An Approach to ICT based school education in Tanzania
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Abstract
Introduction of Information and Communication Technology (ICT) in school education needs the development of a framework by the policy-making authorities. In this work an approach has been suggested based on survey conducted by the authors and an implemented model in another developing country. The main focus of this approach is the use of ICT in schools, both primary and secondary, in Tanzania considering resource constraint as a major factor.

Introduction
In recent years there has been a general outcry on the quality of education being provided in Tanzania. Government, parents, teachers, students/pupils and the society in general are all aware, but there doesn’t seem to be any effort being made to alleviate the situation. As a result, parents who can afford are sending their children to neighbouring countries, and even Europe and America as an alternative. Those who cannot afford the associated costs are just complacent that their children are at least going to school. One of the contributing factors could be the method of delivery that is used in the transfer of knowledge.

The teaching-learning process in Tanzania is mostly teacher-led as a survey carried out in Dar es Salaam, Morogoro and Arusha indicates. This happens in an environment in which there are no enough teachers, no enough teaching-learning resources, and no enough suitable textbooks. The “chalk and talk” method presupposes that learning is merely listening – denying the students the chance to actively participate in the learning process. This seriously hampers the rate of retention and therefore the quality of education provided.

The use of ICT in Tanzanian schools is not a new concept. In the late 1960’s and early 1970’s primary and secondary schools were provided with radios to enable them listen to educational programmes designed in collaboration with and broadcast by the Radio Tanzania, Dar es Salaam. Audiocassettes with pre-recorded subject matter were also used. No one knows what went wrong, because such training materials are no longer provided. In early 1990’s institutions like the then High Precision Technology Centre were already using videocassettes to teach subjects like electronics and quality assurance. The wide spread use of TVs in the mid 1990’s would probably have been another step in introducing ICT based school education, but there were no efforts made to integrate these electronic media into education delivery. Only DTV (Dar es Salaam Television) broadcasts South African designed lessons on various subjects. The TV era is augmented by the introduction of computers in business and hence the need for training people to man them. As a response to this, most higher learning institutions introduced courses in computer science and information technology. The private sector also did not want to miss this opportunity and hence they jumped on the bandwagon. Several private training institutions were established. There are also plans by the Government to provide computers to (some schools have been provided with) secondary schools. In 1997, the Ministry of Education and Culture issued a syllabus for computer studies for secondary schools, which was revised in 2002 although the 1997 version is what is still operational. Already the subject is being examined by the
National Examination Council of Tanzania. The performance in the subject at both O and A levels is indicated in tables 1 and 2 respectively.

<table>
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<th>C</th>
<th>D</th>
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Table 1 : examination results for computer studies at ‘O’ level

Source: NECTA Statistical Analyses

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<th>C</th>
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<th>E</th>
<th>S</th>
<th>F</th>
<th>Total Number of Candidates</th>
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<td>Total</td>
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<td>12</td>
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Table 2: Examination results for computer science at ’A’ level

Source: NECTA Statistical Analyses

However, those who have sat for the examinations (both at O and A level) are from privately owned schools. Even the schools, both private and government, are using computers to learn some basic programming skills, word processing, spreadsheet and database. They are not used as teaching/learning tools in other subjects. The computer quickly calculates, organizes and contains the banks of knowledge, but is still just the tool for the people who must make knowledgeable decisions. The use of ICT in teaching other subjects would improve performance in subjects whose concepts are difficult to explain. For example, statistics show that the performance of candidates in Basic Mathematics examinations has been very poor (see tables 3) and the average overall failure rate for the years 1995 –2002 is 73.3% (Mazigo 2003). The 2001 form two examinations show that the failure rate in Basic Mathematics in three out of seven education zones is 80% (see table 4).
Table 3 Performance in Basic Mathematics at Certificate of Secondary Education Examination 1995-2002:

Source: NECTA

Among other things, Mazigo attributes this failure to inability of some teachers to write or express themselves in English and shortage of textbooks and reference books. The use of ICT will ameliorate the performance and actually Mazigo supports this view by suggesting use of modern technological equipment in teaching and the revision of curriculum delivery methodologies as remedial measures. This work starts by looking at the need for introducing ICT-enabled education in Tanzanian schools and the existing ICT infrastructure and proceeds by discussing the results of the survey, and finally provides alternative implementation solutions.
Table 4: Performance in Basic Mathematics at Form Two Secondary Education Examination for three Zones in 2001

Need for introduction of ICT in Schools

Education plays an important role in the society (Ignacimuthu et al 2002). It has been defined as a conscious, deliberate and planned process designed to modify behaviour in a desirable and socially acceptable way to impart knowledge and skills (Natarajan, 1999). In teacher-led classroom, the teacher is thought of as knowledge dispenser and in most cases the student is a passive recipient. However, the rapidly growing impact of Information and Communication Technology has brought about a revolutionary change in every sphere of life (Kamal, 2002), education being no exception. This calls for a proportional shift of the role of the teacher as a knowledge dispenser to the role of mentor, guide and manager of the learning process and more responsibilities on the part of the learners. This can only be achieved by shifting from the conventional teacher-led teaching and learning to a more interactive teaching/learning methodology. In his paper titled “Technology Enabled Learning Initiatives”, (Natarajan, 2002) identifies two ways in which technology provides inputs to education, namely adding to content the accumulated knowledge and experiences from the various shades and forms of technology and more effective and convenient ways of information delivery.

ICT helps in the development of new teaching/learning methods. There is no doubt that ICT can play an important role in transforming teaching and learning (Dhar 2002) and the education of the future will be more dependent on the availability and the use of Information and Communication Technologies. In a survey of 300 primary and 100 secondary Scottish schools in the UK, William et al (2000) found out that the impact of ICT in education is positive and more than 60% of the teachers were of this view. It was also evident in the survey that the future training should focus on the familiarity with wider range of ICT practices, the use of ICT as a tool for life long learning for teachers and students, flexibility in ICT and information technology literacy to allow for choice and guidance, and the types of ICT resources available. However to make it a success, it will need the training, the skills, the knowledge, the relevance to educational goals, and the resources to meet the increasing ICT costs (Dhar, 2002).

The world is increasingly becoming an information society and heavily relying on the use of ICT as a means of communication and business transaction. As Maltha (2000) noted the global economy is becoming a network and knowledge-based economy, and the knowledge gaps contribute to the economic gaps. Introduction of ICT in schools will help in reducing this gap. A nation’s ability to acquire and apply knowledge influences development greatly and as knowledge becomes more important, so does higher education (World Bank, 1998) and this is particularly true for lower echelons of education as it is at these levels where a solid foundation is laid. An ICT illiterate individual will find it difficult to cope with this knowledge economy. The delay in introducing ICT in Tanzania school education means that the future generation will find it difficult to share ideas with their counter parts in other countries, leave alone doing business with them. The today’s business community depends more heavily on the use of ICT and so an individual who is competent in the use of such technologies stands a better chance when it comes to competing in the labour market. The world society today is becoming technology based, from the grocery store checkout scanner to the computers operating the space shuttle. The Tanzania community then, has to prepare its children for this competition, compounded by privatization of the economy.
Higher learning institutions are increasingly orienting themselves in the use of ICT as a means of delivering subject matter. An A level student aspiring to join the top educational echelon will not be able to cope if one has had no basic training in ICT use in secondary schools. The problem is more serious when it comes to undergoing training abroad. Are we ready to suffer the consequences?

