + c$ (where $a \neq 0$) and then to verify the relation $b^2 = 4ac$ is used to help students form an understanding of the concept of quadratic equations (prefect squares). Where y represents power and x represents current.

The table below shows a spreadsheet, which formatted with formulas to help students in learning.

| 1st solution | 2nd solution | Perfect Square? | $b^2 = 4ac$? |
|---|---|---|---|
| =-(B2+SQRT(B2*B2-4*A2*C2))/(2*A2) | =-(B2-SQRT(B2*B2-4*A2*C2))/(2*A2) | =IF(D2=E2, "yes”,” no") | =IF(B2*B2=4*A2*C2, "yes”,” no") |
| =-(B3+SQRT(B3*B3-4*A3*C3))/(2*A3) | =-(B3-SQRT(B3*B3-4*A3*C3))/(2*A3) | =IF(D3=E3, "yes”,” no") | =IF(B3*B3=4*A3*C3, "yes”,” no") |
| =-(B4+SQRT(B4*B4-4*A4*C4))/(2*A4) | =-(B4-SQRT(B4*B4-4*A4*C4))/(2*A4) | =IF(D4=E4, "yes”,” no") | =IF(B4*B4=4*A4*C4, "yes”,” no") |
| =-(B5+SQRT(B5*B5-4*A5*C5))/(2*A5) | =-(B5-SQRT(B5*B5-4*A5*C5))/(2*A5) | =IF(D5=E5, "yes”,” no") | =IF(B5*B5=4*A5*C5, "yes”,” no") |
| =-(B6+SQRT(B6*B6-4*A6*C6))/(2*A6) | =-(B6-SQRT(B6*B6-4*A6*C6))/(2*A6) | =IF(D6=E6, "yes”,” no") | =IF(B6*B6=4*A6*C6, "yes”,” no") |
| =-(B7+SQRT(B7*B7-4*A7*C7))/(2*A7) | =-(B7-SQRT(B7*B7-4*A7*C7))/(2*A7) | =IF(D7=E7, "yes”,” no") | =IF(B7*B7=4*A7*C7, "yes”,” no") |
| =-(B8+SQRT(B8*B8-4*A8*C8))/(2*A8) | =-(B8-SQRT(B8*B8-4*A8*C8))/(2*A8) | =IF(D8=E8, "yes”,” no") | =IF(B8*B8=4*A8*C8, "yes”,” no") |
| =-(B9+SQRT(B9*B9-4*A9*C9))/(2*A9) | =-(B9-SQRT(B9*B9-4*A9*C9))/(2*A9) | =IF(D9=E9, "yes”,” no") | =IF(B9*B9=4*A9*C9, "yes”,” no") |

**Table 2.** the part of spreadsheet that is formatted with formulas.

In the activity students are asked to enter different values of coefficient $x^2$, coefficient of x, and the constant term and the formulas given will help them to get the corresponding values of first solution and second solution and then show whether the relation $b^2 = 4ac$ is true or not. Students are supposed to continue entering different values of coefficient $x^2$, coefficient of x, and the constant term, observing solutions and then check whether the relation $b^2 = 4ac$ is true or not. Also students are instructed to draw graphs from the data they enter and calculate using the quadratic equations given, and then observe the nature of their graphs.

After multiple attempts to the model the students may come to an understanding that for all perfect squares, they have repeated roots, the graphs cut the x-axis only once and the relation $b^2 = 4ac$ is true, which is the general condition for a quadratic equation be a perfect square.

This activity facilitates the construction of an internal representation of the concept of perfect squares that may serve as the basis for learning the symbolic representation.
This activity provides the translations between enactive, iconic, and symbolic representations that are necessary for learning abstract concepts. This allows the students to practice interpreting the graphs, tables and charts as they are presented and also helps to lighten the cognitive load and serve to organize each student's understanding of a concept as the external representation embodies the concept to be learned.

## 5.4 What are the benefits for teachers and students

This section describes the benefits of using ICT in the teaching and learning process for both teachers and students. There is a need for classification of the importance of ICT to the content, didactic methods of the subject including the consequences of an increased ICT integration on the organization for teaching. The rapid technological development has caused the knowledge to be no longer the experience that occurs once to an individual in his/her lifetime, but an asset that must be updated continuously. In this case teachers should not be considered as the only source of learning resources, but they should be looked as facilitators of the learning process.

### 5.41 Teachers' Benefits

True enough, any change requires knowledge, pressure and support, but here, in addition, one must keep in mind that the teacher professional development in using ICT as a pedagogical tool, is equally of crucial importance. As technology improves and unfolds in the context of classroom life, the teacher must identify with the learners the proper inquiry questions, or Internet resources. The structure of a learning activity, the way it is embodied into the student's experience is more important than the features of the technology itself. The outcome, unanticipated by many concerned with ICT and education, lies in the fact that with the advanced technology, the teacher is called to act pedagogically, not technically. It is important that teachers see a clear relation between the use of ICT and the learning curriculum. Expected effects of ICT on learning are closely correlated with the teachers' and learners' abilities to use them. Maddux, Johnson, & Willis (1997) distinguished two types of computer uses in education. First type applications are those in which technology is sued to teach the same thing as before, but here the tool makes it easier, quicker, and more efficient; second type applications are new and provide better ways of teaching with the

support of technology, and of other professional educators. The proper use of technology in teaching and learning, support teachers in engaging in advanced pedagogies instead of remaining transmitters of information. Teachers being facilitators of the learning in the technology environment, have the following benefits:

- Teachers' can make more apparent, the need for longer blocks of time to study one particular subject matter or integrated subject matters
- Teachers can be able to develop learning activities and projects that involve more than one subject matter at a time easily, quickly, and effectively.
- Teachers' are supported in organizing cooperative work groups, and multiple parallel classroom activities.
- They can be able to apply current instructional principles, research, and appropriate assessment practices
- They can create effective computer-based presentations as well as multimedia documents to support instruction
- They can search internet for resources
- They can integrate ICT tools into students learning activities across the curriculum
- It helps to keep teachers up-to-date as far as educational technology is concern.

  In assuming their new roles, teachers are expected to upgrade their knowledge and acquire new skills so that, they can take full advantage of the technology to enhance student learning.

## 5.42 Students' Benefits

On the other hand, students are supposed to be active participants of the learning, instead of being passive listener and notes takers. They must engage themselves in investigations that will allow them to draw meaning and understanding.

ICT in schools and classroom tend to attract school learners' interest and motivation. The most extensive meta-analysis conducted on school learning (Wang, Haertel, & Walber, 1993) pointed out that the positive relationship between the learner and the environment was the most critical factor. For those students who do have access to computers at home, the classroom becomes more attractive when it contain some computers. For the learners who do not have access to computers at home, the presence computers in schools helps to narrow the gap between those using computers at home and those who don't. another gain regards to equity is that digital communication

can engender the promotion of a more equitable participation among disadvantaged groups (His & Hoadly, 1997).
When an adequate level of access and use is achieved, the specific pedagogical benefits that may be expected out of integrating ICT in schools and classrooms are as follows:

- Students' acquire new computer and networking skills that help them to use on-line and/or off-line resources and tools in learning.
- Students have access to extended sources of information and learning basic skills.
- Students are presented with context-based or authentic learning activities, and new problem solving methods
- Students get involved in intra- and inter-classroom talk
- They learn through problem solving approach
- It improves their communication skills, independent thinking and decision making based on evidence and experience.
- It improves their hands-on activities ability.
- It helps to overcome the problem of misconception or misunderstanding of the abstract concepts..

In general, the ultimate goal of any form of activity-based learning is to develop the critical thinking skills necessary to increase scientific literacy and motivate them to learn more.

## 5.5 Potential of using ICT while Teaching Mathematics and Science.

This section describes how ICT will help teachers in teaching mathematics and science subjects. Socio-constructivist suggest that almost every thing students learn depends on social interaction. They consider it very important that computers be capable of supporting person-to-person interaction and talk in and between classroom settings for learning purpose (Wegerif & Scrimshaw, 1997).
Computer based technologies expand the repertoire of methods by which students can learn and teachers can teach. There are so many computer-based learning systems designed to be used as socio-cognitive tools, which can support that interaction ( e.g. for communication and collaborative learning)

The critical issue in education is which software to be used in teaching and learning, as it determines what teachers and students can do with the computer to enhance the learning. In order to be able to select appropriate

software or technology to be used in teaching a particular subject matter, ongoing professional development is necessary to help teachers learn not only how to use new technology but also how to provide meaningful instruction and activities using technology in the classroom. Teachers need in-depth, sustained assistance not only in the use of technology but also in their efforts to integrate technology into the curriculum. Besides pedagogical support to help students use technology to reach learning goals, teachers also need time to become familiar with available products, software, and no-line resources. They also need time to discuss technology use with other teachers. All these issues are important in using technology to improve student achievement. When

The following are what modern technologies can do to support teachers who are engaged in the following:

- *Teaching for understanding.*
  When it comes to what subjects are to be learned, contemporary learning theory puts the emphasis on complex ideas – as they occur in authentic situations – because it is known today that school learners are capable of more advanced thinking than what is usually asked of them. In such circumstances, however, the evaluation of learning outcomes requires methods that measure understanding as opposed to methods that reflect the behaviorist theories of the past (Brown, 1998).

- *Making a fundamental difference to students` achievement in academic subjects*. Students then tend to review and revise their own work more, and work on longer projects. Research demonstrates more persistence in solving problems and improved written communication when students use computers in learning. When the conditions are right (teacher basic technical training, constructivist pedagogy, team work among teachers, and administrative support), the learning outcomes on standardized tests as well as the mastery of advance topics are evidenced.

- *Improving students` higher-thinking skills*. The use of networked computer as cognitive tools, that is, with software designed to enhance the cognitive power of learners while searching for information writing, thinking, and solving problems (Jonassen and Reeves, 1996), helps them do more advanced academic work.

