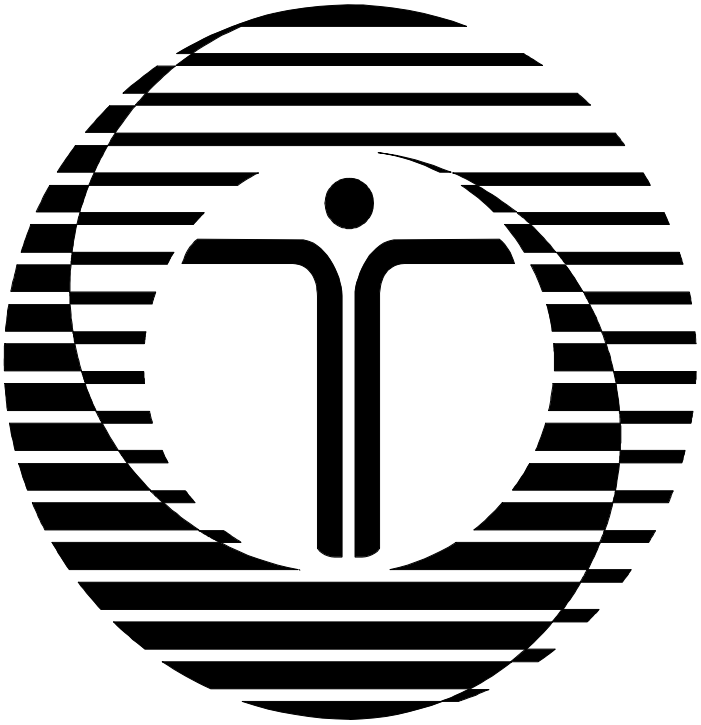
The use of ICTs in the curriculum in Botswana, Namibia and Seychelles



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List of acronyms

AED	Academy for Educational Development
ALDEC	Adult Learning and Distance Education Centre
ASB	Association of Small Businesses
BAC	Botswana Accounting College
BETD	Basic Education Teacher Diploma
BIAC	Botswana Institute of Administration and Commerce
BTEP	Botswana Technical Education Programme
CA	Computer awareness
CAD	Computer-Aided Design
CATT	Computer Assisted Teacher Training
CECS	Community Education Computer Society
CES	computer education studies
CITs	Computer Integration Teachers
CJSS	Community junior secondary school
DFID	Department for International Development
DG-ETD	Director General – Educational Technology Division
DRC	Democratic Republic of the Congo
EFA	Education for all
EMIS	Education Management Information System
ERNESA	Education Research Network of Eastern and Southern Africa
ETDP	Education, Training and Development Practitioners
GCB	Government Computer Bureau
GER	Gross enrolment ratio
GNP	Gross National Product
HDI	Human Development Index
HIGCSE	Higher International General Certificate of Secondary Education
HPI	Human Poverty Index
ICDL	International Computer Drivers License
ICT	Information and communication technology
ICTAN	ICT Alliance of Namibia
IGCSE	International General Certificate of Secondary Education
ILT	Internet Learning Trust
IT	Information technology
LAN	Local area network
LCCI	London Chamber of Commerce and Industry
MBESC	Ministry of Basic Education, Sport and Culture
MEY	Ministry of Education and Youth
MoE	Ministry of Education

MSAM	Ministry of Social Affairs and Manpower Development
NAMCOL	Namibian College of Open Learning
NER	Net enrolment ratios
NGO	Non-governmental organisation
NIE	National Institute for Education
NIED	National Institute for Educational Development
NIIT	National Institute for Information Technology
NOLNET	Namibian Open Learning Network
OECD	Organisation for Economic Cooperation and Development
OPI	One Page Introductory
OS	Operating System
RNPE	Revised National Policy on Education
S&T	Science and technology
SACOS	State Assurance Corporation of Seychelles
SACU	Southern African Customs Union
SADC EPSI	Southern African Development Community Education Policy Support Initiative
SADC	Southern African Development Countries
SCCI	Seychelles Chamber of Commerce
SETA	Sector Education and Training Authority
SGBs	School-governing boards
SITZ	Seychelles International Trade Zone
SMT	Senior management team
SNYC	Seychelles National Youth Council
SQA	Scottish Qualifications Authority
SSS	Senior secondary school
SSU	Student Support Unit
UB	University of Botswana
UBEL	University of Botswana E-learning Programme
UBEL	University of Botswana E Learning Programme
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
VCS	Victoria Computer Services

Executive summary

In 2002, the Southern African Development Community Education Policy Support Initiative (SADC EPSI) initiated a research process in order to strengthen regional policy dialogue and research co-operation. Grants were awarded to SACHES, ERNESA and SAQMEQ to conduct research in three related areas: poverty alleviation, decentralisation, and the use of ICTs in curricula. SACHES won the grant to conduct research on the use of ICTs in curricula. On 25 August, a draft report will be presented to the SADC Ministries and Permanent Secretaries of Education by Linda Chisholm, Rubby Dhunpath and Andrew Paterson, who conducted the research on behalf of SACHES.

The purpose of the study was to establish the conditions necessary for successful implementation in contexts of poverty. This is done through investigating how ICTs are taken up in both the formal curriculum and the curriculum-in-use in three SADC countries: Botswana, Namibia and Seychelles. Each country has prioritised the implementation of ICTs in schools and developed policy and curriculum in this regard. Botswana, Namibia and Seychelles fall in the upper bracket of e-ready countries in SADC but are still considered to be part of a broader sub-Saharan context where poverty is a characteristic of development.

A huge gap exists in our knowledge as to what actually exists, specifically in relation to curriculum, implementation and costs at the school level. If a high priority is placed on greater ICT connectivity and increased application in institutional and domestic contexts on the African continent in order to enhance social, economic and personal development, and education is perceived as playing a major role in ensuring achieving these goals, then initiatives undertaken at the school level deserve closer examination.

Policy dialogue was intrinsic to the research process; it framed the research priorities, sites, partners, process and outcomes. Dialogue between ministries and researchers occurred through the joint determination and implementation of research instruments (a survey and key-informant in-country interviews), the fieldwork and products. In addition, desktop research was conducted to analyse and understand broader contextual SADC-wide and national issues and conditions. Case studies were produced for each of the countries based on this work.

Closer examination of the e-readiness, conditions of human development, basic education and ICTs in curriculum in these three countries in relation to other SADC countries have to date revealed that:

- All three countries are in the upper bracket of SADC countries in terms of e-readiness, the human development index and achievement of basic education.
- There is a correspondence between the level of e-readiness, human development and level of achievement of basic education.
- Each country has national and educational policies, plans and strategies for the use of ICTs in schools.

- There are substantial differences between and within countries that have undertaken such policies.
- Despite the relative strengths in e-readiness, human development and basic education, there are significant implementation weaknesses that undermine relative achievements.
- The key to improving implementation lies in improved teacher training, development and support.
- Attention needs to be paid to improving school leadership, curriculum development, and provision of learning support materials.
- Partnerships between schools and communities with respect to access and support need to be developed.
- Costing requires co-ordinated planning within clearly formulated project management time frames for each aspect of implementation.

Part one:
General report

Linda Chisholm

Introduction and purpose

Improving information and communication technology (ICT) on the African continent has in recent years become a major priority of pan-African as well as regional and national initiatives. At a regional level, SADC Ministries of Education have likewise also taken the issue on board and indicated the need for research and action. At national level, many countries have conducted research and implemented various strategies to improve access to these technologies. The purpose of this study is to understand the conditions necessary for successful implementation of ICTs in curricula in contexts of poverty. This is done through investigating how ICTs are taken up in both the formal curriculum and the curriculum-in-use in three SADC countries: Botswana, Namibia and Seychelles.

The main rationale in sub-Saharan countries for the introduction of 'vocational' subjects such as information and communication technologies in schools 'has been the hope that inserting such subjects into the mainstream of secondary schooling would ease the students' transition to the world of work' (Lauglo, Akyeampong, Mwiria & Weeks 2003: 37). This is underlined in the case of ICTs in schools. The skills developed through the use of ICTs are seen as critical for making the transition to and the development of information mediated economic activity. Despite the enormous constraints and difficulties that are faced, the question in Africa, as in other world regions, it is argued, is that it 'is not *whether* computing skills need to be taught, but *how soon* it will be affordable and practicable to introduce such skills, and in what precise ways ICT can be most helpful in a school setting (Lauglo, Akyeampong, Mwiria & Weeks 2003: 16). Thus a driving force for implementation is the feeling that marginalised countries could be 'left behind' if some effort is not made to address these issues (Wright 2000).

Despite the widely recognised importance of the issue and introduction into curricula in some countries, there is still a degree of ambivalence. This is linked to the history of previous efforts to effect economic change through schools as well as the cost, cultural and organisational barriers, and rather modest achievements of recent initiatives (Lauglo et al. 2003). There is a well-recorded history of the poor results of investments in new educational technologies, substantial questions about feasibility and pressures arising from competing priorities (Lauglo et al. 2003). Severe constraints do hamper the introduction of ICTs in contexts of poverty. These include complex tooling-up, staffing and servicing/logistical requirements. In this context, it makes sense to ask how ICTs are being implemented in school curricula and what the conditions are that are necessary for their successful implementation.

A huge gap exists in our knowledge as to what actually exists, specifically in relation to curriculum, implementation and costs at the school level. If a high priority is placed on greater connectivity of the African continent in order to enhance social, economic and personal development, and education is perceived as playing a major role in ensuring achieving these goals, then initiatives undertaken at the school level deserve closer examination.

It is important to place such initiatives in their proper context which includes both the broader social, political and economic context, as well as the educational context. Blind enthusiasm for ICTs in schools – 'globalisation evangelism' – will not go very far. Advocating the use of ICT must be accompanied by a call for improvements in infrastructure and the social and economic conditions necessary for schooling. As Jansen has pointed out, 'war, floods, drought and their concomitant effect on poverty, aggravate and devastate the social and economic conditions of schooling. The HIV/AIDS pandemic has stretched the sustainability of social cohesion of many school schools to their limits (Jansen 2001). ICTs require attention to infrastructure even as their introduction can assist in improving infrastructures and dealing with broader social and economic questions. Introduction of ICTs can also be meaningful only 'if the basic education conditions are in place' (Jansen 2001). Infrastructure and basic education are essential to the successful implementation of ICTs. By the same token, the implementation of ICTs can assist in ensuring the spread of and improvements to the quality of infrastructure and basic education. These issues highlight the importance of contextual analysis alongside a curricular analysis.

Three countries were selected for this study through a process of policy dialogue: Botswana, Namibia and Seychelles. Policy dialogue was intrinsic to the research process; it framed the research priorities, sites, research partners and process. Dialogue between ministries and researchers occurred through the joint determination and implementation of research instruments (a survey and key-informant in-country interviews), the fieldwork and products. In addition, desktop research was conducted to analyse and understand broader contextual SADC-wide and national issues and conditions.

Each of the selected countries has very recently begun to introduce ICTs in education. In order to examine the use of ICTs in curriculum, country-specific curricular initiatives were examined in terms of conditions and criteria identified as necessary for creating an ICT-enhanced learning environment (OECD 2001). These included:

- The need for radical curriculum change.
- Compatibility of student assessment with ICT-enriched learning.
- Digital literacy as a fundamental learning objective for all.
- Suitable levels of equipment in all schools.
- Plentiful educational software of quality and easily accessed information on it.
- An extended professional role for teachers in schools.
- Commitment of school leadership and management to adopting ICT.
- New partnerships between school, home and community.

Closer examination of the e-readiness and conditions of basic education in these three countries in relation to other SADC countries revealed that:

- All three countries are in the 'upper bracket' of SADC countries in terms of e-readiness, the human development index and achievement of basic education.
- There is a correspondence between the level of e-readiness, human development and level of achievement of basic education.
- There are substantial differences between and within countries that have undertaken such policies.
- Despite the relative strengths in e-readiness, human development and basic education, there are significant implementation weaknesses that undermine relative achievements.
- The key to improving implementation lies in improved teacher training, development and support.
- Attention needs to be paid to improving school leadership, curriculum development, and provision of learning support materials.
- Partnerships between schools and communities with respect to access and support need to be developed.
- Costing requires co-ordinated planning within clearly formulated project management time frames for each aspect of implementation.

Implementation efforts reveal an ambivalence, which can be corrected, through more focused attention and strengthening of these key areas. These are not sufficient, however, for contexts of poverty. Here more sustained attention also needs to be given to those infrastructural issues that hamper access to the technology itself. Introduction of ICTs in curricula thus needs to be accompanied by broader infrastructural provision.

For the purpose of placing this ICT in the curriculum study in a broader context, this introduction now provides a brief overview of:

- SADC e-readiness indicators to show the general readiness of each country for participation in ICT-mediated social and economic activities.
- SADC human development and basic education indicators, since fundamental human and basic education needs if unmet will severely limit moves to increase the level of ICT-mediated social and economic activity.

SADC e-readiness

The SADC context is a highly differentiated context with different experiences. A 2002 SADC-initiated overview of country e-readiness shows that countries in SADC can be divided into two groups:

Group 1: Seychelles, Mauritius, South Africa and Tanzania

Group 2: Namibia, Botswana, Swaziland, Lesotho, DRC, Zimbabwe, Angola, Malawi and Zambia.

The SADC e-readiness study of 2002 used a ***framework of indicators*** to identify the e-readiness of countries in SADC. The framework identified 'three overlapping levels of e-readiness' which were used to 'cluster the different countries' (SADC 2002a: 24) The fundamental or 'ground level enablers' include a level of infrastructure to enable technology to be of use. This infrastructure includes electricity, education, access to media (eg. television and radio) and basic access to telecommunications. The middle level involves access to higher-level telecommunication services, PC penetration and an ICT infrastructure focused on priority applications like e-government, e-education and e-health. The advanced level implies use of the Internet for global trade and other e-commerce activities. This includes a well-developed banking infrastructure and other commercial and legal support frameworks. This study focused on the progress being made in education as a ground-level enabler.

Seychelles, Botswana and Namibia can all be said to be leading in the field of ICTs in SADC. Seychelles is one of four countries amongst the SADC group which has a more developed infrastructure than the rest and is participating in the e-world (SADC 2002a: 15). The main challenges that this group of countries faces includes shortages of skilled individuals, bad economic conditions, expensive subscription fees and relatively low PC penetration.

Namibia and Botswana, by contrast, form part of a second group which faces serious challenges. These include poor infrastructure, lack of skilled individuals, low education levels, high costs of Internet access and a very large percentage of populations living in rural areas (SADC 2002a: 15). Amongst this group, however, Namibia and Botswana 'show significant growth and potential to participate in the e-world' (SADC 2002a: 15).

Basic infrastructure/foundation level

In this study, SA, Mauritius and Seychelles are singled out as leading with basic infrastructure. Even here, though, service is not universal (see also Appendix A) Whereas Seychelles and Mauritius have 100 per cent electricity penetration, SA shows a penetration of more than 40 per cent (34). Mauritius and Seychelles also have the highest fixed line density, mobile penetration rate, and number of households with television and radio, followed by South Africa (35). Zimbabwe and Botswana also achieve highly on basic infrastructure, but Angola, Mozambique and the DRC score very low.

Middle level

At the middle level, where strong policy, a degree of PC penetration and higher-level telecommunications should exist, all countries, except for Seychelles, South Africa and Mauritius, score very low. But even here, there are big differences between urban and rural areas, such that 'the SADC region is … generally ill-prepared for a move to even higher levels of e-readiness and advanced applications' (SADC 2002a: 26).

Advanced level

The key message on the advanced level is the serious differences that exist within countries and between countries. Thus, while South Africa shows strong leadership, especially in regard to e-commerce activities and a banking infrastructure, there is a sharp and serious gap between the 'connected' and the 'disconnected'. Despite good infrastructure, a low proportion of the population in the Seychelles and Mauritius actually use the Internet; in Tanzania, despite poor infrastructure, there is a large use of the cyber café model (SADC 2002a: 27). Thus South Africa and Tanzania, with widely differing levels of infrastructure, have the largest number of Internet users.

PC penetration is highest in Seychelles and Mauritius, but overall, the region still has very low PC penetration. In most countries, the cost of Internet accounts is extremely high, and as such is a real limitation on use. Tanzania, which has one of the highest numbers of Internet subscribers, also has the lowest cost for use of the cyber café per hour.

Based on this brief overview, the main difference between Seychelles and Namibia and Botswana is the question of equality of provision. Whereas Seychelles shows evidence of both ground level and middle level conditions such as electrification, infrastructure, human resource development, expanding and enhancing telecommunications services and increased personal computer penetration, the evidence for Namibia and Botswana is more uneven and imbalanced. Thus, for example, while Seychelles has electricity, roads and a banking infrastructure in place, Namibia and Botswana have such an infrastructure concentrated in the more urban centres.

The ***general implication*** of these differences is that whereas the priority in Seychelles would be to ensure greater depth of provision and penetration in all these areas to allow for increased Internet access and utilisation, banking, software content development and an e-commerce infrastructure, the priority in Namibia and Botswana may be to provide the basic infrastructure and telecommunications that are necessary to enable universal development across the country as a whole. The specific curricular implications flow from an examination of the use of ICTs in the curriculum itself.

SADC human development and basic education

Human Development Index (HDI)

An understanding of conditions in basic education needs to be contextualised in terms of the development index of each country. The SADC Regional Human Development Report (2002) places Seychelles 1st, Namibia 5th and Botswana 6th in its Human Development Index ranking of SADC countries. Mauritius, South Africa and Swaziland precede Namibia and Botswana, which, however, remain in the top half of this index. The SADC HDI ranking is as follows:

1. Seychelles
2. Mauritius
3. South Africa

4. Swaziland
5. Namibia
6. Botswana
7. Lesotho
8. Zimbabwe
9. DRC
10. Zambia
11. Tanzania
12. Angola
13. Malawi
14. Mozambique

In the ranking according to poverty, these are by no means the poorest countries, with Namibia and Botswana being the 7th and 8th poorest countries. Accurate statistics are hard to come by, but illiteracy rates for each country are relatively low. In 1998 the illiteracy rate in Seychelles was 16 per cent, Namibia 19,2 per cent and Botswana 24,4 per cent. The percentage of children not reaching Grade 5 in the 1995–97 period in each of these countries is also relatively low: one per cent in Seychelles, 14 per cent in Namibia and 10 per cent in Botswana. The table below provides some comparative indicators which demonstrate they relative positions of SADC countries on key human development indicators:

Table 1: SADC: Key Human Development Indicators

SADC countries	Human Poverty Index (HPI-1) value rank	Adult illiteracy rate % 1998	Life expectancy index 1998	Infant mortality rate (per 1000 live births) 1998	Children not reaching Grade 5 % 1995–97	Combined primary, secondary and tertiary gross enrolment ratio (GER) % 1998
Seychelles		16	71	14	1	76
Mauritius	12	16,2	71,6	19	1	63
SA	11	15,4	53,2	60	35	95
Swaziland	9	21,7	60,7	64	24	72
Namibia	7	19,2	50,1	57	14	84
Botswana	8	24,4	46,2	38	10	71
Lesotho	10	17,6	58,1	94	20	57
Zimbabwe	5	12,8	43,5	59	21	68
DRC	--	41,1	51,2	128	26	33
Zambia	4	23,7	40,5	112	16	49
Tanzania	6	26,4	47,9	91	19	33
Angola	1	58	47	170	--	25
Malawi	3	41,8	39,5	134	--	75
Mozambique	2	57,7	43,8	129	54	25

Source: These tables are contained in the SADC Regional Human Development Report 2000: Challenges and Opportunities for Regional Integration. The United Nations Development Programme, the Southern African Development Community and the Southern African Political Economy Series Trust publish the report.

Achievement of Education for All

More telling is the position of the countries as demonstrated in relation to the achievement of Education for All. The SADC e-readiness study considers education and 'curricula that introduce exposure to the use of different technologies in the e-world' as a 'ground-level enabler' of ICT development. Key areas for maximising benefits to communities include (see SADC 2000a: 43-45):

- Electrification
- Basic infrastructure, eg. roads
- Education
- Healthcare
- Integration of ICT by government
- Increased telegeography
- Growth of teledensity and mobile penetration
- Increased PC penetration
- Increased Internet population
- Growth of banking infrastructure
- Culturalisation
- Policy and regulation: liberalisation of communications infrastructure
- Affordability
- Multipurpose community centres
- Development of entrepreneurship

The SADC e-readiness review and strategy provides an understanding of broader contextual issues. But what are the conditions relating to basic education in the three countries studied? To what extent is basic education in place? To what extent is this condition met in the countries studied?

At this point, it must be observed that there is a difficulty with the quality of the information available. For many countries, statistics are simply not available on key indicators when using the *EFA Global Monitoring Report 2002* (UNESCO 2002). Those that are available provide roughly the same pattern as is evident in the e-readiness and Human Development Index (HDI). Whereas information is often simply not available for Seychelles, it performs well where information is available; there are for example no statistics available for Seychelles on adult and youth literacy, but all children in Seychelles entering primary schools appear to have had early childhood education. Namibia and Botswana also generally feature in the upper brackets of achievement. But there are also distinct gaps, inequalities and unevenness.

Adult and youth literacy

Adult and youth literacy are general indicators of the consequences of basic education. For Namibia and Botswana, youth literacy is markedly higher than adult literacy, suggesting improvements in basic education in recent decades. As the table below illustrates both Botswana and Namibia appear to be performing better than average in adult literacy. The issue of literacy in the household is important, given that use of ICT is heavily dependent on literacy and related skills of 'reading' information on computer screens.

Table 2: Adult literacy (age 15 and over)

Adult literacy (age 15 and over)						
Country	Adult literacy rate (%)					
	1990			2000		
	Total	Male	Female	Total	Male	Female
Angola	…	…	…	…	…	…
Botswana	68,1	65,7	70,3	77,2	74,5	79,8
Democratic Republic of the Congo (DRC)	47,5	61,4	34,4	61,4	73,1	50,2
Lesotho	78,0	65,4	89,5	83,4	72,6	93,6
Malawi	51,8	68,8	36,2	60,1	74,5	46,5
Mauritius	79,8	84,8	75,0	84,5	87,8	81,2
Mozambique	33,5	49,3	18,4	44,0	60,0	28,7
Namibia	74,9	77,4	72,4	82,0	82,8	81,2
Seychelles	…	…	…	…	…	…
South Africa	81,2	82,2	80,2	85,2	86	84,6
Swaziland	71,6	73,7	69,9	79,6	80,8	78,6
Tanzania (United Republic of Tanzania)	62,9	75,5	51,0	75,0	83,9	66,5
Zambia	68,2	78,6	58,7	78,2	85,2	71,5
Zimbabwe	80,7	86,6	75	88,7	92,8	84,6

Source: Compiled from the UNESCO (2002), EFA Global Monitoring Report: Education for All: is the world on track?

Primary education

Analysis of the EFA Global Monitoring Report (UNESCO 2002) highlights two main issues that have implications for ICTs in curricula:

Higher enrolments at primary than secondary level

The EFA Global Monitoring Report (UNESCO 2002) suggests that Botswana and Namibia show relatively high net enrolment ratios (NER) of 83,6 and 79,7 per cent respectively. Generally, gross enrolment ratios (GER) in secondary education are very poor. Countries which exhibit the highest GERs in secondary education here are Mauritius (107,3 per cent), South Africa (90,2 per cent) and Botswana (81,8 per cent). Namibia's is at 59,8 per cent; no statistics are available for Seychelles. The NERs is also generally very low (or missing), with Mauritius the highest at 72,5 per cent, followed by Botswana (58,8 per cent). Again, no data was available for Seychelles. Namibia's NER was at a low 34,2 per cent; this figure was higher than most in the group.

If enrolment is higher at primary then at secondary level, questions are raised about whether ICTs should be introduced at earlier or later levels. If access to ICTs is considered a

primary learning objective for all, then secondary education is too late as too few progress to secondary education.

Need for teacher training, education and development

The percentage of trained primary education teacher was especially low in Namibia, 1998/1999 at 29,1 per cent with not much change the following year at 29,3 per cent. Botswana has a relatively high percentage of trained primary teachers (90,2 per cent) with Seychelles not too far behind at 83,7 per cent respectively.

The percentage of trained teachers in lower secondary education is low for Namibia and relatively high for Botswana and Seychelles.

These figures raise questions about the level of preparedness of teachers in general and specifically to teach ICTs and the need to address teacher training at all levels. The question of teacher training is particularly important, as it requires that issues of technical capacity, content mastery and pedagogical style all be addressed for successful adoption of ICT in the curriculum.

ICT in curricula: findings

All three countries demonstrate medium-range achievement on indicators that will ensure strong ICT environments in schools. The main successes are in the establishment of digital literacy as a learning objective across all three countries and in the establishment of new partnerships between school, home and community in two of them.

Here the degree of ***decentralisation*** of responsibility for school ICT provision and technical support has influenced the extent of development of partnerships. This is also a double-edged sword. In Seychelles, for example, centralised responsibility has enabled greater equity of provision but also some frustration with inabilities to build on strengths and use local resources to enhance ICT environments in schools. In Namibia, decentralised funding models have enabled the development of partnerships but this has also to some extent resulted in inequitable provision.

Poverty is the principal issue across all contexts that compromise access. Conditions necessary for contexts of poverty include the above as well as

- Infrastructural development including electrification and development of roads
- Universal basic education
- Health
- e-government
- e-commerce

A more detailed analysis of the specific implementation issues shows where the challenges lie:

Digital literacy as a fundamental learning objective

Policy exists in all three countries to a greater or lesser degree, with differences in the extent to which the aims of policy are pursued. In all but Seychelles, policy is not sufficiently developed and comprehensive to ensure digital literacy as a fundamental learning objective. It is also not considered a fundamental learning objective by all teachers, especially when computer literacy and/or awareness are non-examinable in early grades.

Radical curriculum change

Radical curriculum change implies three things: inclusion of ICT within the formal curriculum both as a separate subject and as taught across the curriculum; the content of the curriculum; pedagogy. All three countries have a new ICT curriculum with computer literacy as the foundation and an elective but non-examinable computer studies component in the senior grades.

A learner-centred philosophy is manifest in theory but not in practice. Teacher awareness of the link between ICT and learner-centred pedagogy appears to be low. Groundwork in respect to the development of a fully-fledged, flexible ICT curriculum is underway, but does not yet address radical change.

In some cases it is already out-of-date. In all three countries, up-to-date textbooks and learning materials are required.

Compatibility of assessment

Policy advocates ICT integration and infusion across the curriculum, but assessment practices are uneven and traditional tests which focus on the individual level tend to predominate. Assessment is linked to traditional teaching styles and undeveloped with respect to alternative activity and group bases for testing. Assessment has received relatively little attention compared to basic access issues.

Suitable levels of equipment in all schools

In all three cases, strategies exist to ensure suitable levels of equipment. In Seychelles, technical support services are slow and frustrating, while in Botswana and Namibia access in remote areas is limited by cost and financing strategies.

Plentiful software of quality and easily accessed information

In all three countries, there is minimal availability of indigenous software, software purchasing is ad hoc, there is some use of free-ware off the Internet, but few teachers are engaged in development of their own materials and there is minimal servicing of school level software needs. Unreliable Internet connections limit accessibility of free-ware off the Internet in remote rural areas in Botswana and Namibia.

An extended professional role for teachers

This is conceptualised but is not yet in practice. There are low levels of awareness among teachers of the value of ICT in their own teaching discipline. In-service training of teachers is undeveloped. As yet, no coherent programme has been devised for the pedagogical aspects of ICT as a medium across the curriculum. The links between critical and problem-solving pedagogies and ICTs are undeveloped in all but exceptional cases in all three countries.

Commitment of school leadership and management

Principals differ in levels of support for school-based ICT activity. More principals need exposure to training in the use of ICT in school administration. More principals need exposure to training in how to develop an ICT team/environment in the school. More principals need support and advice in promoting ICT in their school.

New partnerships between home and community

This differs across the three countries. In Botswana and Seychelles there is an inadequate framework for and development of partnerships, but in Namibia there are strong and working partnerships at national level. The centralised model of MoE provision in Seychelles permits equitable provision but limited partnerships to strengthen provision, while the decentralised model in Namibia ensure free development of partnerships based on need, but inequitable access as a consequence. Even where these partnerships exist, as in Seychelles, there is minimal access to computer laboratories by parents or the community.

Priorities

A combined analysis of broader contextual conditions, as well as the specific curricular conditions suggests that implementation of ICT-enhanced learning environments in the SADC context depend on:

- Basic infrastructure including electrification and roads.
- Level of human development.
- Available universal basic education.
- Policy, curriculum and human resource conditions including teacher training, development and support as the core.
- Additional conditions specific to each country's policy, curriculum and implementation strategy: these include:
  - Strengthened policy environments.
  - Strengthened and challenging curriculum and assessment procedures.
  - Strengthened teacher training in new pedagogies linked to the use of ICTs as tool.
  - Readily available, up-to-date learning support materials and textbooks.

- Safe and secure environments for equipment.
- Improved monitoring and support.

Conclusion and recommendations

The use of ICTs in curricula has begun: 'the genie is out of the bottle'. Previous vocationalisation efforts and the cost of implementation cannot be presented as an impediment where it has been made a priority. If it is a priority, and if it is being implemented, then governments need to tackle this implementation with conviction and ensure that conditions are met for successful implementation.

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APPENDIX A

Table 1: Overview of Internet usage and international bandwidth for Southern African countries

Country	Dial-up Internet subs total number	Number ISPs	International bandwidth Kbps	International hubs number
Total	892 850	132	793 634	32
South Africa	750 000	75	750 050	5
Total excluding SA	142 850	57	43 634	27
Mauritius	35 000	1	4 096	1
Botswana	25 000	6	14 000	1
Zimbabwe	20 000	8	5 120	1
Tanzania	20 000	14	4 096	3
Namibia	15 000	3	3 072	2
Zambia	6 500	3	3 072	3
Madagascar				
Mozambique	6 000	5	2 048	3
DRC	4 500	5	2 048	3
Angola	4 000	4	192	1
Malawi	2 400	2	1 024	3
Seychelles	3 000	2	4 098	2
Swaziland	1 200	2	256	2

From: Jensen (2001)

Source: Information Policy Handbook (2001), Chapter 5 Policy Mechanisms for Stimulating e-Commerce, 5.6 e-Commerce Practice and Policy in Africa, 5.6.1 e-Commerce in Practice Table 2

In: http://www.dbsa.org/publications/ictpolsa/ch5/ch5-6.htm#tab2

Date 08/07/2003

Table 2: Number of domains and websites in SADC countries

Country	Domains	Websites			
		Business	News & media	Tourism	Total
South Africa	187 649	117	41	352	3 002
Mauritius	3 275	42	7	45	160
Namibia	3 251	111	13	130	567
Zimbabwe	2 918	270	437	63	1 313
Botswana	2 356	60	8	21	176
Swaziland	981	5	9	23	62
Zambia	892	23	9	22	121
Tanzania	816	94	27	130	326
Madagascar					
Mozambique	112	9	17	7	129
Lesotho	102	8	7	18	91
DRC	83	3	7	13	91
Malawi	13	19	2	21	100
Seychelles	9	13	2	32	71
Angola	8	17	18	7	136

From: Domains are from the January 2001 Network Domains tally, http://www.isc.org/; Websites are from the Google country directory, http://www.directory.google.com/Top/Regional/Africa. http://www.yahoo.com/ also maintains country directories and there are significant discrepancies between the two. The table must be treated as a rough guide only.

Source: Information Policy Handbook (2001) Chapter 5 Policy Mechanisms for Stimulating e-Commerce, 5.6 e-Commerce Practice and Policy in Africa, 5.6.1 e-Commerce in Practice, Table 3 In: http://www.dbsa.org/publications/ictpolsa/ch5/ch5-6.htm#tab2, Date 08/07/2003

Table 3: African Internet statistics, 2002

Country	Dialup Internet subs total number	Cities with POPs	International bandwidth outgoing Kbps
Angola	16 000	3	5 126
Botswana	20 000	11	14 000
DRC	4 500	1	1 024
Lesotho	750	2	784
Madagascar	10 000	1	2 750
Malawi	3 500	2	2 300
Mauritius	35 000	1	4 096
Mozambique	6 000	11	2 048
Namibia	15 000	100	6 144
Seychelles	3 000	3	4 098
South Africa	**750 000- 900 000**	**2(?)**	**342 000**
Swaziland	5 000 – 20 000	1	256
Tanzania	30 000	4	12 000
Zambia	7 000	1	5 120
Zimbabwe	25 000	4	11 000
Total	**892 850**	**132**	**793 634**
Total excluding SA	**142 850**	**57**	**43 634**

From: Sangonet http://www3.sn.apc.org/africa

Source: Jensen, M. (2003) ICT in Africa: A status report. http://www.developmentgateway.org/node/130685/search/redir?item_id=318618&url=%2fdownload%2f189100%2fICT_Africa%2epdf&searchtext=ICT%20in%20Africa: %20A%20status%20report; date: 02/06/2003

Part two:
Methodology

Rubby Dhunpath

Methodology

The research methodology used in the ICT policy initiative focused in particular on the policy dialogue process, which was conceived as an integral and crucial component of the study. Launched in 2001, SADC EPSI project steering committee agreed, after extensive consultation, that the project should divide full operational management of the joint policy activities and research between the three research organisations, and that the programme would address key education policy and research issues identified by SADC Ministries of Education. This in turn would 'Quality Education for All'. The policy dialogue process would support Ministries of Education to identify key policy issues, dialogue with key stakeholders on the issues, and involve itself in research commissions to expedite policy decision making. After a discussion of the central characteristics of the policy dialogue process, the section examines how the policy dialogue process was operationalised; it explores the instrumentation and data collection and finally, reflects briefly on the analysis and dissemination of findings.

The policy dialogue process

A critical component of the policy initiative is the policy dialogue process. The notion of policy dialogue derives from recognition that there is a tenuous relationship between research and policy and an acknowledgement that contribution of research to the policy process is at best, weak. The reasons for this weakness are manifold, but there is increasing consensus that the absence of dialogue between the various participants in the policy process, accounts for why some policy ideas are embraced and internalised, instead of others.

There is increasing agreement amongst policy scholars and policy makers that the policy process is neither linear nor coherent. There is also increasing admission by policy scholars that the rationalist model of a divided, dichotomous and linear sequence is simplistic and reductionist. Increasingly, there is acceptance that the positivist view of the policy process as rational, balanced, value-neutral and analytical cannot survive empirical scrutiny. Instead, they acknowledge the inherent political nature of policy development and the implicit assumptions and discourses embodied in policy, as well as the unpredictable and experimental life of policies and the weak link between policy making and practice. Thus, Clay and Schaffer (1984) suggest that a more plausible conception of the policy process would be one that acknowledges it rather as a process through which policy implementers interact with policy makers, by adapting new policies, co-opting the embodied project designs, or simply ignoring new policies (Maxwell 2000). For this reason, regional formations such as SADC,

encourage informal and 'non-linear' policy decision-making processes taking into account the influences that determine which policy ideas are noticed and which are ignored.[1]

Hence, policy dialogue is emerging as an interdisciplinary science that has the potential to provide a bridge between academia and practice and between political and civil structures of society (Pampallis in Hoppers 1997). One of the more influential proponents of policy dialogue in Southern Africa, Catherine Hoppers (1997: 1) defines policy dialogue as:

> …a kind of 'intermediate policy science' is about communication and breaking barriers between academics and practitioners, between analysts, politicians and civil society, and across disciplines. It is about empowerment in the policy sphere by levelling the playing field in order that truly democratic and egalitarian participation can occur. This should involve developing early warning systems that can highlight pitfalls along the course of policy development. It should involve the supplying of relevant information and generation of analyses to policy processes, while developing the capacity to translate information into knowledge to enable effective participation by civil society and other marginalised groups.

