

INTEGRATION OF ICTS IN EDUCATION: THE LEVEL AT WHICH ICT TRAINING SHOULD BE INTRODUCED IN ZAMBIAN EDUCATION

Precious Chisunka-Mwila, Kaoma Lamba Daka, Felesia Mulauzi, Benson Njobvu

University of Zambia, School of Education, Department of Library and Information Studies

ABSTRACT

The role that Information and Communications Technologies (ICTs) play in every sector of the economy cannot be overemphasised. Be it in health, education, governance among other sectors of the economy. In today's changing world, there has been a recognition that there is need to integrate ICTs in Education. This is because of the worldwide recognition that ICTs can improve both the learning and teaching processes for both the learners and the teachers respectively. However, it is not clear at what level ICT Training should be introduced in Zambia. Should it be done as early as pre-school, basic school, high school or should it be introduced at tertiary level? The purpose of this study was to investigate the level at which ICT Training should be introduced in Zambia. This study was highly qualitative in nature. 14 learning institutions were purposively selected mainly in Lusaka, Zambia inclusive of institutions ranging from preschool to tertiary in both government and the private sector. The data was collected using focus group discussions, interviews and questionnaires. Focus group discussions were done for teachers and learners respectively. In addition, self administered questionnaires were answered by school managers and teachers and IT persons or IT teachers in schools where they exist. There were also some interviews done. The results are reported and include proposed levels at which ICTs should be introduced in Zambia Education with reasons why as well as why they should not be introduced at certain levels, how ICT Training is done in Zambia institutions of learning and the challenges faced in ICT training.

Key words: ICTs, ICT Education, ICT curriculum, Zambia, Training, Teachers, learners

1.0 INTRODUCTION

The integration of Information Communication Technologies (ICTs) everyday life has become the norm in today's fast changing environment. Over time, people have come to recognize the benefits that the use of ICT has brought, among them efficiency and effectiveness.

In as far as education is concerned, the use of ICTs in African schools is slowly taking ground and they are being used by both teachers and learners. This is because ICTs have the ability to efficiently manipulate and transmit information in ways that enhance the teaching and learning experience. These ICTs include hardware such as computers, various accessories, projectors, printers and photocopiers, radios and televisions, communication devices such as mobile telephones, video and audio recorders and various software among other things.

The integration of ICTs in education happens at two distinct levels. According to Raby (2004), the introduction of ICTs in schools for occasional use by teachers and learners is called physical integration, while the pedagogical integration of ICTs in schools refers to routine use of ICTs in the teaching and learning processes.

However, to facilitate the successful integration of ICTs in schools, familiarity with the various technologies and how they can be manipulated is important. Thus, the training of teachers and learners in the use of ICTs is inevitable. In some Zambian schools, such training is offered at various levels from school to school. The question then that arises is at what level this ICT training should be introduced in order to be effective.

1.1 Background

While ICTs have penetrated schools in the Northern countries in great numbers, Africa has lagged far behind. For several years now, African education systems have been coping with a multitude of problems, such as funding and countries have had to make some hard choices which generally do not attach much importance to ICTs. Thus, even when computers were first introduced to African schools in the 1970s, the governments' initial goal was to initiate the learners to the equipment and introduce certain software programs. Introductory computer courses were introduced in a few middle schools and universities.

Sadly, the developing countries could not match the pace of technological advancement of the developed world. Thus, in the 1980s, when advances in ICTs brought about the Personal

Computer, these schools were still struggling with basics of computer processing. With time however, teachers soon got interested in Computer-programmed Teaching (CPT), an innovation developed in North America and Europe. This allowed the teachers in some African countries to offer instruction in certain subjects with the help of technology. (PanAf, 2009).

Computer-Assisted Teaching (CAT) came next. This type of instruction was delivered partially or totally through the use of computers. This was done through various tutorials, or educational software, specifically designed to help learners acquire knowledge and develop skills in a given subject area. It could be used at all levels of education from primary to post-secondary courses and thus proved particularly popular in the schools it was introduced in developed African schools, (Clark & Mayer, 2003). By the early 1980s, Computer-Assisted Learning (CAL) was introduced and in the mid 1990s, ICTs were being used in a variety of disciplines. CAL covered a range of computer-based software packages and applications aimed at providing interactive instruction usually in a specific subject area.