- *Co-constructing with students knowledge of value to others (group productivity).* There should be collaborative work spaces for on-line knowledge building, that is, learning environment in which learners must co-construct knowledge and build their expertise in specific areas of inquire. The Web becomes a medium for learners to construct representations of their knowledge and negotiate the results and meanings of their inquiries. This collaborative-building model deserves increasing attention and understanding (Brown, 1997, Hewitt and Scardamalia, 1998).
- *Deep understanding of advanced topics.* Students will reach a deep understanding of what they learn given that they are interacting with teachers who are capable of advanced pedagogies. The level of mastery changes.
- *Distributed learning*. Using a proper learning environment, networked computers create a collaborative learning space where learning may occur when students and/or teachers are not in the same room or accessing the Internet at the same time during the day or the week. It is a shift away from one-to-one/one-to-many communication patterns and toward many-to-many communication patterns, in which multiple individuals can simultaneously contribute to a classroom discourse ( Tiessen and Ward, 1998).
- *Lifelong learning.* The networked computer enables the implementation of a new learning paradigm, in which learning is viewed as an active process in which ideas and concepts are acquired and, manipulating symbols and data, put to test in action for deeper understanding. Students will get a solid foundation for lifelong learning in a rapidly changing world.

There are other potentials of using ICT while teaching mathematics and science in classroom, especially when ICT tools are properly like; to develop molt-media materials, to enhance the initial preparation of good teaching material, to facilitates simulations, to capture and analyze the teaching process and to bring the world experience into classroom teaching and learning.

Teaching mathematical and science using ICT may help to material teacher and learners by breaking the professional salutation that is making communication with colleagues and mentors, with universities and centers of expertise, and with teaching and learning resources.

Further more teachers and leaner in remote location can access online libraries and current research which can significantly enhance learning and

enable individual initiative. Teacher can undertake online training session and apply the new technique or use new material in their classes immediately.
Use virtual communities to facilitate sharing of information, ideas, and experience as well as exchanging materials with colleagues.

# CHAPTER 6

# 6. DESIGNING THE RESEARCH WORK


***6.1. Selection of target group and controlled group***
***6.2. Lesson preparation and presentation using computer and without using computer***
***6.3. Assessment at end of the chapter***
***6.4. Results***
***6.5. Analysis***
***6.6. Inference***


## 6.1 Selection of target group and controlled group.

This section discusses the process of designing instructional materials that are relevant to the level of students that are involved in this study. Through it, the general principles of learning and instruction are translated into elaborate and detailed plans for instructional materials and learning (Reigeluth 1999). The designer whose main goal is to make learning easier quicker and more enjoyable, has to consider member of elements during instructional designing process (Tillya 2002)
The contents of this study were taken from quadratic equations in the algebra section of the secondary basic mathematics curriculum. According to the Tanzanian basic mathematics curriculum the quadratic equations are taught in the level of form two. In this case the participants of this study are form two students and their mathematics teachers from three secondary schools based in Dar –es –salaam. In order to involve students from different learning environment we selected one boy's school, one girl's school, and

one co-education (mixed) school. These schools were named as school M, school G, and school K respectively. The teachers who participated in this study were named as Mw1 from school M, Mw2 from school G, and Mw3 and Mw4 both from school K. the table below summarizes the qualifications, teaching experience, and the computer literacy of these teachers.

| **Name of the Teacher** | **Qualifications** | **Teaching Experience** | **Computer Knowledge** |
|---|---|---|---|
| Mw1 | Diploma in Education | 5 Years | Literate |
| Mw2 | Diploma in Education | 11 Years | Literate |
| Mw3 | Diploma in Education | 6 Years | Literate |
| Mw4 | Diploma in Education | 15 Years | Literate |

Table 2. Summary of teacher's qualification, experience and knowledge of computer.

Before teaching in the classes where computers were used in the teaching and learning process, students were taught the basic skills on how to open Microsoft Excel, enter data in the worksheet, and find the required values in the formatted cells. Students cannot be expected to benefit from technology if their teachers are neither familiar nor comfortable with it. The primary reason teachers do not use technology in their classrooms is a lack of experience with the technology (Wenglinsky, 1998; Rosen & Weil, 1995). Due to this reason all teachers who participated in the study were trained how to use the technology and also how to integrate that technology into the curriculum. The observations showed that, almost all students who participated in the study were completely computer illiterate, except few students who could start computers. All teachers were computer literate as shown in the table, but they lack enough experience. Also teachers were trained to prepare detailed and computer-based lesson plans, use Microsoft PowerPoint to prepare presentations and present, and use computer to teach

active-based learning lessons. The school administration in all three schools was informed before the process began in order to get permission and support from them. The materials consists of lesson series aimed at assisting students or learners to explore and learn how to solve quadratic equation using the completing perfect square method.

| **Name of school** | **School M** | **School G** | **School K** |
|---|---|---|---|
| Average class size | 46 | 42 | 38 |
| Student's computer knowledge | Very few are literate | Very few are literate | Very few are literate |
| Duration | Six days | Five days | Twelve days |
| Number of hours spent | Nine hours | Eight hours | Eighteen hours |

Table 3. The summary of student's information

The topic was chosen because it is covered in the Tanzania a basic mathematics curriculum and also the experience shows that students have difficulty in understanding how to make quadratic equation a perfect square. In a constructivist perspective students learn best through active engagement in their own student in an environment that encourage them to actively examine reconstruct and communicate their own knowledge and understanding (Tillya, 2003). Students were given spreadsheet that contains formula to enter the coefficients of $x^2$, x and constant so as to see the rots and then discover relationship $b^2 = 4ac$. Hence the integration of ICT into mathematics curriculum requires restructuring of the learning environment that will create a more efficient and meaningful learning environments. Algebra is a fundamental concept in mathematical necessary for understands

a wide variety of phenomena of importance to mathematics, and barrier to learning is of significant value (Tillya 2002). The application of algebra in solving mathematic problem and gaining deep understanding is also fundamental part of learning and doing mathematics.

## 6.2 Lesson Preparation and Presentation Using Computers and Without Using Computers

This section describes how the lessons were prepared and presented in classes where computers were used in teaching, and also how the lessons were prepared and presented in those classes where computers were not used.

### 6.2.1 Lesson Preparation and presentation in a class with computer

Let's start with lesson preparation and presentation in classes where computers were used in teaching and learning. This lesson was developed so as to enable students to use the spreadsheet (i.e. Microsoft Excel which is a computer application program used in mathematics ) in a computer- based lesson to investigate and discover the principles/concepts underlying the perfect squares.

The set up consists of a spreadsheet which was formatted with formulas in some fields (columns) that will help students to get the desired results whenever they enter the coefficients of $x^2$, x. and the constant terms for the quadratic equation of the form $ax^2 + bx + c = 0$ (i.e. a, b and c).

The desired results include.

i. To find the solution of a quadratic equation(s) and whether it has the repeated roots.
ii. To show that if the quadratic equation has repeated roots, then it is a perfect square.
iii. To check whether the relation $b^2 = 4ac$ is true, and then verify that the quadratic equation is a perfect square.

iv. To check another relation $\left(\frac{b}{2a}\right)^2 = \frac{c}{a}$ that will help in completing the square.

We believe that this setup is suitable for helping students get understanding of the perfect square as the process involved are simple to follow visually to manipulate and analyze.
Further more the following materials was provided to guide the teachers in both groups of classes (i.e. the classes which use computers and the those which do not use computers)

i. A lesson plan that outline the instructional procedures for the effective implementation of each lesson presentation stage.
ii. The supportive background information to arts teacher in their own understanding of the mathematical concepts
iii. The set of question to ask students during the lesson order to help learn to explore and understand the underlying mathematical concepts (i.e. formative evaluation)
iv. The set of lest question to be asked at the end of the lesson on topic in order to access the lever of achievement of the instructional objectives

There are eight areas of consideration for teachers to successfully integrate ICT into curriculum. Therefore of concentration is fear of charge training in basis personal use teaching meads learning base climate motivation and support.
Below a samples of a lesson plan that was used to teaching in one class by using the technology.

## **FORM TWO MATHEMATICS LESSON PLAN**(using a computer)

| | |
|---|---|
| **Teacher Name:** | Gideon Rwechungura |
| **School** | Kilindoni High School |
| **E-mail:** | giddy@yahoo.co.uk |

| | |
|---|---|
| **Grade level:** | Form two |
| **Subject area(s):** | Algebraic Expressions |
| **Lesson Title:** | Perfect Squares |

| |
|---|
| **Overview of Lesson:** (what is the activity? Keep in mind that the problem should be open-ended to allow for more higher level/critical thinking and problem-solving skills)**:** perfect squares is an effective method for solving quadratic equations. |
| **Time Required for Completion of Lesson: 80 minutes** |
| **Intended Outcome:** The student will be able to factorize quadratic expressions by using the perfect square method. |
| **Subject Area:** Algebraic Expressions. |
| **Preliminary Preparation:** List any prior skills/knowledge the students will need to have in order to accomplish success with the activities. The general form of a quadratic expression,<br>i.e. $ax^2 + bx + c = 0$. |
| Student knowledge needed prior to the Lesson (vocabulary, math skills, etc) The coefficients of $x^2$ and x, and the constant term. |
| **Materials Needed:** |
| **Basic Supplies, handouts, etc,**<br>List materials needed for the lesson, Computer, Projector, etc. |
| **Use of Real World (Authentic) Tools:**<br>Technology (software, websites, video, etc. used)<br>Microsoft excel, Microsoft word,<br><br>Other resources (books, newspapers, manipulative, people, etc. Secondary Basic Mathematics, Book Two. |
| **Instructional Strategies (**project/problem-based, student groupings, etc)<br>Problem solving. |

□Other (please list)

**Part IIIA: Classroom Management –** How will you group students?
**Active Learning model(s) to be used:**
□Expert
□Navigator
□Collaborative Groups✓
□Multiple Learning stations
□Other (please list)
What learning styles will be addressed (Howard Gardner)?
□Visual □Oral/Auditory □Tactile/Kinesthetic □Interpersonal □Mathematical/Logical✓

**Part IIIB: Assessment –** How will you know that students have attained the objectives of the lesson? In other words, how will you monitor their progress?
Will assessment be □on going (formative) or □final (Summative) or □both?✓

**Check all forms of assessment you plan to use:**
□Discussion
□Questions and answers
□Journals/writings/essay
□Tests, quizzes, examination✓
□Homework/class work
□Performance based✓
□Drawings/models
□Projects
□Portfolio (please explain what the portfolio will contain)
□Other (please explain)

**Procedure:** Each activity should be related to a particular outcome and a particular instructional objective. Make sure to include what the teacher and students are doing. Remember that other teachers will be using your ideas so include a very detailed and clear explanation of what you are doing.

a) Introduction to perfect squares.