Policy dialogue necessitates the transformation of the role of researchers by infusing responsibility for academic outcomes, including research findings, particularly in Africa where the past few decades has seen a vigorous production and enactment of policies, the success of which is not always apparent. Often, the cause of policy failure is attributed to the lack of capacity, as is frequently the case cited in Africa for unsatisfactory service delivery. The lack of capacity is seen as a consequence of the absence of frameworks for deeper communication and dialogue between various actors at all levels of the policy process. Sometimes, the absence of dialogue is compounded by the latent distrust (Hoppers 1997) between the government ministry and the academic institution.

Operationalising the policy dialogue process

To operationalise the policy dialogue process, the research themes identified above were a product of extensive consultation with SADC member states. They were identified among a number of other themes at the Annual SADC Policy Capacity Building Forum held in Livingstone, Zambia (November 2001). Subsequently, four consultative meetings were held in:

- Pretoria (February 03)
- Swaziland (March 03).
- Botswana (May 03).
- Zanzibar (August 03)

At these consultative forums, crucial decisions were taken about a broad range of conceptual and methodological issues, including the selection of research themes, research organisations

[1] For a more substantive debate on the policy process, see Dhunpath and Paterson (2003) The interaction between research and policy dialogue, paper presented at the 2003 SACHES/KENTON conference.

that would participate in the study, as well as the countries participating in each study. SADC further requested Ministries of Education to rank the themes in terms of their country priorities, since the projects could not be conducted in every SADC member state for the obvious reasons of time-scale, budget and logistics. For this reason, SADC member states elected to be involved in one of the three research projects that coincided with their own policy imperatives. Out of this self-selecting process, Botswana, Namibia and the Seychelles became the countries in which the ICT-focused research would be conducted.

One of the prescriptions of the policy initiative was that the methodology for undertaking the joint policy activities and research should achieve a balance between engaging policy dialogue among stakeholders and producing high quality research outputs useful for policy support. While a critical ingredient of effective policy research is the three-way process of communication that links researchers, decision makers and those who are affected by the issues under consideration, it was acknowledged that it would be misleading to assume that the act of linking the three groups is a sufficient condition for quality research output of the type needed by policy makers and programme managers. It would be equally misleading to suggest that having produced quality policy research (even if identified by government) necessarily lends itself to consumption. The challenge for researchers would be to present a methodology that achieves the right balance between consultation among stakeholders, engagement of government in the process of the policy research and producing a final product of high quality research.

It was agreed that research organisations would:

- Establish the necessary structures for their theme area including the establishment of a review committee consisting of three or more recognised education research experts with either regional education experience or specific knowledge of the researched theme area.
- Develop an agreed set of criteria for research evaluation. These jointly agreed quality assurance criteria would be used to assess the quality of research produced across all the theme areas.
- Organise and host the introductory workshop to which all selected research consultants were invited in order to set the guidelines for project implementation, discuss research methodologies and strategies appropriate for this programme and agree on joint quality assurance criteria for measuring project outcomes.
- Ensure that the lead research consultants are linked with the interested Ministries of Education.
- Ensure that research deadlines are met.
- Ensure that SADC EPSI are informed on a three monthly basis on the status of research progress of the approved research consultancy.
- Ensure that the research consultancy holds an introductory national or multicountry workshop to refine their terms of reference and that a final workshop to validate their preliminary findings is made to interested stakeholders in the countries of research.

An additional component of the process was the research capacity building initiative in which the lead in-country researchers contracted to undertake the fieldwork would recruit associate researchers and serve as mentors to them. Funding was provided by SACHES for this purpose.

Adopting a common negotiated approach

The common approach recommended to the research organisations for the implementation of the joint policy activities and research would follow the following steps:

- Obtain buy-in from the interested Ministries of Education on the topic to be researched in terms of their own internal issues and processes. The topics chosen have to be linked directly to a critical issue that the Ministry is engaging with.
- Undertake meta-analysis on the theme agreed upon with Ministries. Commission research to undertake comparative analysis and link it with their countries agreed topics.
- Ensure a policy dialogue process takes place with senior policy makers. Support the conversion of the research findings into pragmatic policy recommendations in terms of legislation and ministry directives needed. The latter component would be part of the consultative and dissemination phase at the end of the process.
- Support a ministerial dialogue on a commonly agreed action package, national ratification and programming into legislation and administrative directives.

The methodological parameters

The research design was conceived as having four integrated components:

- The compilation of an in-country position paper by in-country research partners.
- The desk review of existing ICT policy and initiatives as well as a review of other national and international studies.
- Administration of the survey instrument.
- Interviews with key informants and site visits.
- The preparation of a reflective report on the research process by in-country research partners.

Although it was proposed that the research outputs did not have to be based on primary field research and could rely on secondary analysis of existing research, the SACHES team believed that in order for the policy proposals to have sufficient credibility and enjoy legitimacy, the research would have to be grounded in a strong empirical base. The methodology involved, as a first step, the establishment of a common frame of reference, followed by a desk review of interested member country policies on ICTs in curricula. The meta analysis that emerged from the desk review in turn informed and shaped the instrument design. The fieldwork instruments were designed collaboratively with in-country researchers at a two-day instrument development workshop. The instruments, a quantitive survey

component and a series of interview schedules were then refined to accommodate the conditions that prevailed in each of the three countries.

An important but unintended consequence of this project is that the group of participating countries share characteristics that are not representative of the possible range of education, economic, social and information infrastructure conditions evident across the SADC member states. All three countries are small states, have a relatively well-developed basic schooling infrastructure, and also can show evidence of the existence of ICT activities in a core of schools. On account of the restricted range of in-country characteristics identified, this research study is unlikely to reveal the full experience of school-based ICT implementation particularly in conditions of poverty and rurality. However, the individual case studies explicated later in this report will demonstrate that there are several important lessons to be drawn from the research.

The survey instrument

The development of a survey instrument to be administered to school was intended to obtain a complete audit of ICT equipment in the school, and capture all the recurrent costs in goods (eg. consumables) and in services (eg. computer repairs, network maintenance etc.). The purpose was to develop a model for estimating costs of ICT in schools in each participating country. The following were the criteria for selecting the schools:

- The site selected must have computers that are used for teaching and learning.
- The site selected must have a computer room.
- The number of sites visited must be a minimum of 30.
- The sites selected must contain a balance of the high and primary schools as well as public and private schools. The balance between these categories must be judged by the researcher responsible, and should be proportionate to the occurrence of these school types (which have computers) in the national school system.
- The sites selected may include up to a maximum of four cases of a computer centre for school age learners which is not located in a school, and is operated and/or funded by a donor or NGO. (Obviously this requirement will fall away where no such sites exist in the region to be covered.)
- The sites selected must not be a private for profit computer education establishment.

The fieldwork component involving interviews and panel discussions in each country

The fieldwork component was based on in-depth *interview*s (which were audio taped) with key managers and participants in each of the three countries. The interviews, a combination of individual and focus group, were conducted by two SACHES researchers and the two in-country researchers which sometimes included the ministerial resource person. The schedule, was administered in each country as follows (where available):

	Survey	Interviews with the following participants: *where appropriate and available
Schools	30 randomly selected schools	1. Principal 2. IT teacher 3. Guidance counsellor
Learners		Five selected from each of five selected schools
Ministry of Education		1. Director of Education 2. Director if IT 3. Director of Planning 4. Director of Curriculum Development 5. Permanent Secretaries 6. Director of ICT Procurement 7. Directorate of Teacher Development 8. Minister of Education 9. Minister of Communication
Telecentres: government, private and NGOs		Selected telecentres in each country
School-governing boards (SGBs)		Selected SGBs
Service providers to the Department of Education		Selected service providers to the DoE
Universities, technikons and teacher training institutes		1. Education faculties 2. IT and support services
Donors and funders of ICT		**Examples:** USAID DFID SIDA World-links SchoolNet Other?
Non-governmental organisations (NGOs)		NGOs involved in service delivery

Compiling the report

The writing up of the report was an iterative process, which in the first instance necessitated bringing together the survey data, the in-country position papers as well as the in-country reflective reports. Draft versions were then circulated amongst the three researchers and reworked on the basis of critical comments received. The reports were circulated to in-country researchers who were asked to interrogate the reports to ensure that:

- The reports were an authentic reflection of the research process.
- The data record was comprehensive, and accurate.
- The analyses and conclusions were reasonable and defensible.

Following the presentation at Zanzibar, the draft report was be sent to readers approved by SACHES and revised in accordance with recommendations from the Zanzibar meeting as well as the SACHES readers.

Figure 1: Policy dialogue opportunities

The table below provides a summary of the fieldwork phases, in this case highlighting the opportunities for policy dialogue, which occurred at three different levels: with the SADC Permanent Secretaries, with officials in the national Ministries of Education, with stakeholders in each country, and with the in-country researchers themselves.

Date	Research phase	Policy dialogue opportunity		
		At SADC level	At country level	
		With MoE Permanent Secretaries	With ministry officials and various stakeholders	With in-country researchers
Feb 2003	Proposal development	Discussion of research proposal for common frame of reference		
Mar 2003	Refining proposal desktop analysis			
April 2003	Country overviews			Researchers write position paper: which includes an overview of ICT in their country
May 2003	Instrument design			Researchers participate in a workshop
May 2003	Report back	Discussion on methodology and design of instruments		
May 2003	Fieldwork planning			Researchers participate in a workshop
June 2003	Survey in schools based on sample			Researchers administer instrument on ICT facilities in schools
June 2003 to July 2003	Fieldwork (5 days per country)	Interviews, panel discussions, workshops, site visits, classroom observations, document collection		Researchers discuss fieldwork process with SACHES team. Researchers write up reflective report on their impression of the visit
July 2003	Data capture and document analysis			
Ju.ly 2003	Write case studies			Researchers participate in member checks, triangulation and editing
Aug 2003	Presentation of initial findings at conference of PSs	Discussion of findings		
Sept 2003	Revision			
Nov 2003	Publication			

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Part three:
Country case studies

BOTSWANA

Rubby Dhunpath

Executive summary

Botswana has a progressive ICT policy underpinned by a broader macroeconomic strategy to shift focus from an agro-based economy to a technology-based economy and ultimately, to launch the nation as the regional financial services centre and the ICT hub of the Southern African region. The new Ministry of Science and Technology has been launched to promote this vision. To this end, the country pursues a developmental goal to enable it to join the information age, with full access to the media of communication and technologies. An ICT-rich environment is perceived to be one of the pillars of a quality, relevant and accessible education system as a means of elevating the level of human capacity and productivity. Of particular note is that this vision has permeated all levels of the education system.

The Revised National Policy on Education (RNPE) underscores the importance of proficiency in computer use by students and their teachers. The Ministry of Education has pursued an aggressive roll out campaign to equip all secondary schools with a fully networked computer laboratory with at least 20 computers and access to the Internet. However, there were significant differences in the capacity of schools to use the IT resources optimally. This may in some degree be attributed to the difficulties experienced in the co-ordination between the roll out of IT infrastructure and the development of IT skills, resulting in CITs (Computer Integration Teachers) being trained before computer labs were installed with the lag resulting in skills being forgotten.

The model of curriculum development propagated by the National Curriculum Development Unit is the integration and infusion of ICT into, and across the curriculum. The success of the training initiative is apparent in some of the sites visited. To support the resourcing initiative, training was provided to head teachers. In addition, computer integration support officers were trained to cascade IT skills to their colleagues at school level. However, in general, the level and depth of training is considered inadequate to support the use of ICT as a pedagogical tool, envisioned by curriculum developers in the infusion-integration strategy. Further, in the absence of an evaluation strategy, the effectiveness of this approach and its relative success remains untested.

Another factor that constrains the laudable integration-infusion strategy, particularly at secondary level is the timetable format, which most educators claim allows insufficient time for IT lessons to secure meaningful learning gains. There was a strong call amongst teachers and school heads for a more flexible timetable model that allows students to spend longer

periods of time in laboratories to optimise the opportunities offered by technology. Successful implementation of the infusion strategy is further constrained by the prohibitive cost of appropriate, locally developed subject-specific software and core textbooks. The time allocate for computer awareness (subject) is also influenced by the fact that it is not a compulsory curriculum offering, and hence, it is not examined. This accords computer awareness marginal status, as it is regarded as having less value than subjects that are examined.

One of the concerns articulated by most participants interviewed is the inability of training institutions to adequately cope with the demand for skilled IT professionals to translate the state's ambitious policy. This is exacerbated by the high turnover of skilled professionals lost from within the education system to the private sector, and the inability of the Department of Education to control the levels of poaching. Because of the absence of a specialised teaching qualification, the lack of clearly defined career pathing for IT teachers and inappropriate levels of remuneration, there are few incentives for teachers to volunteer as CITs and even fewer incentives for trained professionals to remain in educational service.

The Ministry of Education has made significant progress in providing 'equal access' to IT resources to all schools. However, the availability of electricity and telephone services in rural areas is a major impediment to connectivity and access. Other impediments include an unpopular IT maintenance policy, the potentially wasteful four-year renewal policy and a state-tendering policy that does not guarantee efficiency or cost effectiveness.[2]

As the Ministry of Education embarks on the next phase in its ITC-enrichment strategy there are other crucial questions that need to be considered. Among these questions are:

- Whether a co-ordinated approach to infrastructure delivery and teacher training is likely to yield higher returns from investments in ICT?
- Whether it is desirable to introduce a specialised teacher-training programme for ICT teachers which harness the combined capacities of the University of Botswana, the Mochudi Media Centre and other teacher training colleges?
- How to re-design the timetable to accord greater prominence to ICT and to enable the infusion-integration strategy to permeate all subject areas?
- Whether providing accreditation to computer awareness would elevate the importance of the subject?
- Is there a need to research creative strategies for addressing impediments to take up of ICT in rural areas such as state-supported telecentres, Internet kiosks and similar initiatives which have the potential to promote digital literacy?
- Whether there is a need to create enabling conditions for greater involvement of NGOs in the development of ICT in education?

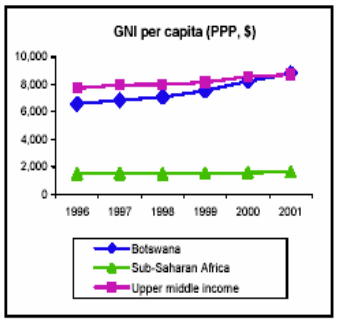
[2] The 4-year renewal policy was the de-facto policy at the time of data collection. It must be noted however, that this policy was under review and by August 2004, the policy had been amended to extend the lifespan of equipment.

Context

Botswana, one of the most prosperous landlocked countries in SADC shares its borders with Namibia, South Africa and Zimbabwe. It spans an area of 575,000 square kilometres and has a population of approximately 1,5 million people, of whom 79% live in the rural areas. It gained its independence from Britain on September 1966. While Botswana has an unreliable inadequate rainfall, the large-scale diamond mining in the country has transformed the largely agricultural economy. Botswana has also extensive coal reserves, which are exploited for electricity generation. At over US$3,310, its GNP per capita is among the highest on the continent. However, there is an acute awareness amongst Motswana that the country needs to wean itself off its dependence on its non-renewable mineral resources. In its attempt to launch an alternative economy, Botswana envisions itself as the financial services capital of the region. This vision is enabled by the fact that Botswana has one of the most highly developed telecommunications infrastructures in Africa and a rapidly growing ICT infrastructure.

Figure 1: Country background information

Country background information	Botswana		Sub-Saharan Africa	Upper middle income
	1995	2001	2001	2001
Population, mid year (millions)	1.5	1.6	673.9	503.7
Poverty (% of population below $1 a day)	..	..	..	..
Adult literacy rate (% ages 15 and over)	72.6	78.1	62.6	90.4
Urban population (% of total population)	47.2	49.4	32.3	77.2
GNI per capita (Atlas method, $)	3,520.0	3,630.0	470.0	4,460.0
GNI per capita (PPP, $)	6,340.0	8,810.0	1,620.0	8,730.0
GDP growth (1990-95 and 1995-2001, %)	3.8	6.4	3.1	2.7
Scientists and engineers in R&D (per mill. people)	..	..	..	*452.6*
Expenditures for R&D (% of GNI)	..	..	..	*0.6*



Source: http://www.worldbank.org/data/countrydata/ict/bwa_ict.pdf

It is of critical importance to situate this account of the use of information and communication technologies in the Botswana education system, firstly, because the developments related to ICT in education are driven by a far-reaching national economic development plan, and secondly because the links between the curriculum and the labour market are particularly important for the success of such a plan.

The state is the main driver of ICT in Botswana. 'Vision 2016' aims to have an educated and informed nation by the year 2016 (the 50th year of its independence). The vision is propelled by a drive to establish Botswana as a regional financial centre and acknowledges the need to position itself swiftly to develop the capacity and strength of its financial services sector. It is these sectors, which utilise information technologies intensely. In recognition of the need to maintain and upgrade accessibility and quality of national information and communication technology infrastructures, the Botswana government recently established the Ministry of Communications Science and Technology. The Ministry has a wide range of responsibilities and powers, which include infrastructure development for telecommunications, broadcasting and information services (Mogara 2003: 7). It is responsible for a number of implementation agencies – both government and parastatals

including the Government Computer Bureau (GCB), which plays an important part in procurement and standards setting to maximise interoperability and encourage networking.

Figure 2: Comparative e-readiness status of SADC member states

Country	Population (in millions)	GDP/Capita (USD)	HDI	Teledensity (%)	No. of ISPs	PCs per 100	Internet users per 100 population	Internet bandwidth (Kbps)	Cost per hr (USD)
Angola	12,30	1690	160	0,47	4	0,13	0,44	192	6,00
Botswana	1,60	3252	122	4,83	3	3,89	1,54	640	0,60
DRC	53,60	833	152	0,08	2	0,39	0,01	*128*	1,60
Ethiopia	59,65	103	171	0,25	1	0,12	0,04	512	2,60
Kenya	29,01	347	138	0,82	34	0,56	1,60	512	1,56
Lesotho	2,20	547	127	0,90	2	0,24	0,23	*512*	1,40
Madagascar	16,36	224	140	0,26	8	0,24	0,21	*128*	2,20
Malawi	10,75	242	163	0,35	2	0,11	0,17	128	1,56
Mauritius	1,20	3661	71	26,00	1	10,83	13,17	1024	1,00
Mozambique	18,88	86	168	0,34	5	0,35	0,07	572	0,80
Namibia	1,66	2051	115	5,43	4	3,64	2,52	1000	1,00
Rwanda	7,30	317	164	1,09	1	0,75	0,25	128	1,60
Seychelles	0,08	6995	53	23,00	1	15,00	11,25	128	0,90
South Africa	44,31	2979	103	12,00	75	6,85	7,01	80000	1,60
Swaziland	0,95	1388	112	2,19	2	1,45	1,37	*512*	1,56
Tanzania	32,10	244	156	0,30	5	0,66	0,83	1098	1,94
Uganda	20,55	317	158	0,24	3	0,31	0,27	512	8,40
Zambia	8,78	463	153	0,94	3	0,70	0,23	256	1,60
Zimbabwe	12,68	712	130	1,47	10	1,21	0,73	2048	4,00

Source: Samfat, Ghosh, Reesaul, Nundalallee & Louis (2003) *The ICT Backbone for Africa,* Mauritius Conference on Access to ICTs for all (Mauritius, 3-5 April).

Significant progress has been made in developing ICT infrastructure to support the aim of promoting the country as the financial services centre of the region. Relative to its size, it has the fifth highest teledensity percentage in the region. It also ranks fifth highest in terms of the number of PCs per 100 people (Figure 2). It also has a rapidly growing telecommunications infrastructure (Figure 3).

In addition, a range of conditions has been put in place that makes Botswana an attractive base from which international enterprises can conduct business in the region. These include:

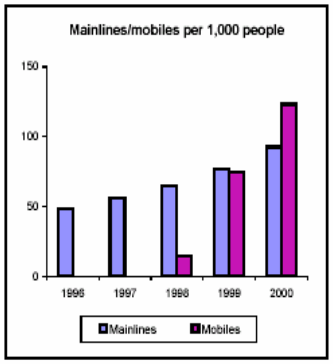
- A stable economy with high growth averaging nine per cent per annum between 1990 and 2000.
- One of the lowest corporate tax rates in the region.
- One of the lowest personal tax rates in the region.
- No exchange controls, which means that profits, and capital can be repatriated.
- Lack of aggressive trade unionism.
- Botswana is a member of the Southern African Customs Union (SACU), which permits duty-free movement of goods between member countries.
- Double taxation avoidance treaties (eg. Sweden, UK, South Africa, Mauritius).

- There is good infrastructure both in terms of physical and telecommunications infrastructure.
- Aggressive financing structures to encourage local investment through the National Development Bank and the Botswana Development Corporation.
- A creditworthiness rating at A+ from Standard and Poors.
- A sound rating for transparency from Transparency International (Mogara 2003: 7-8).

Furthermore, Botswana as a member of SADC has ratified a protocol that focuses on turning that region into a Free Trade Area by 2010. The SADC market is currently not particularly rich in comparison with northern regional economies, but it is large with approximately 200 million people.

Figure 3: ICT infrastructure and access

ICT infrastructure & access	1995	2000	2000	2000
Telephone mainlines				
Per 1,000 people	41	93	14	190
In largest city (per 1,000 people)	168	*180*	*33*	*202*
Waiting list (thousands)	11	*12*	*1,295*	*7,594*
Waiting time (years)	..	0.5	4.4	0.5
Revenue per line ($)	1,212	*974*	1,266	867
Cost of local call ($ per 3 minutes)	0.03	0.02	0.06	0.07
Mobile phones (per 1,000 people)	0	123	17	160
International telecommunications				
Outgoing traffic (minutes per subscriber)	500	*323*	240	93
Cost of call to U.S. ($ per 3 minutes)	..	*3.60*	..	2.64
Daily newspapers (per 1,000 people)	31	*27*	*12*	*95*
Radios (per 1,000 people)	130	*155*	*198*	*457*
Television sets (per 1,000 people)	19	25	59	317



Source: http://www.worldbank.org/data/countrydata/ict/bwa_ict.pdf

This concentration of effort on the ICT infrastructure is also based on the recognition in Botswana that intensive development of its own ICT-based industries will not be possible without attracting multinational IT companies to set up in Botswana. In this regard, the National Development Plans 8 and 9, recognise the importance of government and private sectors to collaborate in their mutual interest.

Policy

Information and Communication Technology in education in Botswana is based on the Revised National Policy on Education of 1994.

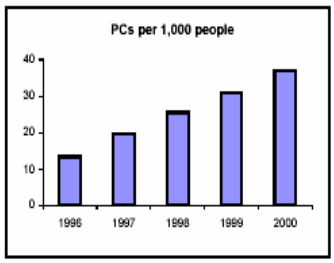
- ICT is promoted as a resource entity in its own right: i.e. as a medium for development.
- ICT is promoted as an outcome: i.e. the country envisions itself the 'E capital' of the region.

The aggressive drive for an ICT-rich nation has permeated all levels of schooling, notably the discourse of the Ministry of Education itself, which has embedded ICT in its philosophy, mission and vision. There is an awareness that the economic policy, and institutional pillars identified above will alone not be sufficient to ensure that Botswana achieves its goal of

becoming a regional financial hub. A component essential to success is human resources, because innovative human resources represent the means through which real value is leveraged from technological investment. This vital dimension is also recognised in the National Development Plans. Of particular interest is the intention to conduct an 'IT citizen empowerment report' which focuses on: educational opportunities, incentives for human resources development in the work environment, and encouragement for entrepreneurial activity (Mogara 2003: 8). Furthermore, there is the stated intention to conduct a feasibility study for the possible establishment of a national IT accreditation body for syllabi as well as the accreditation of training institutions and their staff.

Figure 4: Computers and the Internet

Computers & the Internet	1995	2000	2000	2000
Personal computers				
Per 1,000 people	10.3	37.0	9.2	58.9
Installed in education (thousands)	..	..	..	..
Networked PCs (%)	..	..	..	..
Internet				
Users (thousands)	1.0	15.0	3,694.8	26,349.4
Monthly off-peak access charges				
Service provider charge ($)	..	14.7 [a]	35.6 [a]	20.4 [a]
Telephone usage charge ($)	..	0.14 [a]	0.53 [a]	0.42 [a]



Source: http://www.worldbank.org/data/countrydata/ict/bwa_ict.pdf

Naturally, education policy must be aligned as closely as possible with the intention of the Botswana government bringing their economic development plans to fruition. It is within this context that this report now turns to examine the educational needs associated with the policy identified above. Of particular interest is the importance of establishing the necessary conditions for implementing ICT training in schools and to consider the extent to which the education system has made progress toward this goal.

The Revised National Policy on Education (RNPE)

The RNPE views education as an investment that will lead to a higher quality of human capacity and productivity for all. Recommendations 32c and 42f emphasise the importance of computer awareness at both junior and secondary level. The curriculum provides for computer awareness (CA) at junior secondary level, and for computer education studies (CES) at secondary level. Every learner exiting junior secondary is expected to have acquired computer literacy. While the tension involving the development of secondary schooling in Botswana has been between the pressures to achieve full vocationalisation versus opting for only providing some pre-vocational education through a limited number of practical subjects (Weeks 2002), it is proposed that the equipment in the proposed resource centres for primary schools should include computers to ensure early exposure to computing as a learning resource.

Table 1 demonstrates the number of students in 1992 and 2001, who were able to take practical subjects. While in 1992 agriculture led, with 45,1 per cent of the Form 5 students,

the other practical subjects ranged from only 0,2 per cent to nearly 12,8 per cent. In 2001 agriculture was now taken by 64,9 per cent of the students, commerce by 42,2 per cent, and design and technology 22,2 per cent. The other subjects ranged from 3,2 to 14,9 per cent. By 2001 the senior schools had expanded, had new buildings and equipment, and more practical subject teachers. Additionally, the policy proposes the acquisition of a sufficient number of computers to ensure the development of computer literacy by all senior secondary school teachers and their students.

In addition Table 1 demonstrates the commitment to expand the provision of practical subjects in the senior secondary schools. Where as the number of students in the 27 schools taking the final examination has grown by 258 per cent, those taking practical subjects have risen by 410 per cent. In 1992 there were facilities and staff for an average of 1,16 students to take any practical subjects; by 2002 this had risen to 1,85 (or nearly two practical subjects to a student). Computer awareness and computer studies are usually conceived of as falling into the generic 'practical' category (Weeks 2002).

Table 1: Number of students taking practical subjects—COSC/BGCSE—1992 & 2001 #

Subject	1992		2001		Change
	Number	Per cent	Number	Per cent	% +/-
Agriculture	2891	45,1	10,732	64,9	+ 371
Art (Art & design)	640	10,0	2,464	14,9	+ 385
Commerce	730	11,4	6,979	42,2	+ 956
Principles of accounts	374	5,8	2,002	12,1	+ 535
Food & nutrition	821	12,8	2,390	14,5	+ 291
Fashion & fabrics	215	3,4	953	5,8	+ 443
+ Home management	123	1,9	532	3,2	+ 432
* Computer studies	14	0,2	547	3,3	+ 3907
**Design & tech.	176	2,7	3,671	22,2	+ 2086
++ Business studies	-	-	306	1,9	-
@Technical drawing	782	12,2	-	-	-
@Woodwork	684	10,7	-	-	-
Total taking PS	7,450		30,576		+ 410 %
TOTAL Form 5	6,406		16,524		+ 258 %
Average taking PS	1,16		1,85		

* = one school in 1992; 14 schools in 2001

** = five schools in 1992; all 27 senior secondary schools in 2001

+ = fourteen schools in 2001

++ = three schools in 2001

@ = Technical drawing and woodwork (also electronics and metal work which were only taught at one school) were phased into design and technology

\# = *Sources*: Department of Secondary Education, 1991 and 1992 COSC Reports; 2001 Examinations, Research and Testing, Ministry of Education.

Source: Weeks (2002).

To expedite the enactment of the RNPE, the policy proposes that the teacher-training curriculum should be diversified to meet the needs of the national curriculum. The pre-service curriculum for new trainees is supported by an in-service programme for teachers already in the field. The programme focused on the upgrading of skills and teacher support is targeted at four levels: school; cluster; regional and national.

A further component of the training programme is the training of computer integration support officers. This group of education officers, from the departments of secondary education and teacher training are skilled to keep abreast of ICT developments and to provide support to schools on ICT-related matters. This support is provided through a cascade model of competency-based modularised training, with a view to establishing teams of teachers in a school who implement and sustain the programme. The training programme is conceived on a developmental five-tier model, which coincides with the levels of ICT-infrastructure resourcing (see Appendix 1).

Enactment of the ICT policy: connectivity, resourcing and maintenance

Figure 5: Status of roll out

Objectives	Achievements
Primary school *The commission recommends that, 'Computers, in particular should constitute some of the equipment in the proposed resource centres for primary schools to ensure early exposure to computing as a learning resource.'*	• Has been prioritised by the Ministry of Education as the next phase for roll out. • Provision of IT facilities largely the initiatives of individual schools and school communities.
Community junior secondary school (CJSS) *One of the junior secondary goals is 'to develop in all children computer literacy and readiness for the world of work'.* *The commission recommends that 'each student should take a basic computer awareness course'.* **Senior secondary school (SSS)** *The commission recommends that 'all senior secondary school teachers should acquire computer literacy and the schools should be allocated enough computers to enable all students to develop computer skills'.*	• RNPE started with construction of computer laboratories in all secondary schools. This exercise was completed before 1997 in all the 205 community junior secondary schools (CJSS) and a few years later in the senior secondary schools (SSS). • A computer awareness programme, for the CJSS, was then designed and developed to guide the acquisition of computer skills through teaching/learning at the school level. • The programme was piloted out in 11 CJSSs which had been equipped with 20 computers. • The government then installed 25 CJSSs with 20 computers each and a server all networked to two printers. • The World Links programmes, which started in 15 schools, were eventually expanded to 29 CJSS government-equipped schools. • During 2002, government made computer equipment available to all the remaining 154 CJSSs and the 29 senior secondary schools. All the schools received 20 computers, a server and a network with a switch. • The 154 CJSSs are now being prepared to start the computer awareness programme. In the 29 SSS, two courses are being implemented. These are the computer awareness programme for all Form 4 and 5 students and a computer studies course which has been developed locally and cater for those students who would like to pursue computer courses for their tertiary level studies.

Objectives	Achievements
Tertiary *The commission recommends that 'the teacher training curriculum should be diversified to meet the needs of the new three year JC. It should include training of secondary teachers with a commercial subject, including computer studies as one of the teaching subjects and emphasis on pre-vocational preparation'.*	• The computer awareness programme drew out two teachers from each of the participating schools to champion the initiative at the school level. • Workshops were organised to provide the teachers with basic computer skills (Phase 0 – computer literacy) to enable them to go back to their schools and train other teachers. The basic computer skills covered were: • Introduction to computer technology • Introduction to software • Operating systems • Word processing • Spreadsheets • Database • Educational software • Infusion strategy

Source: Adapted from: Botswana ICT initiative for schools: Country report - Mauritius Conference on Access to ICTs for all (Mauritius, 3-5 April 2003).

Roll out to secondary schools

The roll out of a fully functional computer laboratory to all junior and senior secondary schools has been completed in 2003. All labs have at least 20 networked computer workstations with printers and Internet access. Appropriate security installations have been provided. A significant feature of the roll out is that the GCB provides high quality branded products, and discourages the use of cheaper clones. However, the challenge experienced by IT teachers and learners in some schools is how to manage PC and Apple Mac platforms in the same laboratory.

Another significant aspect of government policy is the commitment to provide equal facilities to both urban and rural schools. While this has been achieved in terms of provision of IT infrastructure, availability of auxiliary and support services such as electricity, telephone lines and bandwidth remains a major impediment for rural schools. Solar power, which could provide a viable alternative source of energy, is expensive and thieves reportedly seek after the solar panels. Perhaps one of the most enduring complaints of participants interviewed is the monopoly held by Botswana Telekom, which is regarded as an obstacle to connectivity. The slow pace of delivery of landlines is hampering the state's policy of providing equal access to both urban and rural schools.

Procurement procedures for ICT equipment and services

The state has a tendering procedure for procurement of hardware and allied services that attempts to promote equity by sub-contracting different aspects of IT provisioning to different

suppliers. There is some evidence the practice is expensive and potentially inefficient. The fragmented nature of the process results in excessive delays between the delivery and installation of various components of IT infrastructure such as hardware, networking, peripherals and security provision. It is believed that costs could be significantly lowered if the contract is managed by companies offering bundling of the whole package – from cabling through to peripherals. Tenders would then be issued not on the basis of suppliers' expertise in one aspect of ICT provision, but on the basis of their capability to work in consortia to successfully provide an end-to-end solution within a particular region. This means that each supplier has to be responsible for the full roll out of bundled services or supplies which can easily be monitored and followed up on not only at the moment of roll out but also over a service period which takes into account debugging. The co-ordinated phased approach could also eliminate problems of incomplete work, profiteering and cross charging. This approach could also ensure that culpability is established and penalties imposed on defaulting suppliers. While this kind of service delivery might be perceived as difficult to find in a smaller economy, interviews with suppliers and vendors indicates that such capacity does in fact exist in Botswana.

Maintenance of school ICT infrastructure

To maintain high standards, the Government Computer Bureau follows a rigid replacement policy, which stipulates that:

1. All computers utilised in the civil service may only be maintained by private companies contracted to the state.
2. Computers have to be replaced every four years. The 'obsolete' computers are to be disposed off by public auction.

This maintenance policy has both positive and negative consequences. The positive aspect of this policy is that the country aims to keep pace with technology change and enjoys access to relatively new technology. The negative effects of this policy are twofold:

Firstly, the replacement policy is expensive and in some instances unnecessary. A large number of the 'obsolete' workstations are fully functional and could be retained to increase access at schools and reduce the number of learners per workstation. Some ministry officials believe that obsolescence should not be determined by the availability of new hardware and software, but by the level of use and condition of existing equipment. This principle is clearly demonstrated in Mochudi Teachers' Centre where ultra-modern technology is used alongside older 'obsolete' technology.

Secondly, the maintenance contract awarded to private contractors is considered inefficient. Teachers and principals contend that they have to contend with inordinate delays in having systems repaired. They point out that where a single computer is out of commission even for a short period of time, this affects a number of learners in many classes. The

cumulative effect of interruptions of computer service in a school, they say, produces long-term detrimental effects in learning progress.