Discussion of survey results
A survey carried out in 32 schools and institutions of higher learning in Dar es Salaam, Morogoro and Arusha show that teacher-led method is still the main delivery mechanism used in teaching in our schools. Despite the fact that the number of schools surveyed is very little compared to the number of schools in the country, some qualitative statements can still be made. All of the schools and institutions use this method, although majority of them use teacher-led delivery method with a combination of some ICT (video/Audio cassettes, internet etc.). This may not be true for the whole country, given that the areas surveyed are more urban than rural and in just three regions. It is interesting to note that majority of the institutions had computers with a good chunk having more than twenty computers. Of the schools/institutions having computers half of them had a one to one computer-student sitting arrangement in computer labs. However, most of them did not use the computers for teaching. When asked what was the source of power, majority of the respondents said that they had electricity connection. Of course this is far from the truth for Tanzania rural. All secondary schools and institutions of higher learning have electricity connection while only few primary schools have the connection. This means that introduction of ICT based education in primary schools may be hindered by lack of electrical energy or an alternative solution may have to be sought. Nonetheless, majority of the respondents see the use of ICT in schools as an approach that could improve delivery of subject matter -underscoring the need for a better delivery mechanism. The use of ICT however, is hampered by associated cost and lack of expertise in developing local content. Well above half of the respondents think it is an expensive venture while some attribute nonuse of ICT to lack of expertise. The results are encouraging as far as use of Internet as source of literature is concerned. All higher learning institutions have access to Internet and use it to complement textbooks and lecture notes as well as for communication (e-mail). The survey results also reveal that majority of the schools/institutions use basic Microsoft applications for tasks related to word processing spreadsheet and database management.

Available solutions for implementation
There are several approaches that can be used to introduce ICT based education in our schools. Under this section, four such implementation solutions are discussed.

Institutions of higher education adopting the nearby schools
Institutions of higher education, majority of which have computers, could make arrangements (maybe on rotational basis) to invite nearby schools students at least once a week to learn ICT skills and then how to use ICT as a learning tool. This is possible because almost all higher learning institutions have some form of ICT in use and have the expertise. But this approach is limited by the demand from the institutions’ large number of users, both staff and students and as such the approach may not be practicable. Another limiting factor is the location of the higher learning institutions. Majority of the higher learning institutions are in urban areas and so even if it were practicable it is only pupils from urban primary schools who would benefit.
Worse still, these higher learning institutions are not localized in the sense that the concentration of such institutions is only in some regions while other regions have none.
This would mean that only few regions in the country will benefit from the introduction of ICT based education in our schools. Lastly, the sheer number of pupils (6,796, 555) as shown in tables 5 (206,751 in secondary schools) and 6 (6,589,804 in primary schools) is a limiting factor compared to the number of higher learning institutions available in the country (both public and private). It is just impossible to accommodate such a big number in our higher learning institutions. Furthermore, even the higher learning institutions do not have enough facilities to cater for the needs of their own students.

**Introduction of mobile computing laboratory facilities**

Another approach could be the introduction of mobile computing services on regional or district bases. Teams of experts may be constituted and provided with computers fitted in large motor vehicles – mobile computer laboratories. These mobile laboratories will be visiting schools on rotational basis and teaching computer lessons to pupils and even teachers. This approach may probably solve the problems associated with lack of electrical power in some schools as the engine of the motor vehicle can be used as an alternative source of power. The approach is also less expensive as a single or two mobile units can serve the whole district.
### Table 6: Regional Enrollments of Students in Primary schools and distribution of teachers in the Country.  
**Source:** Ministry of Education and Culture

<table>
<thead>
<tr>
<th>Location</th>
<th>Enrollments</th>
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<tr>
<td>Mara</td>
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<tr>
<td>Mwanga</td>
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<td>Mbeya</td>
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<td>Morogoro</td>
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<td>Mwanza</td>
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<td>Rukwa</td>
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<tr>
<td>Ruvuma</td>
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<td>Shinyanga</td>
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<td>Singida</td>
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<tr>
<td>Tabora</td>
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<tr>
<td>Tanga</td>
<td>755</td>
<td>5,566</td>
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<tr>
<td>Total</td>
<td>12592</td>
<td>6,589,804</td>
</tr>
</tbody>
</table>

However, given the road infrastructure in the country this approach may be an infeasible venture. The number of schools and pupils also limits the approach. Running computer training on such rotational basis will only serve demonstration purposes but not a serious computer technology transfer. The lack of adequate computer trained teachers/professionals may also seriously hamper the move.