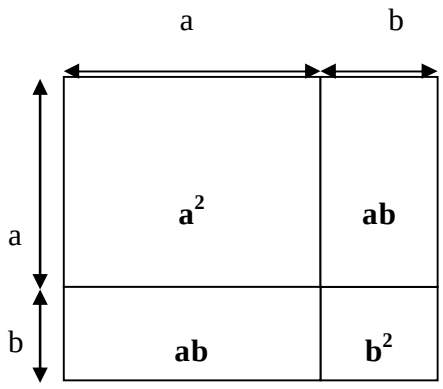
## Perfect Squares

A quadratic expression that has two identical factors is known as a perfect square.

The following are examples of perfect squares: -

1. $x^2 + 6x + 9 = (x+3)(x+3) = (x+3)^2$
2. $n^2 - 14n + 49 = (n - 7)(n - 7) = (n - 7)^2$
3. $x^2 + 6x + 9$
4. $x^2 - 4x + 4$
5. $x^2 - 12x + 36$

The perfect square $a^2 + 2ab + b^2$ is an identity, which can be shown geometrically as follows: -




A square of side (a +b) has been divided into regions with areas $a^2$, ab, ab, $b^2$ as shown in the figure above. This gives a total area of $a^2 + 2ab + b^2$, but the area of the same square is $(a + b)^2$

**.:** $(a + b)^2 = a^2 + 2ab + b^2$

By using Microsoft Excel we can show that no. 3 – 5 above are perfect squares as shown below:

| Coefficient of $x^2$ (a) | Coefficient of x (b) | Constant (c ) | 1st solution | 2nd solution | IS IT A PERFECT SQUARE? |
|---|---|---|---|---|---|
| 1 | 6 | 9 | -3.0 | -3.0 | IS A PERFECT SQUARE |
| 1 | -14 | 49 | 7.0 | 7.0 | IS A PERFECT SQUARE |
| 1 | 8 | 16 | -4.0 | -4.0 | IS A PERFECT SQUARE |
| 1 | -4 | 4 | 2.0 | 2.0 | IS A PERFECT SQUARE |
| 1 | -12 | 36 | 6.0 | 6.0 | IS A PERFECT SQUARE |

***Question 1:*** What is the **general relationship** between the values in the coefficient of x ( b) column and the values in the constant (c ) column in each row in the table above.

Expected answer: a half the coefficient of x squared is equal to the constant term, i.e. $(\frac{b}{2})^2 = \frac{c}{a}$

Some perfect square expressions has coefficient of $x^2$, which is not one as shown below.

6. $25x^2 - 10x + 1$
7. $4x^2 + 20x + 25$
8. $9x^2 - 12x + 4$

Again by using Microsoft Excel we can show that no. 6 – 8 above are perfect squares

| | | | | | |
|---|---|---|---|---|---|
| 25 | 10 | 1 | - 1/5 | - 1/5 | IS A PERFECT SQUARE |
| 4 | 20 | 25 | -2 1/2 | -2 1/2 | IS A PERFECT SQUARE |
| 9 | -12 | 4 | 2/3 | 2/3 | IS A PERFECT SQUARE |

***Question 2***: From the table above what is the **general relationship** between the values in the coefficient of $x^2$ (a) column, the values in the coefficient of x (b) column and the values in the constant (c ) column in each row.

Expected answer: $\boldsymbol{b^2 = 4ac}$**.**

Where: a the values in the coefficient of $x^2$

b the values in the coefficient of x

c is a constant term.

**NB:** The equation $\boldsymbol{b^2 = 4ac}$ is the general condition for the expression to be a perfect square.

For expressions which are not perfect squares the condition above doesn't work as shown below:

| Coefficient of $x^2$ (a) | Coefficient of x (b) | Constant (c) ) | 1st solution | 2nd solution | IS IT A PERFECT SQUARE? | Is $b^2=4ac$? |
|---|---|---|---|---|---|---|
| 1 | 6 | 9 | -3.0 | -3.0 | IS A PERFECT SQUARE | yes |
| 1 | -14 | 49 | 7.0 | 7.0 | IS A PERFECT SQUARE | yes |
| 1 | 8 | 16 | -4.0 | -4.0 | IS A PERFECT SQUARE | yes |
| 1 | -4 | 4 | 2.0 | 2.0 | IS A PERFECT SQUARE | yes |
| 1 | -12 | 36 | 6.0 | 6.0 | IS A PERFECT SQUARE | yes |
| 25 | 10 | 1 | - 1/5 | - 1/5 | IS A PERFECT SQUARE | yes |
| 4 | 20 | 25 | -2 1/2 | -2 1/2 | IS A PERFECT SQUARE | yes |
| 9 | -12 | 4 | 2/3 | 2/3 | IS A PERFECT SQUARE | yes |
| 10 | 9 | 2 | -0.4 | 0.1 | IS NOT A PERFECT SQUARE | no |
| 1 | 6 | 8 | -2.0 | 0.2 | IS NOT A PERFECT SQUARE | no |
| 1 | -5 | 4 | 4.0 | -0.6 | IS NOT A PERFECT SQUARE | no |
| 4 | -13 | 3 | 3.0 | -0.4 | IS NOT A PERFECT SQUARE | no |
| 2 | -12 | -14 | 7.0 | -1.5 | IS NOT A PERFECT SQUARE | no |

Therefore in order to test whether the expression is a perfect square you must use the relation $\boldsymbol{b^2 = 4ac}$

*b) Lesson Focus – Factorization of Perfect Square Expression.*

***Example 1***: Factorize $x^2 + 8x + 16$

***Solution:***

First split the middle term into two equal halves as shown below:

$x^2 + 8x + 16 = x^2 + 4x + 4x + 16$.

Then enclose the left two terms and the right two terms together as shown below:

$= (x^2 + 4x) + (4x + 16)$.

Factor out the factor which common for the two enclosed terms.

$= x(x + 4) + 4(x + 4)$

$= (x + 4)(x + 4)$

$= (x + 4)^2$

***Example*** 2: factorize $9m^2 – 24m + 16$

***Solution:***

$9m^2 - 24m + 16 = 9m^2 - 12m - 12m + 16$

$= (9m^2 - 12m) - (12m + 16)$

$= 3m(3m - 4) - 4(3m - 4)$

$= (3m - 4)^2$

*c) Lesson Activity – Problem solving*

factorize the following perfect squares.

1. $x^2 + 26x + 169$
2. $a^2 - 16a + 64$
3. $x^2 - 7x + 49/4$
4. if $9x^2 + bx + 16$ is a perfect square find the value of b.
5. if $m^2 - 10m + c$ is a perfect square find the value of c.

*d) Closure: Evaluation*

The students' performance shows that the lesson is understood by almost 85%, this shows that using a computer increases the level of understanding.

**Back-up Plan: (**What will you do if the technology piece fails or is unavailable?) I will use an alternative way only which does not need that technology

**Student reflections: (**Facilitator led, small group or individual with whole group) individual with all group.

**Notes or changes:**

The sample of a computer-based lesson plan.

Through training motivation and support the problem of fear can be solved and help the teacher to realize the benefits of using ICT Teacher and learning . He fore teachers need to be provided with material that are relevant to the ICT based classes as well as new amassment techniques that focus on the understanding needed in order to operate a non-traditional type of classroom.

## 6.2.2 Lesson Preparation and presentation in a class without computer

Some lessons was developed so as to enable teachers and students to use the traditional methods of teaching and learning. The set up consists of lesson development stages that will help students to understand the subject matter

and then the teacher evaluate the achievement of the lesson objectives. Teaching and learning mathematical concepts is very difficult for both teachers and students. The main job of the teacher is how to help the students used their experience like graphs, curves, and tables in learning the new concepts like the x-intercept of any curve is a solution of a quadratic or polynomial equation. In this example the teacher has helped the student form accurate internal representation of an abstract mathematical concept embodied in the graph.

In this study, the teacher defines a perfect square as a quadratic equation with two identical solution, and then solve some quadratic equations in order to find and compare their solutions. From the solutions the teacher and students identify quadratic equations which are perfect squares and the teacher state the relations $b^2=4ac$. below is a sample of lesson plan which was used to teach in a class without computer.