At the time of data gathering, a decision was made to enter into a contract with a number of service providers for the technical maintenance-wide contract intended to meet the technical maintenance needs throughout government. The contract specified three levels of service, with the highest levels (gold) allocated to critical government IT functions, whereas schools were placed on the lowest (bronze) level of service agreement. In response to this concern, the approach to supporting schools has been revised, with the intention to provide a 'carry-in' service. This requires the service provider to bring a functioning computer to replace the faulty unit and conduct repairs in its own time.

Another problem identified with the fully serviced approach is that it precludes the option of employing educators who have ICT skills from participating in the maintenance of the ICT system in their own school. This represents a potential waste of resources and counterproductive to developing local skills amongst teachers and students. In some of the schools visited, teachers considered themselves competent at providing basic maintenance and repair such as replacing a hard drive or floppy disc. However, because of the national policy on maintenance, they were forbidden from offering their skills.

Alternative modes of maintenance

In the course of implementing further plans to supply extended ICT infrastructure in the schooling system, the Ministry of Education may have to consider alternative options available for maintaining infrastructure at the school level. The resources for a school level maintenance programme may reside in schools in the form of teachers who have the knowledge and capacity to run ICT systems at that level. This would be dependent on the skills base already in existence in the teaching corps, the distribution of teachers with such capacities between schools, and the complexity of the ICT systems being implemented. The more complex the systems envisaged for implementation, the higher the necessary skills levels required. It is not only the complexity of the ICT systems that necessitates higher skills levels, but also the availability of technical support in the environment. Thus in a school system where schools are located relatively far from technical support, internal skills become more important.

However, the main point here is that the proportion of teachers with the appropriate technical skills to operate a school-based ICT system is very small. There are compelling reasons for the Botswana government to shift as quickly as possible from the externally serviced model to a model in which adequately skilled teachers conduct first-line maintenance. First, contracting to a supplier – without using capacities in the schools – represents an ongoing dependency, which may in the medium term become financially prohibitive. Second, even though the initial costs of training a cohort of teachers to manage school ICT systems may be high, this will accrue considerable savings in the long term since thereafter, only upgrading training will be required. Third, it is preferable to train educators

who can conduct first-line systems maintenance because it is a means of empowering them in the process. This brings us to the question of teacher training for such a task.

Teacher professional development

Teacher development in IT is clearly one of the most critical imperatives in the Motswana education system. World Links Botswana has instituted the five-phase training programme in which teachers have achieved Phase 2 of training. Phase 3 now in progress through e-learning, targeting 100 teachers.

In addition, the University of Botswana (UB) has instituted 'UBEL' (University of Botswana E Learning Programme). Launched in 2001, UBEL is a strategic approach that plans to infuse ICT in the curriculum of all faculties by 2004.

- Teacher trainees at UB are exposed to web technology and e-learning programmes.
- Trainees are provided with generic skills to re-engineer and adapt materials downloaded from the Internet. Trainees are skilled in designing templates using visual basic. These templates may be adapted and used to develop teaching and testing materials.

While there is a vigorous 'push' for all teachers to achieve IT literacy, the actual levels of literacy amongst teachers is still low, and the attitudinal barriers are difficult to overcome. Many principals interviewed alluded to the critical need to overcome these attitudinal barriers by embarking on a national campaign to conscientise teachers about the benefits of ICT relative to their conventional practices.

The ICT-skills development through the training of CITs (Computer Integration Teachers) and the development of the multimedia centre in Mochudi is a laudable attempt at providing access to higher order skills in teacher training. The centre has adopted the principle that it is not technology that drives the need for skills but the inherent value of the skills themselves, and the portability of the skills to other disciplines and contexts. An interesting feature of the centre, which gives substance to the above principle, is the existence of state of the art technology alongside 'obsolete' technology which is fully functional. The Centre is also a good illustration of how the development of an ICT-embedded curriculum can be supported by multimedia and allied ICT technology. The Centre is equipped with recording studios, computers, data projectors and printing machines. Teachers, who use the centre, have access to these technologies, which enables them to record videos and generate curriculum materials and other publications, which they are able to share in their schools. This approach to technology helps to demystify the perception that 'ICT is all about computers'. The Centre is exemplary in its potential to provide an enabling environment for the use of ICT in curricula. Additionally, the Centre adopts the philosophy that ICT literacy involves making an informed judgement on when to use technology and, and when not to use technology.

However, while Mochudi is acknowledged to be providing a valuable service, there was agreement amongst most participants that the pace of teacher development in general is incommensurate with the country's vision of an ICT literate citizenry. The slow pace of

training the Computer Integration Teachers (CITs) means the loss of opportunities to implement infusion and integration in the curriculum. Furthermore, most teachers interviewed argued that providing ad hoc training teachers in a context where they are expected to carry out their normal duties is counterproductive. This model of teacher training provides too little time for substantive development, and faces the risk of reducing a sophisticated curriculum strategy, to a token attempt, which only succeeds in achieving minimal levels of IT awareness and literacy.

Furthermore, the training of CITs is voluntary. There are no incentives for volunteer teachers and there is no remuneration attached. Once teachers are trained, there is no logical progression along a defined IT career path and no designated specialised IT post at school level. The consequence of this is that there is a high level of teacher attrition through poaching by the private sector. To broaden the available pool of appropriately trained IT teachers to institute the integration-infusion strategy at all levels of schooling, there is a compelling challenge to move away from the widely held notion that IT is the preserve of science and technology by providing incentives for non-science and technology teachers to participate in IT-training programmes. Several members of the Ministry have acknowledged this and initiatives at certain schools are gradually eroding this trend.

The absence of a co-ordinated teacher development strategy involving the University of Botswana (UB) and the Department of Education as well the Mochudi Media Centre and other teacher development units further contributes to the shortage of skilled educators. Academics at UB are critical of the poor lines of communication between ministry officials and UB and the reluctance of the ministry to consult with the university on policy issues. The alleged lack of communication between the University and the Ministry of Education is seen to impact on the development of capacity to satisfy the growing demand for human resources in ICT. The University has started a training programme for teachers of computer studies without the full knowledge of some officers in charge of the subject in the Ministry of Education. On the other hand the Ministry of Education continues recruiting teachers for the subject from abroad, due to absence of an appropriate training institution in SADC.

Ministry officials allege that there is apparent duplication of roles within departments in UB, due to lack of communication about the precise human resource needs for ICT in the country. The Department of Maths & Science Education in UB is training teachers for delivery of computer education in schools. While the Department of Educational Technology in UB is calling on MoE to recommend teachers for further studies in the Department to ensure appropriate use of ICT in education delivery. At the same time, the Centre of Academic Development at UB has an Educational Technology Unit whose main aim is the promotion of e-learning. This apparent duplication, at least in the minds of ministry officials, is perhaps a consequence of the absence of a forum to align the pockets of training, a problem which both MoE representatives and university academics agree, can easily be resolved by initiating a consultative forum.

The launch of a consultative forum could also address the issue of what constitutes an appropriately trained IT teacher who teaches computer awareness classes, particularly whether an IT awareness teacher should possess both pedagogical skills as well as technical

skills. While the University of Botswana has the capacity to provide appropriate skills development, it needs to be responsive to the needs of schooling environments. Appropriate skills provision might necessitate replicating the school computer environment to provide holistic skills development, which includes elements of pedagogy as well as technical skills to manage a networked environment.

The above is particularly cogent since many teachers believe that the technical skills within the teaching corps are being underutilised because of the state's maintenance policy. This policy also results in discontent, as technically-skilled educators often have to wait long periods for relatively unskilled technicians to undertake maintenance that they could have undertaken themselves. In this regard, many IT teachers, frustrated with the long delays in procuring technical support from approved service providers argued that the university should consider introducing a full-time one-year programme. Fifty per cent of the programme should comprise a pedagogy component while the equivalent of the Microsoft A+ certification should comprise the other fifty per cent. In deciding on the levels of technical expertise required by the person(s) who are responsible for maintaining the computer laboratory, the following needs to be considered:

- Get the infrastructure running (initiation).
- Keep technically operational.
- Trouble-shoot problems that are generated by normal operations and by learners (eg. changed settings, delete files etc.).
- Provide first line support to obviate the necessity for calling in an outside agent.
- Conducting accurate and actionable diagnostics.
- Obtain appropriate assistance from a supplier at a manageable cost.

Appropriate skilling of teachers who manage the school ICT system

Based on the above comments, there is an urgent need to develop the capacity in the teaching corps to undertake maintenance of school-based ICT systems. At the outset there is the matter of who should be trained? In Botswana, the MoE elected to recruit teachers who professed interest in such a responsibility. It was reported that the MoE undertook this strategy so as to ensure that teachers from all disciplines and of both genders would join the ranks of this group of computer integration teachers. There were good reasons for this strategy based on the need to break stereotyped notions that ICT should be the preserve of science teachers and male teachers.

The consequence of this move not to apply selection criteria was that not all teachers volunteering could be said to exhibit an acceptable level of background or aptitude to take on the role envisaged for them. Thus, the absence of selection criteria worked against efficiency requirements. The decision concerning applying some form of diagnostic test must obviously be balanced against other issues.

Overseas scholarships and the risk of 'overtraining'

Because of Botswana's high demand for higher education, there is a spill over of prospective students to neighbouring or overseas institutions, underwritten by a generous state-sponsored overseas scholarships programme. However, the real value of this policy is uncertain. In the context of appropriate training for ICT professionals, there is some evidence that state-sponsored scholarships results in a degree of 'overtraining' accelerating in the loss of professionals from the education system to more lucrative posts in the private sector or in other countries, reinforcing the perennial problem of the state sponsoring the supply of skilled labour to business and the private sector.

One ministry official noted the following after a visit to various schools:

> 'What we are witnessing here are the effects of uncontrolled choice of further training on teachers of IT. When teachers are due for further training after four years of continuous service, they are free to choose any course they deem suitable for their further professional development. In the field of IT, teachers can choose institutions outside SADC and as far afield as UK or US. While studying teachers do not necessarily have to restrict themselves to education-based courses. As such, after completion of their studies, teachers may perceive themselves as having undergone 'highly polished' industrial-based training, and yet cannot arrange for basic contingency measures to secure students' work from virus attacks.
>
> Therefore, teachers need to be monitored on their choice of courses and the institutions they attend on order to get proper value for money in the education service they render after completion of their further training. The government funding that goes into their so-called 'high polished' industry-based training they go through in US and UK institutions can be expended cost effectively on four to six trainees in education-based courses in SADC countries.'

Academics within UB supported by certain education ministry officials believe that the solution to this problem lies in tailoring specialist degrees and diplomas for IT teachers, with a strong focus on pedagogy and appropriate methodologies to realise the aim of under girding the curriculum with ICT.

Post-school ICT training

The existence of post-school training opportunities for individuals interested in pursuing a career in ICT-related fields is a very important condition for sustained development of ICT skills within an economy. A lack of post-school ICT learning opportunities will operate as a disincentive to learners who may otherwise have considered further study towards a career in an ICT or related field. Moreover, post-school training is essential for virtually all ICT-based workers because of the speed with which the hardware and software environments change, requiring frequent upgrading and reskilling.

Research on the general links in Botswana between education, certification and the labour market undertaken in the mid-1990s show rising rates of return by level of education and that there is room for private financing of upper secondary and tertiary levels of education (Siphambe 1999, 2000a). It appears that these conditions are particularly strong in the ICT-based labour market (Mogara 2003: 16).

In Botswana, opportunities for vocational and technical training are available at the end of junior secondary school. In 1994, the Department of Vocational Education and Training was created with a post of 'Technical Education Officer for Commerce and Computer Studies'. From this period, moves were put in place for the standardisation and formalisation of course content, and the development of course content for learners with some employment history. As a result, the vocational training centres and brigades centres offer computer operator courses, basic end user courses (Magetse 1997: 7-9). The level of these courses and their links to further training are of concern but cannot be discussed further in this report.

In addition to the above, technical colleges at Gaborone, Jwaneng, Selebi Phikwe, Palapye, as well as the Automotive Trades Technical College offer either 'computer studies' or the 'BTEP information and communications technology' or both courses. The Botswana Ministry of Education and the Scottish Qualifications Authority (SQA) accredit the BTEP (Botswana Technical Education Programme). In the BTEP programme, ICT is incorporated as both a mandatory vocational unit for the development of general skills and as a specific area of specialisation (Ministry of Education 2003).

It is likely that increased access to computer awareness that is planned for primary school learners will produce significant additional demand among those leaving school at the end of the junior secondary school phase.

Currently, the main thrust of computer training in Botswana lies in the opportunities for individuals to pursue studies beyond secondary school (Mogara 2003: 15-16).

- **University of Botswana**

The University computer studies offer a two-year diploma and a four-year degree programme in computer science, with an annual throughput of 70 and 30 students completing the programme per year.

- **Botswana Institute of Administration and Commerce (BIAC) (Government)**

The BIAC offers a diploma and a certificate programme in computer studies with emphasis on business applications (eg. accounting, databases).

- **Botswana Accounting College (BAC)**

The BAC offers a national certificate and a higher national diploma in computer studies. These courses are accredited with the National Computer Centre in the UK and a total of about 60 students complete either of these courses per year.

- **National Institute for Information Technology (NIIT) (Non-government)**

The NIIT offers a broad range of courses including an advanced end-user certificate, diplomas in computer networking and M-Commerce. In addition, Microsoft-certified courses are also

offered (eg. MCSD, MCSE). The enrolment at NIIT across these courses is approximately 200.

In addition to these institutions, there are another five private enterprises that either specialise in providing education services in the ICT field, or provide some form of training as a service (that is apart from training that provided as part of contracts for delivery of IT systems to enterprises). The various courses equip graduates to work as: data entry operators/clerks, technicians, graphic designers, programmers, software engineers and IT project managers in both the private and public sector.

In a large country like Botswana with a relatively small population, access to education opportunities is always a matter of concern. It must be pointed out that of the nine public and private institutions offering ICT education; only two are located outside Gaborone, one in Lobatse and one in Phalapye. This means that learners from anywhere else in Botswana will need to travel to obtain training. Furthermore, ICT-based enterprises are massively concentrated in Gaborone. Out of the 97 enterprises operating in Botswana as of 2002, only eleven were located outside of Gaborone (Francistown four, Phalapye three, Maun two, Lobatse one, and Mogoditshane one) (Mogara 2003: 22-38). This means that with low levels of local opportunity, almost all learners who have any intention to obtain employment in an ICT-related field must relocate to Gaborone. Lastly, and by no means least, the lack of computer businesses outside of Gaborone implies that learners in other areas will have far fewer opportunities to interact with computers as part of their daily lives. As a result, we must consider the issue of how they will sustain their skills or interest in ICT.

NGOs involved in ICT in education in Botswana

There is a small number of NGOs operating ICT projects in Botswana, which emphasise international networking. These projects which have close links to government include:

- **WorldLinks** is a global learning network linking thousands of students and teachers around the world via the Internet for collaborative projects and integration of technology into learning.
- **iEARN** works with the WorldLinks programme to involve students and teachers in Botswana in global networking projects. The programme is based within the Ministry of Education. They are active in cross-cultural, environmental and literary projects.
- **ILT** (Internet Learning Trust) has provided learning and development opportunities for students and teachers through linking schools in the UK (Northampton) and in Botswana.
- **SchoolNet** has links with the Botswana Ministry of Education with the view to establishing a national SchoolNet.

A characteristic feature of these NGOs is that they emphasise the value of networking as a means of generating interaction and sharing information between schools and on integrating ICT across the curriculum. However, the majority of these were international agencies and there was little evidence of local NGOs.

The ICT school curriculum

The curriculum development unit located in the Ministry of Education is responsible for the production, design, layout and dissemination of materials. It produces syllabi, teaching and learning guides and magazines. It is also responsible for research and evaluation, troubleshooting implementation problems, resource provisioning and curriculum intervention with a view to improvement. The Department of Curriculum Development and Evaluation is responsible for the development of the curriculum, identifying resource materials to support the curriculum and assist in training of trainers. The Department of Secondary Education does actual provision and procurement of equipment and maintenance management.

Integration and infusion

In an attempt to achieve an ICT-rich curriculum, the Curriculum Development Unit promotes the core principles of **integration** and **infusion**. Integration involves the identification of specific topics or aspects of the curriculum that is mediated via information technology. This approach appears to be enjoying popularity in mathematics and the sciences as well as business studies and English. This approach is also popular in social studies where students are required to use an integrated approach employing word processing, graphics and spreadsheets. The ultimate goal of the integrated approach is to facilitate infusion.

Infusion is a broader strategy, which uses ICT to underpin aspects of the curriculum that can be supported by ICT. It is a foundational principle that aims to make ICT an inherent component that permeates all aspects of learning and teaching. Through infusion, the Ministry of Education attempts to institutionalise ICT for skills development and cognitive development.

The discourse on education reform is replete with arguments which demonstrate that 'the infusion of new technologies produces little results if underlying relations do not change' (Warschauer 2000). The root of the problem, argues Warschauer, is the mismatch between industrial models of schooling, and the post-industrial organisation of society. While the policy of infusion is consonant with the national vision of an ICT-literate society, its implementation is uncoordinated and its effectiveness not evaluated. Furthermore, the following conditions devalue this laudable curriculum initiative:

- Infusion and integration are dependent on a flexible timetable model and access to the computer laboratory. The relatively inflexible timetable format especially at secondary level militates against the flexible use of time required for creative use of IT facilities. The continued use of the 35-minute period needs to be re-evaluated in terms of whether it can support the new models of interactive, autonomous, student-centred learning required for effective use of technology.
- The successful implementation of the infusion strategy is constrained by the prohibitive cost of appropriate-subject specific software. This problem is compounded by the fact that most teaching software is imported, and not always relevant to local contexts. University

academics are critical of the fact that there are no software developers in Botswana as there is little support for it. There is a suggestion that in the absence of local software development, vendors of imported software and certain bureaucrats are the beneficiaries. Academics argue that UB has the capacity to train software developers but in the absence of support and funding from the ministry, the existing IT skills will continue to be underutilised.

- There appears to be a lack of co-ordination between the roll out of IT infrastructure and IT-skills development. This is evident in the fact that CITs were trained before computer labs were installed. The time lag resulted in skills being forgotten because they did not have an opportunity to apply them.
- The absence of a comprehensive core of locally produced textbooks means that teachers are reliant on imported materials, or to their own devices, especially in the computer studies classes.
- Although computer awareness is a compulsory curriculum offering, it is not examined. This accords the subject marginal status as it is seen as having less value than examined subjects.
- The computer studies curriculum has elements of the computer awareness curriculum even in the senior phases. This repetition of basic elements should become unnecessary since all learners are exposed to computer awareness in the junior phase. The computer studies curriculum will therefore need to be overhauled and include elements of increasing complexity once basic literacy is excluded from the senior phases.

Curriculum practices at schools visited were uneven. The ministry official who accompanied us on the visits noted:

> At one school there were four classes of Form 4, and six classes of Form 5 offering computer studies and there are classes of computer awareness in the school. There was no sign of any other subject areas using the computer lab facilities in the school. The two computer studies teachers in the school claim to suggest the idea of computer awareness for all, but the SMT has not been supportive.

A visit to another school revealed that the use of ICT in the curriculum seems to be well grounded. There were indications of computer awareness being well established in the school, hence:

- The IT co-ordinator was away attending a workshop but the deputy school head was readily able to identify the assistants.
- The identified computer awareness team member articulated how well IT is embedded in the school's curriculum.
- The computer lab was open and another team member was teaching a Form 1 computer awareness class.
- Other teachers were aware of when the computer laboratory was available for their use, with or without a class in the lab.

The ministry official noted further:

> The school seems to have a well-directed programme of delivering IT to the school community. However,
>
> - Although the school continues to offer computer studies, it is seen not to be a viable option for students who do not offer pure science.
> - There is no time for computer awareness in the timetable, but religious education is a core subject for all grades as per requirements of the Catholic mission school.
> - The only teachers involved in computer education in the school are the two computer studies teachers.
> - The aim of teaching computer studies as opposed to computer awareness was not well articulated by the computer studies staff.

Dominant forms of pedagogy impact on the style of teaching with ICT

Because of time constraints, the methodology of this project precluded extensive observation of ICT-based class teaching in schools. However, observations drawn from the school visits did highlight the importance of the interaction between pedagogical style and ICT. This is because the variety of technologies embedded in the concept of ICT provide for greater flexibility and autonomy for the learner to engage in self-directed and even independent learning. However, teacher attitudes cannot be assumed consonant with greater learner independence. Research shows that in Botswana – as in many other countries – 'prescriptive teacher-dominated classroom practices which limit pupil's learning opportunities' are evident, especially in the primary schools and junior secondary schools (Arthur 1998: 323; Tafa 2002: 17-26).

To maximise the advantages presented by ICT will require a shift in mindset away from the notion that the educator should dominate the learning-teaching process. Relations of authority that have traditionally characterised the profession are under threat in learning situations where ICT is applied and where the initiative for utilising ICT as a tool for learning will increasingly come from learners who are no longer solely dependent on the teacher or the textbook as their primary source of information. The training of educators must take on board the fundamental curriculum assumptions that underlie the implementation of ICT as a means of empowering the learner to engage in self-directed learning (Paterson & Lundall 2001). Changes in the attitude of educators are therefore a central condition for successful implementation of ICT in schools.

In all of the school sites visited, there was a correlation between the attitudes of the principal and management team and the quality of ICT experience learners enjoyed. One school head appreciated the power of a computer in the running of a school, as he exclaimed: 'In this world there is very little that can be done without a PC.' He noted that with computers

available, not only could teachers type their own tests, work on the school timetable easily, access teachers' database at the press of a button, but that they were also enable their students to access resources outside the classroom and school via the Internet. Interestingly, this principal confesses that he was once a 'technophobe'. He was forced to deal with his aversion to computers when he engaged in post-graduate studies, and is now a strong advocate for IT literacy by both teachers and learners.

However, one ministry official who accompanied researchers to the site visits noted that it was regrettable that:

- There was only one teacher entrusted to teach computer awareness in the school such that in the absence of the teacher the laboratory had to close down.
- Not all of the senior management team (SMT) appreciated the power of a PC as much as the school head does and it was therefore difficult for the head to enforce IT literacy policy/regulation if his staff, especially the SMT, were not fully convinced of the value of technology as a pedagogic tool.

Gendered bias in ICT access

While there was no systematic attempt to survey the phenomenon of gender and access to ICT, ministry officials as well as teachers indicated that this was not a problem in Botswana. However, concern regarding the issue of gender equity and gender discrimination in the workplace has been observed as a general problem (Siphambe 1999, 2000a, 2000b) and was certainly a problem identified in the other two sites in this study. Therefore, care needs to be taken to ensure that the ICT curriculum does not replicate this pattern. Furthermore, the failure to identify gender bias as a problem does not preclude its existence, and it should be acknowledged that its 'invisibility' might be linked to broader forms of patriarchy prevalent in the society.

Important contextual conditions

Key questions regarding speed and intensity of implementation

The implementation of the Botswana ICT policy in terms of its roll out in the secondary phase may be considered aggressive. The question that often arises in a context where ICT is considered an urgent policy imperative is whether there are merits is adopting an aggressive implementation policy, and whether fast tracking yields the benefits envisioned by the policy. This is measured against the evolutionary approach where the physical delivery of resources is co-ordinated with the training of ICT teachers to enable them to utilise the resources optimally. This is regarded as something of a 'chicken and egg situation' where you cannot train teachers if you don't deliver computers, but if you wait to train teachers before delivering computers you are likely to find that having trained teachers in one operating system, in the time taken to conduct training, there is a new operating system in place,

necessitating retraining. There are no ideal solutions to this dilemma, but it does emphasise the need to adopt flexible models that achieve a balance between in-loco apprenticeships learning with the 'extrusion' model in-service training such as that offered by the Mochudi Education Centre.

Take-up of computers rural contexts

According to Kent and Towse (1997: 167) the apparent failure of science and technology in Africa 'can be attributed to the quick rush for the linear and sequential concept of development' without recourse to their cultural impact'. Although science and technology are viewed by Botswana youth to have positive benefits in terms of economic development and employment possibilities, the view was also expressed that the incursion of science and technology would lead to a 'deterioration in family relationships between generations' (Kent & Towse 1997: 169). In a recent study, Kesamang and Taiwo (2002) observe that among junior secondary school learners, elements of the student's culture that may be in tension with 'scientific culture' which could affect achievement. To the knowledge of the researchers, there is no publicly available research, which explores either the cultural construction of ICT or the impact of traditional Setswana culture on the willingness to take-up ICT in everyday life.

Also there were some school learners who have the view that 'not much technology has reached the village' (Kent & Towse 1997: 169). In the course of interviews for this project, a service provider expressed the view that the 'most modern thing in that village is the computer'. The point here is to consider on what terms people in Botswana will adopt ICT and more importantly, on what grounds adults encourage or discourage their children – especially girls – from taking ICT-learning opportunities seriously. In this regard, there is need for further research to explore cultural conceptions of ICT in rural communities to support the ministry's goal of providing equal access and opportunity to both urban and rural communities.

The crucial role of teacher training for meaningful learning gains

Any attempt at costing the provision of ICT in a developing nation, must factor in the crucial role of teacher training to justify the cost of infrastructure expenditure. For instance, even in a developed context such as the USA, the cost of installation of the physical equipment accounts for only ten per cent of the total cost. Ninety per cent of the cost is accounted for by the cost of training and support (Kenny 2002). In this context, the 'digital divide' in not so much a consequence of the availability of access to technology, but access to training. For example, there is some evidence in Tanzania, that low IT usage was due in part to entrepreneurs simply not knowing how to use the technology.

Assessment in terms of OECD criteria

OECD criteria	Comments
The need for radical curriculum change.	• Learner-centred in theory but not in practice. • Locally developed textbooks and learning support materials required. • Computer literacy not taken seriously as a non-examinable subject.
Compatibility of student assessment with ICT-enriched learning.	• Policy advocates integration and infusion, but assessment practices are uneven. • Traditional methods predominate.
Digital literacy as a fundamental learning objective for all.	Policy exists but not comprehensive enough to cohere education and training sector with higher education sector.
Suitable levels of equipment in all schools.	• Roll out of networked laboratories in secondary phase completed. • A start has been made in primary schools.
Plentiful educational software of quality and easily-accessed information on it.	• Availability of locally produced, contextually relevant software is limited. • University of Botswana claims that it has the capacity to develop software, but there is no demand and support for it from the Ministry.
An extended professional role for teachers in schools.	Conceptualised but not yet in practice.
Commitment of school leadership and management to adopting ICT.	Uneven.
New partnerships between school, home and community.	• Inadequate and involvement of NGOs. • Inadequate framework for partnerships.

Summary of conclusions

1. Ministry of Education and the various levels of the schooling system, including primary schools where many have taken the initiative to acquire the technology at their own cost.
2. There is a healthy variance between the state's conceptions of ICT with that of the Ministry of Education. The state regards ICT as a vocational tool while the Ministry of Education is attempting to transcend this conception by promoting ICT as a pedagogic tool for cognitive development.
3. University academics argue that while the country's vision for an ICT-rich country is commendable, this vision cannot be realised in the absence of a cohesive national ICT policy, which is comprehensive enough to co-ordinate the pockets of disparate initiatives in the country.
4. Further training for teachers in the field of ICT should be closely monitored, to guide the teachers in their choice of relevant, cost-effective and sustainable training, with a possible balance between pedagogic and technical skills. The expensive overseas scholarship

programme needs to be re-evaluated. A database of overseas graduates needs to be developed, and a tracer study conducted to investigate the career trajectories of these teachers with a view to determining a cost-benefit analysis for the country's investment.

5. There is a pervasive awareness about the value of ICT in education and in the lives of Batswana in general. Students are enthusiastic and have a thirst for ICT. However, equal levels of enthusiasm by school heads do not always support this. There is scope for a further concerted campaign to sensitise heads about the value of the inclusion and management of ICT in the curriculum. There is also a need to assist schools and school-governing boards to understand government policy about the place of ICT in the curriculum.
6. Curriculum reform has been initiated through the integration-infusion strategies. The effectiveness of this approach needs to be evaluated and the methodologies refined as the schools demonstrating best practice, in the delivery of ICT in their school community should be used as exemplars to provide models for neighbouring schools and ultimately to other schools countrywide.
7. Media centres like the one at Mochudi Education Centre should be established at strategic locations around the country since they provide valuable resources for teachers to make creative use of ICT in their classrooms.

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Appendix 1: ICT courses training levels

Course level	Characterised by	Implementation phase
1	Basics in ICT literacy and school computer laboratory setup.	Takes place immediately after installation and is done by suppliers.
2	Administration and management of programme and ICT-school resources.	After teachers spend a term 'tuning up' their skills.
3	Developing curriculum support materials.	Two terms elapse to allow teachers to internalise experiment and experience ICT teaching in class.
4	ICT integration into the curriculum.	Depends on schools adoption of the programme, follows after a year of teaching.
5	Developing ICT integration support materials.	A term elapses after Level 4.

Source: ICTs in African schools: A workshop for practitioners and policy makers

Appendix 2: Index of preparedness to provide ICT for all (Sub-Saharan African countries

Country	Composite ICT index	Rank	Simple ICT index	Rank
Seychelles	86,45	1	59,36	1
Mauritius	58,26	2	47,8	2
South Africa	44,15	3	38,4	3
Botswana	38,92	4	26,82	4
Namibia	31,47	5	18,99	5
Swaziland	26,12	6	11,2	7
Angola	20,15	7	3,16	18
Lesotho	19,43	8	8,75	8
Zimbabwe	18,78	9	5,39	15
DRC	18,18	10	7,75	11
Kenya	17,03	11	7,71	12
Zambia	16,44	12	8,05	10
Madagascar	15,38	13	5,07	16
Mozambique	15,35	14	13,27	6
Rwanda	15,14	15	8,57	9
Tanzania	14,63	16	6,44	14
Malawi	14,35	17	7,07	13
Uganda	13,38	18	2,05	19
Ethiopia	12,32	19	4,49	17

NAMIBIA

Linda Chilsholm

Executive summary

This report is one of three country reports for a study commissioned by the SADC EPSI on the use of ICTs in curricula. This study is in turn one of three currently being conducted and also including studies on poverty alleviation and decentralisation. This report will provide the basis for the overall report on the conditions necessary for effective implementation of ICTs in contexts of poverty.

The project team for this study has conducted desk research, a survey to model costs and a fieldtrip where interviews were conducted with a range of stakeholders in ICT in education. The draft was prepared and submitted to the country participants for comment.

This report consists of sections on the context, curriculum reform after independence, ICT policy and curriculum, the financing, organisation and control of ICTs in education, curriculum in use, learning support materials, software and connectivity issues and teacher education and development. It argues that while the Namibian government and Ministry of Basic Education, Sport and Culture have an ICT policy for schools in place as well as strong partnerships and an active ICT community to support implementation efforts, policy is neither comprehensive enough nor integrated with initiatives from other ministries. Financing and provision of ICTs to schools is decentralised, and so access is generally unequal. Cost is strongly related to access and cost factors include not only who pays but also the costs of connectivity and reliability of ICT systems in remote rural areas.

Although ICT is present in the curriculum, there are very few trained teachers and learners. As computer literacy is a non-examinable subject in the primary phases, and dependent on available resources and facilities, there is little incentive to improve the curriculum. Teachers rely on their own worksheets in the primary phases. The existing curriculum in Grades 8-10, where there are textbooks, is out-of-date. An excellent curriculum exists at the higher levels. Current revision efforts by the NIED need to pay attention to the availability of up-to-date curricula, hardware, software, textbooks and learning support materials. Training the trainers is crucial if teacher-training needs are to be met. Substantial attention needs to be paid to integrating technical knowledge skills with learning skills: critical and problem-solving pedagogies are a priority. Teacher support exists in the form of projects and organisations, but many teachers are isolated and need to be linked to ICT teacher networks.

The chapter concludes with an assessment of the extent to which conditions for effective use are met and provides those additional conditions that need to be in place in the Namibian context and contexts of poverty.

Context

Namibia today is a sparely populated country of about 1,8 million. It came to independence in 1990, espouses a democratic constitution and adopts a market-oriented economic policy. Since independence on 21 March 1990, the economy has grown in all sectors except mining and conditions of the black majority have improved significantly: 'Schools, rural roads, water, health care and public utilities have increased many times over in a coordinated effort to give the majority access to these services' (Hesselmark & Miller 2002).

Enjoying high levels of per capita income relative to other African countries, Namibia also has one of the most uneven distributions of income. Sixty per cent of the population lives in absolute poverty in the northern rural areas. Unemployment levels here are high.

Namibia is in the upper bracket of e-ready countries in SADC. According to a recent assessment of Namibia's e-readiness (Hesselmark & Miller 2002), infrastructure has improved dramatically since independence, the number of fixed lines has improved, the mobile network covers most of the population, the Internet can be accessed throughout the country and 600 leased lines are in operation. ICT competence is widespread, several large companies in the modern sector operate sophisticated enterprise software, and practically all tourist operators, and lodges and guest farms can communicate via e-mail and the Internet (Hesselmark & Miller 2002: 23-25).

This e-readiness must be balanced against the fact that the majority of the population are not touched by the ICT revolution and that there are a number of problems with Internet use in Namibia (Hesselmark & Miller 2002). These include slow Internet access linked to congestion and caused by high prices for bandwidth. Monopolistic behaviour by Telecom Namibia and its subsidiary Infinitum constrains the supply of international bandwidth. The only other supplier, UUNET, also charges high prices. In addition, Namibia still has limited overall capacity in the field of ICTs, and government itself is not yet fully connected and so does not see the benefits of connectivity. Indeed, despite the technological capabilities of the country, ICT use in business and government are lagging behind. There are untapped and squandered opportunities linked in part to the absence of a comprehensive and facilitative policy and regulatory environment for ICT initiatives to flourish.

Nonetheless, substantial strides have been made and a great burden is placed on the education sector to address the human resource issues that will enable Namibia to accelerate its development as a networked society. Closer analysis reveals that progress and challenges in schools mirrors the broader national situation. This makes an interconnected strategy vitally important. To what extent does such a policy exist?

ICT policy and curriculum

Namibia has different ICT policies in place, which have a bearing on education:

- Government of Namibia, Information Technology Policy for the Public Service.

- Ministry of Basic Education, Sport and Culture, Policy for Information and Communication Technology in Education in Namibia.
- National Institute for Educational Development, NIED IT Users Policy.

In 1995 the Ministry of Basic Education, Sport and Culture (MBESC) published a policy for information and communication technology in education. The policy argues that for Namibia to keep pace with progress in other countries, it needs to participate fully in ICTs. The objective, according to this document is that:

> The ideal situation is to ensure that all learners become computer literate while at schools; that all adults achieve computer literacy; and that the education system produces a sufficient number of learners with skills in information and communication technology not only to sustain the use of computers in society, but also to be innovative in an international perspective (MBESC 1995: 3.3, 3).

