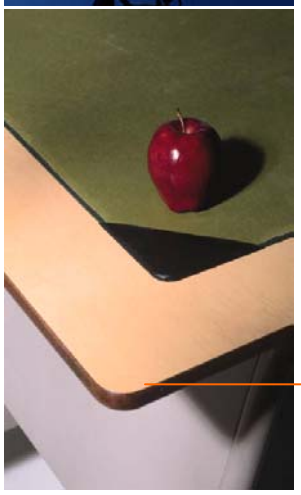


OECS EDUCATION REFORM UNIT
EASTERN CARIBBEAN EDUCATION REFORM PROJECT (ECERP)

INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) LEARNING OUTCOMES

IN MATHEMATICS AND LANGUAGE ARTS FOR LOWER SECONDARY SCHOOL STUDENTS OF THE EASTERN CARIBBEAN

June 2002

Information and Communication Technology (ICT) Learning Outcomes

In Mathematics and Language Arts for Lower Secondary School Students in the Eastern Caribbean

Prepared by

Stephen L. Boyce, B.Sc. M.Phil.
Education Consultant

Edited by

Mark Ernest, BSc (Hons), MSc (MIS)
Information Specialist, OERU

OECS Education Reform Unit
Eastern Caribbean Education Reform Project (ECERP)
2002

Information and Communication Technology (ICT) Learning Outcomes In Mathematics and Language Arts

For Lower Secondary School Students in the Eastern Caribbean

Prepared by Stephen L. Boyce

Information and Communication Technology (ICT) Learning Outcomes in Mathematics and English Language For Lower Secondary School Students in the Eastern Caribbean

Some graphics reproduced from: UNESCO/IFIP Curriculum – Information and Communication Technology in Secondary Education (http://wwwedu.ge.ch/cptic/prospective/projets/unesco/en/ict.html)

1. Introduction

Information and Communication Technology (ICT) permeates the business environment and underpins the success of modern corporations while providing governments with cost efficient civil service systems. At the same time, the tools and techniques of ICT are of value in the processes of learning, and in the organisation and management of learning institutions.[1]

For countries to be able to benefit from these technological developments they must equip both teachers and students with the ICT knowledge, skills and tools to become competitive in an increasingly global work place.

Indeed, technological developments lead to changes in work and changes in the organisation of work. Therefore required competencies are changing. Gaining in importance are the following competencies:

- inductive thinking;
- generalist (broad) competencies;
- ICT competencies enabling expert work;
- decision making;
- handling of dynamic situations;
- teamwork competencies;
- communication competencies.

ICT skills must therefore be allied with effective literacy and numeracy skills, as well as higher order skills, so as to mould citizens for life in the 21st Century.

1.1 Rationale for the Development of ICT Learning Outcomes in the OECS

The OECS Education Reform Unit (OERU), in pursuit of achieving Strategy #19 of Pillars for Partnership and Progress, is developing ICT learning outcomes for primary and lower secondary schools in the sub-region.

[1] Extracted from: UNESCO/IFIP Curriculum – Information and Communication Technology in Secondary Education (http://wwwedu.ge.ch/cptic/prospective/projets/unesco/en/ict.html)

Several member states have begun some form of ICT intervention in their education systems. The attempt by the OERU to develop learning outcomes in ICT for the school system is primarily to ensure that these interventions are done effectively and in a harmonised manner throughout the sub-region.

This document sets out guidelines for the development of Information and Communication Technology capability for students aged 11-14 in the lower forms of secondary schools in the Eastern Caribbean. It also complements the ICT Course Manual for Teachers developed by the Unit, which is expected to guide teacher-preparedness efforts for integration of ICT in the Classroom.

The proposed strategy is based on existing good practice, but also takes into account local initiatives and national development agendas. They set out a progression of knowledge, skills and attitudes in ICT as students progress through the first three years of secondary school.

The OERU believes that the integration/infusion of technology into the curriculum is the "way to go". The strategy is therefore designed to provide a framework for the integration of ICT into the existing core curriculum of schools rather than being implemented as a separate subject. As such, it is expected that students will become skilled, confident and informed users and also gain the maximum benefit in using ICT in other curricular areas.

Acknowledgements

The ICT Learning Outcomes in Mathematics and Language Arts for Lower Secondary School Students were presented at a Workshop held in Grenada from 18-20 March 2002. The following individuals made valuable contributions in the refinement of the outcomes and production of the final document.