**FORM TWO MATHEMATICS LESSON PLAN(not using a computer)**

| | |
|---|---|
| **Teacher Name:** | Gideon Rwechungura |
| **School** | Kilindoni High School |
| **E-mail:** | giddy@yahoo.co.uk |
| **Grade level:** | Form two |
| **Subject area(s):** | Algebraic Expressions |
| **Lesson Title:** | Perfect Squares |

| |
|---|
| **Overview of Lesson:** (what is the activity? Keep in mind that the problem should be open-ended to allow for more higher level/critical thinking and problem-solving skills)**:** perfect squares is an effective method for solving quadratic equations. |
| **Time Required for Completion of Lesson: 80 minutes** |
| **Intended Outcome:** The student will be able to factorize quadratic expressions by using the perfect square method. |
| **Subject Area:** Algebraic Expressions. |
| **Preliminary Preparation:** List any prior skills/knowledge the students will need to have in order to accomplish success with the activities. The general form of a quadratic expression,<br>i.e. $ax^2 + bx + c$. |

| |
|---|
| Student knowledge needed prior to the Lesson (vocabulary, math skills, etc) The coefficients of $x^2$ and x, and the constant term. |
| **Materials Needed:** |
| **Basic Supplies, handouts, etc,**<br>List materials needed for the lesson, Meter Rule, Chalk board, etc. |
| **Use of Real World (Authentic) Tools:**<br>Technology (software, websites, video, etc. used)<br>Non<br><br>Other resources (books, newspapers, manipulative, people, etc. Secondary Basic Mathematics, Book Two. |
| **Instructional Strategies (**project/problem-based, student groupings, etc)<br>Problem solving. |

□Other (please list)

**Part IIIA: Classroom Management –** How will you group students?
**Active Learning model(s) to be used:**
□Expert
□Navigator
□Collaborative Groups✓
□Multiple Learning stations
□Other (please list)
What learning styles will be addressed (Howard Gardner)?
□Visual □Oral/Auditory □Tactile/Kinesthetic □Interpersonal □Mathematical/Logical✓

**Part IIIB: Assessment –** How will you know that students have attained the objectives of the lesson? In other words, how will you monitor their progress?
Will assessment be □on going (formative) or □final (Summative) or □both?✓
**Check all forms of assessment you plan to use:**
□Discussion
□Questions and answers
□Journals/writings/essay
□Tests, quizzes, examination✓
□Homework/class work
□Performance based✓
□Drawings/models
□Projects
□Portfolio (please explain what the portfolio will contain)
□Other (please explain)

**Procedure:** Each activity should be related to a particular outcome and a particular instructional objective. Make sure to include what the teacher and students are doing. Remember that other teachers will be using your ideas so include a very detailed and clear explanation of what you are doing.

a) Introduction to perfect squares.

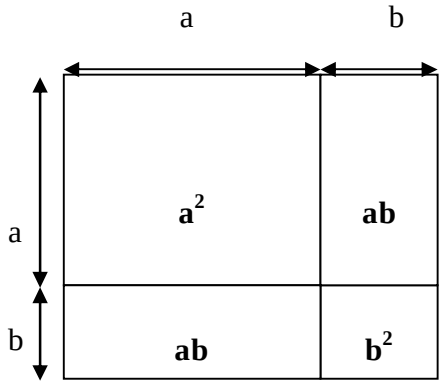
## Perfect Squares

A quadratic expression that has two identical factors is known as a perfect square.

The following are examples of perfect squares: -

9. $x^2 + 6x + 9 = (x+3)(x+3) = (x+3)^2$
10. $n^2 - 14n + 49 = (n-7)(n-7) = (n-7)^2$
11. $x^2 + 6x + 9$
12. $x^2 - 4x + 4$
13. $x^2 - 12x + 36$

The perfect square $a^2 + 2ab + b^2$ is an identity, which can be shown geometrically as follows: -




A square of side (a +b) has been divided into regions with areas $a^2$, ab, ab, $b^2$ as shown in the figure above. This gives a total area of $a^2 + 2ab + b^2$, but the area of the same square is $(a + b)^2$

**.:** $(a + b)^2 = a^2 + 2ab + b^2$

***Question 1:*** By using the perfect squares above what is the **general relationship** between the coefficients of x and the constant terms.

Expected answer: a half the coefficient of x squared is equal to the constant term, i.e.

$(\frac{b}{2})^2 = c$

Some perfect square expressions has coefficient of $x^2$, which is not one as shown below.

14. $25x^2 - 10x + 1$
15. $4x^2 + 20x + 25$

16. $9x^2 - 12x + 4$

Solve expressions above on the chalk board:

Expected answers;

6. $25x^2 - 10x + 1 = (5x + 1)^2$

7. $4x^2 + 20x + 25 = (2x + 5)^2$

8. $9x^2 - 20x + 4 = (3x + 2)^2$

Therefore they are perfect squares.

***Question 2***: From the all perfect squares above what is the **general relationship** between the coefficients of $x^2$, the coefficients of x and the constant terms.

Expected answer: $\boldsymbol{b^2 = 4ac}$**.**

Where: a the values in the coefficient of $x^2$

b the values in the coefficient of x

c is a constant term.

**NB:** The equation $\boldsymbol{b^2 = 4ac}$ is the general condition for the expression to be a perfect square.

For expressions which are not perfect squares the condition above doesn't work as shown below:

Therefore in order to test whether the expression is a perfect square you must use the relation

$\boldsymbol{b^2 = 4ac}$

*b) Lesson Focus – Factorization of Perfect Square Expression.*

***Example 1***: factorize $x^2 + 8x + 16$

***Solution:***

First split the middle term into two equal halves as shown below:

$x^2 + 8x + 16 = x^2 + 4x + 4x + 16$.

Then enclose the left two terms and the right two terms together as shown below:

$= (x^2 + 4x) + (4x + 16)$.

Factor out the factor which common for the two enclosed terms.

$= x(x + 4) + 4(x + 4)$

$= (x + 4)(x + 4)$

$= (x + 4)^2$

***Example*** 2: factorize $9m^2 – 24m + 16$

***Solution:***

$9m^2 – 24m + 16 = 9m^2 – 12m – 12m + 16$

$= (9m^2 – 12m) – (12m + 16)$

$= 3m(3m – 4) – 4(3m – 4)$

$= (3m – 4)^2$

*c) Lesson Activity – Problem solving*
factorize the following perfect squares.

6. $x^2 + 26x + 169$
7. $a^2 – 16a + 64$
8. $x^2 – 7x + 49/4$
9. if $9x^2 + bx + 16$ is a perfect square find the value of b.
10. if $m^2 – 10m + c$ is a perfect square find the value of c.

*d) Closure: Evaluation*
The students' performance shows that the lesson is understood by about 70% and I will continue with the next sub-topic.

**Back-up Plan: (**What will you do if the technology piece fails or is unavailable?) I will use an alternative way which does not need that technology

**Student reflections: (**Facilitator led, small group or individual with whole group) individual and small group

**Notes or changes:**

## 6.3 Assessment at the end of the chapter

The main aim of this study is to determine whether the integration of ICT in education can enhance the teaching and learning of mathematics and science subjects.
That means, we need to asses and compare the effectiveness of the instructions delivered in classes using computers and with classes that computers was not used. Most research on technology and student achievement has used traditional standardized assessments to measure changes in student's performance. This research has focused on students' knowledge of isolated facts but has paid little attention to how well students think. To measure the effect of specific technologies on student achievement, assessment methods and instruments should be appropriate to the learning outcomes promoted by those technologies (Glennan &Melmed, 1996; Conte, 1997). Newer standardized tests may be appropriate if they fit in the schools' learning goals and are designed to measure the effects of technology use. In many cases, however, alternative assessment may be more appropriate for meaningful research about the relationship between technology and student achievement.
Many publications have demonstrated that if students are actively engaged in learning their performance is significantly better than that of student taught in the traditional way (Tillya 2002). This can be verified by evaluating the teaching and learning process at the end of each lesson or the end of the chapter. Students' learning is evaluated in order to determine the effective of the instruction.
The student's assessment aligns with curricular aims, instructional practices, and performance tasks (Tillya 2002).
In order to determine the effective of the instructions in all classes involved in this study students were given test questions at the end of the lesson as well as at the end of the chapter. The same test questions were given to all classes regardless the computer was used in the instruction delivery or not. This main aim of providing the same test question to all classes was to compare the level of achievement of the curricular objectives between the students in classes were computers were used and the students in classes were computers were not used. The test results indicate that, students in classes where computers were used in teaching performed better than the students in other classes where computers were not used. The table below shows the results of the end of chapter test for all classes that participated in this study.

| Name of school | average score in a computer class | Average score in a non-computer class | total number of students in school | mean score |
|---|---|---|---|---|
| M | 60.9 | 45.3 | 70 | 53.5 |
| G | 47.7 | 43.7 | 80 | 45.5 |
| K | 58.4 | 49.6 | 151 | 53.9 |
| Average | 55.7 | 46.2 | | 51.0 |

Table: Comparison of test scores for students who used computers in learning with those who did not use computers in learning.

The results above shows that in all schools the average score for students who used computers in learning is greater than the average score of students who did not use computers in learning. Except in school K all students (i.e. who used computers in learning and who did not use computers in learning) in other schools were taught by the same teacher.

## 6.4 Results

This section describes the effects of this study on student. In this study the main aim was to explore the knowledge and skills students gained by analyzing the performance of students in the tests given in class at the end of the chapter.
Generally in all schools the observations indicate that, students experienced difficulties at the beginning of the lessons due to the shift from traditional approach of teaching to the new technological approach where students have to make their own observations and decisions with little or no assistance from their teachers. These difficulties were observed in all classes where ICT was used in the teaching and learning process. In other classes where computer was not used there was no difficulties because the traditional approach of table below which shows the result of end of lesson assignment given in all classes.

| lessons | computers used | computers not used |
|---|---|---|
| first lesson | 42 | 54 |
| intermediate lesson | 53.3 | 56 |
| last lesson | 67.3 | 54 |

Table : Results of tests given to determine whether computers can improve the level of understanding to students who participated in the study.

The value of assignment score suggest that there was a slight improvement in students under tending the mathematical skills the end of the lesson compared to students who did not computers.
The result in the table above is summarized in graphical form in the chart below showing the arrange score for students performance at the end of lessons. This illustrates that there was increase in students understanding in classes where computer was used because their learning environment allows work investigation critical thinking and making decisions.

