An Approach to ICT-based School Education in Tanzania

SenzigeJ.P. & Sarukesi K.**

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 about the quality of education being provided in Tanzania. The Government, parents, teachers, students/pupils and the society in general are all aware, but there does not 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. Audio-cassettes with pre-recorded subject matter were also used. No one knows what went wrong, because such training materials are no longer provided. In the 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 secondary schools (some schools have already been provided).

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' level is indicated in Tables 1 and 2 respectively.

* Department of Computing and Information Technology, The Institute of Finance Management, P.O. Box 3918 Dar es Salaam, Tanzania.

Table 1: *Examination results for computer studies at 'O' level Grade*

GRADE / YEAR	SEX	A	B	C	D	F	Total number of candidates
2000	F	00	02	06	14	02	24
	M	01	18	20	17	04	60
2001	F	01	00	00	16	12	29
	M	11	20	17	14	05	. 67
2002	F	04	04	07	13	51	79
	M	27	20	08	10	12	77
Overall	F	05	06	13	43	65	132
	M	39	58	45	41	21	204

Source: NECTA Statistical Analyses.

Table 2: *Examination results for computer science at 'A' level*

GRADE / YEAR	SEX	A	B	C	D	E	S	F	Total Number of Candidates
2001	F	00	00	01	00	00	00	01	02
	M	00	00	03	09	09	02	03	26
2002	F	00	00	01	00	01	00	01	03
	M	00	07	07	05	03	04	00	26
Total	F	00	00	02	00	01	00	02	05
	M	00	07	10	14	12	06	03	52

However, those who 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).

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.

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*.

Table 1: *Performance in Basic Mathematic at Certificate of Secondary Education Examination 1995- 2000.:*

	Grade	A		B		C		D		F					
Year		Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	T/Girls	T/Boys	G/Total	Failure Rate
1995	No.	86	651	180	991	453	1,634	2,110	4,808	13,785	12,563	16,614	20,647	37,261	71%
	%	0.2%	1.7%	0.5%	2.7%	1.2%	4.4%	5.7%	12.9%	37.0%	33.7%	44.6%	55.4%		
1996	No.	19	177	64	418	205	1,112	1,714	5,371	16,858	13,903	18,860	20,981	39,841	77%
	%	0.05%	0.4%	0.2%	1.0%	0.5%	2.8%	4.3%	13.5%	42.3%	34.9%	47.3%	52.7%		
1997	No.	131	948	237	1,119	758	2,727	2,022	4,431	15,368	13,903	18,516	22,628	41,144	71%
	%	0.3%	2.3%	0.6%	2.7%	1.8%	6.6%	4.9%	10.8%	37.4%	33.8%	45.0%	55.0%		
1998	No.	44	413	125	640	507	2,256	1,401	3,593	17,565	15,457	19,642	22,359	42,001	79%
	%	0.1%	1.0%	0.3%	1.5%	1.2%	5.4%	3.3%	8.6%	41.8%	36.8%	46.8%	53.2%		
1999	No.	47	421	85	660	316	1,612	2,411	6,169	17,409	14,597	20,268	23,459	43,727	73%
	%	0.1%	1.0%	0.2%	1.5%	0.7%	3.7%	5.5%	14.1%	39.8%	33.4%	46.4%	53.6%		
2000	No.	75	577	158	952	304	1,484	2,809	7,078	17,964	15,486	21,310	25,577	46,887	71%
	%	0.2%	1.2%	0.3%	2.0%	0.6%	3.2%	6.0%	15.1%	38.3%	33.0%	45.4%	54.6%		
2001	No.	77	523	174	749	669	2,502	2,247	5,411	20,031	18,099	23,198	27,284	50,482	76%
	%	0.2%	1.0%	0.3%	1.5%	1.3%	5.0%	4.5%	10.7%	39.7%	35.9%	46.0%	54.0%		
2002	No.	230	1,187	392	1,581	1,433	3,917	2,267	4,391	17,309	16,557	21,631	27,633	49,264	69%
	%	0.5%	2.4%	0.8%	3.2%	2.9%	8.0%	4.6%	8.9%	35.1%	33.6%	43.9%	56.1%		
Total	No.	709	4,897	1,415	7,110	4,645	17,244	16,981	41,252	136,289	120,065	160,039	190,568	350,607	73%
	%	0.2%	1.4%	0.4%	2.0%	1.3%	4.9%	4.8%	11.8%	38.9%	34.2%	45.6%	54.4%		