ICT training often cuts across various education levels in Africa, from primary school to higher education. This training is slowly being taught at primary schools, covering the basics of computer training and manipulation of a few other equipments. ICT training is popular at this level as it is seen to compliment foundational teaching in by the teachers. And this is of benefit to learners because ICT help in broadening the ideas and imaginations of the young learners encourages emotional and social development, motor skills, cognitive skills as well as language development.

The debate about the perceived merits and demerits of introducing children at pre-school level to ICTs remains, (Stephen & Plowman, 2003; Kreuger, Karger & Barwick, 1988). While some researchers postulate that ICT training should be introduced at that level, others are of the view that children at this level are too young to be exposed to technologies that are as pervasive in nature as ICTs. (Kaye, 2008; Archana Shah, Sunita Godiya, n.d).

In a research by PanAf (2009) noted that ICT utilization was more widespread in African secondary schools and that these technologies are used in teaching subjects taught at that level. They are also more specifically used in the teaching and learning of specialized fields

in technical and professional schools. In some well-endowed schools, they are used in interactive learning, group work, research and information analysis for problem solving.

At tertiary education level, ICT training and utilization appears to be of great importance. Thus, it is considered necessary that both teachers and learners in these institutions are familiar with at least the basics in ICT use. What is taught however varies depending on the type of institution and disciplines. ICTs are also now being used at graduate level as well as in the area of distance education. In these settings, ICTs have proved to be valuable tools in self-training and lifelong education independent of time and location, (PanAf, 2009).

On the whole, however, most African countries are still struggling to fully integrate ICTs in their education system. While some have acquired various technologies and are using them regularly, others are barely able to meet their budget requirements. Conversely, while some countries have been able to provide the appropriate, habitual and sufficiently regular use of ICTs, others are still at the stage where they are introducing and deploying these technologies as well as equipping the teachers and learners with the basic skills on how to use them.

1.1.1 Zambia

As a developing country, Zambia hasn't been spared from economic and social woes. In an effort to promote growth, the Zambian government liberalized the economy in the early 1990s. Under these reforms, the education landscape was transformed and the country saw the coming up of privately-run schools, as alternatives to the government-run schools that had been overwhelmed by demand. The country's education structure consists seven years of primary education; from age six/seven to 12/13 years, followed by five years of secondary education, from age 14/15 year to 18 years. Basic school level is from grade one to grade 9 and high school is from grade 10 to 12. And while pre-school education is not compulsory in Zambia as currently the government has no mandate to provide it, many privately-run pre-schools exist. These provide early childhood instruction to children aged two/three years to five years old.

In an effort to attain the Millennium development goal of providing access to education for all by the year 2015, the government has placed great emphasis on nine years of free basic education. The government also provides tertiary education through various specialized institutions, colleges and three universities. Tertiary education varies in length and scope. In

addition, other higher learning institutions have been established by various stakeholders, such as non-governmental organizations (NGOs), churches and private organizations as alternatives to government-run ones.

Over the years, however disparities in the overall quality of education have emerged and have been a serious source of concern. These ranged from curriculum to staffing, teaching styles, quality of education, and infrastructure. Hence the need for successful integration of ICT in education as it has the great potential of improving teaching and learning in schools, (Tilya, n.d). As a result, the country's low ICT adoption rate in as far as education is concerned has been a source of great concern and seems to be more prevalent in government-run schools. Even where computer studies have been introduced, the situation has not been seen to improve, (Isaacs, 2007). The ministry of education recognized the role that ICTs play in the education sector and formulated the draft Information and Telecommunications Policy for education as a follow up to the National Information Communications Policy of 2006.

One of the policy's objectives is to "deploy ICTs at all levels of the Zambian educational system in order to improve and expand access to education, training and research facilities," (Isaacs, 2007). Thus depending on their capacity in terms of funding and staffing, some Zambian schools have over time been able to acquire and make available for use various technologies as well as to integrate ICTs in their teaching and learning at various levels.