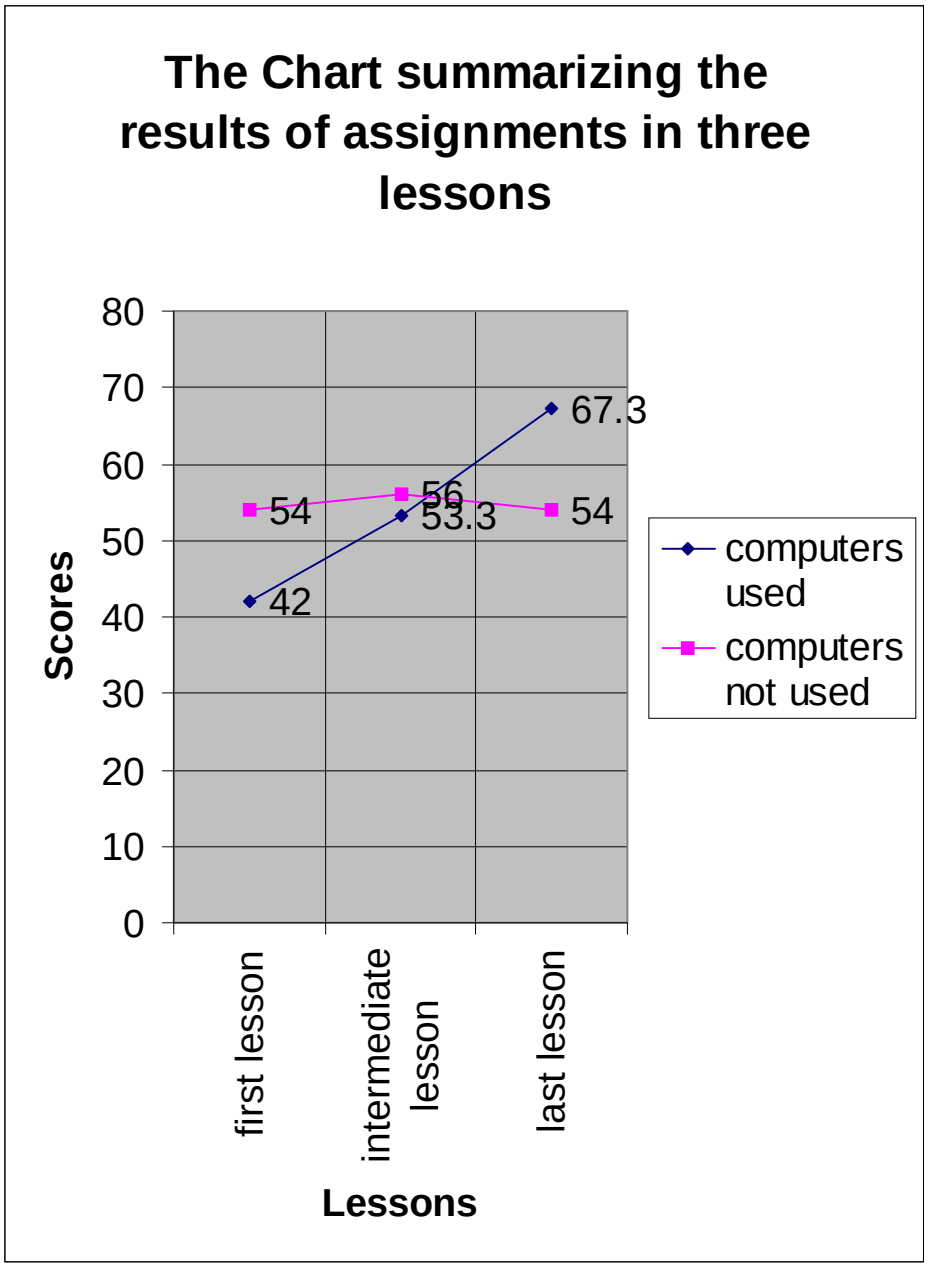



Chart:

The results of the test given of the and of chapter shows that there is a difference in performance between the students who used computer and those who did not used computers the table below séance the result of students in the test given tat the end of chapter.

Table

| **Name of school** | **With computer** | | | **Without computers** | | |
|---|---|---|---|---|---|---|
| | No. of students | Average score | Gender | No. of students | Average score | Gender |
| M | 37 | 60.9 | Males | 33 | 45.3 | Males |
| G | 35 | 47.7 | Females | 45 | 43.7 | Female |
| K | 38 | 55.6 | Mixed | 41 | 46.2 | Mixed |
| K | 36 | 61.3 | Mixed | 36 | 53.4 | Mixed |

Starting with student in classes where computers was not used in the teaching and teaching and leaning process. The general performance of these students in this study less than the students in classes were computer was used. Even though the experience shows that the performance of all these classes were the same when the traditional approach was being used in teaching and learning.

On the side of the results of students in classes where computer was used in their teaching and learning is their performance higher than their other classes in all schools which participated in this study score of the end of chapter test suggest that thee is a big improvement in students performance if the ICT facilities are properly used in the classroom environment a below more investigations critical thinking and confidence in interacting with computer hardware and software (spreadsheet) which assists students in making decisions.

The results the table above are for all participating students. The increase in performance for classes where computer were used in teaching shows that using computes in teaching and learning were used in can improve students level of understanding the abstract concepts.

But the level of increase is not the same for all schools especially in schools G that is a girl school. The level of increase student's performance is very small. Compared to other schools the boys and mixed schools. This suggest that the girls need boys much practice in using before they charge form traditional approach instructions delivery to new technological approach.

On the other side the difference in performance in all school where computers ware not used in teaching is small. This suggest that the level of understanding the concept in traditional approach in almost the same depending on the ability of students in that class as well as the methods used by the teacher.

## 6.5 Analysis

This section analyses the results of tests given to all students who participated in this study regardless the computers was used in teaching and learning or not.
An analysis of test results should provide valid answers for these key questions:

- *How well did each student do on each standard?* Essential to answering this question is some form of item analysis indicating a students` s test performance on each standard. Knowing how many, or the percentage, of questions the students answered correctly for each standard is important in designing instructional strategies, as is why certain question were answered incorrectly. Understanding each test question is fundamental because weak question construction, unlearned vocabulary, or attractive wrong answers inhibit an accurate assessment of a student` s ability.

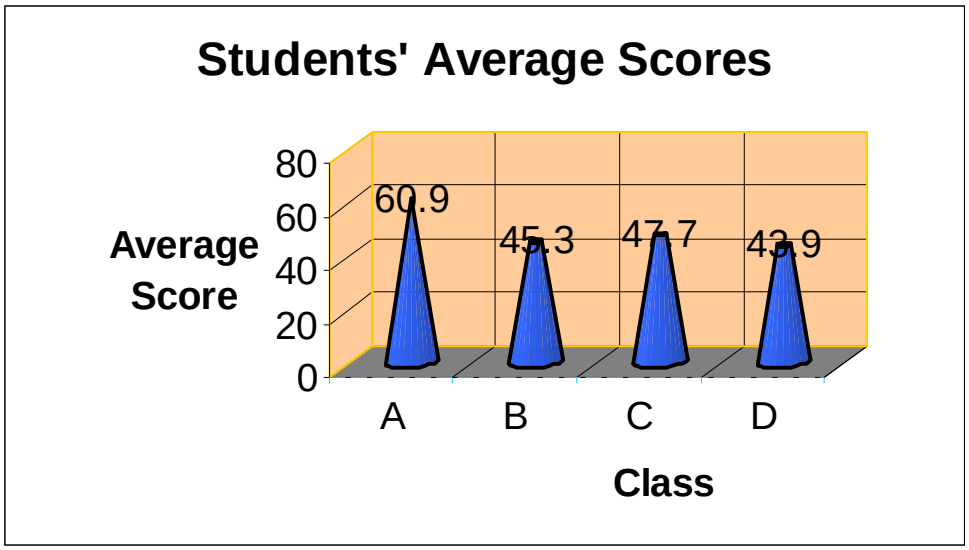
- *How well did each subgroup do on each standard?* . It is important to remember that an individual students can "count" in several subgroup. For example, a students can be a members of female students group, male students group, a socio-economic group, an exceptional children` s group. Educators and teachers need to know which subgroups are in their classes and how those students are performing. Analysis of the test performance of students in a given subgroup can indicated weaknesses in addressing their instructional needs.

  Once weaknesses are identified, plans can be developed to address those weaknesses , including training teachers to use different instructional strategies, or adding material or personnel resources. An added benefit of subgroup analysis is that teachers become more adepts in meeting the needs of individual students within their classrooms through better application of differentiated instructional practices.
- *How well did each class do on each standard*? While individual student performance is important, so it is class performance.

Significant variations can indicate class-wide weaknesses, suggesting the need for changes in curriculum, sequencing, or teaching methods. For example, teacher may use small-group instruction to improve standards that were weak for the whole group.

***Statistical Data Analysis***

Using test data requires understanding and care. A thorough statistical analysis of any experiment should include descriptive statistics, graphical summaries and formal decision rules (known as hypothesis tests) to test the hypotheses. Common descriptive statistics that are used to measure the center of the distribution are the mean and the median. The mean is the average the observations and the median is the "middle" observation. Two common visual displays that can be used to provide a graphical summary of the data are histograms and box plots. Histograms are formed by partitioning the range of the data into small intervals and finding out how many of the observations fall into each of these intervals.




The average Score of Students who participated in the study.

Box plots are constructed from five descriptive statistics (minimum, 25$^{th}$ percentile, median, 75$^{th}$ percentile, maximum) and they are extremely useful for comparing two or more observations. Although these exploratory data analysis techniques are extremely useful and should be included in any analysis, many journals require formal statistical inference for publication. The most common used vehicle for completing the inference is a hypothesis test. Documenting excellent or poor teaching requires more than class-level test analysis. When test results are used effectively, teachers will come to value them as a major tool in planning for effective instruction.