Table 4: *Performance in Basic Mathematics at Form Two Secondary Education Examination for three Zones in 2001*

	Grade	A		B		C		D		F					
ZONE		Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	T/Girls	T/Boys	G/Total	Failure Rate
LAKE	No.	-	6	6	123	81	702	259	1,059	5,261	5,299	5,607	7,189	12,796	83%
	%	0 0%	0.0%	0.0%	1.0%	0.6%	5.5%	2.0%	8.3%	41.1%	41.4%	43.8%	56.2%		
HIGHLANDS	No.	3	11	39	132	139	600	396	868	5,480	5,130	6,057	6,761	12,798	83%
	%	0.02%	0.1%	0.3%	1.0%	1.1%	4.7%	3.1%	6.8%	42.8%	40.1%	47.3%	52.8%		
WESTERN	No.	-	5	19	85	90	322	238	589	3,006	2,931	3,353	3,932	7,285	81%
	%	0.0%	0.1%	0.3%	1.2%	1.2%	4.4%	3.3%	8.1%	41.3%	40.2%	46.0%	54.0%		
TOTAL	No.	3	22	64	340	310	1,624	893	2,516	13,747	13,360	15,017	17,862	32,879	82%
	%	0.0%	0.1%	0.2%	1.0%	0.9%	4.9%	2.7%	7.7%	41.8%	40.6%	45.7%	54.3%		

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 use of Information and Communication Technologies. In a survey of 300 primary and 100 Scottish secondary schools in the UK, William *et al* (2000) found 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 future training should focus on familiarity with a 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, skills, knowledge, 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 reliant 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 reduce 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). This is particularly true for lower echelons of education as it is at these levels that 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 Tanzanian 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. Today's business community depends more on the use of ICT and so an individual who is competent in the use of such technologies stands a better chance of competing in the labour market. The world society today is becoming technology-based, from the grocery store checkout scanner to computers operating the space shuttle. The Tanzanian 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 shows 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 small 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 the majority of them use teacher-led delivery methods 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 the majority of the institutions had computers with a good number of them 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 computers for teaching. When asked what was the source of power, the 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 power. This means that introduction of ICT based education in primary schools may be hindered by lack of electricity or an alternative solution may have to be sought. Nonetheless, the 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 the 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 Nearby School

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. The majority of 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 means that only a 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.

Table 5: *Regional Enrollments of Students in Secondary Schools and Distribution of Teachers in the Country*

	Government Secondary Schools			Non Government Secondary Schools		
Region	No. of Schools	No. of Students	No. of Teachers	No. of Schools	No. of Students	No. of Teachers
Arusha	40	11,798	322	27	7,637	364
DSM	14	13,645	909	53	30,912	1,472
Dodoma	33	10,676	413	13	2,019	96
Iringa	42	13,995	595	29	9,809	467
Kagera	44	17,555	290	16	4,052	193
Kigoma	18	4,802	158	09	1,304	62
Kilimanjaro	67	21,215	749	82	16,452	783
Lindi	15	3,751	113	03	511	24
Manyara	29	5,962	232	06	480	23
Mara	39	9,494	333	14	2,658	127
Mbeya	38	10,632	469	39	12,837	611
Morogoro	30	10,279	563	19	5,980	285
Mtwara	21	5,927	234	04	1,109	53
Mwanza	40	14,980	547	18	5,820	277
Pwani	19	6,946	438	12	3,487	166
Rukwa	20	5,586	192	08	1,517	72
Ruvuma	25	6,724	294	15	3,646	174
Shinyanga	29	7,841	243	12	4,232	201
Singida	23	6,455	184	10	1,027	49
Tabora	21	6,345	281	14	4,286	204
Tanga	42	12,143	484	29	6,967	332
Total	649	206,751	8,043	432	126,742	6,035

Table 6: ***Regional Enrollments of Students in Primary schools and Distribution of Teachers in the Country***