Earlier studies revealed that in government-run primary and basic schools, ICTs have not been widely deployed and that computer related studies have not been formally introduced as subjects, (Sikazwe, Kalabula & Chizambe, 2003). On the other hand, government-run high schools seem slightly better off, with them having access to a limited number of computers, some even having a semi-functional computer laboratory for the students. These computers are often shared amongst the learners as they are often not adequate in comparison to the number of learners. ICT training is generally not being offered in pre-schools in the country. A number of privately-run primary and secondary schools have made great strides in trying to integrate ICTs in teaching and learning. A number have acquired computers, some accessories such as printers, photocopiers, scanners and projectors, other have radios, television sets, access to digital satellite television (DSTV) etc. In these schools, it is expected that both the teachers and learners will have basic computer literacy and are trained

as such, (Sikazwe, Kalabula & Chizambe, 2003). In addition, these schools often have internet connectivity, but the cost of sustaining this service is often a hindrance. There is also often a teacher specifically assigned to offer ICT training based on a particular syllabus. Access to these facilities is however often timetabled and thus tends to be restrictive to the learners.

At tertiary level, the presence of ICTs is more visible. In colleges and universities, computers are available, though still inadequate for all the users and are housed in computer laboratories or rooms. These are often used by teaching staff to prepare class materials or by learners to source for additional learning material as well as for research. Some of these institutions have internet connectivity, but often have difficulty sustaining the service, for instance due to budget constraints. Additionally, deliberate ICT training is limited to those institutions offering ICT-related fields of study. This problem is more pronounced in government universities and colleges, mostly due to inadequate equipment or staffing.

1.1.2 Challenges of ICT Integration in Education in Africa

Efforts to provide ICT training to users in Africa have been beset by numerous challenges. Among the prominent ones are the inadequate initial ICT training of the teachers, insufficient resources to purchase and maintain the technology, rapid and inconsistent evolvement of ICTs across the continent, cost and stability of electricity supply and internet connectivity, as well as insufficient time for learners to access ICTs within the school timetable, (PanAf, 2009, Cossa & Cronje, 2004).

The problem of inadequate training of teachers stems from the fact that few teachers have been exposed to ICTs during their training. This has resulted in the inability and/or reluctance of these teachers to get involved in efforts to train learners. This has also affected the attitude of these teachers towards the integration of ICTs in teaching and learning. Insufficient funding remains a crippling problem in most African schools, more so in government-run ones. Many struggle to meet overhead running costs and thus school authorities often sideline ICT-related needs in preference for those that are seen to have a more direct bearing on the school.

The constantly changing arena of ICTs has also posed a great challenge to developing African countries that find it difficult to keep up with regular upgrades in both software and

hardware. This leads to situations where schools are left with older versions of important software that become difficult to use due to compatibility problems. The cost of making new purchases and maintenance of old equipment is another drawback for most schools already struggling to stay within budget allocations. Few would have staff with technical know-how required for the maintenance and repair of equipment. Thus schools that are unable to outsource technical manpower often have a number of their equipment either stored away awaiting repair or not functioning properly. (Oladele, 2001; Selinger, 2001; Tunca, 2002;)

Electricity and internet connectivity are costly in Africa and proving stable supply of both is a challenge for schools. When faced with shortage of electricity supply, such as frequent power-cuts, load shedding and large electricity bills, schools find themselves unable to meet the demand for the commodity. This problem has a huge bearing on internet access, as computers and most modems run on electricity. In addition, internet speed is a huge drawback as it limits what one can do on the internet within a specified period of time.

Another compelling challenge is limited time in which access to ICTs for teaching and learning in schools. This is because ICT training and use is timetabled into the school program in order to facilitate access by all to the limited facilities. Thus, learners are given a particular time per week in which to access the equipment, which are usually stored in computer laboratories/rooms. And often these facilities are not adequate, so are shared among users at a time. These and many other challenges have hampered efforts to introduce and train learners in the use of ICT in African schools.

1.1.3 Statement of the problem

The successful integration of ICTs in education will remain a farfetched concept if adequate and appropriate training on how to manipulate these technologies is not provided to users. While there have been efforts to train both teachers and learners, much of the emphasis has been on teachers. It has also been noted that there are a lot of inconsistencies regarding the level at which ICT training is introduced to learners, resulting in discrepancies in learners' response to ICTs. Some learners are introduced to ICT training at primary level, while others as late as tertiary level. Thus, the study sought to find out at what level ICT training should be introduced to learners in Zambian schools.