Parents play an important role in efforts to improve student performance. By monitoring homework, emphasizing good health and sleep habits, and encouraging their children to do well at schools, they make a valuable contribution to student motivation.
Students` attitudes about testing must be taken into account, considering the emotional impact that some students experience.
Providing reasonable test schedules that offer breaks between test sections is one way to address this concern. Offering incentives for efforts is another. Encouraging a positive attitude toward testing can reduce anxiety and increase performance. When student results do improve, recognition is important for the students and for all faculty and staff who contributed to he improvement.
As explained in earlier chapters the aim of this study is to compare the results of students who were taught by using a computer as a tool in teaching mathematics and another group of students taught without using computer (i.e. using traditional approach of teaching)
To get the general feel for the change of students' level of understanding the mathematical concepts, the end of chapter test was carried out, and the table below sows the summary of the end of chapter test results.

| Item | Students taught by Using Computers | Students taught Without Using Computers |
|---|---|---|
| No. of Students | 73 | 78 |
| Mean Score | 54.4 | 44.25 |
| Standard Deviation | 22.09 | 20.95 |
| T- test | 3.05 | |
| P- value | 0.00159 | |
| df | 72 | |

The summary of the analyzed test results for all students who participated in the study.

| Item | Students taught by Using Computers | Students taught Without Using Computers |
|---|---|---|
| No. of Students | 37 | 33 |
| Mean Score | 60.95 | 45.33 |
| Standard Deviation | 23.65 | 23.57 |
| T- test | 4.38 | |
| P- value | <0.0001 | |
| df | 36 | |

The summary of the analyzed test results for male students who participated in the study.

| Item | Students taught by Using Computers | Students taught Without Using Computers |
|---|---|---|
| No. of Students | 36 | 45 |
| Mean Score | 47.69 | 43.47 |
| Standard Deviation | 18.35 | 19.04 |
| T- test | 1.14 | |
| P- value | 0.13 | |
| df | 35 | |

The summary of the analyzed test results for female students who participated in the study.

The results in the tables above are for all participating students.
Form the tables, the increase in performance in all classes where computer were used in teaching shows that using computers (ICT) in teaching/ learning can improve the students level of understanding the abstract concepts. But the level of increase in performance as shown above on the table is not the same for all schools. For examples school G, which is a girl's school, we can see that the level of increase in performance is small compared to other schools (i. e the boys schools and the mixed school k). This suggest that girls needs much more practice and time before they charge and adopt the new technological approach of instruction delivery. On the other hand the difference in performance school wise in classes where computers way not used in teaching is very small. This also suggest that the level of understanding the mathematical concepts in a traditional approach of teaching is almost the same for boys and girls but the difference depends of the ability of students in the class as well as methods used by the teacher.

## 6.5 Inference

This section involves the process of ensuring that tests are not biased, testing the hypothesis, and making decision based on the result of the test done by the student who participated in this study. The main aim of this study was to test whether the new technological approach of instruction delivery can help teachers to improve their teaching methodology as well as making sure that students will be able to understand scientific/ mathematical concept easily. This is a difficult and complex process as it involves change in teacher belief, in the school learning infrastructure and the administrative support system (Tillya 2002). Education institution use tests to accomplish specific purposes based on their educational goals, including making placement, graduation, admissions, and other decisions. It is only after education institutions have determined the underlying goal they want to accomplish that they can identity the types of information that will best inform their decision-making. That information may include test results as well as other relevant measures that can effectively, accurately, and fairly address the purposes the and goals specified by the institutions.

In using tests as part of high-stakes decision-making, educational institutions should ensure that the test will provide accurate results that are valid, reliable, and fair for all test takers. This includes obtaining adequate evidence of test quality about the current test being proposed and its use evaluating the evidence, and ensuring that appropriate test use is based on adequate evidence.

Test developers and users and as appropriated the validity refers to a determination of how well a test actually measures what it says it measures. It is not the test that is validated per se, but the inferences or meaning derived from the test scores for a given use that is, for a specifics type of purposed, in a specific type of situation and with specific groups of students. The meaning of test scopes will differ based on such factors as how the test is designed, the types of question that are asked, and the documentation that supports how all groups of students are effectively their performance can be generalized beyond the test.

***Eliminating Bias.***

This involve ensuring that your assessment instruments are valid, reliable and fairy.

***Test Validity***

A test is said to be valid if it measures accurately what is intended to measure. Test specifications and representative samples of the functions that

are meant to be covered are essential to ensure content validity. But, the best test can give invalid and unreliable results if it is not carefully administered.

***Construct validity.***

Construct validity refers to the degree to which the scores of takers accurately reflect the constructs a test is attempting to measure.

Test scores and there inferences are validated to measure one or more constructs, which together comprise a particular content domain. For instance, the domain of mathematics content standards may involve the constructs of mathematical problem solving and knowledge of number system.

Appropriate validation would include adequate evidence that the test is measuring the constructs identified in the curriculum, and that the inferences of the scores accurately reflect the intended constructs for all test takers.

Evidence about the intended and unintended consequences of test use can provide important information about the validity of the inferences drawn from the test results, or it can raise concerns about an inappropriate use of a test where the inference may be valid for other uses.

***Test Reliability.***

A test is said to be reliable if it consistently measures what is required to be measured.

A test may accurately measure differences in the level of students academic achievement that is low scores may accurately reflect that some students do not know the content. However, test users should ensure that they interpret those scores correctly in the context of their high-stakes decision. For instance, test users could incorrectly conclude that the scores reflect lack of ability to master the content for some students when in fact the low-test scores reflect the limited educational opportunities that the students have received. In this case, it would be inappropriate to use the test scores to place low-performing students in a reliability refers to the degree of consistency of test results over test administrations forms items, scorers, and /or other facets of testing.

Example of reliability of test results over test administrations is when the same students taking the test multiple times receive similar scores.

Reliability can also include estimates of a high degree of relationship across similar items within a single test or subtest that are intended to measure the same knowledge or skill.

***Test Fairness***

Tests are fair when they yield score interpretations that are valid an reliable for all groups of students who take the tests. That is, the tests must measure the same academic constructs (knowledge and skills) for all group of student who take them, regardless of race national origin, gender, or disability. Similarly, it is important that the scores not substantially and systematically underestimate or overestimate.

Demonstrating fairness in the validation of test score inferences focuses primarily on making sure that the scores reflect the same intended knowledge and skills for all students taking the test. A test score should accurately reflect how well impacted by construct irrelevant influences. For all groups of test takers, evidence should support that valid inferences can be drawn from the scores.

All aspects of validity, reliability, and fairness discussed above are applicable to the measurement of knowledge and skills of all students, Whenever test are intended to evaluate the knowledge of skills of different groups of students, ensuring that test scope inferences accurately reflect the intended constructs for all students is a complex task. It involves several aspects of test construction, pilot testing, implementation, analysis, and reporting. Making similar inferences about scores from academic achievement tests for all test takers, and making appropriate decisions when using these scores, requires accurately measuring the same academic constructs (knowledge and skills in specific subject areas) across groups and contexts.

## *6.6. Hypothesis Testing and Making Decision*

After ensuring, that tests given to students were not biased as discussed above, we can make accurate decisions based on the test scores. A formal statistical analysis of the data indicates that there is a significant increase ($t = 3.05$ , $p = 0.00159$ ) in the student achievement in all classes where computers were used in teaching and learning compared to other classes where computers were not used. For female students statistical analysis of the data indicates that there is a significant increase ($t = 1.14$ , $p = 0.131$ ) in female student achievement in the classes , which had female students, and computers were used in teaching and learning compared to other classes (female) where computers were not used. For male students as well, the statistical analysis of the data indicates that there is a significant increase ($t = 4.38$ , $p < 0.0001$ ) in male students achievement in the classes which had male students and computers were used in teaching and learning compared

to other classes (male) where computers were not used. Although the level of students achievement is not the same, in case of school and gender, but the statistical analysis indicates an increases in all three schools and both females and males.
This suggests that, the use of computers (ICT) in teaching and learning can contribute to enhance the instruction delivery in classroom as well as the level of students to understand the mathematical concepts.
There is a very good future expectation for use of computer in teaching and learning mathematics/ science because, both teachers and students who participated in the study were highly impressed by it and showed interest in using it in the future. They suggested that the mathematical and scientific concepts can be easily understood by all students if it will be carefully prepared and organized. Therefore there is a need to have more in-service program for training the teachers to use computers in teaching mathematics and other science subjects.
The in-service programmes should be deigned in such a way that it focuses on the needs, beliefs and interest of its participants. The designer of these programmes must understand that teachers has different needs interests and beliefs depending on their qualifications experience and environment therefore it is better to prepare programmes that will satisfy all groups categories of there teacher.

# CHAPTER 7

# 7 EFFECTS OF USING COMPUTES IN CLASSROOM


***7.1. What did the teacher learn ?***
***7.2. What did the student learn?***
***7.3. What are the effects on class management ?***
***7.4. Students as independent learners***


## 7.1 What did the teacher learn?

From the analysis and inference above we have seen that teachers who participated in this study enjoyed and learned new knowledge, new skills, and new teaching methodologies.

The responses from all teachers in three school which participated in the study shows that they were satisfied to a great extent by the preparation of teachers on how to prepare lessons and teach by using new technological approach of instruction delivery as well as teaching in the classroom by using this new techniques. Through the short and brief training for these teachers on how understand the subject content deeply, prepare the computer-based lessons and teach by using the active-based learning approach conducted before their teaching, the teachers acquired new knowledge and skills which will help them to master the ICT – tools in their classroom activities such as teaching and evaluation of the teaching and learning process.

The teachers who participated in this study has now new knowledge and skills that shall help them to prepare and teach mathematics and science subjects by using the spreadsheet and other educational/generic software as instructional tools. Also teacher were equipped with new knowledge and skills that will help them to make mathematical calculations (use formula) by using the spreadsheet, make presentations by using the presentation software (i.e. Microsoft PowerPoint) as well as establishing their own formulas in spreadsheet (i.e. they know the syntax of writing formulas in spreadsheets ).