An updated document in 2001 spells out a number of objectives with short (three year), medium and long-term (five-year) strategies.

A range of short-term objectives were also pinpointed and included an emphasis on the achievement of:

Short-term objectives

- Computer literacy and connectivity at tertiary level.
- Computer literacy for limited numbers of learners from junior and senior secondary schools.
- Pilot projects to expose learners to ICTs.
- More teachers to be using computers as a working tool and teaching aid.
- Teachers skills to be updated.
- Teachers and students in special education to be specifically targeted.
- Teacher resource centres and some school libraries are to be linked.
- A survey was to be conducted of existing resources and how they are used.
- An appropriate structure for ICT is to be established.

Medium-term objectives:

- Most learners completing senior secondary education and some students completing Grade 10 being computer literate.
- Connecting all senior secondary schools to Internet.
- Initiation of several school-based projects in ICTs.
- Most teachers using computers as their working tool, are computer literate and many using it as a teaching aid.
- Phasing in on-line info centres for better access to information.
- Periodic INSET for all teachers.
- Support structures for ICT to be developed.

- Establishment of an institute for special education as a training centre for computers in special education.
- Updating the Namibian database.

Long-term objectives:

- All students completing Grade 10 being computer literate.
- All junior secondary schools, including special schools and the Institute for Special Education, being connected to the Internet.
- Ongoing school-based ICT projects.
- All teachers using computers as a working tool and teaching aid.
- Adequate number of ICT professionals for the needs of the Namibian private and public sector.
- Strong support structure.
- Continuing phasing in of online info centres for access to information.
- Updating and expanding Namibian database.

But by 2001 not much had been done to meet the objectives of this policy. More likely than the official explanations of lack of finances and qualified teachers, a draft policy document for the Department of Foreign Affairs, Communication and Broadcasting argued that, 'this policy lacked a champion to drive its implementation… (and) an implementation strategy to ensure that finances are obtained from the centre, and adequately allocated to achieve the stated objectives' (Schoemans Office Systems 1993).

The Ministry's Strategic Plan for 2001-2006 does establish ICT as a national priority in terms of ensuring equitable access (MBESC 2001). One of the main priorities is to 'ensure that learners and school communities have access to, and use, modern information and communication technology (ICT) and relevant sources of information by 2005'. Specific objectives were spelt out (see Appendix 1 for details). A 2003 ministry status report (MBESC 2003) noted achievements as follows:

Objectives	Achievements
No of schools with computer rooms and 20+ computers and learner support will increase to 400 by 2006.	SchoolNet has established 21 working computer centres in primary schools (of which there are 1 010) and 63 in secondary schools (of which there are 527). Where schools have bought their own facilities, there is no reliable information; these do, however, exist.
All senior secondary schools with computers will be networked by 2005.	
Persons in cities with a population >5 000 people will have access to ICT by 2005.	
At least 20 community learning and development centres will be established in rural areas to provide ICT access by 2005.	21 teachers resource centres have been established. Five have round-the-clock Internet access and five have dial-up facilities. Each centre has at least 20 computers and a permanent trainer.

The Ministry of Basic Education, Sport and Culture thus have a policy, strategic plan and implementing agents for ICTs in education. The latter include SchoolNet to ensure provision, the National Institute for Educational Development (NIED) to ensure curriculum development and professional development of teachers and school managers. NIED undertakes pre-service development in cooperation with the colleges of education and the university and in-service training through teachers resource centres established at regional, district and local level.

Although the Ministry of Basic Education, Sport and Culture has a policy, strategic plan and implementing agent for ICTs in education, there is a widespread perception that there is not a clear and comprehensive policy integrated with other governmental initiatives; the absence of a such a policy results in lack of co-ordination and a degree of ad hocery. Reasons given for this vary from the absence of a champion to drive ICT development in the Ministry to ICT not being located in a single ministry to the lack of awareness amongst officials of the potential and specifically cost-saving dimensions of ICTs.

As a result, there is little co-ordination between ministries, no dedicated Basic Education, Sport and Culture Ministry budget for ICTs, a vacant position for Deputy Director of ICT that remains unfilled, no advisory and support services for schools, inadequately connected head office and regional offices which continue to use telephones and faxes rather than e-mail and an apparent perception that ICT is only about computers in classrooms which may be useful in replacing typewriters. Decision making on key issues appears to be slow and indecisive.

A draft ICT policy document prepared for the Department of Foreign Affairs, Information and Broadcasting for Namibia in 2001 (mentioned above) identified a number of key actions necessary for the successful implementation of an ICT policy for Namibia. This document identified a broader range of issues that need to be addressed alongside educational change if there is to be effective implementation.

Essential are ‘a strong national body with committed leadership to guide the implementation of ICT Policy and a detailed implementation plan that defines indicators against which to measure success, lay out practical growth steps towards achievable targets, name responsible parties and sets realistic timeframes’ (Schoemans Office Systems 2001: 5). Other priorities are identified as:

- Enhancing rural access to information through support for existing multipurpose telecentre and community centre projects and realising the proposed Universal Service Agency and corresponding Universal Service Fund’s mandatory contributions from all telecommunications licensees.
- Growing and stabilising the ICT professional community through encouraging immigration of skilled ICT workers, forming a single Namibian ICT association and providing incentives to all government employees to obtain ICT qualifications.
- Facilitating excellent ICT public education, especially in schools through recognising ICT qualifications as a key promotion in the promotion of teachers, continuing to support schools connectivity through strong initiatives such as SchoolNet.
- Revising the 1995 IT in education policy and implementing it.

- Fostering e-commerce, e-business and e-government by amending all relevant laws, establishing appropriate statutory bodies to manage the e-enabled environment and carrying out a pilot e-procurement project in government.
- Strengthening the ICT infrastructure by proceeding with the programme of liberalisation of the telecommunications environment.
- Growing the ICT industry by creating an ICT cluster in Windhoek linking the ICT industry, academic institutions and government.

It identified the existing Resource Network Group as the appropriate starting point for an effective 'Namibian Council for ICT'. There is also the ICT Alliance of Namibia (ICTAN). ICTAN was constituted as a cross-sectoral advisory council and support group on all matters related to ICTs on development in Namibia. It has a clear mandate to assist the public sector in this regard.

The Information Technology Policy for the Public Service prepared by the Public Service Committee on Information Technology (November 2002) has also taken on board and re-emphasised specific strategies for education and training:

- Introducing IT education at junior secondary level.
- Identifying secondary school teachers who can be trained in computer education in order to implement the curriculum.
- Ensuring as far as possible that every primary and secondary school acquires at least one computer.
- Including computer science as a compulsory component in school curricula.
- Encouraging the University of Namibia and the Polytechnic to develop degree and diploma courses relevant to public service needs.
- Establishing a system of short courses, and co-operative education, vocational and part-time INSET courses that will enable individuals in the IT profession to improve and gradually attain various levels of competence while at work.
- Committing government to training a specific number of candidates every year.
- Promoting applied research and development activities within the country.

An overall policy framework is gradually being brought into being, but by the time of writing this report, it was far from co-ordinated, comprehensive and able to meet all the needs and demands of an increasingly complex ICT environment in schools. Various solutions had been proposed that need decision making and action. These include:

- Revising the ICT policy and implementing it.
- Introducing a budget for ICTs.
- Making a significant appointment at ministry level.
- Introducing subject advisory and support services.
- Recognising ICT qualifications and rewarding them appropriately.

Implementation

Key areas of implementation that need to be addressed include financing and control, curriculum, learning support materials and teacher education, development and support.

Financing

Much of the information here is drawn from the EMIS of the Ministry (MBESC 2001). Each of the 13 administrative regions in Namibia forms an educational region. These are as follows:

Educational region

Caprivi

Kavango

Ohangwena

Oshikoto

Omusati

Oshana

Kunene

Erongo

Otjozondupa

Omaheke

Khomas

Hardap

Karas

The great bulk of Namibia's schooling system fits into Grades 1-12, these being divided into four phases:

- Lower primary (Grades 1-4).
- Upper primary (Grades 5-7).
- Junior secondary (Grades 8-10).
- Senior secondary (Grades 11 and 12).

In 2001, Namibia nationally had 1 545 schools with 528 958 learners, 18 117 teachers and 3 524 support staff. Only 4,3 per cent of all learners were in private schools in 2001. The highest number of learners in private schools is in pre-primary schools, where 75 per cent of learners attend private schools. Pre-primary grades were only offered in private and special schools. The majority of these were in the north of the country, in Ondangwa West, Ondangwa East and Rundu.

Government school financing

School financing and control is relatively decentralised. Central government pays for teachers' salaries and makes allocations to schools for stationery, textbooks, maintenance and other small items. Government is not currently budgeting for the purchase of school computers or for necessary learning support materials or systems, but it does facilitate donor funding for school provision by an NGO, SchoolNet and schools are permitted to raise additional funds to pay for needs not met by the central allocation and/or SchoolNet. Many schools use school funds to buy or supplement and enhance supplies and teachers to teach computer literacy, while others seek sponsorships or receive donations. Whereas some schools charge school fees, others charge computer fees. SchoolNet develops low-cost solutions for providing equipment, connectivity and ongoing technical support to school. Schools are selected on the basis of official criteria. If a school has an ICT champion but no funds, the school can apply to SchoolNet which will try to accommodate them in their plan.

This funding model gives schools with initiative the freedom to purchase and expand ICT resources and compensates in rural areas through direct supply through SchoolNet. But it is a double-edged sword on two counts. First, resourcing of schools is very uneven. Many poorer schools in rural areas do not have the resources to provide the back-up necessary to compensate for low bandwidth, erratic electricity supplies and technical and maintenance support. Although new initiatives and resources are concentrated in the previously deprived Northern regions, these still appear to carry the brunt of inadequate infrastructure and human resources. For those with computers, hardware ranges from the obsolete 286 to state of the art Pentium 4.

Second, the absence of a clear policy means that the system is open to abuse and contradiction of the broader goal of the achievement of equity. One school in Windhoek charges computer fees and allows only those able to pay to do the non-compulsory computer literacy classes. If learners can afford $2,50, they can use breaktime to play games on the computers. Under current conditions it is also possible for private operators to use school premises to provide computer classes for adults and learners at a price without registration, quality controls, accreditation or benefits being ploughed back into the school. SchoolNet does not provide support to schools on the basis of making a profit, and has the elements of a policy on this in place, but it is not integrated into a national policy concerning the use of the school computer lab for private enterprise. Any policy on ICTs would need to consider regulation of the use of school computer labs by private firms.

And finally, the reliance on donor aid postpones the development of a comprehensive policy and raises serious concerns about sustainability.

SchoolNet Namibia (Hesselmark & Miller 2001; www.nied.edu.na) is funded by USAID and SIDA. It is an association with membership open to individuals, corporations and institutions with an interest in information technology and its application in the field of education. It was started in 1999 but began to grow in 2001. SchoolNet's main objective is to introduce computer technology and Internet access to all schools in Namibia. Because of the exorbitant cost of computers and software, SchoolNet solicits and refurbishes redundant equipment. In addition it aims to:

- Explore and implement creative ways of ensuring the sustainability of school networking activities, low-cost and appropriate solutions that extend the democratisation of access, especially to rural areas.
- Develop local applications and educational content, and encourage the critical role of ICT champions and mechanisms to ensure sustainability.
- Monitor and evaluate the impact and use of ICTs on education, increase awareness and understanding of the potential of ICTs in education, share information on best practices in school networking and in developing partnerships, and to encourage relationships and build trust among the key players that enable such networking.

Its task is to connect as many schools as possible in the rural areas to the Internet and SchoolNet, using volunteers as trainers and facilitators in installing and starting up computer and communication facilities. The underlying idea is that schools are well suited to become hosts for rural information and communication centres, and that teachers and students jointly assume the role of facilitating the provision of information in their communities.

Within the first three years of its existence, SchoolNet has registered 460 volunteers, serviced 200 schools and institutions, initiated a wireless network for schools without telephones and developed a solar solution for off-grid schools (http://www.schoolnet.na/news/). The Internet community (ISPs, computer companies, Telecom Namibia, NamPower) have supported SchoolNet's work. All computers have been donated to SchoolNet by Namibian companies and organisations or through international local area network. At present, in most cases the Internet connection is via dial-up telephone modems, but this solution is proving too expensive for most schools and Internet performance is too slow for realistic access to the web. In 2002, a wireless network solution began to be installed in the Ondangwa/Oshakati area with SIDA financing. Even the wireless solution, though, is unpredictable in its performance. For schools without electricity, SIDA has provided money for the installation of solar power in about 75 schools from November to December 2002.

Apart from the expense of connectivity and low performance of current network solutions, there are other significant challenges linked to maintenance and support, as well as training teachers and personnel to use the computers effectively. SchoolNet may need to shed some of its tasks, or share these with other institutions, if its tasks are to be performed effectively. Serious attention also needs to be paid to the inequitable access, which has arisen from the current funding and provision model. Whereas some of the better-resourced schools in the urban centres are connected, poorer schools in more remote areas are not.

Donor funding

Both USAID and SIDA play a significant role in funding ICT initiatives in Namibia. Here, the focus is on USAID/Namibia, which plays a substantial role in providing financial support to the Ministry of Basic Education, Sport and Culture. It focuses on policy support, affordable access and application and training (USAID/Namibia 2003). Its strategic objectives include the achievement of a Universal Service Fund supporting ICT access and usage that provides

finance to schools, community telecentres and other types of institutions; a number of multipurpose information centres in targeted areas, individuals and groups in targeted schools, community multipurpose centres and other types of institutions having access to ICT and making active use of it, a series of IT-based learning modules, ICT-based civil society networks, connectivity of regional and local government offices and making available online resources via project activities. The USAID/Namibia-led Global Development Alliance provides support to the programme.

USAID/Namibia sees the following as priorities:

- Telecommunications policy, regulatory reform and their effective implementation (which implies support for the new telecommunications regulatory body).
- Affordable access through, for example, the Universal Service Fund and Schools Information Technology Alliance and a laptop leasing programme.
- Application and training through, for example, support of, for example, e-commerce activities as well as the Initiative for Namibian Education Technology (iNet) which works in basic education, a mobile training unit.

In order to achieve them it anticipates that 'coordination of dozens of Namibian, US, regional, and USAID partners' will be necessary (USAID/Namibia 2003: 4).

Although donor funding provides invaluable policy and financial support to government, its sustainability is questionable and ultimately cannot be a substitute for internal processes of prioritisation and budgeting.

In conclusion, then, Namibia follows a relatively *laissez faire*, decentralised funding model which mobilised support for ICTs in schools through local school initiative and donor funding. Although there are strengths to this model, in that it maximises partnerships to achieve strategic objectives in the context of scarce resources, there is also a downside to this model. This downside includes inequality and entrenchment of digital divides between those with and without resources.

Recommendations thus include:

- Addressing access and equity issues systematically in a revised IT policy.
- Benchmarking minimum standards and specification for hardware and software.
- Providing minimum standards and guidelines on security installations.
- Abolishing levy of fees for use of ICT facilities by learners.
- Strengthening and supporting co-ordinating bodies such as the Resource Networking Group, the Global Development Alliance on ICT, and the Namibian Education Technology Alliance.

The curriculum

Since independence, curriculum reform has addressed new challenges presented by the digital revolution and inequalities linked to it. This is addressed below.

Curriculum reform after independence

The Ministry's policy is outlined in *Towards Education for All: A Development Brief for Education, Culture and Training*. It spells out the major goals as including access, equity, quality, efficiency and democracy. The main change in the curriculum was a move towards learner-centredness. More recent reforms are emphasising localisation of content.

The National Institute for Educational Development (NIED) was established in 1990, at independence, as the Department within the Ministry of Basic Education, Sport and Culture (MBESC). It is responsible for evaluating, designing and developing curricula for the educational system, introducing effective approaches to teaching and learning, co-ordinating the development of instructional materials, educational research, preparing and co-ordinating an effective system of pre-service and in-service teacher education, and providing training in educational management.

At the end of 1995 curriculum panels/committees and working groups were established (MBESC Home page: http://www.op.gov.na/Decade_peace/b_edu.htm). Starting in 1996, they drew up 14 new primary syllabi, revised 28 junior secondary syllabi, developed and translated lower primary syllabi into all local languages and developed five new senior secondary syllabi in African languages. In addition, they evaluated and recommended teaching and learning materials, and where necessary, developed appropriate new materials, as well as updated the textbook catalogue. Work also commenced on the broad curriculum for special education.

The National Institute for Educational Development and the Professional and Resource Development Division of the Ministry, took charge of in-service training. These teachers did some of the groundwork for curriculum materials development and evaluation during the workshops.

In 1998, new curriculum panels and subject committees for the next three-year phase were established. All panel and committee members attended a course on the development and evaluation of textbooks and educational materials. The Department writes that 'such an exercise was necessary to bring about a better understanding between educationalists and publishing houses'. Twenty-one subject syllabi were developed and approved by the Curriculum Coordinating Committee and the Examination Board. At this stage a continuous assessment working group developed a continuous assessment policy for formal education (Grades 1-12). In this year, 1998, activities focused mainly on the development and dissemination of materials and the training of trainers and facilitators.

Lower primary reform focused on Grade 4. Syllabi were revised and supplementary teaching and learning materials developed. The first language syllabus was translated into eleven Namibian languages.

The Basic Education Teacher Diploma (BETD) was brought into being; its curriculum was approved and implemented in 1998 and the new BETD subject syllabi are presently serving as working documents in the colleges of education. A network of subject co-ordinators, who will eventually facilitate possible adjustments, monitors the implementation of these syllabi.

ICTs in the curriculum

ICTs do feature in the curriculum at all levels (MBESC 2001, passim):

- Basic information science and computer literacy are provided in the upper primary from Grades 4-7.
- Computer practice is available in junior secondary classes (Grades 8-10).
- Computer studies is taught in the senior secondary classes (Grades 11 and 12).

In 2001, 842 learners enrolled for the junior secondary certificate exam in computer practice and 90 learners for keyboard and word processing. Forty-three students enrolled for the Higher International General Certificate of Secondary Education (HIGCSE) in 2001. In the Junior Senior Certificate exam, it was only in additional maths, computer practice and fitting and turning that more than ten per cent of students gained an A aggregate. Students performed relatively highly in these subjects. In the International General Certificate of Secondary Education (IGCSE), the failure rate for computer studies was extremely low and an average of 16 per cent of those enrolled gained A's or A*.

The table below summarises the statistics for these subjects for the year 2001, and reveal that absolutely negligible numbers of learners are doing the subject. This is probably linked to the lack of access on the part of the majority of schools as well as to the fact that it is not an examinable subject. Nonetheless, students taking computer studies do well in it. The level of achievement of an A grade in computer studies is higher than for the majority of other subjects.

Subject	Grades taught	No of students taking the subject	Total number of students for the grades	% of students taking the subject	% passing with A and A*
Basic information science	Grades 4-7	2 711	396 252	Less than 1%: 0,6%	Not examinable
Computer literacy	Grades 4-7	166	396 252	Negligible: 0,04%	Not examinable
Computer practice	Grades 8-10	842	105 643	Less than 1%: 0,8%	10,9
Computer study	Grades 11 and 12	190	249 34		15,8

Textbooks and learning support materials

In understanding what the curriculum does, it is best to look at a sample of textbooks in use. It is not possible to provide an exhaustive review of all the textbooks in use. As is to be expected, there appears to be some unevenness of quality and availability of texts. Government is working on providing up-to-date texts and these efforts should be supported.

Basic information science

This is taught from Grades 4 to 7 and is non-examinable. Many schools appoint young people from the private sector who are computer-literate but not trained teachers. They are paid for from school funds and not by government. Many of these teachers create their own curricula and learning support materials, although guides do exist.

Computer literacy

Teachers' major concern is that there are no resources, manuals or magazines for teachers to use. Many teachers create their own materials and worksheets, but they find this a problem, as they need to be able to pace themselves with guidance that can come from manuals. A new manual has just been produced but is not yet available to teachers. *A teach-yourself guide to computer literacy for Namibian schools Grade 1-7* (Champion 2003) includes a guide to reading and using menu features, including inserting pictures, creating greeting cards, using text boxes, borders and creating letterheads, spreadsheets, entering and editing graph titles, databases, learning to use the Internet, e-mail and applications of technology.

Computer practice

The syllabus in computer practice also needs to be updated and schools need to be provided with regularly updated materials, textbooks and reference books. Although comprehensive textbooks exist, these were published in 1997 and 1999; many teachers consider them to be out of date. Rapid development in computer technology has already overtaken the systems to which learners are introduced. These include MSDOS and Turbo Pascal, for example.

Computer studies

Computer studies are provided for Grades 11 and 12. International General Certificate of Secondary Education (IGCSE) syllabuses are designed as two-year courses for examination at 16+. Computer studies forms part of a cluster of creative, technical and vocational subjects and includes no significant mathematical or numerical content. The intention of the syllabus is that students should gain knowledge of the nature of information processing and the broad range of its applications, together with a general understanding of how an information processing system is designed to suit a particular application and how such a system works. The syllabus concentrates on the principles of information processing so that, although students will study contemporary hardware, software and applications as examples, they should be well equipped to appreciate future developments in the technology and its applications. All candidates are expected to do practical work (University of Cambridge 2003).

The syllabus focuses on developing knowledge and understanding, problem solving and realisation and communication.

Information technology

The NIED has applied to place this subject in the broader curriculum as an improvement. The curriculum appears to be up to date and provides information on the more modern technologies. It is however not in use yet.

Software and connectivity

Schools receive software either through SchoolNet or they purchase it themselves. The quality of the software is entirely dependent on school resources and connectedness to the Internet.

Conclusion

A closer examination reveals that the curriculum is in need of serious renewal. There is little support for IT in primary schools. Computer literacy is offered as an unexamined elective with the result that there are inadequate incentives to participate and perform optimally. Inadequate time is allocated for meaningful skills development. The curriculum up to Grade 10 is out of date and textbooks and support materials non-existent.

One of the main criticisms of the curriculum is the focus on subject content. There is little to encourage teachers and learners to access the Internet for research purposes, use CD-ROMs to support learning, develop content knowledge and practice certain skills. NIED still focuses primarily on textbooks to the exclusion of the development of electronic teaching and learning materials. The question of ICT across the curriculum and a more holistic approach could be encouraged.

Teacher education, development and support

Teacher education, development and support are a critical components of a successful ICT strategy in Namibia. Unless teachers are skilled, knowledgeable about and accustomed to working with ICTs, there will be little point in placing computers in schools. Computer labs will simply become white elephants and expensive equipment gather dust if teachers are unaware of the possibilities of ICTs in education and lack skills and confidence in using them. The greatest challenge thus lies with teacher education and development.

In 2001, Namibia had 18 117 teachers (MBESC 2001). Although there are no accurate figures of mortality and attrition rates amongst teachers due to HIV/AIDS in Namibia, this is clearly an issue which has a bearing on the overall picture of the teaching force. More than half of Namibia's teachers are concentrated in the Northern areas and the majority are women. About two-thirds were in primary schools. There are great regional disparities in teachers' qualifications. While primary teachers in the central region around Windhoek have the highest qualifications, a large proportion of teachers in the North have had no teacher training and have a qualification of less than Grade 12. This changes for secondary school teachers. In all regions, more than 60 per cent of secondary teachers had at least three years' tertiary education, which included teacher training. Very few primary teachers are reported as teaching computer literacy, and most of them are barely qualified to do so. If ICT is expected to be introduced at primary level, then more primary school teachers should be trained to teach it.

The appointment of teachers to teach computer literacy is often taken at the initiative of the school, as it is a non-examinable subject. Many schools in the Khomas region employed young people, fresh out of high schools, who have some experience of computers through work in industry and commerce but have no teacher qualification. The school board,

sometimes a little more than other teachers, pays them. There appears to be no ICT teachers' subject association or panel, which brings teachers with an interest in ICT together. They receive little support from the Ministry of Education, which does not provide advisory services to schools teaching ICTs. In general, they remain unconnected and unnetworked with one another.

National Institute for Educational Development

The NIED is the central node for pre-service and in-service teacher education, which is done in collaboration with the colleges of education and the university. It has brought into being two new qualifications to improve primary school teachers' practices and introduce teachers to concepts of learner-centred education:

- As mentioned earlier, the NIED introduced the Basic Education Teacher Diploma to provide INSET support to teachers; its curriculum was approved and implemented in 1998 and the new BETD subject syllabi are presently serving as working documents in the colleges of education. It is intended to serve teachers who have a basic Grade 12 qualification, but no formal teaching qualifications. It is a four-year, comprehensive INSET teacher-training programme intended to provide its participants with the necessary pedagogical background.
- An instructional skills certificate exists for teachers who have neither a Grade 12 nor formal teaching qualifications. It is a year-long programme that uses 20 modules to improve teacher competencies.

Little information exists on the methodologies used, but questions are raised about the quality of courses and indications are that learner-centred approaches are not modelled.

University of Namibia and Polytechnic of Namibia

The University of Namibia and the Polytechnic both have excellent resources and skilled personnel but there is no demand on universities to train IT teachers or to provide a professional qualification. The University of Namibia does however have four full-time programmes relating to ICT: computer science, information studies and journalism and information technology. Numbers of students taking computer science have grown progressively over the last three years.

The Polytechnic of Namibia offers a variety of programmes with regards to ICT. Here, however, experience with training graduates in IT who have never had experience of computers has suggested that two changes can be made to ensure confidence, proficiency and understanding amongst IT graduates who will enter the labour market as potential teachers:

- A bridging year can be introduced in which students are familiarised with ICTs, maths, English and study skills.
- A far greater emphasis on pedagogies which are aimed at developing student confidence and active participation in learning; without this confidence to experiment, dissect

problems and explore creative solutions, students' ability to use ICTs and computers in particular will be limited.

- Training the (teacher) trainer's programme that models and demonstrates such pedagogies rather than only teaches the philosophy that underpins them.

In addition to these two main tertiary institutions, there are seven vocational training centres, four colleges of education, three agricultural colleges and one police training college. There are also parastatals like NAMCOL (Namibian College of Open Learning) and private colleges like Damelin and the Higher Education institute, which offer a variety of programmes in collaboration with external institutions. To date, there has been little attention given to the colleges of education. At the College of Windhoek, however, a tender has been approved for two computer centres with 20 to 30 terminals each. The Namibian Open Learning Network (NOLNET) has also been created to provide support to teachers. It is a consortium of Namibia's four publicly funded distance education groups, the University of Namibia, the Namibian College of Open Learning, the Polytechnic of Namibia and the National Institute for Educational Development. The institutional infrastructure exists, but whether it is providing the teacher education and development necessary to support creative and informed use of computers is a moot point.

Two projects with technical support staff and teacher trainers in the field suggest that despite the existence of these institutions, there is little connection between them and teachers in the field.

NIED/USAID/AED/Learnlink Computer Assisted Teacher Training project (2000-2002)

In 2000 the Ministry of Basic Education, Sport and Culture initiated a Computer Assisted Teacher Training (CATT) project with USAID support. Through CATT, US-based resource persons were brought in through the Academy for Educational Development (AED) and the National Institute for Educational Development (NIED) to provide technical support for teacher training in Namibia. One project activity included developing a small group of computer resource centres located at NIED and at teacher resource centres in the northern regions of Ongwediva, Rundu and Katima Mulilo (Boer, Goveia, Malone; Coupe and Goveia; Goveia and Ilukena; Goveia 2001). The main aims were to provide venues for teachers to gain access to computer-based in-service training, the Internet and computer-based resources for teacher training, lesson preparation and lesson research. Each centre was equipped with a small local area network (LAN) with at least seven multimedia workstations, a laser printer, Zip drive, and CD writer and teleconferencing camera. The server and associated connectivity were developed and deployed by SchoolNet/Namibia. The servers run a Linux operating system and the LANs are connected to share 64K Internet lines.

Three innovative features of the project include:

- The successful appointment and training of out-of-school youth to run the centres.
- The establishment of regional education technology teams, each one consisting of eight members: a teacher training college lecturer, a student teacher, an inspector, two lower

primary advisory teachers, a continuing education officer and two lower primary class teachers.

- An inquiry-based, student-centred approach to training which emphasised minimal prescription and guidance from the mentor; it can be summarised by the view of the Learnlink NGO participating in the project that 'Adults and children learn how to use IECTs by using IECTs' (Malone 2002: 10) and that 'computers can teach people how to use computers' (Malone 2002: 16). One Page Introductory (OPI) sheets were provided, but 'we found that the less information we gave, the more likely team members were to lead their own learning activities with their colleagues. The most important component of an OPI seems to be showing a user where to start on a given programme' (Malone 2002: 13).

The project learnt several valuable lessons, which can and should inform further policy and development in the area of teacher training. It identified conditions for successful adoption of technologies and analysed the extent to which these conditions have been met or not and identified additional constraints that need to be taken into account (Coupe & Goveia 2002).

Conditions for successful adoption of technologies	Achieved by the project or not
A large percentage of intended end-users (underqualified, in-service teachers) must have sufficient access to the technology.	Older teachers in in-service do not have access to computer technology.
Intended end-users must be comfortable with the technology.	Teachers are not comfortable with the technology.
Technology must be simple enough.	Can be met.
High quality programmes incorporating the technology.	'…Has been particularly problematic for the project…. Although NIED staff have learned the basic skills and competencies needed to produce simple computerised training materials, it is clear that they will not continue with this work after the project ends.'
Computerised programmes that encourage learner-centred, constructivist approaches to teacher training.	'The project has concerns regarding whether computerised teacher training approaches are appropriate for an education system seeking to reform itself in favour of more learner-centred and constructivist approaches.'
Computerised programmes that model effective teaching.	'Computers cannot teach teachers to teach.'

The project is thus not optimistic about the use of new technologies in teacher training. Even greater contextual and environmental constraints are also identified. These are:

- Lack of access.
- Staff structure of the NIED militates against effective implementation of support for teacher education.
- IT costs – linked to procurement and maintenance of the hardware and software and cost of connectivity.
- Limited bandwidth (Coupe & Goveia 2002: 55).
- Scarcity of technical skills outside Windhoek.
- Insufficient time to develop programmes.

The greatest lessons learned from this relatively short project was thus that if the Ministry's goal of equitable access is to be achieved, then the following need to be addressed:

- Cost and access of ICT technology.
- Human resource development within an activity-based, problem-solving learning framework.
- Ongoing materials development to support training.

Worldteach

Worldteach is an NGO that provides volunteer teachers experienced with the use of ICTs into schools to assist in obtaining and using computers. The project currently places both one-year and shorter-term volunteers in primary schools. It works in partnership with SchoolNet. Worldteach teachers echo many of the same concerns as those raised in the CATT project. The investment in computers in schools is considered worthwhile only if the currently excessive cost factors are taken into account. Worldteach teachers drew attention to technologies not working on site: the 'thin client' model of SchoolNet is a good idea, but many of the 'clients' are simply not working. Likewise the cheaper wireless Internet is a good idea, but is also unpredictable in whether it works or not. Landline dial-ups are too expensive for schools even if they have subsidies.

In this context, Worldteach teachers argue that the emphasis should be on 'building minds' through teaching learners to read, write and speak clearly and confidently in English.

More importantly, critical thinking skills, analytic skills, creativity, self-expression: It's the thinking skills that are important. ICTs are communication tools like books, pens, papers – which are much more important than ICTs. We have to think carefully about money being pumped into it. It may just be a big expense with nothing to show for it.

For those working in the field concerns with ICT equipment, curricula and syllabi were with:

- Absence of updated syllabi and textbooks.
- Absence of advisory teachers at the circuit level.
- Lack of integration of SchoolNet schools with Ministry.
- Lack of co-ordination at ministerial and regional levels in organising equipment and running services.
- Lack of clear networking of ICT teachers.
- Lack of an ICT policy for schools linked to the ICT Policy for the Public Service.
- Poor licensing arrangements.

In conclusion, teacher education, development and support are the most critical aspect of a successful ICT policy in education. There are pockets of excellence in national institutions, and a healthy volunteerism is evident in the range of organisations and individuals involved in teacher training. But teacher pedagogies are mostly conservative and theoretical and do not demonstrate much evidence of interactive learning or using ICT as a pedagogic tool. This is not helped by the absence of suitable textbooks and learning support materials. Teachers teaching or using ICTs tend to work in isolation. They are unsupported and unaffirmed, many

initiatives and innovations go unnoticed and there are lost opportunities to share innovations, expertise and successful ideas. Recommendations might include:

- Evaluation of existing teacher training programmes with regard to preparing teachers to use ICTs in the classroom.
- Link colleges of education to centres of excellence and innovation (such as the NIED, Polytechnic and University of Namibia) more actively.
- Require the university to introduce a specialisation in ICT in its B.Ed. course, as well as INSET courses in maintenance of the e-learning environment in schools.
- Emphasise learner-centred pedagogies in all aspects of higher education and teacher training as well as in teacher training for ICTs.
- Training the trainers responsible for ICT teacher training.
- Support teacher resource centres as hubs for ICT teacher development.
- Give support to ICT teacher networks such as those being forged with the Community Education Computer Society (CECS) of SA.

Assessment

An overall assessment of Namibian interventions in terms of criteria designed to ascertain whether learning environments are ICT-enhanced or not, demonstrates that although there are some initiatives in every area, very few of the criteria are adequately fulfilled.

Criteria	Comments
The need for radical curriculum change.	Learner-centred in theory but not in practice. Curriculum out of date; textbooks and learning support materials required. Computer literacy not taken seriously as a non-examinable subject.
Compatibility of student assessment with ICT-enriched learning.	Uneven, but traditional methods predominate.
Digital literacy as a fundamental learning objective for all.	Policy exists but not comprehensive enough.
Suitable levels of equipment in all schools.	A start has been made but problems of access and cost limit use.
Plentiful educational software of quality and easily accessed information on it.	Limited information and software; poverty and unreliable connections limits easy accessibility of information.
An extended professional role for teachers in schools.	Conceptualised but not yet in practice.
Commitment of school leadership and management to adopting ICT.	Uneven.
New partnerships between school, home and community.	Strong, positive partnerships; inadequate framework.

Conclusion

Although Namibia enjoys many advantages in SADC in terms of e-readiness and basic education, a closer analysis of ICTs in the curriculum suggests room for improvement. This can be summarised as follows:

Policy

- Revising the ICT policy and implementing it.
- Benchmark minimum standards and specification for hardware and software.
- Provide minimum standards and guidelines on security installations.
- Introducing a budget for ICTs.
- Making a significant appointment at ministry level.
- Introducing subject advisory and support services.
- Recognising ICT qualifications and rewarding them appropriately.
- Consolidate Linux systems.
- Consider abolition of fees for use of ICT facilities by learners.
- Strengthen and support co-ordinating bodies.
- Appoint at least one qualified ICT teacher in each school to serve as a champion for implementation.

Finance

- Government can support schools that have purchased their own computers with lower bank interest and insurance rates to encourage them to take the initiative for procurement of infrastructure.
- Government can approach the Development Bank to assist in providing affordable loans to schools to purchase infrastructure and software with government serving as a guarantor.