1.1.4 Objectives

The principle objective was to find out the level at which ICT training should be introduced in Zambian Education. Specifically, the study aimed:

1. To investigate if ICT training should be introduced at Pre-school level
2. To investigate if ICT training should be introduced at Basic School level
3. To investigate if ICT Training should be introduced at High School level
4. To investigate if ICT training should be introduced at Tertiary level
- 6 To investigate how ICT training is done in Zambian schools
- 7 To investigate what challenges are faced in the ICT training

2.0 METHODOLOGY

This study was highly qualitative in nature because it aimed at answering the questions how and why. It did not aim at finding out how many people think ICTs should be introduced at certain levels and not other levels, but rather why it should be introduced at certain levels and not other levels in Zambian Education. It was also not aimed at finding out how many schools offer ICT training but how the ICT training is done in schools where it is offered hence purposive sampling had to be done as explained below.

2.1 Sample

The study sample comprised two university lecturers in the department of Library and Information studies who teach the introduction to ICTs LIS 242 course at the University of Zambia. 10 head teachers, 97 teachers inclusive of eight teachers of ICT training, 89 pupils and three pre-school Teachers. The teachers and pupils were from 10 schools including private and government schools at both basic and high school level. The three pre-school teachers were from three different pre-schools.

2.2 Justification for the sample

The lecturers who teach Introduction to ICTs course were picked because the researchers wanted them to share the experience they have had in teaching the course to people who were introduced to ICTs at different levels in their education. In Zambian education not much of ICT courses exist at tertiary level unless one was pursuing information or computer related programme. For example, the Bachelor of Arts with Library and Information Studies (BA. L.I.S) programme at the University of Zambia. The pre-school teachers were selected to give

an insight on their pupils' ability to learn ICTs. The rest of the sample was from schools which were thought to be doing some ICT training as they would be in the best position to answer the questions of the study.

2.3 Data Collection

Several methods of data collection were used. The lecturers and the pre-school teachers were interviewed face to face. Focus group discussions were held with the teachers and pupils respectively in the different schools. This is because the researchers sought to get in-depth and comprehensive information. The ICT personnel, ICT Teachers, head teachers had different sets of questionnaires to fill in. Some teachers were also given some questionnaires to answer in addition to the focus group discussion.

2.4 Data Analysis

The data obtained were analysed using qualitative techniques.

3.0 FINDINGS AND DISCUSSION

The first objective was based on finding out if the ICT training should be introduced at pre-school. The three teachers interviewed were of the view that it was a bit too early to introduce the kids to that kind of learning. They said they would rather concentrate on teaching them how to count, colour, trace and identify objects as these were cardinal in early childhood learning. The majority of the other respondents also thought pre-school level was a bit too early. Only a few thought it was the best level.

Several studies have been done on ICTs and children but, the concern of this paper is education-centred. The underlying concerns are that computers might have a negative effect on the child's development if introduced too early. Healy (1998) qualifies this when he states that using computers before the age of seven subtracts from important developmental tasks. Yelland (1999) sums it all up when he argues that the predominant view among those who are critical about introducing ICTs to children is that the screen based medium activities on the computer are not as effective as the manipulative or concrete activities in developing and understanding skills in the early years of a child. Haugland (2000) also agrees with this view when he says that computers are not developmentally appropriate as children learn through their bodies. Nevertheless, the debate continues with others saying that this level is appropriate (Kaye, 2008; Archana Shah, Sunita Godiya, n.d).

In Zambia, since pre-school education is optional and the government has no mandate to run pre-schools as earlier alluded to if ICTs were to be introduced at that level, some kids would miss out especially in the rural areas where pre-school education is almost non-existent. The second objective was to find out if the ICT training should be introduced at basic school level. There was a general understanding from most of the respondents that this was the best level. The reasons they gave among others were that at ages 6 and above the pupils were ready to take in some basic ICT training. They said it was important to introduce them to software such as Microsoft office so that as they got to higher levels they would be able to make use of ICTs effectively.

The findings also indicated that there is more ICT use and training in private schools than government schools at this level. The private schools which offer the ICT training start as early as grade one and get into more detail as they progress. At these schools, Learners indicated that they used ICTs for a number of activities. They used their personal laptops to store information materials; such as text books in electronic form, to prepare their assignments and make presentations. They also used their mobile camera cell phones and digital cameras to take pictures and videos of objects under research. They also used LCD projectors to project images during class presentations. Some indicated that they also used voice recording devices and uploaded the data onto their laptops or played them as part of their presentations. These pupils have access to TV sets and digital video device (DVD) players that they used to watch various educational materials. The findings also indicated that the programmes mostly used were Microsoft word, PowerPoint, Excel and some statistical packages for data analysis. This clearly shows that starting the ICT training at this level enables them to grasp the content more easily and enables them to gain the confidence they need to handle more sophisticated programmes in their later years.