The observations made to all teachers from the beginning to the end of this study show that, teachers were improving gradually in lesson preparation, classroom management during the teaching process, as well as how to assess the achievement of the lesson or curriculum objectives as the study continues.

In general the results suggest that the lesson had a positive impact to both teachers and students. Teachers realized that computers (ICT) are very important tools that can improve the methods, approaches and techniques of teaching, if properly used.

## 7.2 What did the students learn?

This section describes the new knowledge, skills, attitudes and beliefs that was learned and/or acquired by the students who participated in this study. The overall objective of the education system is to qualify the individual human being for working life and for life in general, and main aim of education in any society is to prepare the learners or young generation to become good and productive members of that society. On the other hand, the main aim of education system in the information society is to enable young people and adults to acquire new methods of learning process in order to

enable them to sort, select, process and use the information, which ICT gives access to and continues with the process of updating their qualifications.
The main focus of this study is how to use computer as a tool in teaching and learning mathematics so as to simplify the process of teaching and learning the abstract mathematical concepts, which is believed to be a very difficult task for both teachers and students.
Teachers often struggle to help students construct internal representations of the abstract concepts embodied in the external representation.
Internal representations are cognitive abstractions of mathematical concepts that are developed through experience. External representation such as tables, diagram, and charts servers as images of these mathematical concept and may be regarded as embodiments of ideas or concepts to be learned (Janvier, Girardon, and Morand 19993 and p. 81)
In this study we have seen how representations such as enactive iconic and symbolic can easily help learners to internalize the abstract mathematical concepts through use if ICT - tools (computer). By using spreadsheet work book which was formatted with formula in some fields (columns) students are to make many attempts which help them to make decision (generalization) of the mathematical relations such as $b^2 = 4$ ac in perfect squares (quadratic equation) of the form $ax^2 + bx + c = 0$ and many other relations associated with perfect square.
Also this study help the students to learn independently with minimum guide from the teacher, think critically and to make decisions based on the results obtained from their own observations. Again this study helped the students to improve their communication skills, problem solving skills, computational skills and decision-making or generalization skills.
Further more students learned how to used computer especially entering data and find solutions in spreadsheets.
In general student acquired enough knowledge and skills that will help them in learning other topic as well as other subjects using the ICT tools.

## 7.3 What are the effects on class management?

This section describes how the use of computes in teaching and learning can help teachers to manage their classes. One of the key factors that determines the effectives teaching and learning process is the management of the classroom during the teaching and learning process. In this case it is very important for a teacher to state in the lesson plan, about how he/she will manage the class during his/her lesson.
From the lesson plan it was stated that students will be arranged in groups depending on the number of students in a class as well as the number of computers available in the computer laboratory. After introductory part of the lesson all students were supposed to arrange themselves in groups as stated above. Since all students were taught before how to start the computer and open the spreadsheet program, enter data and then find results in the columns formatted with formula. Students in all groups were given the data o be entered in the spreadsheet and then find their own solutions. This helped teachers to manage their classes easily by visiting one group by another asking and answering some question as well as assisting them whenever there is a problem. The students in each group were very busy to enter data. Finding the results , thinking and discussing so as to make decisions and relationships.

- The content covered in this study was appropriate to students as well as teachers enjoyed and learned a lot from it. The content involved creating a spreadsheet workbook inserting formula in some fields (columns) entering data and finding the values in the formatted fields. This enabled students to make relationship, which helped them to make decision and then solving problems related to real world.
- Teachers' classroom practices were adequate and the teacher's task was only to guide the student- centered and activity-based learning process (Tillya 2002). From the classroom observations it is clear that the teachers role has to change form being source of all learning material to facilitators of the learning process. This implies that, the teaching approach has changed from teacher-centered lecture method to the students-centered active-based learning.

On the other side students are supposed take a greater responsibility for their own learning and have the opportunity of displaying the independence in the learning process. Teachers have to personally master the ICT- tool and their responsibilities concurrently with the fact that computer is used as a integral part of the individual education and

subjects. Therefore there is a need of implementing teacher's in- service training focusing on the pedagogical possibilities which lies in the use of ICT including the importance of computer to the content didactic and pedagogical principles of the subjects.
The observation from the results((I. e and of lesson assignments and of chapter test) suggests that, there is a need of integrating ICT in the education system of Tanzania because students in classes where ICT was used performed better compared to students in classes where ICT was not used. This charge requires much effort form stakeholders and financial support form local from international agencies to establish teacher's in-service – training procurement of ICT equipment and preparation of ICT infrastructures. because the observation shows that only few public secondary schools have computer laboratories and other ICT facilities, also there is no enough ICT professional in Tanzania which means all teacher need to be trained.

- The process integrating ICT in education expensive. This process needs a lot of money to purchase the computer software and hardware to establish Internet service in schools train teacher and technician e t c. Therefore education is not cheap but expensive in the environment where technology must be used in the education system.

# CHAPTER 8

# 8. CONCLUSION

*8.1. Rationale for the study and design*
*8.2. Reflections on the outcomes*
*8.3. Reflections on the Research Methodology*
*8.4. How does the study help Tanzanian teachers/researchers in the field of ICT in Education*
*8.5. Recommendations*

## 8.1 Rationale for the study and design

This section describes the reasons on which this study and its design is based.
Mathematics and science are very important subjects in the education system of any country as they play a major role in the economy and social life of its people. Information and communication technology (ICT) tools can enhance the mathematics and science learning process.
In Tanzania mathematic and science subjects has been taught by using in a teacher- centered approach. In this approach of teaching the lesson is dominated by the teacher learning the students listening and copying notes. With this teaching approach, students can reproduce facts and use formulaic algorithms, but they rarely internalize and develop deeper insights in to the mathematics they are learning (Tillya 2002).
Although an official secondary school computer studies syllabus for form 1-v1 was issued in 1997 till now it is not yet properly implement due to the lack of programs for training teachers on computers and very few secondary schools have computer laboratories.
The main focus of this study was how to improve the teaching methodologies by integrating computers in education system especially in secondary mathematics curriculum.

The study in general was aimed at preparing secondary school teachers so as enable then to use ICT in teaching mathematics subject and then try it in classroom environment in order to determine whether it can be implemented in the Tanzania mathematics curriculum. One of the objectives of this study was to determine if teachers when supported can learn new knowledge and new teaching skills and then apply them successfully in classroom. Teachers were supported by helping them to develop deeper understanding of the subject content (i. e mathematical concept) how to enter formulas in spreadsheets that will help learners enter date and make decision to find results and then how the help their students learn the contents.

The classroom observations shows that all teaches who participated in this study managed to apply the new knowledge and new teaching skills very successfully.

Students were able to discover mathematical concepts themselves, with little assistance from the teacher. This approach helped them to interpret graphs and diagrams, solve problems, which are related to real world and making decision on the mathematical relationships.

Generally this approach of teaching is associated with active involvement of students in the classroom discussion.

Teaches appreciated the new knowledge and teaching skills because this will help them to improve their lesson preparations presentations and classroom management. Some teacher found that it was their good opportunity to discuss with another teacher on how they can improve their teacher methods. Also teacher leaned new subject contents how to prepare lesson plans that will actively involve students in the leaning process, how use the lesson appropriately and how to manage their class.

Teachers who participated in this study promised to adopt these new knowledge and teaching skills because it simplifies the teaching process. But charge can be a difficult and complex process depending greatly on how much teachers incorporate what they learned into classroom (Tillya 2003 cited DAVIS 2003). This is because over time in the context of their classroom who teachers construct personal practical knowledge – an integrated set of knowledge conceptions belief and values – which greatly influences their practice and how they respond to educational charge (Tillya 2003, cited Van Driel, e. t al, 2001, P.141). Therefore creating strong links with personal learning and classroom contexts is important inducing teacher charge in beliefs and practices (Tillya 2003 cited, 2003).

The study in general was aimed to prepare secondary schools teachers, so as to enable them use computers as tools in teaching basic mathematics subjects and then try it in classroom in order to determine whether it can

be implemented in the Tanzanian mathematics curriculum. Te central objective of this study was to determine whether teacher when supported can learn new knowledge and new teaching skills and then apply then properly in classroom. Teachers were supported by helping them to develop deeper understanding of the subject content (e. I mathematical concepts) trained how to enter formulas in a spreadsheet sells that will enable learners to enter date and find results that will help them to make decisions and then supported on how to help their students learn the contents. Form the classroom observation all teachers who participated in this study managed to understand new knowledge and new teaching skills and then applied then successfully in their classroom.
The results above suggests that teaches once supported can early learn new knowledge and new teaching skills and then apply then properly in their classroom.

## 8.2 Reflections on the Outcome

This section provided information that is bade of the results presented in chapter five. Starting with the results of assessments for by students at the end to lessons it is clear that at the beginning the score of students who used computer were very how compared to other students who did not use computes in learning.
But as the students continues to learn by using computes their score in the end of lesson assessment increased as shows in the table of results in chapter five.
From the table the performance of students who used computes increased and in some schools were even more than the score of the students who did not use computer which suggest that there was a big improvement. The score of students who computers in learning continued to increase as shown in the table in chapter five that in the last lesson the assessment score for students who used computers was very high in all schools compare to other who did not use computer.
The results in the first lesson, intermediate lesson last lesson assessments respectively suggests that it ICT will continued to increase as well.
On the other side the score of the test given at the end of chapter as shows in chapter five. It is clean that the average scores for students who used computers was very high compared to the average score of students who did not used computers in all schools.

The performance of students at the end of lesson assessment and the of chapter test verity that students understand more when they actively involved in the teaching and learning process.
This study took place during the normal schools tie table and hence teachers and students did not get enough time to be trained how to used computers. Its is learn that if teachers and students can get enough time to prepare themselves especially during vacation time the performance can be even move than what we expect.