Curriculum

- Encourage links between ICT teachers and the world of e-commerce and e-business.
- Provide for syllabi and learning support materials that can accommodate constant changes in the technologies.
- Examine gender representation and use.
- Strengthen curriculum and materials development linkages between NIED and higher education institutions.
- Consider ways of increasing numbers of students taking computer literacy, practice and studies at primary level.
- Encourage ICT-enhanced learning across the curriculum.

Teacher education, development and support

- Evaluate existing teacher training programmes with regard to preparing teachers to use ICTs in the classroom and school.
- Examine patterns of gender use.

- Place greater demands on institutions of higher education to train teachers at all levels in ICTs.
- Place greater demands on institutions of higher education to model learner-centred, activity-based, problem-solving pedagogies.
- Link colleges of education to centres of excellence and innovation (such as the NIED, Polytechnic and University of Namibia) more actively.
- Support and strengthen voluntary initiatives.
- Support networking of ICT teachers.
- Introduce regular monitoring and support systems.

Namibia is in the upper bracket of e-ready countries and has policies in place to advance ICTs in curricula. Poverty and infrastructure in rural areas is a major challenge to access for all. Decentralisation of provision imposes a particular pattern of provision that requires further investigation. Partnerships play an important role in compensating for inequalities. While urban and rural differences are most overwhelming, how these are gendered requires much more investigation.

The Namibian MBESC has taken initiatives in this area in the belief that it is an important dimension of lifelong learning. Many areas of implementation can however be strengthened in order to improve access and the quality of teaching and learning. Where the use of ICTs in curricula is most successful is not only where there is access, but also where ICTs are used across the curriculum as a teaching tool to aid learning.

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APPENDIX 1: Strategic Plan for 2001-2006

Targets	Lead unit	Indicators	Strategies	Cost elements
1.5.1 At least 400 schools will have computer rooms and will provide support for learners to use them by 2006.	PAD: (A, C) School- Net: (B)	National plan in place. No of schools with no of computers in place.	Develop a joint plan together with NIED and SchoolNet for expanding access and how to maximise use of computers by schools and local communities. Equip new schools with computers through SchoolNet. Provide or adapt existing rooms to computer rooms.	Equipment, burglar proofing, rooms.
1.5.2 All secondary schools with computers will be linked to the Internet by 2005.	EMIS EPI NLS	No of secondary schools with and without these facilities. Policy in place. Curriculum in place. Number of teachers trained to teach BIS/ICT. No of learners taking part. No of teachers trained	Expand EMIS questionnaire. Give budget support to SchoolNet. Develop policy for maintenance of computer equipment in schools. Evaluate and revise (as required) the curriculum/syllabus for ICT-related subjects at JSE and HIGCSE level to ensure that they are up to date, practical and relevant to the Namibian context. Ensure that the syllabus for basic information science includes foundation training in the use of ICT and that all secondary learners take part in these courses. Train teachers to implement curriculum.	Grant-in-aid to SchoolNet. Printing, distribution. Printing. Curriculum, syllabus revision. S&T.
1.5.3 All library collections in schools are properly utilised by July 2005.	NLIS	Number of libraries. Statistics on loans, etc.	Determine criteria for establishing full-scale libraries at schools. Establish libraries and stock. Devise strategies for maintaining collections kept in classrooms etc. Develop strategies to maximise use of libraries.	
1.5.4 Increase number of fully equipped community libraries to at least 48 by 2005.	NLIS	Number of libraries. Policy in place. Stat on stock. Report on provision. Circulation and membership stats.	Co-ordinate with other initiatives in education sector on the siting of new community libraries Develop book selection policy. Upgrade stock of existing libraries according to criteria to be developed by NLIS. Equip libraries with fax copiers, and computers.	Stock. S&T. Stock.

Targets	Lead unit	Indicators	Strategies	Cost elements
			Develop strategies to maximise use of libraries.	Equipment. Printing.
1.5.5 Establish two inter-mediate archives depots by July 2003.	NLIS	Depots functioning. No of staff trained.	Draw up specifications for a depot. Alert consultant on regional centres of need. Train regional and local authority staff on procedures for depositing materials.	Buildings, equipment, installation, staff, S&T, materials.
1.5.6 Establish two legal deposit centres.	NLIS	Depots functioning. No of staff trained.	Draw up specifications for a legal deposit centre. Co-ordinate with construction of regional complexes. Train staff.	
1.5.7 Persons in cities or towns with a population of over 5 000 people will have access to ICT by 2005.	NLIS DABE PAD	No of cities/towns with facilities. No of persons using facilities. Policy in place.	Expand the Namibian open learning network in order to provide ICT equipment to category 1 centres. Establish CLDCs in each region, in co-operation with NAMCOL. Develop a policy on fees for use of educational facilities in order to ensure that the full recurrent cost for use of ICT is recovered from users. Map of centres.	Equipment, staff. Equipment, staff. Printing, distribution.
1.5.8. At least 20 community learning and development centres shall be established in rural areas to provide access to ICT by 2005.	DABE.	No of centres established. No of persons making use of ICT facilities.	Increase the number of CLDCs. Make sure that CLDCs affiliate to the Namibian open learning network	Cost of establishing and equipping additional centres.

List of interviews

Ministry of Basic Education, Sport and Culture Namibia

Loine Katome	Permanent Secretary	
Justin Ellis	Under Secretary	Culture and Lifelong Learning
Patti Swartz	Under Secretary	Formal Education
Edda Bohn	SEO	Math and Science Coordination
Alfred Ilukena	Director	National Institute of Educational Development
Robert West	Director	Planning and Development

ICT teachers in schools (meeting at University of Namibia)

Frans van Solms	David Bezuidenhout
Henrico Handster	Martti Athisaari
Isalu Hooseb	Namibia Primary
Ms van Wyk	MH Greeff
Michael	Theo Katjimune
CV Zemburuka	Kids on the Block

World Teach

Vince O'Hara	Field Director of World Teach

Consultants

Andrew Clegg	Consultant to UNESCO, World Bank and Center for British Teachers

National Institute of Educational Development

Alfred Ilukena	Director
MC van der Merwe	Education Officer
Jeffrey Goveia	AED/iNet
Elbe Boshoff	Library assistant/Webmaster
Todd Malone	AED/iNet

USAID/Namibia

Tina Dooley-Jones	Director for Technical Programmes
MW Goagobeb	Project Assistant

Schools visited

David Bezuidenhout
Martti Atthisaari
Theo Katjimune
Namibia English Primary School
Eldorado TOAMS laboratory

Polytechnic of Namibia

Prof. Kiekebusch

NAMCOL

Mr J Beukes	Deputy Director

Northern Areas Video-Conference

Peacecorps volunteer of Garbiel Taapopi Senior Secondary School
Principal of Gabriel Taapopi Senior Secondary School
WorldTeach volunteer at Oshakati Secondary School
Teacher of Oshigambo High School

SEYCHELLES

Andrew Paterson

Conditions necessary for the successful implementation of ICT in the Seychelles school system

National economic development strategy and ICTs

Since independence, per capita output in the Seychelles has expanded to seven times the near subsistence levels of the mid-1970s. The Seychelles constitution was amended in 1991 to allow for the registration of political parties and the creation of a fair electoral process (Hatchard 1993). This move towards democracy signalled more liberal economic policy including privatisation and market-oriented strategies. In particular, government encouraged foreign investment in order to enable the upgrading of hotels and increased competitiveness of the tourism industry (Emulateme 2003).

Development theory suggests that a microstate such as the Seychelles can only engage in economic activities where it can 'maintain its comparative advantage over time relative to its larger and better-endowed competitors. Inevitably such activities tend to be, by nature service oriented, labour-intensive ones, since these are activities which are not generally observed to demonstrate marked variation in labour productivity over time and across countries' (UNESCO 2000: 3). One might therefore expect the Seychelles to focus on economic activities that are labour intensive such as tourism. The narrow base of viable economic activity largely in the services sector has left the economy exposed to external shocks. For example, tourism was negatively affected during the Gulf War, and in the period following September 11.

Consequently, there have been attempts since the early 1980s to diversify the economy and encourage small-scale manufacturing and this yielded some success, but perhaps not as much as was hoped. Comparatively high wage levels, and the small local market have contributed further in restricting the size of the manufacturing sector. Primary industry derives its revenues mainly from tuna fishing licenses, products and canning. The smallness of the economy makes it difficult to benefit from economies of scale or to acquire the critical mass that is required for many economic activities, and the small domestic market is accentuated by distance from external markets and raw materials (UNESCO 2000: 2; UNDP 2002: 2).

In response the Seychelles has made progress in modernising its infrastructure, with the view to becoming a hub for investment and financial services. It seeks to exploit its location midway between the largest trading and manufacturing blocs in Asia and Europe, and which also confers favourable time zone overlaps with working hours in both the Middle East and Asia.

In order to encourage foreign investment, government set up the Seychelles International Business Authority (1995) to drive a portfolio of incentives such as preferential tariffs and tax concessions for investors. By 2000, there were over 1 000 international companies registered in the country (Seychelles Super Site 2002: 2). The Seychelles International Trade Zone (SITZ) has been established to operate as a 'trans-shipment, redistribution and export processing and manufacturing offshore facility' (Mbendi 2002). This strategy opens up opportunities for banking and financial institutions in the services sector.

The respective contribution to GDP of agriculture, industry and services (1999 data) are 3,1; 26,3 and 70,6 per cent respectively (Emulateme 2003: 5), while total employment in the Seychelles in 2001 (33 213 workers) was distributed as follows: public sector 32 per cent (10 695), private sector 53 per cent (17 472) and parastatal sector 15 per cent (5 046) (MISD 2001: 3). Unemployment is in the range of 2,5 per cent. The heavy emphasis on services in the economy means that Seychelles human resources development strategy must emphasise information and communication technology (ICT) skills in the labour force.

The generous social welfare system that places the Seychelles at the top of the Human Development Index ranking list of African countries has come under threat because in the period between the early 1990s and 2002, overseas development assistance (mainly from France, UK, Australia, and the African Development Bank) fell by over 75 per cent. The effect of this has been to place the government budget under severe pressure. In order to sustain financing of its development goals, government has increasingly been forced to borrow at commercial rates. Unfortunately this change 'corresponds to a slowdown of the real economy' (UNDP 2002: 2). In the period 1998 to 2001, the tourism and tuna industries were particularly sluggish. Government is now applying measures to curb the budget deficit. It is predicted that tight controls on exchange rates and the scarcity of foreign exchange may impair short-term economic prospects, but hopefully will free long-term growth.

The shrinking fiscus and the intent to modernise and improve effectiveness in government service delivery have caused the Seychelles to move towards developing an e-government platform, and to this end government has launched an initiative to develop ICT skills in the public sector. There is a strong need to improve the capacity of government departments to improve delivery of the 'Social Development Strategy for the Seychelles: beyond 2000'. The Director General for Social Development, Dr Rosalie argued that exchange of information between government departments stands at an unacceptably low level. The DG stated: 'It is at this moment very difficult for social workers, Ministry of Education Youth and National Council for Children personnel to share information, yet all these people work towards the same goals' (NATION 2003g). The need for provision of timely data on social development issues, effective means of impact assessment and benchmarking are clear indications that government's internal information infrastructure must be improved. And this requires government personnel to be properly trained in ICT, which emphasises the importance of ICT-based learning in the schools.

Furthermore, in terms of equity, there is a growing awareness of the importance of ICT and the possible value of ICT in generating equitable opportunities for women in the workplace. To mark International Women's Day in 2003, a panel discussion was organised by

the Gender Education Committee of the Ministry of Education and Youth (MEY) to take up ICT-gender issues in the Seychelles (NATION 2003c).

From this short overview, we can see that four main influences are fuelling the impetus for the Seychelles to increase ICT competencies in the labour force and in civil society. First, the economic emphasis on the services sector, especially tourism and financial services places a strong emphasis on the need for an ICT-skilled labour force. Secondly, the aim of the Seychelles to improve its profile as an offshore financial hub adds emphasis to the need for skilled ICT labour. Third, it is clear that government is moving towards application of ICT in order to raise efficiencies in operations and assist in curbing spending on provision of services. Not only government servants will need ICT skills: citizens of the Seychelles must also have ICT skills to access automated government services. Fourth, the isolation of the Seychelles from the African mainland, and its geographical status as an island archipelago points to the need to implement ICT to enhance communication, which requires increased ICT skills in the general population.

Technology Policy and Communications Policy

A sound National Information Infrastructure is needed to support an economy entrenching itself in service-related activities. For example the well-developed Seychelles electronic banking system with automated bank teller machines, as well as SWIFT and Direct Debit (EFTOPS) facilities (UNECA 2003) depends heavily on a good quality telecommunications system.

The economic focus strategy of government has entailed privatisation of the telecommunications infrastructure. Although Cable and Wireless is the major telecommunications provider, government has licensed a second operator, Seychelles Telecom, in the sector. Similarly there are two Internet service providers, Atlas and KokoNet, with a capacity of 4Mbps – expandable – in outgoing bandwidth that compares favourably with capacity in other nations from SADC. A close relationship between government and these key service providers is essential, even unavoidable, especially in such a small market, to ensure that all stakeholders benefit financially, and that the communication needs of the Seychellois are served. A careful balance between profitability and ensuring access at reasonable cost is only achieved through constant vigilance, especially on account of the volatility of the telecommunications and Internet service provider markets.

The Ministry of Telecommunications tries to ensure that more profitable communications services cross-subsidise: Internet café licenses, basic connectivity costs in locations like youth clubs and the setting of preferential student rates for services. The development and launch of a new website by the Seychelles National Youth Council (SNYC) in March 2003 for the purpose of making a directory of information of use to young people, is based on the assumption that increasing numbers of young Seychellois will have access to the Internet (NATION 2003f).

Table 1: Internet usage and international bandwidth for Seychelles (2001)

Country	Dialup Internet Subs Total Number	Number ISPs	International bandwidth Kbps	International Hubs Number	Cities with POPs#
Seychelles	3 000	2	4 098	2	3

From: Jensen (2001)

Source: Information Policy Handbook (2001), Chapter 5 Policy Mechanisms for Stimulating e-Commerce, 5.6 e-Commerce Practice and Policy in Africa, 5.6.1 e-Commerce in Practice Table 2

In: http: etc.

Date 08/07/2003

From: Sangonet http://www3.sn.apc.org/africa

Source: Jensen, M. (2003) ICT in Africa: A status report

http://www.developmentgateway.org/node/133831/dg-contribute/item-detail?item%5fid

Date: 02/06/2003

Table 2: Number of domains and websites Seychelles (2001)

Country	Domains	Websites			
		Business	News & media	Tourism	Total
Seychelles	9	13	2	32	71

From: Domains are from the January 2001 Network Domains tally, http://www.isc.org/; Websites are from the Google country directory, http://www.directory.google.com/Top/Regional/Africa. http://www.yahoo.com/ also maintains country directories and there are significant discrepancies between the two. The table must be treated as a rough guide only.

Source: Information Policy Handbook (2001) Chapter 5 Policy Mechanisms for Stimulating e-Commerce, 5.6 e-Commerce Practice and Policy in Africa, 5.6.1 e-Commerce in Practice, Table 3

In: http: etc.

Date 08/07/2003

The general population in the Seychelles is taking up ICT and the Internet more slowly than the business sector. A spokesperson from the Ministry of Telecommunications observed that 'the population is lagging a little bit in IT'. This is not caused by lack of infrastructure. In 1997, 93,7 per cent of all housing units was reported to have access to electricity (MISD 2002). In 2000 there were over 20 000 telephone main lines in use. Yet as can be seen, even though there is sufficient availability of telephone lines and bandwidth, the number of dial-up Internet subscribers, about 3 000, is quite low.

Similarly the ratio of personal computer ownership in the Seychelles is also low, though this may be ascribed partly to the exhorbitant cost of computer hardware and software. High costs are attributed to the Rupee-US$ exchange rate, the need to purchase this equipment in scarce foreign exchange, and local tariffs. There are also indications that an unnecessary degree of profiteering is taking place in the local consumer market. Government has plans to unblock this bottleneck by regulating the price of imported ICT goods.

The movement of Seychellois onto the Internet will not be achieved by the sole expedient of providing physical access. For people to use ICT and to exploit the possibilities of the Internet requires a change in mindset. This is starting to become visible in the Seychelles. The role of the schools is essential in this process of social and cultural change. In a developing society like the Seychelles, schools can expose young people to the advantages of the Internet, heighten their awareness, and create a cohort of skilled and Internet-savvy school leavers. It was argued by a member of the MISD Department in government that 'you expect computers not only in school, but in homes as well'. By this, she implied that the good work that schools do to introduce young people to computers will not be enough without parents taking up

computer use as part of their daily routine. The Department of Communications recognises that closer interaction with the MEY in collaboratively working to achieve the shared goals of generating greater access and use of ICT resources within the Seychelles population.

ICT policy in education

Through the 1991 and 1999 education reforms the Seychelles education system progressively took on the challenges of: sustaining the policy of free and compulsory education, working towards 100 per cent participation rate, and improving the quality of education, in particular through improvements to teacher training (UNESCO 2000: 3). In 2000 access levels of learners in the age group 3 to 16 years was given as nearly 100 per cent (Khosa, Kanjee & Monyooe 2002: 3). The Seychelles has also put in place a broad series of education system development innovations to raise quality, which include the Seychelles School Improvement Programme (SIP) that was initiated in primary and secondary schools in 1995. The aim of the SIP is to 'bring about improvement in student outcomes by creating a culture of collaborative planning in schools and empowering staff to manage the process of change and reform within their own schools' (Khosa, Kanjee & Monyooe 2002: 6).

The Seychelles education system is currently in a new process of reform, defined by the 'Education for a Learning Society' policy of 2000 which is based on seven fundamental principles of education for: equity, productivity, quality and accountability, empowerment, social cohesion and for global participation (MEY 2000a: 1-7). The last mentioned principle implies the need to implement information and communication technologies (ICT) in schools, as a means of overcoming the levels of isolation that can be experienced by the citizens of a small island state. In the same document, the Ministry affirms its commitment to: 'providing the widest possible access to information technology and harnessing its full potential for supporting and enhancing the learning process, and increasing the effectiveness of management in education' (Ministry of Education 2000a: 8).

The Seychelles National Curriculum Document elaborates on the technology-enhanced learning process in 'Education for a Learning Society'. Particular emphasis is given to preparing students to be life-long learners, supported by the use of ICT in school, and leading to the attainment of 'computer literacy' (MEY 2001a: 3-5). The National Curriculum Document goes further to identify 'Information Technology' as one of the key learning areas in which learners may study ICT: as an 'object of the learning process' (either as a technical construct or as a social phenomenon), as a productivity tool amenable to working across various subject areas, and as a pedagogical environment in its own right – 'as a medium for the learning process' (MEY 2001: 14).

Although the Seychelles' Education Technology Masterplan (SITME) was made public in 1999, two years before the National Curriculum Statement, it is referred to out of historical sequence because it provides more detail on the nature of the ICT curriculum. The SETM (MEY 1999) document refers to the teaching of '(1,2) Computer Literacy' through which 'Learners will be given the opportunity to develop a minimum IT-knowledge based and

acquire the necessary skills so that they can best is positioned to develop independently in their chosen fields, in relation to IT'. This statement makes the link between ICT skills learned at school and their potential usefulness in post-school activities in the form of work or further study.

The SITME document also links ICT skills with higher order learning. It intends '(1,5) To encourage and support effective thinking and independent learning'. As a result, 'Learners should be able to develop competencies in assessing, analyzing and applying information'. The SITME document stresses the value of ICT in facilitating higher order skills, stating that 'strategies based on making use of IT as a medium for learning and teaching will seek to meet the above goals' (MEY 1999: 3).

Despite looming constraints on government fiscal policy, education is a priority, and there is no radical reduction of expenditure foreseen in this sector. However, there is nonetheless a renewed emphasis on better use of resources, and improved responsiveness in the Ministry of Education and Youth (henceforth MEY). Minister Danny Faure has indicated that government recognises that the country's 'Richness lies in our human capital resources …and that …we have been reading the situation for a few years now … (regarding) "Education for a learning society"'.

He is aggressively pursuing a plan to launch distance learning on a national scale (NATION 2003b). The potential of e-learning is recognised for assisting individuals 'who are not in the formal system but still seek to broaden and update their personal and professional development' (MEY 2001b: 1-2). Also, the possibilities of using ICT to generate access to students who would otherwise be disadvantaged by distance is clearly recognised by Minister Faure, who stated: 'We have to set up more programmes so that students and youth can have easier access to IT, thereby eliminating geographical barriers' (NATION 2003e).

The aim is to develop a regional virtual higher education system with partners from long established regional universities in the Caribbean (University of the West Indies and South Pacific, University of the South Pacific). This plan was discussed in October 2003 by Ministers of Education of 31 small states in the Commonwealth (NATION 2003d). In the Seychelles there is recognition of the need for more aggressive use of technologies to build collaborative delivery systems. But in order to expand cost-effective higher education access via distance education to its citizens, the Seychelles must improve the grounding of those students in study skills and in information technology skills.

Finally, the promise of distance learning using the Internet is viewed by Minister Faure as a means of improving the professional education of teachers 'improving the capacities of local instructors' (NATION 2003e). In addition, this is seen as the answer to the costly process of sending young professionals to be overseas for their training.

It should be clear that the application of ICT in education processes at schools and at higher education levels has become a main priority for the Seychelles government.

Implementation of ICT in the school curriculum

The application of ICT in the curriculum is not new in the Seychelles where there is a long history of ICT curriculum initiatives dating from the years of the National Youth Service in the 1980s. These initiatives waxed and waned over time, because ICT was not yet a formal part of the curriculum and depended on the energy and enthusiasm of various individuals and groups. But this work was not institutionalised and as a result lacked continuity.

However, the Seychelles is moving swiftly towards implementing ICT in the curriculum in the following ways:

- First, computer literacy will be presented as a general introductory course at junior secondary school.
- Second, computer studies will be presented as a school subject at senior secondary school.
- Third, the intention is for ICT to be used as a medium of teaching and learning across other subjects in the curriculum.

These three curriculum concepts are inserted into the Seychelles curriculum as follows.

Table 3: Seychelles grade and phase structure

Primary						Secondary				
						Junior			Senior	
P1	P2	P3	P4	P5	P6	S1	S2	S3	S4	S5

Table 4: Seychelles curriculum plan for ICT in schools

	Subject	Primary	Junior SEC	Senior SEC
ICT subjects	Computer awareness		Technical subject compulsory but non examinable	
	Computer studies			Optional O level & IGCSE computing
Cross curriculum use of ICT		Non-subject specific focus on key ICT skills	Use ICT skills across the curriculum	Use ICT skills across the curriculum

Computer literacy (from Secondary 1 to Secondary 3)

Schooling is compulsory through primary school to S4 in the secondary school. The curriculum is based on a general academic model through to the end of the junior secondary cycle (S1, S2, S3). This includes a technical studies curriculum based on a rotational schedule through the year. Currently, computer literacy has been inserted in the junior secondary curriculum as one of five technical studies subjects which together provide compulsory exposure to vocational-based learning and experience. So far, the subject is being taught in S3 in 2003.

An individual is defined as 'computer literate' where he/she 'has knowledge about systems (components, operations, capabilities and limitations) possess(es) the skills in using computer systems to perform appropriate tasks and functions, and have positive attitudes towards ICT use personally and in society' (MEY n.d.: 6).

Each technical subject is taught for seven weeks within a 35-week block. Commonly, learners who take computer literacy will do so in 2 x 40 minute double periods per week. Some schools opt to split the class in half, where one group doing the theory in a classroom alternates with another other group in a laboratory doing the practical. In effect, this means that each learner gets approximately 3,5 weeks of experience on a computer.

Based on discussion with teachers, the major point of concern in respect to this curriculum component is about time. There are several dimensions to this. First, some learners have little or no prior experience with computers, which means that they must begin with fundamental mouse and keyboard skills. This basic starting point introduces a time problem as it slows down their progress through the learning programme. Teachers also complain in a non-specific way that the computer literacy course is too compressed, and that there was not enough time. This needs to be investigated further, as it may not necessarily be a problem unique just to the computer literacy class, but may be associated with the time constraints of the entire technical studies programme. The MEY is aware of the block method used to 'pack in' subjects and will review this as curriculum changes.

Second, teachers are concerned that the short duration of the seven-week course would not enable learners to consolidate their skills, and that these would be forgotten by the time they begin their next computer literacy block the next academic year. It was observed by teachers that students must be afforded the opportunity to practice their skills. We will point out later that this has scheduling consequences for the school computer laboratory.

Third, assessment of the computer literacy course is not undertaken on an ongoing basis. This is because learners share computer workstations in pairs, and teachers understand assessment in an individualistic way that requires individual access to the computer. Providing time for this form of assessment further reduces the time for active learning on the computer and it is avoided. So, in general, assessment takes place only at the end of the programme.

The Information Technology Masterplan (SITME) clearly stipulates that assessment must assess a range of skills from the conceptual to the technical through a variety of means such as: projects, simulations, and self-assessment (MEY 1999: 9). As with the 2000 IT survey, it seems from our experience that assessment of learners in IT skills are limited in extent (MEY 2000c: 5). Evidence from limited observation suggests that evaluation continues to be one of the least well-developed aspects of ICT activity in the schools. This suggests that the National Institute may broaden teachers' views of assessment with the help of in-service training for education.

There are also some concerns expressed about the possible negative association of computer literacy with four technical subjects. It was observed that the other four technical subjects have been converted from the old National Youth Service curriculum into the new framework. Putting computer literacy in with this group of subjects – it was suggested – could

cause students to associate computer literacy with vocational subjects and see it as less important.

Support for learners during the phased implementation of the ICT curriculum

The Seychelles ICT curriculum is being implemented in phases. The decision by the Ministry of Education about the level at which to initiate the new ICT curriculum may require an interim strategy in order to maximise continuity of student learning in ICT through the secondary schools from S1 to S5.

Currently, the formal implementation of ICT in the curriculum is based on the S1 to S3 junior secondary phase. Once this cohort of learners in S3 progress to S4 in the senior secondary phase, further opportunities may – or may not – be open for them. The academic curriculum leading to a national examination and single-subject international Cambridge 'O' level examinations (GCE) in computer science has not been implemented in S4 and S5. For the time being, in some schools there are extra-curricular activities for current S4 and S5 learners who feel left out or neglected especially where students junior to them have curriculum opportunities to use ICT. These programmes will need to be continued in 2004 in order to sustain the interest in ICT among students who will recently have completed S3 computer literacy in 2003. The need to put in place a club-based programme to avoid S4 and S5 students from being disadvantaged was recognised in the implementation plan for the IT masterplan. But this has shown inconsistent application.

Primary school pilot project

Pilot projects are an important means of testing out prospective strategies that might, upon review be converted to policy. Considerable value resides in the pilot ICT project put in place in one primary school on Mahe Island. While most primary schools have one computer for administrative purposes, this school has a computer room. The most powerful finding by teachers at the pilot site was that learners soon mastered the software provided for the pilot. Learner mastery of the software was so quick that teachers have been forced to withdraw computer classes from senior primary grades. Before they reached the end of the primary phase, learners were 'bored' with the available software. Among this group there were also a number of advanced learners who could not be catered for as indicated by the comment: 'we wish we had more software for the high fliers'. This experience points to the need to pursue a strategy of obtaining various software packages that can keep the interest of learners across the age range and across the ability range in the primary level. However, it also suggests that at the school in question, teachers may be dependent on the use of software for providing learners with computer experience. If teachers had been provided support, they may have been confident enough to develop their own lessons for the higher grade learners rather than rule computer lessons out of the timetable.

In the same school the remedial value of software to help special needs learners was explored. The school is mainstreamed, but teachers found that special needs learners who

were exposed to appropriate software (eg. for spelling exercises, matching words to pictures, rhyming words, recognition of letters) showed remarkable improvements. Progress was monitored by the teachers and librarian who developed follow-up activities to check on learning progress (through recognition cards using the same words that were practised).

One important lesson that came from visiting the pilot school is that the staff involved felt that they needed more support and follow-up after initial training at the NIE and SSU (Student Support Unit) (MEY n.d.: 3). For example, teachers indicated that they would have liked more guidance on how to choose learning activities for learners. These impressions suggest that greater attention needs to be paid to following up in pilot schools to ensure that the valuable experience picked up can feed improvements in the same pilot sites and thereby contribute to improved policy.

ICT across the curriculum

This leaves the question as to what extent learners in other subjects are exposed to ICT in the formal curriculum. In one secondary school that was visited, there was interest from other teachers in the use of the computer laboratory from two art and design teachers who are new entrants to the profession from the NIE. This suggests that younger teachers may be better disposed to exploring the use of ICT in their subjects. It must also be noted however, that design and technology are subjects where ICT is integrally part of the curriculum. In one other school, the school librarian had successfully integrated experience in the computer laboratory with the library curriculum. But these instances were in the minority.

Teacher orientation affects learner access to ICT across the curriculum

Some IT mentors ('IT mentor' is the designated title for the person managing the computer laboratory and teaching computer literacy in secondary schools) freely admit that teachers show little interest in using – or even visiting – the computer laboratory. Why this is the case is complicated and should not be simply attributed to the supposed apathy of teachers. What we did observe was that only in a minority of schools was a focused drive put in place to encourage teachers into the laboratory.

Few of the schools had structured specific timeslots in the timetable (eg. one period x 3 per week) for the exclusive access of teachers to the facility. In one of the schools visited, the IT mentor made presentations at staff meetings and ran courses in end-user computing for teachers. The same IT mentors also provided professional development training to teachers from local primary schools in the area. This practice suggests that the secondary schools facilities and especially the expertise of the IT mentors could serve as a base through which to train primary school teachers in the future.

In the schools that were visited, a concerted demand from other teachers for access to the computer laboratory for teaching purposes was not visible. The weekly/monthly timetable for the computer laboratory which would enable teachers to book the computer laboratory well in advance was not made available in the staff room as a matter of course. In one case, the IT mentor did not see any disadvantage in an ad-hoc arrangement where teachers could request

to use the laboratory at short notice. But this casual arrangement suggests that among teachers in that explicit planning for the integration of ICT within other subject curricula does not drive school, using the computer laboratory. This is because the integration of ICT as a medium in other subjects requires careful timetabling of work both in the ordinary classroom and in the computer laboratory through the year.

There is also the ubiquitous time problem. The IT report (MEY 2000c: 5) observed as follows: 'In many schools where computer literate teachers are present, they are inhibited from participating in the delivery of any IT programme as they already have a maximum or very heavy workload in their main subject areas.' This issue is of critical importance, because international studies confirm the time intensive nature of implementing ICT across the curriculum. An investigation into how time as a resource can be most effectively allocated by school principals and most efficiently used by teachers to bring ICT into the curriculum may be useful.

Expanding access to interaction with computers outside of the formal curriculum

In some schools, efforts have been made to provide basic computer opportunities on an open basis to learners. Clearly there are wide differences between schools in terms of their willingness to expand the use of the computer laboratory beyond scheduled classes. In one secondary school, for some years before the formal implementation of the S3 classes, each class from S1 upwards was scheduled to visit the computer laboratory once a week for 40 minutes.

Experience tells us that the extent of learner access to ICT facilities in schools – formal or informal – is not necessarily equal across all grades. Data from the 2000 report on IT in Seychelles schools confirms this general observation, showing that the proportions of classes gaining access in Seychelles schools declined from S1 to S5 (MEY 2000c: 4). This is probably an account of the tendency to drop optional activities as learners move closer to the all-important school leaving examinations.

It is important for schools not to view the formal curriculum components of 'computer literacy' or 'computer science' as the only means of inducting students into the world of ICT. A concerted effort must be made to introduce students to computers outside of the formal curriculum. In some schools there is an active computer club as a part of school culture, and in others this does not exist. It remains an important organ of the school student body that can be fostered to considerable effect, as learners will tend to bring their own friends and classmates in. Also it is a means of structuring and facilitating learner energy and enthusiasm for the world of ICT and its potential.

Skilling of teachers who manage the school ICT system: The IT mentors

The strategy for implementing ICT in an education system, will be dependent on the technical and pedagogical skills base already in existence in the teaching corps, the distribution of teachers with such capacities between schools, and the complexity of the ICT systems and curricula being implemented. The more complex the curricula envisaged for implementation, the higher the necessary skills levels required. It is not only the complexity of the ICT systems that necessitates higher skills levels, but also the availability of technical support in the environment. This is simply because rarely is there sufficient capacity for an autonomous and sustainable computer laboratory within a single school. Thus in a school system where schools are located relatively far from technical support, internal skills become more important.

The IT mentor is a relatively new role that has been created in Seychelles schools. In 2003, there is an IT mentor at each of the Seychellois secondary schools. It is an aim of the MEY to have two IT mentors at each school. The need for two mentors will be discussed later in this section.

From the fieldwork we deduce the role of the IT mentor to include the following responsibilities and tasks:

a) To teach the computer literacy course (S1 to S3).

b) To teach the computer science course (S4 to S5) when it is scheduled to start.

c) To maintain the ICT equipment in the computer laboratory.

d) To provide first line technical support to obviate the necessity for calling in an outside agent.

e) To induct learners into the use of computers over and above ‘a’ and ‘b’ above.

f) To induct teachers in the use of computers as a productivity tool.

g) To induct teachers in the application of computers within their teaching subject.

h) To manage and administer the computer laboratory as a resource for the whole school.

Although by 2003, the majority of secondary schools in the Seychelles have not networked their computers, the aim is to achieve this by some time in 2004. As a result, the requirements that IT mentors have particular technical capacity will increase with time.

The current 2003 group of IT mentors contains a large proportion of teachers new to the kind of responsibilities noted here. Only recently, in 2000, out of ten secondary schools, only seven had personnel teaching IT as a second or additional subject. Furthermore, in two of these cases the personnel doing the teaching were employed primarily as technicians. The point needs to be made that the Seychelles is in the early stages of building its human resources pool that is specifically skilled in the domain of ICT at the schools level. This is an extremely valuable resource that must be built, encouraged and conserved.

The teachers recruited to be IT mentors were not strictly speaking selected. The consequence of the decision not to apply selection criteria is that the teachers are from

different disciplinary backgrounds, which is a good sign that the notion of ICT is not associated solely with the science subjects. However, not all teachers who volunteered could be said to exhibit an equally appropriate background or aptitude to take on the role envisaged for them. Thus the decision to make recruitment open may work against efficiency and effectiveness requirements over time. It has been observed by a senior MEY manager that 'all the IT mentors (will) have the same training but (be) different in motivation'. Will this mean that some schools have demonstrably better ICT functions than others? This is an important question, since much rides on the success of the IT mentors.

In the future, it may be considered prudent to apply some form of selection for IT mentors, in which various criteria are balanced against each other. Furthermore, if teacher placement is centralised in the Seychelles, given the strategic importance of the post of IT mentor, the placement process may be needed to ensure that the appropriate people go to the right schools. Naturally, the appropriate 'fit' of an IT mentor with a particular school must be taken into account, instead of simply imposing a candidate.