**Computer assisted instruction-learning/web based learning**

Utilizing computers as the tool for a teaching and learning seems the path to follow. However, the path has barriers along the way. Technology is expensive, both in terms of hardware and software and though computers are being provided to some schools, they are still not enough to meet the need. Education is still being housed in buildings established before the birth of microcomputers and lacking in electrical wiring and space. Schools lack the technical staff required for the expensive repair and upkeep of equipment and frequently, administration lacks the visionaries required to instigate changes for the future.

Trained staff is also needed within the classroom. Higher education has been unable to keep pace with the rapidly expanding knowledge in technology. Teacher candidates are graduating with little or no experience to utilize the technical tools. The volume of material our children must know to function in the future has outgrown the confines of today’s educational structure. Children must be taught ways to seek knowledge, but this is hampered by the financial limitations.

**Computer Supported Teaching**

This process can be defined as a teaching/learning process, where the multidisciplinary and multimedia approach will be used to address the multiple intelligence faculties of students thereby generating the impact of the teacher on the student and not distancing the learning process between the learner and the facilitator.

This approach is slightly different from the computer-assisted teaching, where the user/student will interact with the system. If the system is voice assisted the language and the pronunciation could be a hindrance to the learning process. Whereas in the computer supported teaching process, the facilitator/teacher will be using the software to support his teaching through displays and animations and has the option to switch on the voice, if needed. The displays/animations will clearly demonstrate the concept, which, otherwise, might have taken much more time for the facilitator to draw and explain on the board. Also this approach will assist the student in getting clear understanding. If a fully drawn picture is shown, the students may not understand
clearly from where and how to start and finish a drawing. Figure 1 illustrates the series of steps followed when drawing a triangle with all the three sides given using such software. It should also be noted that for each class, one computer and monitor/TV screen is sufficient.

The primary advantages of such software systems over the conventional computer assisted teaching/learning software packages are:

- Concepts in subjects like Physics, Chemistry, Economics, Mathematics; Geography etc., can be explained by the facilitator easily and in a similar manner in all the schools, where such systems are used. This will remove the disparity due to facilitator/teacher performance.
- The facilitator has the option to freeze a display and to resume or to repeat a concept any number of times.
- These systems are very user friendly and the facilitators can be trained to use them effectively with minimal effort.

This type of approach has been successfully implemented in a number of private secondary and higher secondary schools in India and the perception analysis done based on the usage is shown in fig 2

**Suggested Framework**

Based on the above discussions it is suggested that a higher level policy making body for introducing ICT based school education in Tanzania need to be formed. This body will have to analyze the implications and come up with workable propositions, which will enable the future generation to have sound system of education.

However this work suggests that, considering that Tanzania has got over 1080 secondary schools and 14070 primary schools, it may be a viable proposition to introduce the computer supported teaching/learning, initially in the secondary schools, with adequate training to the school teachers in using this ICT based education system. Depending upon the students’ strength in the schools, each school may be provided with appropriate number of classrooms, with a basic infrastructure of one computer and one TV/monitor with essential software.
Figure 1 Drawing a triangle when all the three sides are given

STEP 1
AB = 5 cm
BC = 4 cm
AC = 3 cm

STEP 2
AB = 5 cm
BC = 4 cm
AC = 3 cm

STEP 3
AC = 3 cm

STEP 4
AB = 5 cm
BC = 4 cm
AC = 3 cm

STEP 5
AB = 5 cm
BC = 4 cm
AC = 3 cm

STEP 6
AB = 5 cm
BC = 4 cm
AC = 3 cm

STEP 7

STEP 8

STEP 9

STEP 10
AB = 5 cm
BC = 4 cm
AC = 3 cm

3 cm
4 cm

A
5 cm
B

C

A
5 cm
B
Though this work has been carried out in Tanzania, the situation in all other countries in Africa is much similar. The same framework can be confidently suggested for implementation in all African countries.

**Conclusion**

The sample survey results indicate the need for introducing the ICT based school education system. However, if needed, a detailed survey may have to be conducted. It should also be pointed out that any delay in implementing ICT based education will further complicate the introduction of ICT in school education system. The suggested framework is workable and it is essential that the authorities concerned should take early action in this regard.

**Acknowledgement**

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