	Government Primary Schools			Non Government Primary Schools		
Region	Number of Schools	Number of Students	Number of Teachers	Number of Schools	Number of Students	Number of Teachers
Arusha	399	242,139	6,696	20	Not available	Not available
DSM	285	386,716	6,087	35	Not available	Not available
Dodoma	593	290,925	5,261	2	Not available	Not available
Iringa	767	346,320	6,375	11	Not available	Not available
Kagera	803	414,298	6,032	6	Not available	Not available
Kigoma	372	294,750	3,739	2	Not available	Not available
Kilimanjaro	800	355,580	8,084	7	Not available	Not available
Lindi	380	128,799	2,730	0	Not available	Not available
Manyara	429	209,858	Not available	0	Not available	Not available
Mara	586	341,288	5,466	4	Not available	Not available
Mbeya	883	458,138	7,595	7	Not available	Not available
Morogoro	685	316,963	5,942	5	Not available	Not available
Mtwara	524	187,097	4,052	0	Not available	Not available
Mwanza	929	629,697	7,863	12	Not available	Not available
Pwani	433	173,088	3,114	0	Not available	Not available
Rukwa	441	209,735	2,978	1	Not available	Not available
Ruvuma	571	227,964	4,614	3	Not available	Not available
Shinyanga	983	529,193	5,938	9	Not available	Not available
Singida	407	231,862	3,740	1	Not available	Not available
Tabora	567	260,907	3,952	2	Not available	Not available
Tanga	755	354,487	5,663	8	Not available	Not available
Total	12592	6,589,804	10,5921	135	Not available	Not available

Mobile Computing Laboratories

Another approach could be the introduction of mobile computing services on regional or district basis. 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.

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: Web-Based Learning

Utilizing computers as tools 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 demand. 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 vision required to instigate changes for the future.

Trained staff is also needed within the classroom. Higher education is unable to keep pace with the rapidly expanding knowledge in technology. Teacher candidates are graduating with little or no experience in utilizing the technical tools. The volume of materials 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 financial limitations.

Computer Supported Teaching

This process can be defined as a teaching/ learning process whereby 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, whereby the user/ student interacts 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/ her 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