The pressure on the implementation of an ICT curriculum in the short term has caused the MEY to recruit mainly in-service teachers to be converted to IT mentors via a set of focused courses. This approach to obtaining IT mentor skills quickly was unavoidable because of a lack of long-term planning for ICT-skilled teachers. The IT report of 2000 observed: 'It also appears that no in-service training of teachers in relation to IT has been undertaken/organized during the year 2000' (MEY 2000c: 6). Furthermore, the implementation plans of the IT masterplan recognised that the main constraint in implementing the IT-skills programme in S4 and S5 'is that of immediately available human resource' (MEY n.d.: 33). It is important therefore to ensure that the design of a comprehensive training package to take care of pre-service training of would-be IT mentors is put in place. But given the wide range of skills needed, the various components will not necessarily be sourced from the same training institution.

Based on the expectations noted above, the core technical skills needed may be obtained via private IT industry courses such as: the A+ and a LAN administration module. The IT mentors themselves asked for technical training on the basis of the recognition that they are trained teachers but either lacked the technical competence or the confidence. The IT mentor class of 2003 is currently undergoing training as follows:

- **Technical training**

Short course: A+ CompTia, compressed in 2 modules, held in two phases of 5 and 4 days. This training is provided by a private IT services company.

- **Curriculum training**

One-year part time registration with ALDEC for the 'O' level computing course. Two are doing the A level course. The classes are held on Saturdays. This is focused on readying the IT mentors for teaching the 'O' level computing course at S4 and S5 level at some point in the near future. The investigators were given to understand this course would be implemented in 2004.

There is a critical need to support the IT mentoring group, both because of their new and still scarce skills and because of the new experiences they are certain to pick up on site in the schools.

Members of the IT mentor group indicated that they are finding the combined pressure of their ongoing school responsibilities as well as their study commitments to be very pressurised. These pressures are particularly heavy on those in the group who do not have sound background in ICT. For its part, the MEY must be prepared to factor in the possibility of attrition in the group.

The IT mentors need strong institutionalised support at two levels: from the MEY, and from their own principal. First, the MEY level. There is an IT mentor forum that meets at least six times per year. But the meetings are short in duration – about two hours in an afternoon – and focus on business and technical matters such as facilities and the curriculum. It is important to incorporate enrichment activities for this group. The IT mentors should be encouraged to develop a more sophisticated understanding of debates around the pedagogical value of ICT. For example: one disputed issue is the use of games by learners, considered by some as time wasting, while others encourage game playing as one legitimate activity through which pupils learn about and become more comfortable in using the computer. Engaging with issues like this and many others in a semi-structured way will enable the IT mentors to contribute more substantively to policy development, through being better able to reflect on their own practise.

The policy documents clearly show that the MEY is committed to ICT as a major theme in the curriculum and in school life in general. In order to secure a platform within the schools, the MEY may consider means of institutionalising the importance of ICT in the school. This could be done by creating an ICT department in each school, with head of department status accorded to the person taking on this role. There may also be associated expectations of financial rewards commensurate with the task. Some of the IT mentors, without prompting, suggested the creation of an 'allowance' or increment for the IT mentor to show that the MEY is aware of their additional commitment and workload. The possibility of offering incentives was also broached in the 1999 SITME (1999: 4) as follows: 'Incentive schemes will be developed so specialists in IT-related fields are retained within education'. Naturally, decisions such as these are linked to the education fiscus and cannot be anticipated here.

Apart from rewarding IT mentors through their own pockets, there are several means available for financially supporting them in the course of their work. The MEY may consider providing subsidising the cost of computers, and software used by IT mentors in the course of their work. The idea of subsidising the provision of computers to teachers has been discussed by the principals forum, but has not proceeded further. The SITME (1999: 12) refers also to the options of notebook computer loans and subsidies.

The MEY also may consider the ways of opening up career-pathing and progression in ICT expertise for teachers to keep them working in the domain of ICT. This implies the need to develop a clear curriculum for IT mentors and for teachers who take to the use of ICT in their teaching. Otherwise, without a clear path to improving their skills and for promotion, IT

mentors may begin to feel trapped and apply for promotion or transfer back into conventional teaching roles whereupon they will be lost to the IT curriculum stream.

In this regard, consideration needs to be given to the ongoing development of the IT mentors which should obviously include updates on technical aspects of the hardware and software systems in schools and also opportunities to develop a range of skills, around team teaching, collaboration etc. In addition to this, a neglected set of skills involve the capacity to administer the computer laboratory efficiently as a resource for all students – and teachers – at the school must be reinforced.

At the school level, it is important that principals understand the additional workload associated with the tasks of being the IT mentor. Overall principals have shown sensitivity to this matter and have been willing to adjust the workload of the IT mentors by relieving them of some of their direct subject teaching. But the problem here is that this matter is negotiated at the school level, where the principal and the IT mentor may not share the same understanding of the work responsibilities associated with this task. What can be done is that at the MEY level, a document describing the minimum tasks and responsibilities of such a person can be developed. This will enable an improved understanding of the time costs of that role.

It is not possible to judge how a single IT mentor will cope with the variety of demands placed on her/him in a school while the group is still in training. The year 2004 will prove important in assessing the usefulness of the IT mentor's training, and in assessing their capacity to fulfil their multiple responsibilities. Also, it will be critically important to constantly monitor how ICT mentors cope with their tasks, because these will be continuously expanding, for example, as the balance of the formal teaching of computer studies at S4 and S5 levels begins and as requirements mount for the training of all teaching staff in the cross-curriculum use of ICT.

Recruitment and retention

The difficulties for devising appropriate and sustainable ICT teacher training are considerable. These include seemingly intractable problems of recruitment and of retention were identified by Lacey, Jacklin and Leste (1999: 167) in their study on the joint teacher-training programme with Sussex University in the 1990s. Unavoidably, the training provided to the current IT mentors provides them with potential career options beyond the school confines. Difficulties in retaining teachers with ICT training were observed in the Report on the status of IT in schools undertaken in 2000 (MEY 2000c: 5) to the extent that it threatened the continuity of existing programmes. The wastage rate especially of teachers with newly acquired IT skills will have to be watched carefully. Together with movements on account of promotion of IT mentors out of ICT activities, these shifts in personnel must be factored into the projected size of the new IT mentor intake.

The IT mentor and the laboratory technician

SITME refers to the need in the Ministry of Education for: 'specialist technical staff consisting of both IT specialist and educational specialist in this field' (MEY 1999: 20) which makes sense, but there is no certainty that such an arrangement would be feasible at the school level.

The 1999 masterplan stipulated that training of personnel working in the ICT curriculum must have two facets to it: 'IT skills' and 'pedagogical skills' (MEY 1999: 20). But interestingly no reference was made as to how these skills should be bundled. There is currently some confusion between the respective roles of the lab technician and the IT mentor. The implementation report of the masterplan provides for: 'training of school laboratory technicians to undertake first level computer maintenance functions. This has (the) objective to have a computer technician present in every secondary school to assist in the diagnosis of faulty systems'. The reality has not turned out as the masterplan envisaged. The current training of IT mentors provides for their technical skills to be upgraded, rather than the laboratory technicians.

The IT report of 1999 observed that: 'Most schools have a technician trained under the NIE programme in 1999. However many schools feel that the technicians require further training. The satisfaction with the work of these technicians varies greatly from excellent to highly unsatisfactory'. (MEY 2000c: 8). In the course of fieldwork for the current research, most of the interviewers indicated that the lab technician had a marginal role that was generally limited to cleaning the room and the environment and switching on and shutting down the computers. The fact that laboratory technicians were not invited to attend the interviews arranged for this research further emphasises their apparent marginality in the schools themselves. Presumably this is partly because the function of the laboratory technician has traditionally been linked to assisting with the physical and biological sciences curriculum.

The fact that the current IT mentors are being trained in A+ suggests strongly that the laboratory technician is not – at least initially – considered integral to the future plans of IT in the schools. This observation does not necessarily imply that the laboratory technician should be trained in IT. He/she would still have to fulfil a role in servicing the laboratory needs of the science departments in the school. In fact a good argument could be made that the IT mentors should be able to manage the technology in the computer laboratory as well as to support teaching through the medium of technology. A separation of these roles, with the creation of a technician's role, may disempower the IT mentor and create a false division between technical/ICT and pedagogical issues.

Two issues arise out of this discussion. First, has the role of the IT mentor been defined with sufficient clarity? This question is asked in the light of the range of responsibilities that have been allocated to this position. Should these multiple roles be too demanding, IT mentors will be pressurised and feel chronically as though they are unsuccessful. Second, how can an emphasis on a sustainable ICT teaching team – rather than an individual – maximise the ICT capacity of a school? This question is linked to the one above, since it broaches the

possibility of conceiving of a team of teachers involved in the implementation of ICT at the school level. The IT mentor is a crucial position through which the tensions associated with ICT implementation in schools become visible.

Teacher training challenges

In 1999, based on their work in the Seychelles, Lacey, Jacklin and Leste (1999: 167) observed that training teachers for small education systems 'poses severe and intractable problems, especially at the secondary level' in particular in servicing the need to provide quality tuition in a range of subjects. A few years later, the challenge of teacher training is revisiting the Seychelles in another guise: the need to ensure the supply of appropriately trained teachers to support the roll out of a new curriculum component – namely an ICT curriculum.

The implementation of ICT in education in the Seychelles is being undertaken under considerable pressure for speedy curriculum development, and implementation of that curriculum in the schools. This stress on accelerating access to ICT in schools is being felt globally, among developing countries which seek to avoid being outpaced in the race to generate high levels of information and computer literacy in their population and in their workforce in particular. However, the realities of curriculum change driven by ICT require profound adjustments from the leadership of the school down to the ordinary teacher. These changes are not necessarily obtained easily. The Director General of the Educational Technology Division, Mr B Choppy indicated that a critical problem for the work of the Directorate and of the Ministry as a whole is 'getting the buy-in… and commitment to ICT in education as a pedagogical tool'. He observed further that IT is easier to justify as a subject, but 'far more difficult to cross the curriculum'.

Appropriate source of training teachers in using ICT across the curriculum

IT mentors have also a responsibility to assist other teachers to use the computer laboratory, because they are the first point of entry to the facility. But they cannot be assumed to be the mainstay of training teachers in the application of ICT. The SITME recommendation for training of teachers to be 'school based as far as possible' (MEY 1999: 22) makes good sense. But the actual training model put forward under '2.48 The Training Approach Strategy', proposes 'a fan model approach to the training of school personnel will be used. A cumulative effect of gaining more expertise in the form of trainees becoming trainers as they gain more expertise' (MEY 1999: 23). Two aspects of this strategy must be noted with caution.

First, this implies a dependence on the IT mentors for the task of training ordinary teachers at the school level. The use of IT mentors for the purposes of training of teachers in the school to use ICT – in addition to their other tasks – may well be too ambitious. This decision must be based on a pragmatic assessment of whether there is a sufficient human resource base in the school in addition to the IT mentor. International experience suggests that a lone IT advocates in a school will not achieve the success that a team will. For this reason,

IT mentors need to be supported in their role, by drawing in and building a core of committed persons from among the current personnel on the school staff.

Secondly, enticing teachers to use ICT across the curriculum is a complex and time-consuming activity in its own right. Perhaps the most important characteristic needed to convey these skills and knowledge about cross curriculum ICT teaching is experience in teaching the subject. It may prove a wholly negative experience for young IT mentors to attempt this task. This suggests a team-based approach with multiple capacities needs to be built around the IT mentor.

As the curriculum matures and broadens out, the different types of training that can be required for ordinary teachers will be roughly in order of provision:

- End-user or other basic training, depending on the IT background of the teacher.
- Training in what ICT technologies are applicable for particular learning activities.
- Training in how ICT can be integrated with specific subject curricula.
- Training in changing pedagogical style to maximise value from using the technology.

This task is a very large one if implemented across all teachers in the Seychellois schools. As can be seen below, there are some 500 secondary school teachers alone. Also to be borne in mind is the high proportion of expatriate teachers at the secondary (39 per cent) and post-secondary levels (38 per cent) (MEY 2002: 197). A decision would have to be made with regard to how training of this group is undertaken. This observation is made not in order to suggest discrimination against expatriate teachers, but on the basis of the assumption that investment in training expatriate teachers especially those on short contracts will be lost. But if such teachers are employed as ICT teachers this will be unavoidable.

Table 5: Number of schools, pupils and teachers 2001

Phase	No of schools	No of pupils students	Number of teachers
Primary	26[a]	9 782	712
Special education	1	80	26
Secondary	12	7514	525
Post-secondary	11[b]	1 740	216
TOTAL	50	19 036	1453

Note: The crèche level is not included in this analysis

MEY (2002: 193-194)

a. Includes two private schools

b Includes three polytechnic study areas

Teacher access to ICT as part of their work

We have already noted the need for teachers to have access to computers. This is recognised as essential by management in the Seychelles MEY – 'Teachers need access (to computers) to be conversant'. International experience suggests strongly that where school principals and teachers have been able to exploit the capacity of ICT – in school management, departmental management, management of mark schedules, management of testing, in general administration and in the production and use of management information – they are far more likely to explore ICT as a pedagogical tool.

This project is focused on the curriculum-based application of ICT materials, but it is clear that where teachers and school managers experience successes in the non-curriculum – administrative-oriented use of ICT, this provides an important base for generating support for ICT-curriculum interventions. Where the Seychelles MEY is able to provide for better equipped and trained school staff in respect to administrative tasks, this can have the benefit of raising the openness of teachers to using ICT as a classroom tool. One of the principals observed that where teachers have computers at home, she saw a marked improvement in the fulfilment of their administrative duties: 'deadlines are met' and 'better presentation'. This supports a strong case for time to be booked for this purpose in the computer laboratory, especially where few teachers have their own home computer.

Pedagogical style

On account of the constraints of time, the methodology of the project precluded extensive observation of ICT-based class teaching in schools. However, observations drawn from the school visits undertaken did serve to highlight the importance of the interaction between pedagogical style and ICT. This is because the variety of technologies embedded in the concept of ICT provide for greater flexibility and autonomy for the learner to engage in self-directed and even independent learning. However, teacher attitudes cannot be assumed to be consonant with greater learner independence. Anecdotal evidence suggests that traditional teacher-dominated classroom practices which limit pupil's learning opportunities are still evident in the Seychelles schools.

To maximise the advantages presented by ICT will require a shift in mindset away from the notion that the educator should dominate the learning-teaching process. Relations of authority that have traditionally characterised the profession are under threat in learning situations where ICT is applied and where the initiative for utilising ICT as a tool for learning will increasingly come from learners who are no longer solely dependent on the teacher or the textbook as their primary source of information. The training of educators must take on board the fundamental curriculum assumptions that underlie the implementation of ICT as a means of empowering the learner to engage in self-directed learning (Paterson & Lundall 2002). Change in the attitude of teachers is therefore a central condition for successful implementation of ICT in schools.

There is a need to move towards a learner-centred style that values mastery of conceptual skills rather than 'knowing the facts'. In the domain of ICT this means being open to way of thinking. In terms of the IT curriculum learners might say, 'we think we are learning Logo. We don't think we are learning programming'. This is an important expression of the tendency to confuse content with concept as the main focus of learning.

An example of how teachers in classes using ICT seem to be unimaginative lies in the seemingly unvarying configuration of two learners grouped with one computer. Also, it was observable that the standard format for ICT classes is two per computer. There was hardly any variation in this model in the classes observed. It is important to explore the value of occasionally using different configurations of learner group size with computers to raise the

levels of interaction between learners. Larger group sizes become important for learners to practice communicative and collaborative skills with or without the use of technology.

Learners as co-educators

The conservative approach to teaching and learning is based on a view of learners as receptors rather than as creators of knowledge. This view is unfortunate if it blocks the teacher from seeing that learners themselves have potential to teach their classmates – especially in IT. In some of the primary and secondary schools, teachers successfully got senior learners to help as 'peer educators'. In one of the schools visited, senior learners in S5 were made part of the 'IT team' and given responsibilities to assist younger learners. Such an approach is indicative of an important underlying belief that students are able to participate and take on responsibility in the school. According to the IT mentor in the same school, there is vigorous exchange between him and the students during computer club periods. Such interaction serves to build an understanding of ICT as a domain of activity outside has taken for granted teaching and learning roles.

More mature students could also be trained to supervise the computer laboratory for a brief period. In some schools that were visited, learners were not allowed to use the computers 'because there is not teachers to supervise'. When asked whether he would put a senior student in charge of the computer laboratory, this option was not given consideration by the IT mentor. It is understandable that this may be driven by concern about the value of the computer equipment, but it is important to build a culture of maximising the use of the ICT in the school.

It should be clear from this discussion that a key opportunity to socialise teachers in a different way of teaching is to orient their training appropriately. We now turn to examine teacher training in the NIE.

Teacher training in the NIE

Overview

The policy documents identify the National Institute for Education (NIE) 'being the body within the MoE responsible for teacher training and playing a significant role in curriculum development (that) will play a pivotal role in the integration of the IT initiatives in the curriculum. This will take place with the collaboration of relevant MoE HQ sections'(MEY 1999: 10).

The responsibilities of the NIE include the following curriculum development activities:

- Assist with the evaluation of the effectiveness of school curricula.
- Participate in the development of specific subject curricula for schools.

According to the National Curriculum Framework, the NIE is delegated the task to develop the curriculum under the control of a working group. In terms of these requirements, an ICT

curriculum committee has been established which would then submit a draft plan to the National Curriculum Committee.

From the development of the school curriculum, it follows that the NIE is then responsible for developing the teacher-training curriculum, and for the following related training functions in schools:

- Carry out action research on the curricula as an integral part of teacher training.
- Advise on teacher training curriculum policies and implementation strategies.
- Provide relevant management training for school management teams, teachers and other staff.
- Promote the development of a wider learning environment through subject-related co-curricular activities in schools (MEY 2002: 148).

From this, we presume that one of the NIE's functions is to support the new ICT curriculum – or any other curriculum component – through this set of activities.

In summary, the NIE is therefore responsible for curriculum development under the supervision of the National Curriculum Committee at the school level, and is responsible for curriculum development for teacher education. This places extraordinary power and responsibility on the institution. It is argued in the implementation plan for the SITME that 'The NIE will constitute the hub for the training of the MoE personnel in both the pedagogical skills, IT skills and technical training' (MEY, 1999: 40). We argue that this original conception needs to be revised in the light of the range of current challenges.

NIE curriculum

The National Institute for Education offers two main full-time courses, the four-year diploma in primary teacher education and the two-year diploma in secondary teacher education. Both courses are a platform for further study at the BEd level at Edith Cowan University (Australia). Currently, the sizes for the two programmes are as follows:

Table 6: Student enrolment at the NIE (2001)

	Year	Number	Total
Full-time primary	Foundation year	42	86
	Pre-diploma 2	23	
	Diploma year 1	21	
Full-time secondary	Diploma year 1	63	96
	Diploma year 2	33	
			180

Source: MEY (2002: 150-151)

The NIE includes ICT curriculum units in both the primary and secondary diplomas to increase the skills base of the trainee teachers so that they will come out 'at least computer literate'.

Teacher trainees will have completed 'A' level and will have to complete three units of their main teaching subject and may take a maximum of two units of IT. IT is always the

minor subject. The four modules in IT include: (1) improving the individual's skill base, (2) using IT as a pedagogical tool across the curriculum (3&4), the teaching of IT as a subject (i.e. computer awareness). Teachers who seek to work as IT mentors must take all of these modules (comprising two units).

The NIE offers two local part-time certificate courses in 2001 in art and craft and in physical education, but not so far in ICT. This certificate programme format which has already been set up and tested could provide the framework to launch one or more courses focusing on ICT for in-service educators.

It seems that the NIE could be responding more proactively to meet the current and future needs for training in-service teachers in ICT. It may be a lack of capacity, or over commitment to other work, that is slowing down progress on NIE staff designing and implement in-service ICT training programmes. There are 2,5 IT specialists in the NIE teaching complement in mid-2003, but this may not be enough to cover the range of services that may be expected from the NIE.

The NIE is responsible for the following services to teachers in the field: providing sample units of work, guiding heads of subjects and senior teachers, providing guidelines, conducting school-based workshops. All of these will be critical in persuading teachers to integrate ICT in their subject areas. If necessary, the means to assist the NIE in this regard should be sought. The NIE was in the process of a course review in 2001-2002, the outcome of this process might yield some clarity on the matter of ICT training (MEY 2002: 153).

We were told by the Director of the NIE that the NIE's role was to respond to requests from the schools division to launch and run teacher in-service training. The intriguing question is why neither the schools division nor the NIE appear to have activated a medium-term plan for in-service training of teachers in ICT. This situation suggests lack of clarity as to where the responsibility for teacher training in ICT actually rests. By definition, ICT integration is a challenge for all subjects and is at the same time the specific task of no particular subject grouping.

The responsibility for developing curriculum materials for teaching ICT across the curriculum

To suggest that this responsibility should be allocated to those teaching computer literacy or computer studies may not necessarily be appropriate. The criteria for allocating this responsibility must be carefully considered. Another possibility is for the responsibility for in-service teacher training in ICT across the curriculum to be allocated to each subject area within the Seychelles curriculum. Then subject specialists can be tasked to develop modules on IT integration across the curriculum as part of or inside of their own subject methodology. Subject experts may then begin to select parts of their curricula for which they will design ICT-based modules for implementation. This approach can provide teachers with good examples of how integration into the curriculum can take place that are implementable, and may contribute to teacher confidence in using ICT. This will not provide a total solution,

since a key skill for teachers to learn themselves, is to distinguish what part of the curriculum can or should be taught through the medium of ICT.

The possibility that ICT across the curriculum can be taught through a set of generic modules in combination with a set of subject-specific modules has also been mooted. But in the end, the decision has to be made with reference to available human resources.

Training of principals

Thus far, there has been no specific training of principals regarding ICT by the NIE. From our visit, anecdotal evidence confirmed what the literature says about the importance of leadership in the development of an ICT culture in schools. This implies that the training for principals should not necessarily be only about technical skilling. Rather it should bring principals to closer consideration of what their role should be in supporting a new curriculum innovation. For example such training programmes could consider what approaches to team building principals could apply to ensure that the IT mentors are not isolated in their schools. We note the importance of finding 'champion(s)' but this is insufficient and needs to be recognised as such.

The role of the NIE in training of IT mentors

Finally, with reference to the training of the IT mentors, we have noted that the training of this group with regard to technical skills (A+) and knowledge of the ICT curriculum ('O' levels) is being supplied by a private agency and by ALDEC. This does not effectively cover other important aspects of the IT mentor training as we have already observed earlier. The important issue for the NIE and the information technology division to work together on building a programme which will provide a coherent base for the IT mentors even if the components are supplied by different training providers. The question as to which specific division should take the lead must be addressed, so that there is a clear allocation of roles in this important task.

Curriculum development

The IT report of 2000 noted, 'No curriculum development committees or organisation are currently in existence in relation to IT' (MEY 2000c: 6). Given this background, the fact that the 'computer literacy curriculum' is currently being offered in S3 in the junior secondary level is a commendable achievement, though also at the cost of growth pains associated with rapid implementation. The plan for extending this curriculum down to S2 and S1 were not apparent to the IT mentors in the schools.

The implementation of S3 computer literacy means that preparation must be undertaken to complete the design of the ICT curriculum for the secondary school phase (S1 and S2). We have noted the need to avoid at all cost seeing pupils complete S3 only to find that they

cannot pursue their studies in the following year. The 'O' level opportunities need to be implemented urgently in order to sustain continuity of learning.

However, curriculum development does not only require the construction of a set of curriculum content, activities and processes. There is a range of complementary elements for successful curriculum implementation. Especially important is the preparation of the teachers of the curriculum. The current IT mentors many of whom are still busy with their own 'O' levels are contemplating the moment when they must teach that same subject with concern and would like the opportunity to prepare for this responsibility. As yet, the IT mentors are unsure of their role in respect to the 'O' levels.

It would seem that the phased implementation of 'O' level for S4 and S5 needs to be planned as soon as possible. It will also be important to bring NIE training into line with this goal.

Finally, care must be taken to ensure that appropriate guidance and counselling advice for learners is brought into the equation. In line with the introduction of ICT in the secondary school some career advice should be offered to assist with subject choice for the S4 and S5 specialisations.

Teacher support

Teacher support is always critical to the success of a new curriculum innovation, and ICT is of course no different. There are many levels of teacher support, some of these relating to the status, material and equipment needs of IT mentors have already been dealt with. We now focus on support for ordinary teachers who may be interested in using ICT and for whom a receptive environment needs to be created.

The first level of support that teachers must be able to source is their colleague. Yet the signs of this in the Seychelles are not good. A recent HSRC baseline study of primary schools participating in the SIP project revealed that only half (50,4 per cent) of teachers indicated that they had the 'opportunity to participate in joint activities with (teachers at) another school'. The HSRC report suggested that this aspect of operations requires improvement (Khosa, Kanyee & Monyooe 2002: 65, 90). ICT can provide the platform for increased networking among teachers in Seychelles schools located between a number of islands in the Seychelles archipelago. However, the establishment of the medium of communication is insufficient to generate interaction. This depends on the desire to communicate among teachers. It is necessary to develop a community of practice among practitioners of the use of ICT in schools. This may be achieved by establishing an ICT teacher's interest group notwithstanding the fact that the Seychelles teaching corps seems to have a low impetus to organise itself for curriculum or other purposes.

Content development and software

Perhaps the greatest single challenge to teachers in applying ICT in the classroom is access to resources. This is because self-generated material is so time-intensive as it necessarily must

move through a design, testing and implementation phase. Mr Ben Choppy indicated content development in his top four challenges for the future of ICT-based education in the Seychelles.

But content production is costly. It may be necessary to target particular curriculum areas where local content is of particular importance. Co-production rather than full production should also be considered (MEY 3003: 3) such as in a collaborative project with an Australian university and the NIE to develop modular units for both IT mentors and other teachers that is in progress. Finally in this regard, the IT mentors who are currently busy with their 'O' levels are tasked with completing projects some of which may also be of sufficient quality to be considered for application in the Seychelles schools. The last point is important as a reminder that locally produced content can easily be missed.

The SITME also signalled the need to develop a 'centralised service to source, review and recommend software titles and Internet sites' for teacher assistance and as a clearinghouse (MEY 1999: 15). There are plans for the dissemination of these and other materials via a 'web-based database application' (MEY 2003: 2). This is a good idea, and should be pursued vigorously as well as paying attention to the adaptation of existing materials.

Language content

Indications from learner achievement testing of P4 and P6 learners show that English home language learners obtained significantly higher scores than their Kreol and French counterparts for numeracy (Khosa, Kanyee & Monyooe 2002: 101). It is interesting to note that the Seychelles was in the early 1990s the only country in the world where a Kreol language had legal status (Livi 1990: 60-62) thus giving some indication of the commitment of Seychellois to their indigenous language. Kreol is the first language for the majority of Seychellois (about 90 per cent) (Lacey, Jacklin & Leste 1999: 174) but the Internet is dominated by English and the need to provide teaching and learning resources in Kreol on the Internet will require the allocation of resources. Even though the medium of instruction is English from P1 (except with mathematics) code switching in learner groups is quite common in primary schools.

Data projector

It was observed that a data projector is considered a valuable item of equipment for teaching. Note that this is mentioned in this section on curriculum rather than in technical equipment provisioning because the data projector has the potential to leverage considerable value in the teaching process through raising opportunities for interaction. The data projector provides an onscreen view for all learners in the class of the teacher's computer screen (or of any learner's screen). This means that when a particular learner has a problem, the teacher can show the whole class the solution. In effect the data projector makes class discussion and solution finding possible with reference to the screen that all learners can see.

Technical provisioning

The Director General of the Educational Technology Division, Mr B Choppy indicated that after the initial capital investment in the purchase of the first generation of computers for all schools, the primary challenge facing the work of the Division is financial sustainability. The balance therefore is to find the optimal configuration of computers, networking and peripherals in the computer laboratory and then to maximise the use of these resources through time.

Basic infrastructure benchmarks

The SITME (1999: 11) indicates a 2:1 pupil to computer ratio as a standard. In the secondary schools, the number of computers in each lab averages around 10 to 12. This is sufficient to cover the biggest class size. The T:P ratio in both secondary and primary schools is about 1:14, but the classroom:pupil ratio is larger.

But IT mentors are warning that the current levels of equipment in secondary schools may hardly allow for any open access to the computer laboratory after providing access to classes doing computer literacy (S1 to S3) and then to computer studies (S4 to S5). The MEY has plans for secondary schools to have two computer laboratories and primary schools to have a computer room, but this round of provisioning does not seem likely in the short term. The emphasis therefore should be on efficient use of available resources.

Lastly, the MISD indicated that it would welcome working more closely with the MEY on matters of shared interest around systems development planning and procurement.

Connectivity costs

The expressed intention of having all school computer laboratories networked by 2004 is a significant benchmark to achieve, because this means that all computers networked will then have access to the Internet because every secondary school has Internet access. This is very important for the purpose of information access for pupils and learners. As important is the possibility of each person obtaining an e-mail address with which to communicate with others.

There are naturally costs associated with this. We were informed by the MEY that the State Assurance Corporation of Seychelles (SACOS) is sponsoring Internet connectivity costs, but this may change as more learners are networked and as bearing such costs becomes more onerous. The point being that the MEY cannot take this subsidy for granted and must plan ahead to ensure that it is not caught short on connectivity costs.

As important is the charges levied to teachers who use the Internet (eg. for accessing their e-mail etc.). This should be supplied to each teacher for free, as there should be no restriction on teacher access to the Internet which serves as an important medium for teachers to register for distance-based professional development courses. We have noted already that it is important for teachers to seek and offer advice and share experiences with each other over the Internet.

Financing of ICT equipment in schools

The Seychelles schools have not benefited substantially through donations of ICT products or services. There have been donations of a relatively small number of computers from the Chinese government and from the African Development Bank in the 1990s, and the commitment of Cable and Wireless to provide free Internet access to the ten secondary school libraries. But beyond this, the MEY foresees itself as the main provider of ICT in the schools.

The school community makes minimal additional contributions towards ICT costs. This may partly be ascribed to the centralised approach to provision of computer materials in the MEY which seeks through this to minimise problems associated with repairing non-standard equipment. The low community support of computer activities may also be on account of the expectation built over years of social welfare that schools needs will be taken care of by the Ministry. Lastly, there is an understanding among some principals that independent fund raising or soliciting donations has not been encouraged by the MEY. Another consideration raised was that the combination of zoning with differential financial input from parents could contribute to inequality between schools and that additional support from parents was not looked at favourably. As a result, it did seem that the potential initiative of schools to support ICT facilities has been suppressed in the Seychelles. In spite of these apparent constraints, there was one secondary school that had raised funds (eg. from the tuck shop and from recycling work by students) that were used to pay for cabling required for networking the computer laboratory.

Control over equipment

Signs are that in the secondary schools, controls over software were not as good as it should be. Given the future plans for upgrading school ICT systems, it is suggested that the current inventory management system should be overhauled and the inventory audited. This will enable tighter control over licensing costs especially where the growing system needs large numbers of licences. The importance of an inventory system was noted in the SITME (MEY 1999: 25).

Finally, the last two issues highlighted below do not refer directly to the cost or management of ICT equipment. It does draw attention to the importance of ensuring maximal usage of equipment and facilities that are at hand.

Improving the usage of available ICT facilities

The detailed analysis of cost-related issues would be analysed in another chapter. But what is remarkable is that the IT mentors identified few specific items as desperately needed. Yet in every school barring one – including the NIE – came the refrain ‘we need more computers’, ‘we need more machines’ ‘to teach IT you need the equipment’. We contend that this generalised request is at least in part a sign that schools are not utilising the equipment that they do have to maximum effect.

Strikingly, the only school which did not plead for more equipment was the very school which used its equipment most effectively, and where the IT mentor said 'ten (computers) is enough to start with'. In our view, this was not accidental. The more mature and experienced IT mentor was able to maximise the use of the facilities at hand. We suggest that the tendency of less experienced IT mentors was to assume that more technology was the solution, whereas the real solution lay in their becoming more effective and imaginative users of what resources they had available to them. This observation should not be taken as an argument against providing more equipment where necessary. Rather it should serve as a reminder that information technology in itself can do nothing – human agency is needed to realise the value that is latent in the technology.

Furthermore, we must beware of any tendency for a teacher to 'fetishise' the technology by investing her/his belief in the technology as the 'answer'. This easily brings a problematic dimension into play. That is the identity of the teacher as the victim, who claims: 'I could not achieve my objectives, because I did not have the right equipment.' The victim is thus absolved of his/her fundamental responsibility.

Use of computer laboratory time

The visits to secondary schools provided some evidence that: the computer laboratories are not being optimally used both in and out of school hours. We need to consider calculating the cost of idle equipment in order to create an argument for making the computer laboratories open for longer in the afternoon after school and perhaps even in the holidays.

We also need to be mindful of the possibility that the opposite may occur. That once the full curriculum comes in, the scheduling of time in the computer laboratory may become a major challenge to meet all time demands:

Table 7: Demands on a theoretical timetable for the computer laboratory

Activity	Frequency per week	Number of classes	Out of a possible 30 hours of ordinary school time (5 days x 6 hours) per week	Out of a possible 20 after school hours (5 days x 2 hours) per week
Downtime and cleaning	1 hour	-	1	
Computer awareness S3	2 x 1 hour	5	10	
Subject computer studies S4	4 x1 hour	1	4	
Subject computer studies S5	4 x 1 hour	1	4	
Library classes using computer laboratory	1 hour	5	5	
Teacher access	2 x 1 hour		2	
			26	
Time for learners to do school project	1 hours	7		7
Computer club	3 hours per week			3
Open access	2 hours per afternoon			10
				20

Assume 1 hour per period

As can be seen from above, the needs of five S3 classes, one S4 class and one S3 class as well as some access for library classes and some teacher access virtually takes up all computer laboratory time.

Technical support for ICT infrastructure in schools

Interviews undertaken in the course of this project indicated that the MEY is one of the ministries in government which is taking a leading role in utilising ICT as a resource both in its management and administrative role, as well as in targeting ICT implementation in schools. It was reported that in 2001-2002, there was a general expansion of Internet connections in the ministry offices.

The MEY (2002: 39) report refers to the need to promote the productive use of ICT in the Ministry through 'in-house consultation and training'. There is a need to consider ways of encouraging staff in the Ministry to upgrade their computer skills, for two reasons, first to improve their own productivity and second, to demonstrate to teachers and principals in the schools by example that the MEY is taking the use of ICT seriously even in the corridors of the head office.

More broadly, in 2001, the Planning and Statistics Section provided a wide range of ICT support to the entire Ministry comprising 235 computers – in primary schools (26), secondary schools (122) and in the Ministry offices (87) (MEY 2002: 37). Apart from the large number of computers, it must also be noted that these computers were located across a large number of sites. The MEY plans to have the school computers networked by 2004 and this will generate networked Internet access via the computer in each school library. Further down the line, the MEY plans to create a ministry-wide education WAN. Another major development project is the website upon which teacher resources are to be made accessible. All of these factors increase the levels of technical support required in the MEY.