## 8.3 Reflection on the Research Methodology

This study was based as a development research approach. The approach was selected basing its strength and the aim of this study. The underlying strength of the approach is t the possibility o realizing of a series of small scare intervention and drawing methodological guidelines for the design and evaluation of such products in an interactive manner (Tillya, 2003 as cited in van den Akker, 2002 van den Akker and Plomp, 1993). The development research approach helps to understand the classroom teaching n their every day file in terms selecting and the subject contents and how to help students understand the subject concepts.

## 8.4 How does the study help Tanzania teachers and researches in the fled of ICT in education.

Programmes of designed teacher in service training seem to be very important in the process of development teachers professionally .
This study clearly indicates the importance of the in- service training of teachers and all teachers who participated expressed their positive views about the study and its appropriateness in teaching mathematical in the information society. All teacher appreciated the appropriateness of the technology used in the study.
The observation made in the classroom indicated that all teachers who participated in the study managed to used the new knowledge and new teaching skills learned appropriately into the classroom teaching. In general teacher managed to demonstrate how better they understood the new knowledge and skills although they did not achieve at the same level.
The introductory part of the lesson was properly mastered by all teaches but in the case of main body of the lesson some teachers did not demonstrate the

mastery of the new knowledge and skills at the same level as introductory party of the lesson .
The part of the lesson, which was done properly by all teacher, is the conclusion.
On the sides of the out comes. The results fro students in both the and of lesson assessments and the end of chapter test were encouraging. Over all finding environment that they perceived it as more investigative- open ended and well organized and that the computer hardware and software was used friendly and adequate this indication suggests that the teachers were able to create an activity – based learning environment (Tillya 2003).
The classroom observation indicated that all students who participated in this study appreciated the lesson material and the methods used in teaching. The development research approach also supports professional growth and an increase in expertise of various in service participants in the development process.
Teachers were trained to prepare the computer – base lesson notes material and a lesson plan that will actively involve students during the teaching the lesson they developed using the new knowledge and new teaching skills learned during their training. The students were assessed at the end of each lesson and the results were recorded for future use. The results, which has been described, previously were encoring that is they showed improvement of students performance as they continued using computer in learning (i. e the students who used computers for learning in this study).
The study combine qualitative and quantitative methods to give both broadly and scope to the research. Besides the utilization f these methods the decision regarding data collection and analysis was done in order to understand the different aspects of the opinions and understanding of the innovation by the basic mathematics teachers and students. In this way data collection techniques was done during and after lesson and date were analyzed after all date the were collected.
The research methodology used in this study has both strength and weaknesses.
The following the strength of the research methodology used in this study.

- the methodology enable teachers to improve the quantity of the lesson materials they develop because all teacher who participated in this study were involved in the process of preparation and improvement of the lesson materials.
- The lesson materials developed by teacher who participated in this study were practical and effective in classroom environment that

means they can be used in the Tanzania basic mathematics curriculum.

- The methodology also enabled teacher to prepare good and students – centered lesson plans.
- The methodology-helped teachers understand how to use the lesson plans and follow it in each stage of the lesson as well as evaluating the lesson objectives effectively.

Also some weaknesses arising during the design development and classroom implementation of the lesson are as follows.

- Teacher were not able to used the lesson plan prepared and follow the lesson development stages according to what they prepared.
- Teachers were no able to follow the time allocated for each stage of the lesson plan on the classroom implementation. This clearly indicated that more reinforcement was need in training the teachers to tackle the problems observes in the classroom practices.

## 8.5 Recommendations

The general aim of any development research is to make a study and produce the knowledge that focuses on the results and the methods used in the process that led to obtain that result. This section provides the recommendations that will help and guide future researchers who studies will e about ICT and education especially mathematics and science subjects. The suggestions are given in order use or improve the use of computer in teaching different subjects specifically mathematics (Algebra) in Tanzania. The recommendations suggest the following to be done in the future researches.

- There is a very good future expectation for use of computers in teaching and learning mathematical and science since both teachers and students who participated in the study were highly impressed by it and showed interest in using it in the future. They suggested that all students could easily understand the mathematical and scientific concepts if the ministry of education and culture will include it in the curriculum. Therefore there is a need to have more in service programmers for training teachers to use computers in teaching mathematical and other science subjects.
- The in- service programmers should be designed in such a way that it focuses on the needs beliefs and interests of its participants. The designer of these programs must understand that teachers has different need interests and beliefs depending only their qualifications experience and environment therefore it is better to prepare programmers will that satisfy all groups categories of these teachers.
- The subject contents to be used in teaching need to be selected carefully depending on the level of students, hardware and software available. If the contents if not carefully selected this can make the students hard to understand on completely misunderstand the concepts underlying the subject matter.
- Further more it can confuse the students and distort instead of improving the teaching and leaning process.
- The subject development stages must be sequenced in a definite order for the students to learn and judge and discover themselves the concepts intended to be understood by students. This is very important because when the subject development stages will not be arranged in sequential order students will fail to discover or confuse completely.

In general the study recommends the use of computers in teaching mathematical and science subjects and also there subject if possible. This is recommended because both teachers and students who participated in the study realized the importance of using it and recommended its implementation in the school curriculum.

# BIBLIOGRAPHY

**Bitner, N., & Bitner, J.** (2002) Integrating technology into classroom: Eight keys to success. *Journal of Information Technology and Teacher Education* , 95 – 200.

**Blumenfeld, P.C., Marx, R.W., Patrick, H., Krajcik, J. & Soloway E.** (1998) Teaching for understanding. In B. Biddle, T. Good & Goodson (Eds.), *International handbook of teachers and teaching* (pp. 819 – 878). Dordretch: Kluwer Academic Publishers.

**Hakkarainen, K., Muukonen, H., Lipponen, L., Rahikainen, M., & Lahtinen, E.** (2001). Teachers' information and communication technology (ICT) skills and practice of using ICT. *Journal of technology and teacher education*, 9(2), 181 –197.

**Gustafson, K., & Branch, R.** (1997). Survey of instructional development models. Syracuse, NY*: ERIC Clearinghouse on Information Technology*.

**Marx, R.W., Blumenfeld, P.C., Krajcik, J. & Soloway E**. (1998). New technology for teacher professional development. *Teacher and teacher education*, 14, 33 –52.

**MOEC** (1995). Education and training policy, Dar-es-salaam. *Ministry of Education and Culture*.

**MOEC** (2001) Primary Education Development Plan, , Dar-es-salaam. *Ministry of Education and Culture*.

**MOEC** (2004) Secondary Education Development Plan, , Dar-es-salaam. *Ministry of Education and Culture*.

**Mumtaz, S.** (2000). Factors affecting teachers' use of information technology and communication technology: a review of the literature. *Journal of Information Technology for teacher education,* 9(3), 319 – 341.

**Mokros, J.R., & Tinker, R.F.** (1987). The impact of microcomputer-based labs on children's ability to interpret graphs. *Journal of research in science teaching*, 24(5), 369 – 383.

**Schacter, J., & Fagnano, C.** (1999). Does computer technology improve student learning and achievement? How, when, and under what condition? *Journal of Educational Computing Research*, 20(4), 329 – 343

**Thomas, G.P.** (2001). Towards effective computer use in high school science education. *Education and information technology,* 6(1), 29 – 41.

**Tilya, F.** (1997). *Integration of computers in science and mathematics in secondary schools*: Case study of Tanzania. MSc. Thesis, Enschede: University of Twente.
**Tilya, F.** (2003). *Teacher Support for the use of MBL in activity – based physics teaching*: case study of Tanzania. Dr. thesis: University of Twente.

**Ministry of Communication and Transport** (2003). *National ICT Policy of Tanzania*.

**Tom, Alexander**. (2003). Journal of TechKnowlogia. *ICT in Education.*

**Unesco. (**2003). ICT in Teacher Development. Journal of Information & Communication Technology for Education in Asia-Pacific,.

**Unesco-bangkok**. (2003). ICT in primary and secondary education.

## Appendix 1

**Lesson plan evaluation sheet**

| Title | | date |
|---|---|---|
| Focus | Yes/No/Partly | Comments/Suggestions |
| Is there any mathematical knowledge and understanding the students will gain from this lesson? | | |
| Are the mathematical skill developed clear? | | |
| Can the learning outcome realistically be achieved? | | |
| Is the lesson relevant and appropriate to the pupils? | | |
| Will this be an interesting lesson? | | |
| Is it clear how the class will be organized? | | |
| Is there an opportunity to discover what the pupils already know at | | |

| | | |
|---|---|---|
| the start of the lesson? | | |
| Is it clear what the teacher/pupils will be doing at various stages of the lesson? | | |
| Does the lesson have a clear beginning, middle and end? | | |
| Is it clear what will be assessed and how this links with the learning outcomes? | | |
| Does the lesson match the level described? | | |

## Appendix 2

**Teachers' Interview questions**

1. Reflecting on the lessons and how you implemented them in your classroom, what are your views on student learning?
2. with your experience with students, what difficulties do you perceive students had with the lessons?
3. was group work successful in your classroom? Why?
4. in your view did students receive enough support? What attributed to that?
5. assume ICT integrated lessons, could fully be implemented in the school curriculum what difficulties can you foresee?
6. what difficulties did you experience in introducing the computer – based lessons in your classroom?
7. based on how students were doing the activities, what advantages do you think students profited?

## Appendix 3

**Students' Interview question**

1. Of the activities you did, which were your favourites and why?
2. How have the lessons you did been different from your normal classes?
3. Did you notice any advantage or disadvantage? Mention them.
4. Was these lessons interesting to you? Why?
5. Did you participate fully during these lessons? If yes why?
6. Do you think the whole class understood the lessons? Why?
7. Is there anything new you that learned from these lessons?
8. Do you have any comments or suggestions which you think might be useful?