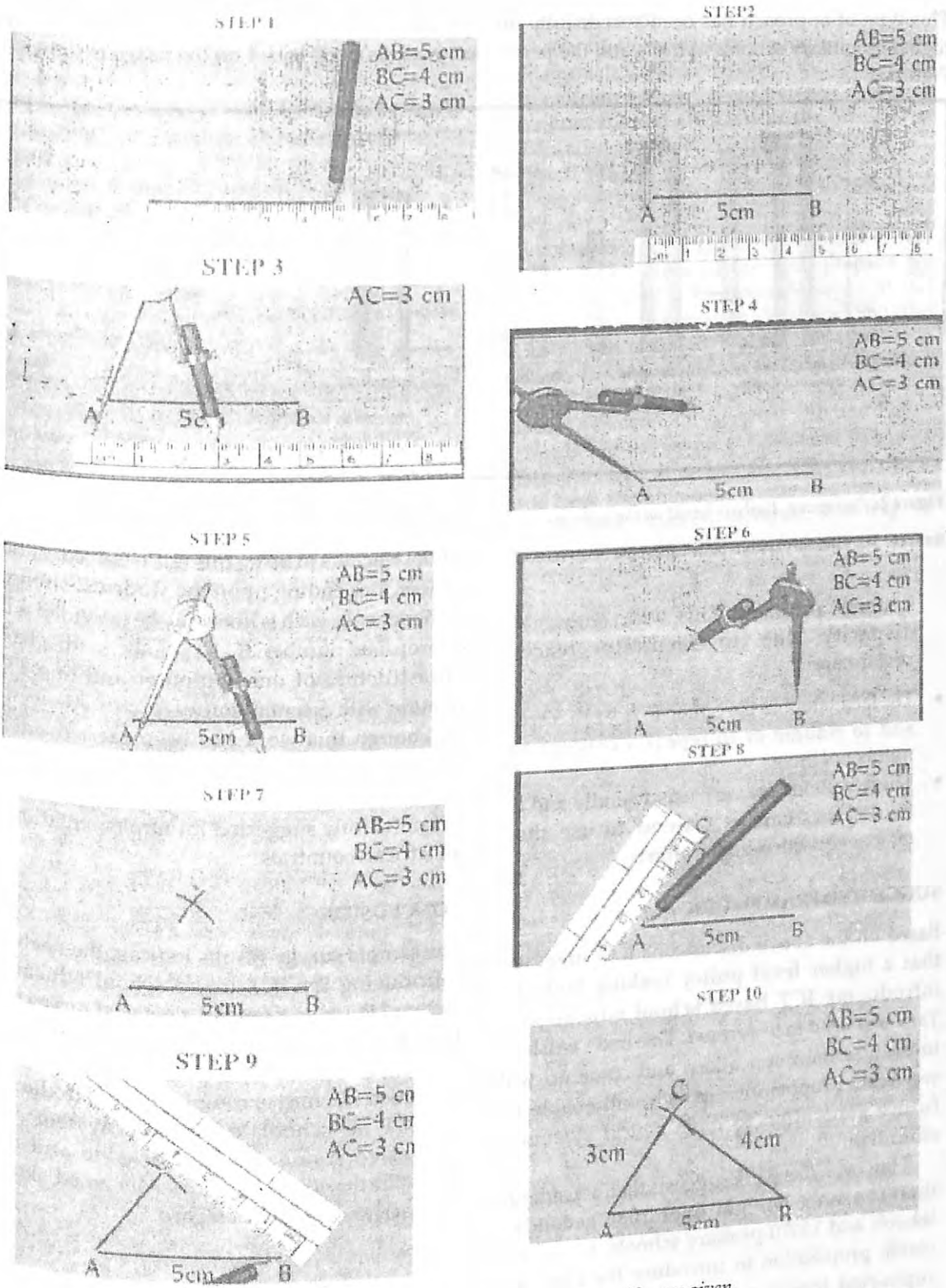

Figure 1: *Drawing a triangle when all the three sides are given.*

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 Figure 2

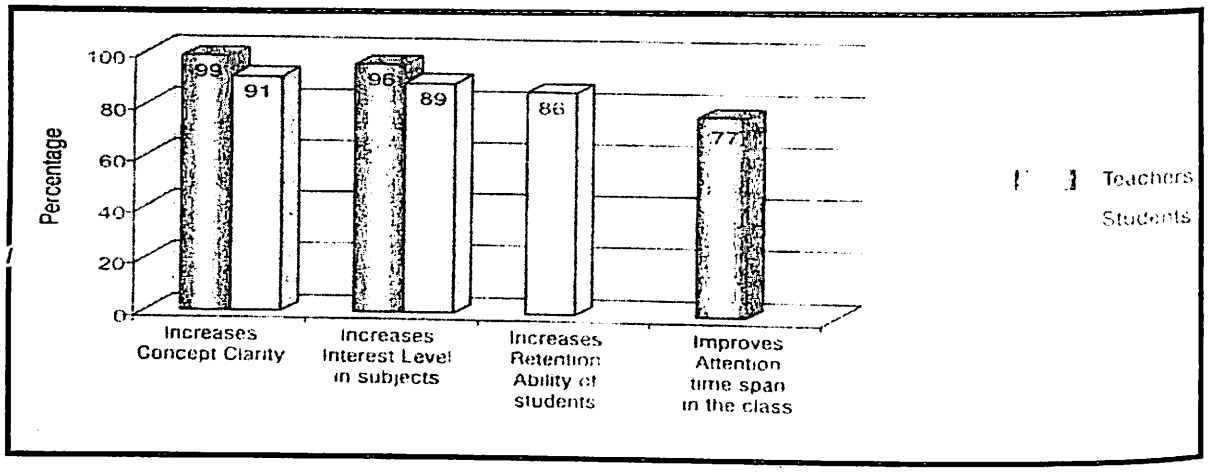

Figure 2: *Perception Analysis based on the software*

Source: JIL Bharatiyavidya publication

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.

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.

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.

REFERENCES

Dhar, B.B
"The Importance of ICT in Teaching: Is it Growing?" Association of Indian Universities 2002

Ignacimuthu, S; Devi, T; Sarukesi, K. (2002)
"Practical Steps for Aligning Technology With Higher Education." Association of Indian Universities 2002.

Kamal Yusuf, M. (2002)
ICT Enabled Education: Association of Indian Universities 2002.

Natarajan, R. (2002)
"Technology-Enabled Learning Initiatives." Association of Indian Universities 2002.

Natarajan, R. (1999)
"Technology, Technical Education and Technology-Enhanced Technical Education." *The Indian Journal of Technical Education* Vol. 22(1).

Mazigo E.M. (2003)
"Factors Influencing Poor Performance in Basic Mathematics and Remedies." Discussion paper at a meeting between Japan Overseas Cooperation Volunteers and Officials of the Ministry of Education and Culture, 20 June 2003

Maltha, H. (2000)
"The Potential for Improved Education and Research in African Universities by Using Information and Communication Technologies." Discussion paper at the workshop on the Importance of a Common Strategy of ICT Applications in Tanzanian Universities and other Institutions of Higher Learning, June 2000

Williams. D, Coles .L, Wilson. K, Richardson A. & J. Tuson (2000)
"Teachers and ICT: Current Use and Future Needs." *British Journal of Educational Technology*, vol. 31, no. 4.

World Bank, (1998)
World Bank Development Report: Knowledge for Development.