The absolute numbers of computers deployed in schools and in the ministry offices will continue to increase over time, and because the schools are going into a phase of networking their ICT equipment which is likely to create additional network, advice, troubleshooting, security, inventory control and other related workload. The more complex the systems envisaged for implementation, the higher the necessary support skills levels required. It is not only the complexity of the ICT systems that necessitates higher skills levels, but also the availability of technical support in the environment.

The responsibility for meeting these various support needs is now understood to lie with the newly created Educational Technology Division under Mr B Choppy, who heads a team that manages support from first line service at school level through to the repairing and return of machinery.

In 2000, the IT report observed that technical support provided by the then providing agency (SSO) was highly satisfactory. It did suggest that the there was a need for clearer communications between the Ministry and schools, 'clear and simple procedures' and 'feedback regarding the machines removed from the schools was felt to be lacking' (MEY

2000c: 8). A lot has changed since then. Furthermore, it seems from this research, that the support provided to the rapidly growing ICT system in the MEY is not as satisfactory as it was in 2000.

One factor arises from difficulties in obtaining components: 'Availability of spares and replacement parts is a continuing problem. Machines, particularly those at schools, may be out of action for a very long time because the necessary component can be neither purchased nor re-couped from a similar machine' (MEY 2002: 39). Even though this problem is not of the making of the MEY, the Ministry must make the best effort to find a solution. In an interview at one of the schools visited on Mahe, it was observed that when a malfunction occurred with a computer, they needed to phone the lady at the Ministry three days to a week before any response was forthcoming (at the time of the interview this school had 3/12 computers down). The consequences of not being able to meet such needs can have serious productivity implications for other sections and schools.

Appropriate level of school self-sufficiency

Self-sufficiency in technical maintenance and troubleshooting seems to be a key issue at the school level. In one of the schools, there was not a word spoken about difficulties in getting IT technical support from the MEY. And this had nothing to do with the service from the Ministry. When we asked why, the IT mentor answered simply: 'No secret. I do the maintenance myself'. This response was possible because the IT mentor in question was experienced, pro-active, procedural and committed in ensuring the health of his system so that problems were minimised. Thereafter, he was able to effectively fault find, diagnose, and troubleshoot independently. As a result his demand on the central services of the MEY was considerably less than other schools.

The question is how to achieve this level of service at the school level? The experience of IT service providers is that proper education and training has the effect of reducing the frequency of support calls. So training in combination with experience among IT mentors will produce benefits. But those with expertise must be retained in the education system in the same function – if not in the same school.

There is also a need to define the roles, responsibilities, and workflow for these services including a help desk. The processes must be specified from first level diagnostics through to solution including call logging and a clear escalation policy. In addition there should be reports which quantify the nature and frequency, and source of particular calls. This data can be analysed to inform further training. This system will assure users in the head office or in a distant school that their needs are being taken care of on a procedurally fair basis.

Monitoring and evaluation research

The importance of rigorous evaluation of all aspects of the implementation of a project is strongly advised. The same is recommended of the evolution of the ICT education programmes in all their facets. The following observations are made in this respect:

In 2001, a working group was set up to develop a new Ministry Policy on Teacher Appraisal (MEY 2002: 16). In that year, a draft policy document was produced. It is recommended that the working group consider how to include teacher use of ICT as part of the appraisal process if they have not already done so.

The Research, Evaluation and Curriculum Planning Section is currently involved in an impressive set of research projects (see for example MEY 2002: 60-65). It is recommended that a strategic decision be made regarding the initiation of one or more projects focused on the implementation of ICT in Seychelles schools. The following options might be considered:

- Baseline study of learner achievement.
- Pilot studies of the current primary schools.
- Research project on gendered use of ICT.
- Research project on teacher use of ICT.
- Tracer study of learner employment.
- Examine outcomes.

Arguments were strongly put forward that the country is experiencing a lack of skills especially in the broad field of IT systems development. In the private sector, IT companies have the view that 'it is very difficult to find and employ Seychellois'. This shortage is crippling government departments especially those which train employees who are lost to the private sector.

What such views underline is that there does not appear to be recent data on the size and structure of the employment market for IT-related labour in the Seychelles. This points to the need to conduct research to establish these dimensions. The recent Seychelles Census will provide one source of information. Another way of obtaining qualitative data would be to conduct a survey of employers – both government and private – and establishing their needs. The data coming out of such a survey would provide useful pointers to the shape of the school curriculum. Another possibility is to survey members of the local Association of Small Businesses (ASB), and the Seychelles Chamber of Commerce (SCCI).

Private ICT training

It was considered important that this examination of ICT training offered by the Seychelles Ministry of Education and Youth be informed by what private training opportunities are taken by young people in their school-going and immediate post-school phase. This is because the private ICT training sector moves quickly to occupy market opportunities that may exploit gaps left by the schooling system. This may be through providing training to learners who are not catered for at school, through providing knowledge that is not offered in the school curriculum and through offering courseware that extends the skills base that learners have obtained while at school. The relationship between school-based learning in ICT and post-school learning is informed by the nature of the ICT curriculum at school. One important

dimension is the extent to which the school ICT curriculum provides basic, end-user, or specific vocational skills and values in the period immediately prior to normal school leaving.

The existence of post-school training opportunities for individuals interested in pursuing a career in ICT-related fields is a very important condition for sustained development of ICT skills within an economy. A lack of post-school ICT-learning opportunities will operate as a disincentive to learners who may otherwise have considered further study towards a career in an ICT or related field. Lastly, training of some kind is essential for virtually all ICT-based workers because of the speed with which the hardware and software environments change, requiring frequent upgrading and reskilling.

In the Seychelles, there are limited opportunities for private ICT training. Two providers dominate the market. 'Compufast Learning Skills' claims to provide courses that meet the needs of elementary, intermediate and advanced ICT users. Some courses are accredited through the London Chamber of Commerce and Industry (LCCI) Examinations Board, and follow a British curriculum. This private academy is responding to a demand from school-age learners for training in computer skills, which enables them to design and present their school projects, and gives them confidence to use the Internet and e-mail. These courses entail modules in basic end user skills (word processing, spreadsheet, database and presentation packages). It is likely that among this group of clients are S4 and S5 learners at the secondary schools who are not provided access to formal computer instruction at the school. This group may be aware of the fact that younger learners than them – S1 and S3 – are getting ICT classes and there may be concerns that they will be disadvantaged in the workplace. Courses are presented over a period of ranging from six to twelve months and learners pay per hour for attendance until they are ready to write the exam. This means that such courses have the advantage of being flexible. But should a learner for whatever circumstances not attend classes, will be likely to spend more time and money on their training (NATION 2003a).

There are signs that the interest in computer training is strong enough to attract other service providers into the business outside of the capital Victoria – where 80 per cent of the Seychelles population is resident. In 2002 it was reported that the 'Computing and Additional Learning Training Centre' was opened in Port Glaud by a former student of the abovementioned Compufast Learning Skills business. This school offers basic computing courses but spreads its service into other subjects as well (NATION 2002a).

There seems to be some sort of market focus with Victoria Computer Services (VCS) offering training to the corporate or business market, and Compufast concentrating on individuals who have more ad-hoc needs or who cannot afford to attend a course offered on a full-day basis for several days running. VCS is a well established company that offers a range of information system solutions including software development, technical customer support services, consulting and business development as an IT services provider, training is one of the company's services. It is frequently integrated in their approach to providing end-to-end solutions to clients including end-user training. But VCS also offers training as a service independent of their IT operations. Their training centre based in Mahe offers a Microsoft certified curriculum which leads to the MOUS certificate as well as technical qualification

such as the A+ as well as training for CAD, web development, accounting applications. VCS also provides skills enhancement at the technical-professional level.

It is reported by the government schools visited in Victoria and on Mahe that pupils do attend private computer training to the extent that parents actually ask for their children to be excused from other school activities in the afternoons which signals the importance with which this is viewed. Of interest is that learners whose parents can afford to pay or who see some advantage for their children in this come to school and are ahead of their classmates who do not have the privilege of additional access. This creates a challenge for the teacher to meet the needs of a varied group of learners. This group is of some use to tutor other learners informally – the warning that they should not do it for their classmates but only help. Also important is that these operators offer training during the school holidays, which will prove profitable since the government schools do not make their facilities available.

Adult Learning and Distance Education Centre (ALDEC)

ALDEC offers computer studies evening classes to adult students and teachers who wish to learn how to use computers. ALDEC does not have its own facilities and therefore depends on using the facilities of the National Institute of Education and the Seychelles Polytechnic (NATION 2003b) and also makes use of the facilities of schools particularly in the Victoria area.

Staff at ALDEC has observed a rise in interest in these courses from senior teachers principals who are interested in specific skills (eg. databases, spreadsheets) and SIP co-ordinators who want to use IT as a productivity tool. Currently (2003) there are nine IT mentors doing the 'O' level, and six other teachers and a principal doing other courses. Have picked up a demand from primary schools but they don't have computer labs.

Summary of the key findings

These findings are informed by an attempt to achieve a balance between interpretations of 'successful' implementation:

- Which can focus on identifying the barriers to 'successful' implementation.
- Which can focus on identifying the impact of 'successful' implementation.

The following key findings are presented below – not in any order.

Curriculum implementation in earlier grades influences implementation in later grades.

We have noted the difficulties experienced by those learners with little prior experience with ICT in completing the computer literacy programme in the junior secondary school. This difficulty could be removed with the implementation of an ICT programme in the primary school. Thus earlier introduction to ICT-related learning could improve the success rate of programmes further up the academic path.

Assessment procedures

Where computer literacy has been implemented, the emphasis has been on developing and teaching the programme, to the relative neglect of assessment procedures. Lack of appropriate assessment procedures may not appear to be an obvious barrier to implementation. But if assessment goals are not upheld, then what is learned will not be diagnostically assessed, and there is the danger that impact will be blunted.

Continuity of learning between formal and informal curriculum opportunities

Continuity of learning is an important concern. For learners who have completed their S3 course, effort must be put in place to ensure that there is adequate opportunity for learners to pursue their interest in S4 and S5. This may be either through formal or informal means at school. In the absence of these options to build on what students have learned, the initial investment in computer literacy may be partially lost.

Appropriate software must be selected, supplied and supported

The experience of the junior school software pilot study shows how important software is for improving learning outcomes of mainstreamed and special needs learners. However, the selection of the appropriate software, monitoring of its consumption, and the servicing of teachers using this software is important for successful implementation.

Expanding ICT implementation across the curriculum: by attracting teacher to use the computer laboratory

Integration of ICT across the curriculum is a long-term goal. Teachers in secondary schools are not inclined to make use of the computer laboratory. And this disinclination serves as a barrier to implementation. Anecdotal evidence from visits to schools suggests that teachers with subjects which depend directly on ICT as a medium are more inclined to use the computer laboratory. For example: teachers offering art and design (uses DTP/Design/Publishing packages), technical studies (uses CAD) and library (uses Internet browsers), tend to be more open to using the computer centre. In order to build a core of teachers who do use the computer laboratory in the school, it may be useful to draw the above teachers in as a first phase in an ongoing programme.

Pedagogical style of teachers can contradict the potential of ICT to facilitate independent learning

To maximise the advantages presented by ICT will require a shift in mindset away from the notion that the educator should dominate the learning-teaching process. Relations of authority that have traditionally characterised the profession are under threat in learning situations where ICT is applied and where the initiative for utilising ICT as a tool for learning will increasingly come from learners who are no longer solely dependent on the teacher or the textbook as their primary source of information. The training of educators must take on board

the fundamental curriculum assumptions that underlie the implementation of ICT as a means of empowering the learner to engage in self-directed learning. Changes in the attitude of educators are therefore a central condition for successful implementation of ICT in schools.

Conserving IT mentor human resources

It is clear that the IT mentors are a critical group in the process of rolling out the Seychelles IT masterplan. A number of programmes must be put in place to ensure: that IT mentors feel that their work is recognised, is rewarded and has future career prospects. In addition, various options exist to support IT mentors with equipment and software. This will contribute to consolidating the IT mentor group within the secondary schools. Rapid turnover in this group will result in deterioration of the rate of change in ICT culture in schools, and in degradation of quality of IT learning and teaching at the school. Also, considering the critical role that the IT mentors must play – as champions, curriculum leaders, technical supporters – a means of assessing candidates for such a post may be considered.

Institutionalisation of the IT function in the school: building an IT team at school level

The Seychelles IT masterplan is multilayered and contains complex demands which focus on the school level. The IT mentor alone will not fulfil the full set of goals specified for ICT curriculum change and technical sustainability at the school level. This means that a team approach to ensuring that ICT impacts the curriculum must be put in place. In particular, the principal becomes a prime player and the potential anchor of the team. For this reason, the principal must be supported as she/he works towards the mobilisation of such an ICT team based at the school level.

Teacher training lies at the core of the success of the ICT curriculum intervention

Unfulfilled teacher training needs will act as a comprehensive barrier to ICT integration across the curriculum. There are several levels that must be taken into consideration, since all teachers must be assisted through a process of interacting with ICT depending on their current level of contact and interest:

- End-user or other training depending on IT background of teacher.
- Training in what ICT technologies are applicable for particular learning activities.
- Training in how ICT can be integrated with specific subject curricula.
- Training in changing pedagogical style to maximise value from using the technology.
- Training in how to apply different resources appropriate to grade, age, difficulty etc.

Both in-service and pre-service curricula must take these aspects into account. In addition, such programmes must also be robust enough to take account of teacher resistance to change.

Institutional structures supporting the roll out of ICT-based curriculum: the load on the NIE

Introducing ICT into the curriculum is multilayered. This involves inter alia:

- ICT curriculum development.
- Development of curriculum implementation strategy.
- Development of teacher training curricula (in-service and pre-service).
- Promotion of subject-related curriculum activities in schools.
- Research on the above processes.

There is concern that the above sets of responsibilities that are identified as the NIE responsibility are beyond what the NIE can provide. This should not be taken to reflect on the individual capacities of the current staff of the NIE. Rather, it is argued that what is outlined above is simply too large a load for the NIE to sustain in addition to its normal responsibilities. It is recommended that the schools division, the NIE and the Educational Technology Directorate of Mr Choppy consider the options for structuring a future division of responsibility.

Curriculum content development

The evolution of ICT integration across the curriculum has shown itself to be hugely time hungry. The Ministry of Education must move toward putting in place the means of obtaining content, sourcing software materials and making it possible to distribute this. Also, attention must be given to locally produced content. For dissemination, the notion of Internet-based applications is attractive. Furthermore, adaptation of available materials may be cheaper and faster than going for new materials.

Technical provisioning: ensuring continuity of school-based computer services

Based on interviews in the schools, it appears that the service to schools for maintenance and technical support is a cause of frustration and can be demotivating. The MoE must put in place the appropriate procedures to improve service including: a help desk, call logging, escalation procedures, etc.

Curriculum monitoring and evaluation

Curriculum monitoring and evaluation is essential to ensure that the curriculum can be improved through cycles of constructively critical feedback. This can be implemented in a number of different ways utilising a range of research methodologies, and covering a wide timescale that can ensure that long-term benefits and unintended consequences of policy can be identified.

Need for professional expertise in teaching institutions across the system

There are continuing vacancies in teaching staff in computer subjects across the Seychelles post-school institutions such as the Polytechnic (MEY 2002: 167). There is a need for training and capacity building here. It is of little value training learners at school in ICT and then for them to enter post-school institutions where the curriculum is incomplete on account of staff vacancies. This may require increased sourcing of appropriate personnel from outside the Seychelles.

Assessment in terms of OECD criteria (and additional suggestions from the Seychelles report)

OECD criteria	Key comments
The need for radical curriculum change	• There is a new ICT curriculum, based on a compulsory (but non-examinable) 'computer literacy' foundation, with an elective but examinable computer studies component in senior secondary. • A learner-centred approach in the curriculum docs is not powerfully expressed. • Teacher awareness of the link between ICT and learner-oriented pedagogy appears to be at a low ebb. • Groundwork in respect to the development of the formal ICT curriculum is underway, but does not yet address radical change.
Compatibility of student assessment with ICT-enriched learning	• Assessment based on traditional tests with focus on individual level. • Assessment is linked to traditional teaching styles. • Assessment is undeveloped with respect to alternative activity and group bases for testing. • Assessment has received relatively little attention compared to bread and butter access issues.
Digital literacy as a fundamental learning objective for all	• Implementation of 'computer awareness' component in junior secondary curriculum which is compulsory but not examinable. • This has so far been implemented in only one year (S3) of the three-year phase (S1 to S3). • Curriculum, once implemented will provide broad coverage preparatory to senior secondary ICT specialisation, and may suffice as basic orientation for school leaving.

OECD criteria	Key comments
Suitable levels of equipment in all schools	• Secondary schools equipped with one laboratory (12 computers), one Internet-enabled computer in the library. • Secondary schools computer labs to be networked in 2004. • Primary schools as yet to be supplied (barring one pilot school). • Technical support services all schools but provides slow service which frustrates school level personnel.
Plentiful educational software of quality and easily-accessed information on it	• Minimal availability of indigenous software, but Seychelles population is too small to justify large outlay. • Software purchasing is ad hoc. • Some use of free-ware off the Internet. • Few teachers engaged in development of own materials. • Minimal servicing of school level software needs.
An extended professional role for teachers in schools	• Low levels of awareness among teachers of value of ICT in their own teaching discipline. • In-service training of teachers is undeveloped. • As yet no programme specifically devised for pedagogical aspects of ICT as a medium across the curriculum.
Commitment of school leadership and management to adopting ICT	• Principals differ in levels of support of school-based ICT activity. Some very positive, and some defensive. • More principals need exposure to training in use of ICT in school administration. • More principals need exposure to training in how to develop an ICT team/environment in the school. • More principals need support and advice in promoting ICT in their school.
New partnerships between school, home and community	• Most principals believe that the MoE does not permit parent involvement in financial support of ICT activities. But fundraising is tacitly accepted. • Minimal access to the computer laboratory by parents or community. ALDEC uses some school laboratories. • Computer laboratories not used in school vacations. • General population may still distrust or resent ICT. • Private training providers take up excess demand or differentiated demand for ICT training services.

Other criteria	Comments

Other criteria	Comments
Teacher training available	• Pre-service teacher training available but only for S1 to S3 junior secondary courses. • In-service teacher training is not available through the main agency for teacher education – the NIE.
Textbooks and LSMs available	• Textbooks and learning support materials required. • Lack of model examples visible for teachers (eg. either by demonstration or by publication).
Educator support group interaction	• Minimal level of teacher community on ICT. This is critical for broad-based implementation.
Continuity of learning in the curriculum for students	• Computer literacy not taken seriously as a non-examinable subject. • Learners completing computer literacy (S3) but without the option of continuing in S4 and S5.
Institutionalisation of ICT structures	• Development of core ICT teams in each school essential. • Development of sufficient capacity in curriculum development based on ICT.
Local costs of IT equipment	• Prohibitive costs of importing computers for a relatively small market. • Is there a plan for government to consolidate buying for economies of scale etc.?
Future-oriented strategy	• Proposals to exploit e-learning need a sound ICT training base of learners at school. Person having had some IT exposure at school is more likely to take advantage of post-school opportunities.
NGO activity	• Low levels of NGO activity in the school ICT sector.
Availability of ICT in the lived environment	• There are a number of Internet Café's in the urban environment of Victoria, which are subsidised by government. • Computer prices prohibit the acquisition of PCs in households.

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Part four:
Cost Analysis

Andrew Paterson

An analysis of ICT costs in three SADC countries: Botswana, Namibia and Seychelles

Introduction

This study focuses on the conditions necessary to successfully implement an ICT curriculum in schools. As part of such a study, it is necessary to consider the costs associated with putting in place appropriate ICT infrastructure to support the curriculum. This is especially important in school systems that suffer resource scarcity and where challenges are experienced in providing equality of educational access, opportunity and outcomes. The key questions are how to obtain maximum effect from ICT investments, and how to minimise the opening up of a 'digital divide' between well resourced and poorly resourced schools.

There is no doubt that the costing of ICT implementation in schools is complex, to the extent that at a recent conference on ICT in African schools held in Botswana, Dzidonu (2003) asked whether we could realistically cost the process of integrating the use of ICT in the curriculum? This complexity arises less from the technical domain of accounting, and far more from the complexity of the school environments in which computers are acquired, installed and utilised.

Notwithstanding these difficulties, it is vitally important to investigate costs related to ICT so that key strategic questions around: effectiveness, efficiency, sustainability, risk sharing and community involvement can be better understood. Such an understanding is particularly important given that sometimes wildly extravagant claims are made for ICT and its impact on education processes.

This chapter will be structured as follows. The first section is important because it describes how ICT hardware and software is deployed, used and supported in schools in Botswana, Namibia and Seychelles. This is essential information because it will assist the reader to understand the cost profiles for each country that will be presented in the last section. Furthermore, the issue of costs must be 'read' against an understanding of the strategy of each country to roll out its ICT infrastructure. In other words, it is important to understand the reasons why the allocation of financial resources has occurred in the way it has in schools in each country.

In the second section, the methodology underlying the cost analysis is presented. Then, the aim of the third section is to generate a cost model that will enable the description of costs as they are recorded across the three participating countries according to a standard set of categories. The intention was not to limit the analysis to financial statistics only. It is

necessary to consider the reasons for why particular costs differed between the different countries, as a means to informing policy.

What follows in the next sections therefore represents an analysis of the context within which costs were accrued by schools in each of the participating countries. Hopefully because this analysis is grounded on an attempt to understand the dynamics and drivers that affect school ICT costs, it will assist policy makers in SADC to frame policy.

Finally, this chapter will also serve as a contribution to the small set of studies that attempt to come to grips with how ICT costs occur in developing countries. Work has been published on Belize (Rock, Glick & Sprout 1991); Belize, Chile, Costa Rica, Jamaica and Mexico (Potashnik & Adkins 1996); on extrapolations to LDCs based on data from Israel (Osin 1998); on Barbados, Turkey, Chile and Egypt (Bakia 2002), and on Zimbabwe and South Africa (Cawthera 2001). As can be seen, extant work on the SADC region is limited to only two countries.

The key cost issues will be discussed according to the following structure. The same structure informs the cost analysis which is presented at the end of the chapter.

Cost analysis: Main cost categories

Building – classroom
Hardware and peripherals
Software
Educational and subject-specific software
Recurrent costs
Connectivity
Consumables
Human resources
Personnel training and professional development
Community involvement

The computer room

The room in which the computer equipment is housed in the school is an important factor, and represents a major investment whether it is purpose built or refurbished. Just under half of all the computer rooms surveyed were converted classrooms (27 out of 56 that responded to the question). Botswana schools had the highest proportion of purpose-built computer laboratories while Namibia had the lowest proportion of purpose-built facilities. In Namibia, 17 out of 19 schools indicated that they use converted classrooms.

On the basis of the fact that a high proportion of schools are using a converted classroom to house their computers, it was decided not to refer to a ‘computer laboratory’ since this usage might create the impression that the learning space was purpose built. Henceforth, reference is made to the ‘computer room’.

It should not be assumed that computers are housed in a single room. Two schools indicated that they housed their computer facilities in two rooms, while a further two schools used three rooms. The use of more than one room should not necessarily be taken to be an

improvement, since this arrangement may signify lack of access to a single adequately-sized space in which to house computers and to accommodate a class of learners.

Computer infrastructure

Distribution of computers

The number of computers available in the computer room crucially affects how it can be used. Too few computers will force configurations such as split classes which create timetable and space problems, or group sharing of workstations which is not ideal for pedagogical reasons. Also, the number of available computers will place a specific limit on the potential number of hours available for free computer access for students. For these reasons, the ratio of learners per computer is an important indicator of relative access to ICT in a school. From Table 2, we see that the ratio of learners per computer is more favourable in Botswana and Namibia than in the Seychelles. The average number of computers in a Seychelles school is about half the average in Botswana and Namibia (Table 1).

Table 1: Number of schools, learners and computers

Country	No of schools	Total no of learners	Total no of computers owned	No of learners per school	No of computers per school	Ratio of learners per computer
Botswana	29	24 446[1]	783[3]	873	29,0	1:30,1
Namibia	20	16 853	535	842	26,8	1:31,4
Seychelles	13	7 138[2]	166[4]	594	13,8	1:43,0
Total	62	48 437	1 484			

1. Based on records for 28 schools
2. Based on records for 12 schools
3. Based on records for 27 schools
4. Based on records for 12 schools

The number of computers reported per school for teaching and learning varied from 2 to 70 in this sample. Of interest is that in Botswana, there are no schools which have less than 20 computers whereas in the Seychelles, most schools have 11 or less (Table 2). In fact, 13 Botswana schools had 20 computers, and 5 Seychelles schools had 11 computers. This reflects the decision in each of these countries to standardise the number of computers per school, based on a particular class size. Naturally these decisions will have an effect on overall costs.

Whether the number of computers in the computer room is sufficient, is relative to the pedagogical objectives of teachers. For example, in the Seychelles, some teachers split their classes so that learners have less time in the computer room, but when they go to the computer room, they do not have to share with a peer. These decisions which affect the intensity and duration of learner interaction with the computer can have different effects on learning.

In Namibia, computer rooms house varying numbers of computers. There is no clear modal category, which suggests that the Ministry of Education does not enforce a standard

size of computer room. This range in computer room size also reflects the organic growth of computer facilities in many Namibian schools. This has occurred through the activities of NGOs which are not necessarily obliged to provide computers to schools according to specified standards. Moreover implementing such a rule would be counterproductive because NGOs must work within the constraints of their available resources.

Table 2: Distribution of schools by number of computers per school

Number of computers	Country			Total
	Botswana	Namibia	Seychelles	
2 to 11	-	1	9	10
12 to 19	-	6	1	7
20 to 25	20	6	-	26
26 to 50	4	5	2	11
51 and more	3	2	-	5
No response	2		1	3

Computer stock specifications and age

We now turn to examine the quality of the computer stock in computer rooms in each of the participating countries. The technology development cycle in the field of computer hardware is extremely short. Tables 3 and 4 refer to processing speed and to memory (RAM) in the three countries. At the time of reporting, Botswana had the most modern installed computer base, followed by the Seychelles. Namibia has the oldest stock of computers as reflected in the higher percentages of equipment with older technology. For example, we can date 286-processor technology back to its appearance in the early 1990s outside of the United States.

Table 3: Processor speeds of computers as a percentage[1] of in country computer stock

Country	Processor speed					
	286	386	486	Pentium 1	Pentium II	Pentium III (or better)
	%	%	%	%	%	%
Botswana	-	-	2,7	6,4	36,9	53,9
Namibia	9,3	0,1	25,6	34,0	7,9	21,8
Seychelles	-	-	6,5	22,6	26,5	44,5

1. Percentages may not add up to 100 on account of rounding off

Table 4: Random Access Memory (RAM) of computers as a percentage[1] of in country computer stock

Country	RAM							
	8	16	32	64	128	256	512	1 024
	%	%	%	%	%	%	%	%
Botswana	-	-	-	23,2	48,9	26,9	0,8	-
Namibia	2,6	19,5	8,5	29,2	34,6	0,2	-	-
Seychelles	-	1,1	50,3	4,5	13,2	25,9	-	-

1. Percentages may not add up to 100 on account of rounding off.

This analysis has revealed how the provision of ICT in Botswana and Seychelles schools has clear characteristics. For example, in Botswana there is a high number of schools with

purpose-built computer rooms, a high level of standardisation in the number of computers per computer room and a narrow band of specifications in terms of RAM and memory size in the installed base. These signs identify Botswana as a country that has found the financial resources and implemented a system of ICT in all middle and secondary schools within a short period of time. A similar scenario has unfolded in the Seychelles, whereas Namibia has not had the same experience.

The Namibia case is likely to reflect the progression of ICT implementation within the majority of SADC countries given the fiscal constraints on their education budgets. Under these circumstances, it is likely that there will be a greater dependence on non-public, mainly NGO and private community provision.

Computer life cycle and replacement policy

Using older computers (with older technologies) is not necessarily bad, but does inherently involve disadvantages, such as increasing incidence of hardware failure, and difficulties arising out of sustaining compatibility with new technologies and associated software versioning. That may raise demand on human technical skills which will have increased cost implications. In this context, the computer life cycle and what is understood to be the optimal lifespan for a computer becomes important for national education systems and their budgets.

Despite the importance of managing the computer life cycle and developing a policy on computer replacement, most schools do not have such a policy. Only 13 out of 53 schools, or 24,5 per cent, indicated that they have a computer replacement policy/plan. One explanation for this low proportion is that because most schools are supplied with their equipment centrally from their Education Ministry, and there was therefore no need perceived for such a policy.

The life cycle of a computer in an organisation begins with strategic decisions with respect to procurement. One option that can be considered is to procure reconditioned computers. There are arguments for and against such an approach that refer to: total cost of ownership over the computer lifetime, and to the possible pedagogical effects of using old technologies on skills acquisition.

What is interesting is that the data from the survey show that only 5 out of 60 schools, or 8,3 per cent, indicated that they purchase second-hand or reconditioned computers. The majority of these schools were from Namibia, which has not engaged in system-wide programme of supplying computers to schools. The data suggest that in Namibia, purchasing second-hand computers are a strategy that is driven by the financial constraints upon individual schools or NGOs. The Namibian experience suggests that acquisition and maintenance of second-hand computers may be efficiently and cost effectively controlled at the individual school level. The question is whether this approach can be successfully applied on a mass basis.

Networked computers

It is important to establish the extent to which computers available in schools are networked or not. Non-networked, or stand-alone computers cannot interact with other computers and therefore cannot enable the computer user to communicate with other computer users electronically. Stand-alone computers also cannot easily share resources in the form of peripherals such as printers, or other resources such as Internet access. Therefore networked computer configurations offer special advantages in educational environments since they provide the basis for three main characteristics of the learning process, namely communication with others, searching for information, and collaboration towards collective generation of knowledge products.

Table 5 shows that in schools that did respond, Seychelles schools have the lowest levels of connectivity to a Local Area Network (LAN). The Seychelles has plans afoot to network its school computers within the next financial year.

Table 5: Schools by number of computers connected to a LAN

Computers on LAN	Country			Total
	Botswana	Namibia	Seychelles	
None	-	3	9	12
1 to 20	10	9	1	20
21 to 64	5	6	1	12
No response	14	2	2	18

Computers linked to the internet

Each school was requested to report the number of computers with Internet access. The average number of computers with Internet access per school was highest in Namibia (19) followed by Seychelles (14) and by Botswana (5,6). It should be noted that the Seychelles average is inflated by virtue of a few schools having large numbers of computers linked to the Internet. The number of computers linked to the Internet is a factor to be taken into account in costing, which is driven by the extent to which Internet-based activities are structured into learning activities by teachers and the extent to which learners are permitted time to freely surf the Internet.

In the sections that follow, the aim is to establish what software; hardware and peripherals schools in the study currently have in their computer rooms. Those items most commonly found in the computer rooms of the three participating countries will be included in the cost analysis. The same analytic procedure will be followed for:

- Computer hardware and peripherals.
- Computer software.
- Curriculum and subject-specific software.

Computer hardware and peripherals

Respondents for each school were requested to provide full information on all hardware and peripherals that were used for teaching and learning. Table 6 describes the information on hardware and peripherals provided by 57 out of the total of 62 schools.

The first column reveals the number of schools which reported owning a particular hardware or peripheral item. This frequency was used to determine the rank order of each hardware or peripheral item in terms of ownership. The third column in Table 6 provides an estimate of how many examples of each equipment item is found in the schools. For example, we can infer that in those schools which reported owning a black and white printer, they would have approximately three printers of this type.

The information is not reported by country, but rather in all schools in order to identify the items of hardware most commonly found in computer rooms across all three countries. It is probable that there were differences in school-based investment priorities between the three countries. However, the sample of schools was not large enough to enable the comparison of patterns of hardware and peripheral acquisition between countries. Moreover, it was deemed preferable to include the cost of only the most common purchases across the three countries. The application of costs to a standard package of items would make comparisons of costs between countries more transparent. Also it would rule out bias that could be introduced by a few schools which could afford to purchase a wider range of more expensive non-basic items. Given the observation that wide variations exist between schools in developing countries in terms of ICT equipment, this approach to costing was considered appropriate.

Although actual computer workstations were in every school computer room, this was not the case with other hardware and peripheral items. For every equipment item, other than PCs, there were always a number of schools that did not possess that item. At least two-thirds of all the schools owned one or more printers, CD-ROMs (which are supplied with the computers), server PCs for their network, and scanners. Far fewer schools – 22 out of 55 – owned DVD players. Other computer peripherals recorded in the possession of schools (with the number of schools in brackets) were: data projector (12), tape backup (6), ISDN modem (3), laptop PC (3), web cam (2), MP3 player (2).

Table 6: Computer hardware and peripherals

	Item	No of schools in posession[1]	Total number in schools	Ave per school
1	Workstation	55	1 252	22,8
2	Printer (mono)	47	153	3,3
3	Printer (colour)	42	75	1,8
4	CD-ROM drive	41	795	19,4
5	Server PC	40	65	1,6
6	Scanner	39	55	1,4
7	DVD player	22	53	2,4
8	Cable modem	18	53	2,9
9	Digital camera	17	22	1,3
10	CD writer	16	27	1,7

1. The total number of schools in the sample was 62. Therefore a small proportion did not provide data.

This data will be used in developing the cost model as follows. First, the data suggests that the most important items of equipment – other than workstations – that are affordable in most schools are: printers, CD-ROMs, server PCs and scanners. On the basis of this evidence, the cost model will incorporate these costs. Except for the workstations and CD-ROM drives (the cost of a CD-ROM is included in the cost of the standard workstation.), the cost model will include the cost of only one example of each of the first six items in Table 6. The total number of workstations costed will be based on the standard number of computers required per computer room in Botswana (20) and Seychelles (10), while for Namibia, the standard of 20 will be adopted.

Software: systems, productivity tools

The same procedure as above was used to generate a description of the kind of software most commonly owned in schools, and how many copies of each kind of software were owned per school.

Table 8 describes the software owned by schools in rank order. From this, we observe that the most commonly found software utilities in schools were: word-processing, spreadsheet, Operating System (OS), database, e-mail, browser and networking packages. Therefore, the costing will include the first eight items of software indicated in Table 7. Additional software in the possession of a minority of schools included: Multimedia authoring software (8) and Computer-Aided Design (CAD)/CAM) packages (4).

The data on the total number of licenses must be treated with some caution for a number of reasons. First, it is not clear from the data that respondents shared the same understanding of the concept of 'license'. Second, the top eight categories of software utility may be bundled together in one package and respondents did not always clearly indicate whether they obtained the software bundled or not. Third, there appears to be a mixed experience with respect to payment for software. Some schools used freeware, and others paid, and yet others may have been using software with only part or no payment.

Fourth, it was not possible to obtain data on software versions used by schools because of the need to limit the length of time taken to complete the instrument. This is important because software vendors do not charge license fees once their software ages beyond a particular cut-off point. For example Microsoft does not charge license fees for educational use of software more than two versions older than the current one.