PanAF (2009) agree with the above by arguing that at this level the greatest benefit of ICTs is the liberation of students' ideas and aspirations. They go on to say that ICTs provide support for pupil learning in that they foster emotional and social development, motor skills, physical health, language acquisition, general knowledge and cognitive skills. ICTs are a core tool for educational basics of reading, writing, communication and listening among other things.

The third objective was to find out if the ICT training should be introduced at high school level. Teachers who taught computer science at high schools from the sample said learners

who were exposed to ICTs at basic school were faster in grasping the content than those who were not. In the government high schools, computer science is an optional subject meaning that some pupils do not even take the subject. This leads to a situation where one is exposed to computers and other ICTs only at tertiary level or in worst case scenarios at the work place. In a changing environment, where ICTs are becoming a part of social interactions, it becomes a very big challenge.

The findings further revealed that there is some integration of ICTs in almost all the high school subjects. For example, they said they have a topic or 2 in maths that are ICT centred. In Geography, projects demand that they hand in the reports typed with diagrams done from the computer and commercial subjects teach the use of ICT in business. Since there seems to be some element of integration of ICTs in almost all the subjects at high school, it is necessary to introduce the pupils to ICTs at basic school level instead of leaving it for this level.

The fourth objective was to find out if ICTs should be introduced at tertiary level. Most of the respondents said that this was a bit too late. One respondent actually said “you can’t teach an old dog new tricks”. What they meant was that it is more difficult to introduce ICT training at this level. The two lecturers who were interviewed said their experience with Introducing ICT Training at this level was that students who were encountering ICT training for the first time tend to very problematic. They usually slow down the class to a point of frustrating the whole class as some students would be far ahead in the skills.

The fifth objective was to find out how the ICT training is done. The findings revealed that firstly some ICT theory was taught and then learners are given an opportunity to get some hands-on experience in the computer laboratories. It was discovered that there was no uniformity as regards ICT training in basic schools. This is because it varied from teacher to teacher and school to school and mostly involved the basics. However, there is a curriculum at high school level which is also very basic. Differences between private-run and government-run schools caused disparities on when, what and how learners in these schools receive ICT instruction. Private run schools seemed to be doing much better than the government schools. This was largely to do with the availability of facilities.

The final objective was to find out the challenges associated with ICT Training. The major challenge that was faced was the lack of resources such as computers. The learners had to

share computers making the practical hands on less effective. Sometimes the ratio would be as bad as 1 computer to 5 pupils. Again this was not across the board, other schools were better than some in that some pupils had a computer to themselves. In some schools, pupils even owned laptops as earlier mentioned.

Further, efforts to train learners in ICT use are often crippled by lack of resources, i.e. funding and human resources. They said that because equipment is expensive to acquire and maintain, most of it being either second hand or refurbished, Zambian schools are constantly faced with difficult choices to make among different priorities. And more often than not, issues of teaching material, utility bills and other pressing needs get the larger portion of the funds available, while ICT needs are made to wait for further allocations. Other concerns raised were also that, computer software and applications are regularly updated and new ones appear on the market quickly. They are expensive to acquire on a regular basis and the updates tend to render previous versions obsolete or raise compatibility problems. This presents a constant challenge for those trying to provide up-to-date ICT training to learners.

When it came to human resources, it was learnt that a number of teachers were unskilled in the use of ICTs and this makes it difficult for the schools to provide adequate ICT training beyond the mere basics. This makes ICT instruction for learners inadequate. Sometimes teachers themselves are hesitant to take part in ICT training as they lack the confidence required. The people who were engaged in the ICT training found in these schools are not trained ICT teachers because the Zambian colleges of Education and the University of Zambia do not train ICT teachers. More often than not, these people were employed by the schools to run the computer laboratories, and do the maintenance as well as offer the ICT training.

The other challenge was to do with the internet. Some schools do not have internet facilities open to the pupils because of the cost associated with it. Where, internet was available the challenge that was mostly reported was the speed. It was found that the internet was very slow making research very frustrating. The findings also reviewed that the time allocated to ICT training was inadequate. The pupils explained that the access to the computer laboratories was limited by timetables. They complained that they did not have enough time to practice what they were taught.