Finally, we observe that large vendors are keen to negotiate with national Ministries of Education and are offering preferential pricing – even free provision – in order to build their own product market through young ICT users in schools. In none of the case study countries was such an arrangement evident. This does not therefore affect the approach to pricing the software used in this cost model, where the average cost of the key generic software packages identified as above is the preferred approach.

Table 7: Software

	Item	No of schools in possession[1]	Total number of licenses in schools	Ave no per school
1	Word processing	58	751	12,9
2	Spreadsheet	44	496	11,2
3	OS	42	614	14,6
4	Database	36	332	9,2
5	E-mail	33	150	4,5
6	Internet browser	30	233	7,7
7	Networking	27	203	7,5
8	Presentation package	25	196	7,8
9	Desktop publishing	22	84	3,8
10	Software on learning to programme	14	222	15,8

1. The total number of schools in the sample was 62. Therefore a small proportion did not provide data.

Curriculum and subject-specific software

The data on curriculum and subject-specific software owned by the schools revealed clearly that this is an underdeveloped area of procurement. Very low numbers of schools owned any software specific to curriculum and learning at all. Barely half of the schools own any subject-specific software and only about one-third of schools have self-learning tutorials, drill and practice and games software. Software owned in smaller numbers in schools included packages for: statistical analysis (9), constructing tests and examinations (6), accounting and financial (4), simulations (2), and modelling of mathematic functions (1).

It is particularly interesting that 41 schools reported that they own CD-ROM drives yet only 21 schools report owning a CD-ROM encyclopaedia. While CD-ROM drives may be used for other purposes than consulting encyclopaedias, this is an example of a situation where schools own IT equipment and where content is lacking. Or put differently, where IT equipment is underutilised, because procurement is not balanced on both the side of technical capability and on the side of content.

There is considerable debate concerning the usefulness of various forms of educational software. The disputed value of games software is an example. This chapter takes for granted the need for educational software and will capture the cost items 1 - 6 indicated in Table 8. What does make the costing difficult is that the small number of schools reporting the use of educational software may affect the accuracy of price allocation to each software form.

Table 8: Curriculum and subject-specific software

	Item	No of schools in possession[1]	Total number of licenses in schools	Ave no per school
1	Subject-specific software	28	194	6,9
2	Tutorial programmes for self-learning	21	139	6,6
3	Interactive multimedia encyclopaedia on CD-ROM	21	70	3,3
4	Drill and practice programmes	18	128	7,1
5	Recreational games	17	120	7,1
6	Software for creative activities (art and music)	10	38	3,8

1. The total number of schools in the sample was 62. Therefore a small proportion did not provide data.

Recurrent expenses and consumables

There is a range of recurrent costs associated with running a computer room. These include:

- Maintenance costs of the hardware, software and network systems.
- Various security and insurance costs.
- Software licensing and upgrading costs.
- Connectivity costs.
- Consumables.

It should be acknowledged that the extent of recurrent expenses would in almost all instances be determined by prior decisions. For example:

- Maintenance costs will be affected by the choice of technology.
- Insurance costs will be linked to value of the primary IT investment.
- Software licensing and upgrading will be determined by the choice of software packages, the number of licenses, and the amount of freeware/shareware used.
- Connectivity costs rise in relation to increased emphasis on Internet use in the classroom.
- Consumable costs are driven by the demand for reproducing learner products in hard copy or in removable media.

The various recurrent cost elements will be described below.

Maintenance costs

Maintenance costs are related to the type and age of the technologies used, the manufacturing quality and durability of the equipment components, and the conditions under which the equipment is used (eg. heat, dust, humidity, salt, handling). Table 9 shows that the proportion of computers that are not operational at a given time is roughly similar across the three countries. This rough measure suggests that any differences in maintenance costs incurred in each country should be ascribed to differences in service costs, and not to differences in the quality of the computer stock. It should be noted that replacement volumes are not necessarily

related to maintenance problems or even computer age, but also reflect the simple availability of finance or the political points that can be won through public allocations of modern ICT equipment to schools.

Table 9: Computers functioning and replaced in the last year (US$)

Country	No of schools	Computers owned	Computers functioning	%	No of schools reporting replace-ment	Replaced in the last year	Replacement as a % of owned
Botswana	29	783	665	84,9	18	73	9,3
Namibia	20	535	463	86,5	20	72	13,4
Seychelles	13	166	141	84,9	9	45	31,9
Total	62	1484	1269				

Replacement can be on account of wear and tear or of new generation brought in.

There are two components of maintenance costs, namely physical (eg. component, test facilities etc.) and human, the most prominent being the latter. The latter will be dealt with under 'Human Resource Costs'.

Table 10: Recurrent expenses: Software licensing and upgrading, maintenance and insurance costs per annum (US$)

Country	Maintenance costs	Insurance costs	Software licensing and upgrading
Botswana	1041	1979	171
Namibia	1116	834	208
Seychelles	4000	nil	570
Ave	2052	1407	316

Security and insurance

A range of social and political conditions, and real and perceived risks that prevail in the communities surrounding the school affects security and insurance costs. The problem with these costs is that they do not appear to materially affect ICT-based teaching and learning, and there is the temptation in schools where the budget is limited to forego these expenditures in the face of risk levels in order to obtain more or better equipment. The following aspects are noteworthy from the data:

Approximately one-quarter of all the computer rooms did not have an alarm system. In the Seychelles, only 2 out of 11 schools had an alarm. This information suggests that in the Seychelles, criminal attacks on computer facilities are currently not a major problem.

A significant number of schools – 44,8 per cent or 26 out of 58 schools – did not have the ICT equipment at the school insured. These cases were mostly in Namibia (10 out of 20) and Seychelles (11 out of 13). The risk of loss of equipment is balanced against the cost of purchasing insurance, which may be experienced as an added burden on the budgets for ICT provision in schools. This possibly explains why so few computer rooms in Namibia are insured. By contrast, the evidence suggests that the Botswana government pays for the ICT insurance needs of schools in that country.

Connectivity

The connectivity costs of schools in the three countries are summarised in Table 11, with reference to the main cost sources, which are call charges and ISP fees. ISDN line fees are included for the few schools that have opted for this higher bandwidth option. Apart from volume, connectivity costs are dependent on the state of the National Information Infrastructure in each country, and on whether the telecommunications services sector operates on a monopolistic or a market basis.

Table 11: Recurrent expenses: Internet connectivity costs per annum (US$)

Country	Call charges Telephone to ISP	Internet Service Provider fee	ISDN line fees
Botswana	2 484	864	100
Namibia	1 416	936	170
Seychelles	648	996	192
Ave	1 516	932	154

Consumables

The main categories of consumable are given in Table 12. These consist mainly of materials that enable the reproduction of student work in hard copy or in removable media for storage. As can be seen, Botswana schools incur the largest costs with respect to consumables.

Table 12: Consumable costs per annum (US$)

Country	Printer cartridges	CDs	Diskettes	Paper	Total
Botswana	1 353	20	456	1870	3 699
Namibia	414	1	38	120	573
Seychelles	770	5	8	135	918
Ave	846	9	167	708	1 730

Human resources

The three key roles that must be fulfilled in order to support the application of ICT at the school level are: maintenance of the IT system; administration and management of the computer room itself; and assistance for any teacher seeking to implement ICT in their teaching.

Technical maintenance

The cost of human expertise in the maintenance of school computer rooms is determined by where the source of maintenance services is located (eg. on the school campus or off the school campus), who the primary employer of the service provider is (eg. the school, the Ministry of Education, private service provider), the nature of the service agreement (formal or informal) and physical distance between client and service provider.

It is the exception rather than the rule where a school has full IT technical capability within its available human resources such as the school staff and the community. Also, a school IT system does not have the scale to require the services of a network administrator on a full-time basis. Therefore, there will invariably be shared responsibility between internal and external technical expertise.

The balance of responsibility will fall more heavily on the resources provided through the national Ministry of Education where the levels of expertise within the ranks of practicing teachers is relatively low. This is a particular challenge in economies where there are relatively low levels of household ownership of computers and even of the basic services that must sustain home computer use. This is the case with both Botswana where IT technical servicing of schools has been centrally provided. In the Seychelles there is also central provision of maintenance services, but there are important differences between the arrangements in these two countries. In the Seychelles, the Ministry of Education itself has developed its own capability to service schools technical needs. In the case of Botswana, the appointment of a service provider to schools was part of a decision undertaken at a government-wide level. In the latter case, the IT technical requirements have been entirely outsourced. Because the schools in Botswana and Seychelles are serviced externally, they could not provide information on costs of the service. For this reason, it was necessary to engage with ministry officials to generate reliable estimates.

By contrast, in Namibia neither central government, nor the Ministry of Education have undertaken a primary role with respect to maintenance. In that country there is significant reliance on the schools to ensure their own IT-technical sustainability. This is achieved in two main ways: through linkages with NGOs that specialise in ICT and education, and through negotiating service contracts with private IT service providers. Even here, obtaining estimates of the value of IT support is not easy, especially if an external NGO provider fulfils the schools needs.

The pattern of maintenance provision is complex and affected by local and sometimes informal arrangements. In answer to whether the school has a service agreement with a private service provider, most of the Botswana schools answered ‘Yes’, because there is a service agreement negotiated by government for the entire government service and hence also for the Ministry of Education and its schools. Most of the Seychelles schools answered ‘No’ because the Ministry of Education itself provides such a service. Only 6 out of 16 Namibian schools indicated that they have a service agreement. Similarly, it was Namibia where the existence of an onsite technician in the schools was recorded in four schools. In these cases, the on-site technician may well be an NGO-funded resource rather than a resource paid for by the school. Only five schools in the entire sample claim to have an on-site computer technician (5 out of 61). Four of these are in Namibia and one in Botswana, though it appears that all of these persons are only available on a part-time basis. Of interest is that only Namibia had persons helping in the computer rooms who were either parents or from the local community.

Finally, even where a staff member provides maintenance internal to the school, such work cannot easily be estimated. This is because staff members invariably are not working

full time in the computer room, they frequently do maintenance work on an ad-hoc basis on request between other duties and find it difficult to estimate their time allocation to their maintenance responsibilities.

Administration and management of the computer room

In addition to the technical needs of the computer centre, there are also significant management and administrative duties. We must not underestimate the importance of tasks related to administration that can ensure the sustainability, and maximise the utility of the computer room. Table 14 shows that a member of the school teaching staff usually undertakes management of the computer facility. Only 5 out of 62 schools had a person working as an administrator of the laboratory who was not a teacher.

Support of teachers who wish to apply ICT across the curriculum

The provision of support to teachers who seek to apply ICT in their teaching and learning processes is a priority in the policy of all three countries participating in the study.

We have noted the three key roles – technical support, pedagogical support and management in the computer room – that must be fulfilled in order to support the application of ICT at the school level. Implicit in these three roles are quite distinct skills and capacities that might in ideal circumstances be attended to by three different people. In practice however, these roles are – with notable exceptions – commonly allocated to a single member of the teaching staff, who may have some assistance from other teachers. In the absence of more complex data describing how this work is undertaken, the cost model will be based on the time costs of a single teacher in the school.

It should be noted that apart from differences in their salary, the next biggest factor affecting human resources costs is what portion of their time teachers are officially entitled to give to their role in supporting the computer system, managing the computer room and providing support to teachers. In the example of this survey, the major difference is that in the Seychelles, the computer teacher is allocated 100 per cent of her time to fulfil these functions. In contrast, her counterpart in Namibia would only be able to allocate a portion of her time. Two important observations are relevant here. First, even if teachers are entitled to allocate only a portion of their time to their computer room responsibilities, they frequently spend far more than the officially recorded allocation. Second, where a teacher is not given a full-time post as computer teacher, the amount of time she will effectively be able to give to this role is frequently the outcome of negotiation with the principal of the school. The outcome of this negotiation may vary, depending on the orientation of the principal.

Table 13: Value of teacher time allocated to ICT roles per year

Country	Teacher M+4 scale	Bisect	Convert annual salary to US$	Divide annual salary by % of time allocated to IT role in school	% of teacher time allocated to IT role
	Local currency[1]				
Botswana	**nd**	**nd**	**nd**	**nd**	**nd**
Namibia	75357 to 86322	80839	10924	2184	@20%
Seychelles	60 000R to 66000R	63000	12115	12115	@100%

Botswana currency - Botswana Pula; Namibia currency – Namibia Dollar; Seychelles currency – Seychelles Rupee

This default or 'all in one' model which requires an individual to take on a multiskilled role, may initially present a simple solution to meeting school ICT needs. But there are some disadvantages. First, this model will suffice in the initial stages of implementing ICT, but as soon as the facility expands and demand from teachers and students grow, it will become unmanageable by only one person. Second, vesting training resources in a single person risks discontinuity should that person leave the school? Third, the computer room becomes too dependent on a single person whose temporary unavailability even can cripple ICT-based activity in the school.

Training

The range of skills required to sustain a computer room in a school cover administration, technical IT aspects, and introducing teachers to the use of ICT in their daily teaching practice. Training courses focused on these core fields were provided in the schools that were surveyed. From Table 14 it is clear that there is some variation across each role, and between the three countries in the intensity with which training is provided. Furthermore, the methodology did not provide for any investigation of the quality and 'dosage' of the training programmes.

Table 14: Number of schools indicating that staff had received training in the past year

Training for	Country			Total responses to question
	Botswana	Namibia	Seychelles[1]	
Assisting teachers to use ICT in their teaching	19	8	9	59
Technical skills with ICT equipment	10	1	-	42
Administration skills in computer room	17	4	8	55
Number of schools in sample	28	20	12	-

1. In the Seychelles there is a move away from laboratory technicians for use in computer rooms. Technicians will only work in the science laboratory.

The focus of training is informed by government prioritisation of skills in the roll out of skills training. Circumstantial evidence from Botswana and Seychelles suggests strongly that the primary current skills focus is technical. The next priority is in preparing ICT teachers to teach 'computer studies' as a subject. Training to support other teachers in using ICT follows this. Training of teachers with respect to how to manage the facility does not feature strongly.

What is not measured in the survey instrument is the cost of training for principals in their support role as supervisory managers who can powerfully influence the pace with which ICT can be brought into everyday teaching and learning practises.

Respondents did not provide sufficient detail in the returns to enable detailed analysis of the type, frequency and duration of training. This is a difficult aspect to obtain accurate data on since there are multiple sources of training with attendant difficulties in devising a means of equating courseware.

To add to the difficulties with data collection, simplistic comparison of training data must be avoided. This is because the measure of training used cannot reveal differences in the training approach across the different countries. In addition, training costs are affected by prior experience of the trainees, their skills levels, and the 'dosage' of training. Lastly, not only are the skill requirements in this field wide ranging – they are potentially deep. Take for example: the field of technical expertise (which includes inter alia: maintenance, network management etc.) or the field of teacher support in integrating ICT into the curriculum (which cuts different disciplines and fields) or the field of computer room management to maximise access. Each area of expertise is extremely complex and demanding. The training estimates presented here cannot capture such levels of qualitative detail. Nor can the value/cost of generating a cohort of teachers with high levels of competence in the fields named be estimated.

What is interesting to note about training activities provided to the ICT teachers in Namibia and in the Seychelles, is that in both instances, government is partly dependent on proprietary training programmes, in particular the A+ (MOUS) and related courses offered by Microsoft. Another internationally accredited course considered by practitioners in Namibia is the ICDL (International Computer Drivers License). Both of these courses are relatively expensive, especially in the full-time version, and governments which take recourse to these training services also have to account for travel, accommodation and other expenses. In Namibia, there were much less costly courseware alternatives on offer by local NGOs, so there is a modicum of choice in that country. The main lesson here is that in all three of the countries, the level of capacity in the national Ministry of Education to provide training courses adapted to local school conditions was not well developed.

Use of the facility

The aims of this costing exercise are first, to consider the cost dimensions associated with implementation of ICT in schools so as to assist in the formulation of policy on roll out of ICT. The second is to provide an analysis which can assist policy makers in formulating policy that will maximise the effectiveness of government investments. In this second instance, it is important to draw attention to key aspects that do not affect cost directly, but which directly influence cost-effectiveness. This latter dimension would be absent from consideration if this survey focused only on a narrow definition of what is 'cost'.

The cost model will provide estimates of total annual cost per country or per facility. These indicators must also be interrogated with reference to actual usage of the facility measured per unit of time (/day or /hour) or per beneficiary/learner. Especially in poorer countries the pressure increases to maximise the use of facilities, such as through extending access time in the scheduled school day to school pupils or extending hours after school to generate access to the community around the school.

It is clear that schools in this survey do not use their computer room near its capacity. There are two issues at stake here. First, whether schools use the computer room for activities other than those for which it is intended and second, whether schools leave the computer room idle for significant time periods. Across the three countries, 11 out of 62 schools, or 17,7 per cent, indicated that the computer room was not used exclusively for computer activities. This raises the issue of conflicting curriculum needs for learning spaces in the school. The conversion of an ordinary classroom for computer purposes can add to stress on usage of other classrooms in the school. The use of the computer room for ordinary non-computer related activities is understandable from the perspective of space shortages, but does not provide for effective use of the computer facilities.

Half of the sample of schools revealed that the use of the computer room was restricted to timetable school hours only. In the case of the Seychelles, only 69 per cent of schools extended computer use beyond timetabled school hours followed by 48 per cent in Botswana and 40 per cent in Namibia. The extent of use of the computer room after school hours will be affected by the time it takes for learners to move between school and home which affects learners in countries where the population is sparsely distributed over a wide area.

There are relatively low levels of community access to school computer rooms. Across the three countries, only 13 out of the 62 schools, or 20,9 per cent, indicated that the computer room was made available to external users which included teachers from other schools, members of the community and government servants such as the police and nurses. Included in this group are four Seychelles schools which by arrangement with the national Adult Learning and Distance Education Centre (ALDEC) make their computer facility available for adult education. However, this activity is managed by ALDEC. All the schools do is donate the facility, and this sharing cannot be said to be a school-based community access imitative.

School-level initiatives

In this section we look beyond effective school and community use of computer facilities to the community's involvement in the financial management and support of the computer classroom. In other words we move from looking at community access to whether the community seizes the responsibility associated with ownership.

We have shown that in the case of both Botswana and Seychelles, the Ministries of Education have undertaken to comprehensively fund and supply schools at the secondary school level. Communities could interpret such massive commitment as a sign that government will continue to provide so generously and that their role is nullified. This would

be an inappropriate assumption because it is too early to tell whether such government programmes are sustainable – however laudable. Under such circumstances, there is good reason to create policy that will facilitate school and community involvement which can have two beneficial effects: first, to raise the sense of community ownership over the facility, and second, to clear the way for communities to raise additional finances should they feel this was worthwhile or achievable.

Community involvement is possible in the procurement process, though not necessarily of high value items that can best be acquired via central or regional government. Procurement processes affect all categories of cost that have been identified for the purposes of this chapter. Yet, there is no strong evidence among schools in this survey of coherent school initiated procurement strategies in order to reduce costs. In all three countries, the responses of schools suggest that there is as yet no clear understanding at the school level regarding what they are entitled to procure, from whom and by what procedure. Furthermore, there is a low tendency for schools to collaboratively engage in bulk buying to save money. Only 11 out of 52 schools (21,2 per cent) indicated that they resort to this strategy.

There is strong contestation around the political and economic implications of policies that provide for so-called 'cost sharing' in education. In Botswana and Seychelles, evidence of learners paying extra funds for use of the computer room appears to be extremely low, while in Namibia, more than half of the schools or 11 out of 20 indicated that students pay fees in. A relatively low proportion of governing bodies in the schools, 17 out of 59 (34 per cent), raise additional moneys for computer costs. And only in Namibia is this group in the majority of 11 out of 20. Some exploration of these policies may be useful, not as a mechanism to transfer responsibility to the community, but to make it possible for contributions to be made, where resources are available.

Methodology

Data

The data discussed were obtained by means of a survey of schools in each participating country. For this purpose, a survey instrument was developed. The instrument was based on key cost categories that were identified from the literature. These main categories were then expanded upon in a workshop attended by researchers from each country. The instrument was intended to obtain a complete audit of ICT hardware, software, and human resources in the school, and also to capture all the recurrent costs in goods (eg. consumables) in services (eg. computer repairs, network maintenance etc.) and in other human resources costs such as training. The purpose was to use the data to establish costs of ICT in schools in each participating country. The instrument included 117 questions based on the following set of themes:

a) Basic information on the school.

b) Services to the school (electricity, telephone, Internet service provision).

c) The computer room.
d) Number of computers for learning and teaching.
e) Functioning of equipment.
f) Location of equipment (other than in the computer room).
g) Hardware and peripherals (number and cost per item).
h) Networked computers.
i) Computer performance (Processor speed and RAM).
j) Basic systems software.
k) Subject-specific software.
l) Procurement practices.
m) Replacement policy.
n) Insurance.
o) Consumables.
p) Support services (technical, administration, training).
q) Financial support and fundraising.
r) Community use of the computer room.

Sample of schools

On account of time and budget constraints, the intention was to take a sample of schools within each country. In order to limit costs, schools were not approached randomly. It was established in advance which schools:

- Had a computer room.
- Used computers for teaching and learning.

The schools with the above characteristics were selected in Namibia, where fortunately a reasonable spread of urban and rural schools was obtained. In the case of the Seychelles, the entire population of secondary schools in that country's school system was captured. In the case of Botswana the sample was restricted to within a reasonable travelling distance of the capital city. What this meant in the case of Botswana was that certain cost data would be representative of urban rather than rural school ICT-cost profiles. Thus, for schools sited at a distance of greater than 50km of the capital city, certain cost categories would present an underestimate.

The sampling instructions to fieldworkers were to obtain a balance of the primary and secondary schools as well as public and private schools: proportionate to the occurrence of these school types (with computers) in the national school system. The original intention was to include up to a maximum of four cases of a computer centre for school age learners which is not located in a school, and is operated and/or funded by a donor or NGO. It was intended that the sites selected should not be private for profit computer education establishments. But in the process of fieldwork administration, it was decided not to survey private or NGO

established computer rooms/computer centres/telecentres in order to maximise the number of public schools included in the sample.

Table 15 describes the sample obtained for this study. As can be seen, there are a low number of primary schools included from Botswana and Seychelles in the sample. This is simply reflective of the low numbers of primary level schools in those countries with a computer room. Both Botswana and Seychelles have supplied a computer room in every school offering post-primary education, but both countries still face the future challenge of putting a computer room in every primary school. The few primary schools in Botswana and Seychelles that do have computer rooms, own these facilities because they are specifically established for pilot purposes, or owe their existence to school community initiatives.

By contrast, there is a greater balance in the distribution of computer rooms in primary and secondary schools in Namibia. This is partly because the Namibia government, though supportive of ICT in schools, has not yet made the strategic decision that all schools in a particular phase or grade range must provide learners with access to ICT. Also, national conditions have been conducive to the evolution of school-based and NGO-based initiatives to set up, facilitate and operate computer facilities in schools in that country. Our observation is that there is significantly greater NGO activity in the field of ICT education in Namibia than in Botswana and Seychelles. NGOs may be influenced by government curricula but will tend to support ICT in schools in terms of their own programmes and objectives. The existence of ICT education-based NGOs across the school spectrum in Namibia partly explains why there is a balance of primary and secondary schools in the sample for that country.

Table 15: Sample of schools

School type	Country			Total
	Botswana	Namibia	Seychelles[1]	
Primary	1	9	1	11
Middle/junior secondary	19	2	-	21
Senior secondary	9	9	12[2]	30
Total	29	20	13	62

1. A post-school group of seven institutions was surveyed as part of this study. However, this post-school group is excluded from this analysis which focuses only on school level ICT provision.
2. The 12 schools surveyed in this study represent the entire population of public secondary schools and two private schools.

Given that the numbers of schools within each of the different levels (primary, middle and secondary) are not consistent across each country, and also because there were very low numbers of accessible primary schools with computer rooms in Botswana and Seychelles, it was decided to collapse school types together by country. International evidence suggests that there are some differences between public primary and secondary schools in terms of ICT provisioning and funding. But this dimension cannot be pursued because the emphasis in the three countries under investigation is mainly on junior and senior secondary school rather than primary school provision. The main dimension of analysis is therefore between schools – of any level – which have a computer room(s) in the three countries. This is based on the assumption that between country differences in the shape and cost of computer rooms will be greater than within country differences.

The 62 returns were captured spot checked for accuracy of capture, and cleaned. The data was loaded into SPSS and queried in SPSS.

Data analysis

The key categories for the cost analysis are given in the text box below. Almost every category is broken down further in Table 16.

Cost model: Main cost categories

1	Building – classroom
2	Hardware and peripherals
3	Software
4	Educational and subject-specific software
5	Recurrent
6	Internet connectivity (recurrent)
7	Consumables
8	Human resources
9	Personnel training and professional development
10	Installation
11	MoE management and administration

As has been indicated, the aim of this part of the study on the ICT curriculum in schools is to consider the costs associated with putting in place appropriate infrastructure to support the curriculum. In all tables in this report, references to computers refer only to computers used for teaching and learning purposes. Computers used for the purpose of school administration were excluded from this analysis, on the basis of the focus of this study on curriculum applications of ICT.

A key question was what costs to include when calculating expenditure on ICT in school computer rooms. For example: not all schools will have obtained a digital camera. The value of a digital camera in collecting evidence/information for classes across the curriculum from biology to history is undisputed, but a school may decide that it would rather obtain a scanner for the transfer of analogue printed data to digital data. Alternatively that school may not be able to afford a digital camera.

The aim was therefore to establish what software, hardware and peripherals are to be found in school computer rooms. Only those items most commonly found in the computer rooms of the three participating countries were included in the cost analysis. The cost model was built using the average in-country cost for each item.

On the basis of the results obtained from the survey, it was possible to populate a table (Table 16) to compare costs across the three countries. However, there were: (a) some missing cost values, and (b) a some values that required confirmation or explanation where they appeared to be 'outlier' amounts that were disproportionately large or small by comparison with the other data. In the latter case, these outliers were checked with members of the research team in each country to ensure as high levels of accuracy as possible.

There was some missing data because some of the costs associated with the implementation of ICT in schools were not incurred at the school level but rather at the level

of the Ministry of Education. For example, both the Botswana and Seychelles Ministries of Education arrange technical support for schools so that at the school level, these costs were not known. The costs at this level had to be obtained through further interaction with the ministries concerned.

Table 16: Description of annual computer costs in Us$, 2003

	Category	Second-level description	Botswana	Namibia	Seychelles
1	Building[1]	Build from scratch	7 241	3 342	5 790
2	Hardware and peripherals[2]	Workstations, peripherals, network and Internet facilities	11 384	7 602	15 742
3	Software[3]	Systems software and applications	443	275	761
4	Curriculum and subject specific software[4]	Subject-specific software	1 570	2 473	1 522
5	Recurrent	Software licensing and upgrading	171	208	570
		Maintenance	1 041	1 116	4 000
		Insurance	1 979	834	0
6	Internet connectivity (recurrent)	Leased Line rental/ ISDN line rental	100	170	192
		Internet Service Provider fees	864	936	996
		Call charges	2 484	1 416	648
7	Consumables		3 719	573	963
	School-level costs		31 176	18 945	31 184
8	Human resources	Computer technician, user support, and computer room manager	n.d.	2184	12 115
9	Personnel training and professional development[5]	Technical support training, computer room manager	n.d.	314	238
10	MoE management and administration	Planning and administration costs	n.d.	754	2 473
	MoE-level costs		n.d.	3252	14 826
	Total annual costs			22 197	46 010
	Average no of learners per school		873	842	594
	Annual cost per learner		n.d.	**26,36**	**77,46**

1 Annualised over 20 years
2 Annualised over 4 years
3 Annualised over 4 years
4 Annualised over 4 years
5 Annualised over 3 years

As can be seen, in Table 16 and in Table 17, the annual cost of computers per school in Namibia is half that of the Seychelles. Unfortunately, data was not available from the Botswana Ministry of Education on the costs at that level.

It is clear that expenditure on computers is higher in the Seychelles than Namibia at the school level and the central ministry level. The difference is marked at the central MoE level. This is an indication of the extent to which the Seychelles MoE has committed itself to ICT as an important element in its strategy. The greater overall share of costs is borne at the school level in Namibia, which suggests that in that country, government depends on school communities and NGOs to sustain computer activity at schools.

The shape of expenditure in Namibia is consistent with a country which is in the process of developing policy but where the MoE does not yet have the budget to underwrite the expansion of computers into schools on a large scale. This is not accidental, the Namibia education system consists of 1 545 schools, while Seychelles system consists of about 50.

It is interesting to observe that in the case of both Botswana and the Seychelles where investment in computer infrastructure in schools is driven by government, the average expenditure on schools is 50 per cent more than the expenditure in Namibia where support for such expenditure comes from NGOs and the community. A key question is whether some form of NGO model of provision, with the support of government, as in Namibia, would provide the equivalent quality of computer facilities and opportunities for learning as a programme (almost) entirely driven by government finances.

The comparison also shows that in Seychelles schools, the expenditure on computers is three times that of Namibian expenditure per learner and four times that of Namibian expenditure per computer.

Table 17: Annual computer cost indicators in US$, 2003

Category	Second-level description	Botswana	Namibia	Seychelles
School-level costs		31 176	18 945	31 184
Central MoE costs		n.d.	3 252	14 826
Total annual costs per school		**n.d.**	**22 197**	**46 010**
Annual cost per learner	Average no of learners per school	873	842	594
		n.d.	**26,36**	**77,46**
Annual cost per computer	Average no of computers per school	29	27	13
		n.d.	**822**	**3 539**

It is difficult to find other studies based in the Africa region that provide data on computer costs. However, comparison with data from Egypt, Zimbabwe and South Africa provides some insight into the level of commitment to computer expenditure in Namibia and Seychelles. First, it is clear that expenditure on computers in Egypt in 1998 was already on parity with that of Seychelles in 2003 – leaving aside the effects of inflation. This shows that in the Africa region, there are examples of schools in countries where expenditure on ICT was substantial before the millennium.

Although the data from Zimbabwe and South Africa is based on a few case studies, comparison with Namibia suggests that the expenditure pattern on computers in schools in that country are roughly comparable.

However, it is crucial to point out that the computer cost data provided in any study is relative to whether this data is based on schools in a country where the MoE has elected to provide computers to all schools of a particular grade range, or whether the computer cost data is based on the 'decentralised' development of computer infrastructure as a consequence of private and NGO initiatives.

In the end, it will become important to understand how computer costing changes as countries move from dependence on higher levels of input from the community and NGO sector towards concerted government driven budgeting and roll out of computer infrastructure and support.

Table 18: Comparative computer cost in US$

Category	Egypt[1]	Zimbabwe[2]	South Africa[3]	Namibia	Seychelles
	1998	2000	2000	2003	2003
Total annual costs per school	45 045	1 794 – 9 655	19 270	22 197	46 010
Annual cost per learner	75	31 - 13	48	26,36	77,46
Annual cost per computer	2 048	359 - 483	714	822	3 539

1 Bakia (2002) 63

2 & 3 Cawthera (2001)17, 21, 36. Data from Zimbabwe is from two schools, and from one rural high school in South Africa.

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Appendix 1: Hardware and peripherals

Item	No of schools in possession[1]	Total number in schools	Ave no per school	Average cost in US$[2]		
				Botswana	Namibia	Seychelles
Workstation	**55**	**1 252**	**22,7**	**(1 549) 30 980[3]**	**(1 092) 21 840[4]**	**(3 061) 30 610[5]**
Printer (mono)	47	153	3,3	383	385	1 110
Printer (colour)	42	75	1,8	381	516	2 000
CD-ROM drive	41	795	19,4	417	81	167
Server PC	40	65	1,6	4 271	1 261	16 000(?)
Scanner	39	55	1,4	363	600	405
DVD player	22	53	2,4	458	189	681
Cable modem	18	53	2,9	151	104	750
TOTAL				37 404	24 976	51 723
Annualised				11 384	7 602	15 742

1 The total number of schools in the sample was 62. Therefore a small proportion did not provide data

2 The average cost per country was given in US$ in Seychelles. In Botswana, an exchange rate of BWP 4,8 to 1US$, and of NAD 7,4 to 1US$ was used.

3 Calculated on 20 workstations

4 Calculated on 20 workstations

5 Calculated on 10 workstations

Other computer peripherals recorded in the possession of schools were: video projector (12), tape backup (6), ISDN modem (3), laptop PC (3), web cam (2), MP3 player (2).

Appendix 2: Software

Item	No of schools in possession[1]	Total number of licenses in schools	Ave no per school	Average cost in US$[2]		
				Botswana	Namibia	Seychelles
Word processing	58	751	12,9	276	75	900
Spreadsheet	44	496	11,2	188	57	(900)
OS	42	614	14,6	188	517	(900)
Database	36	332	9,2	302	128	1 600
E-mail	33	150	4,5	302	-	-
Internet browser	30	233	7,7	302	-	-
Networking	27	203	7,5	-	-	-
Presentation package	25	196	7,8	198	128	(900)
TOTAL				1 454	905	2 500[3]
Annualised				443	275	761

1 The total number of schools in the sample was 62. Therefore a small proportion did not provide data

2 The average cost per country was given in US$ in Seychelles. In Botswana, an exchange rate of BWP 4,8 to 1US$, and of NAD 7,4 to 1US$ was used.

3 The average price cited by respondents from Seychelles was US$900, which is taken to be the cost of bundled software. Therefore, the TOTAL for the Seychelles takes the $900 cost only once.

4 The average cost given is relative to the average number of units in the school.

Additional software in the possession of a minority of schools included: Desktop publishing software (22), software for learning programming skills (14), multimedia authoring software (8) and Computer Aided Design (CAD)/CAM) packages (4).

Appendix 3: Curriculum and subject-specific software

Item	Number of schools in possession[1]	Total number of licenses in schools	Average number per school	Average cost in US$[2]		
				Botswana	Namibia	Seychelles
Subject-specific software	28	194	6,9	68	76	300
Tutorial programmes for self-learning	21	139	6,6	74	-	-
Multimedia encyclopaedia on CD-ROM	21	70	3,3		78	200
Drill and practice programmes	18	128	7,1	56	-	-
Recreational games	17	120	7,1	60	-	-
Software for creative activities (art and music)	10	38	3,8	-	238	-
Subtotal per single license				258	392	500
Cost of licenses per school				5 160[3]	7 840[4]	5 000[5]
Annualised				1 570	2 473	1 522

1 The total number of schools in the sample was 62. Therefore a small proportion did not provide data

2 The average cost per country was converted from national currency. In Botswana, an exchange rate of BWP 4,8 to 1US$, in Namibia of NAD 7,4 to 1US$ and in Seychelles SR 5,2 to 1US$ was used

3 Calculated on 20 workstations

4 Calculated on 20 workstations

5 Calculated on 10 workstations

Software in smaller numbers in schools included packages for: statistical analysis (9), constructing tests and examinations (6), accounting and financial (4) simulations (2), modelling of mathematic functions (1).