4.0 CONCLUSIONS

From this study the following conclusions concerning ICT Training in Zambian Education were arrived at.

1. Introducing ICT training at pre-school was too soon
2. Introducing ICT Training at Basic School level was more appropriate
3. Introducing ICT Training at high School was a bit too late
4. Introducing ICT Training at Tertiary Level was very late
5. The training of ICTs is done by first giving some theory then practicing in computer laboratories. There is no standard curriculum at basic school level. It is done haphazardly depending on the skills of the teacher and the facilities available. However, there is a curriculum at high school level.
6. There were a number of challenges associated with the ICT Training among others were the lack of facilities, lack of trained ICT Teachers, Internet Issues and limited time to practice because of the restrictions on the access to the computers.

5.0 RECOMMENDATIONS

1. There should be a deliberate policy to introduce ICT Training at basic school level in Zambia.
2. There is need to develop a standard curriculum that will be followed by all the ICT teachers in addition to the one at high school level.
3. There is a need to start training ICT Teachers in the colleges of Education and at the University of Zambia. Specifically, at the University of Zambia, the school of Education should collaborate with the school of natural sciences which offers a degree programme called “Bachelor of Science in Computer Science” to train ICT teachers the way they do it for mathematics and science. Or they should tailor make a programme for ICT teachers.
4. The government then should make sure that every school has a computer laboratory to facilitate this training.

5. Where internet connections are slow, efforts need to be directed at making them faster depending on the cause.

REFERENCES

Archana Shah and Sunita Godiyal. (n.d) ICT in the early years: Balancing the risks and benefits. Accessed on 12/08/2011. Available at www.ejournal.aiaer.net/vol21209/17.%20Shah%20&%20Godiyal.pdf

Cossa, G.G. and Cronje, C.J. (2004).” Computers for Africa: lessons learnt from Introducing computers into schools in Mozambique”, Int. J. Learning Technology, Vol. 1, No. 1, 2004

Clark, R C. and Mayer, R.E. (2003). E-Learning and the science of instruction: Pfeiffer, San Francisco.

Haugland, S. (2000). Early Childhood Classrooms in the 21st Century: Using Computers to Maximise Learning. Young Children, 55, 1, pp. 12–18.

Healey, J. (1998). Failure to Connect: How Computers Affect Our Children’s Minds – for Better or Worse. New York: Simon and Schuster.

Isaacs, S (2007). “ICT in Education in Zambia”. Survey of ICT and education in Africa: Zambia country report. Accessed on 10/08/20011. Available at www.infodev.org/en/Document.436.pdf

Kaye, (2008). “Benefits of technology in education.” ICT in early Education

Kreuger, L.W, Karger, H. and Barwick, K. (1988). “A Critical Look at Children and Microcomputers: Some Phenomenological Observations.” Early Child Development and Care. 01 January 1988. Accessed on 14/08/2011. Available at <http://dx.doi.org/10.1080/0300443880320108>

Oladele, B.A. (2001). The imperatives of Challenges for Africa in the Knowledge Age: Status and Role of National Information Policy. 67th IFLA Council and General Conference, August 16 -25, Boston.

Pan African Research Agenda on the Pedagogical Integration of ICTs: Phase 2, Project proposal. (2009). University of Montreal.

Stephen, C. and Plowman, L. (2002) ICT in Pre-school Settings: A ‘benign addition’? A Review of the Literature on ICT in Pre-school Settings. Learning and Teaching: Scotland, Dundee. Accessed on 13/08/2011. Available at <http://www.ltscotland.org.uk/earlyyears/BenignAddition.asp>

Sikazwe, A.K, Kalabula, D.M and Chizambe, E. (2003). Information and Communication Technologies in the Education Sector. Round Table Workshop, 19th – 22nd May 2003. Ndola, Zambia

Selinger, M. (2001). The Imfundo Project: ICTs in teacher education in developing countries. Society for Information Technology and Teacher Education International Conference 2001, (1), 3008 - 3013.

Tunca, B. (2002). Barriers in using Technology. World Conference on Educational Multimedia, Hypermedia and Telecommunications, (1), 1980 - 1982.

Tilya, F.N. (n.d). Policy Issues in ICT Education and Training

Yelland, N. (1999) Reconceptualising schooling with technology for the 21st century. Information Technology in Childhood Education Annual, pp. 39–59.