Country/Organization	Names	Title
Dominica	Conder Romain	Education Officer
St. Kitts and Nevis	Joan Mills-Ible	Graduate Teacher
	Dawn Jeffers	Graduate Teacher
St. Lucia	Cathy Augier-Gill	Curriculum Officer, IT
	Joseph Serieux	Curriculum Officer, Mathematics
St. Vincent & the Grenadines	Chester James	Deputy Education Planner
Anguilla	Marville Richardson	Teacher
Montserrat	Kathleen Greenaway	Principal
British Virgin Islands	Beverlie Brathwaite	Education Officer, IT
	Prudence Mathavious	Education Officer, Language Arts
Antigua and Barbuda	Caron Weston	Mathematics Coordinator
Grenada	Denis Bell	Senior Education Officer
	Leo Cato	Education Officer, IT
	Andrea Philip	Curriculum Development Officer
	Carol Antoine	Curriculum Development Officer
OERU	Mark Ernest	Information Specialist
	Henry Hinds	Curriculum Specialist
	Suzette Merille	Administrative Assistant

2. Developing Learning Outcomes

2.1 Defining Learning Outcomes

Learning outcomes are broad goals that describe *what students are supposed to know or be able to do as a result of a learning activity*. Outcomes are usually expressed as knowledge, skills, or attitudes and should be based on the educational needs of the student and the society. An educational need is something individuals should learn for their own good, for the good of their organization or profession, or for the good of society. A need represents a gap between an individual's current level and some desired level of knowledge, skills, or attitudes.[2]

Because learning outcomes are broad goals, they are stated in general terms. For example, "The student will become familiar with the major forms and conventions of Caribbean literature" or "The student will develop a general understanding of computer terminology" are both reasonable learning outcomes. On their own, however, learning outcomes like these cannot be observed, measured, or evaluated. Each learning outcome, therefore, must be supported and defined by one or more specific objectives.[3]

2.2 Why Learning Outcomes?

Learning outcomes help teachers more precisely to tell students what is expected of them. By doing this, educators assert that they: [4]

- help students learn more effectively;
- make it clear what students can hope to gain from following a particular course or lecture;
- help teachers to design their materials more effectively by acting as a template for them;
- help teachers select the appropriate teaching strategy, for example lecture, seminar, student self-paced, or laboratory class;

[2] Writing Learning Outcomes. http://www.aallnet.org/prodev/outcomes.asp
[3] The Learning Management Corporation. 2000. Developing Outcomes and Objectives. http://www.thelearningmanager.com
[4] NCGIA GISCC Learning Outcomes. 1996.http://www.ncgia.ucsb.edu/education/curricula/giscc/units/format/outcomes.html

- help teachers more precisely to tell their colleagues what a particular activity is designed to achieve;
- assist in setting examinations based on the materials delivered;
- ensure that appropriate assessment strategies are employed.

2.3 What are the Characteristics of Good Learning Outcomes?

Learning outcomes have three distinguishing characteristics.

- The specified action by the students must be observable.
- The specified action by the students must be measurable.
- The specified action must be done by the students.

The ultimate test when writing a learning outcome is whether or not the action taken by the participants can be assessed. If not, the outcome probably does not meet all three of the characteristics.

2.4 Learning Outcomes and the Educational Process

The development of learning outcomes should not be considered in isolation from other educational activities such as course design and evaluation. Moseley *et al.* (1999) have developed a model that demonstrates the relationship between learning outcomes, teaching and learning. This is illustrated in Figure 2.1. A key assumption of the model is that learning outcomes are directly influenced by the actions and behaviours of the teacher and the students in a particular context. In other words, what a teacher does in a classroom and the way the students react to these actions or behaviours influence what they learn.[5]

A more simplified model suggests that learning outcomes may also be visualised as having four interrelated activities, as summarised in Figure 2.2.[6]

This latter model suggests that appropriate learning outcomes allow students to:

- **Learn Actively -** Learning is a personal, interactive achievement that results in greater expertise and a more comprehensive understanding of the world.
    - Develop expertise, broaden perspectives and deepen understanding of the world by seeking information and engaging in meaningful practice;
    - Construct meaning from expanding and conflicting information;

[5] Moseley, D. et. Al. 1999. Ways forward with ICT: Effective Pedagogy using Information and Communication Technology for Literacy and Numeracy in Primary Schools.
6 http://www.cascadia.ctc.edu/teaching_and_learning/diagram.htm

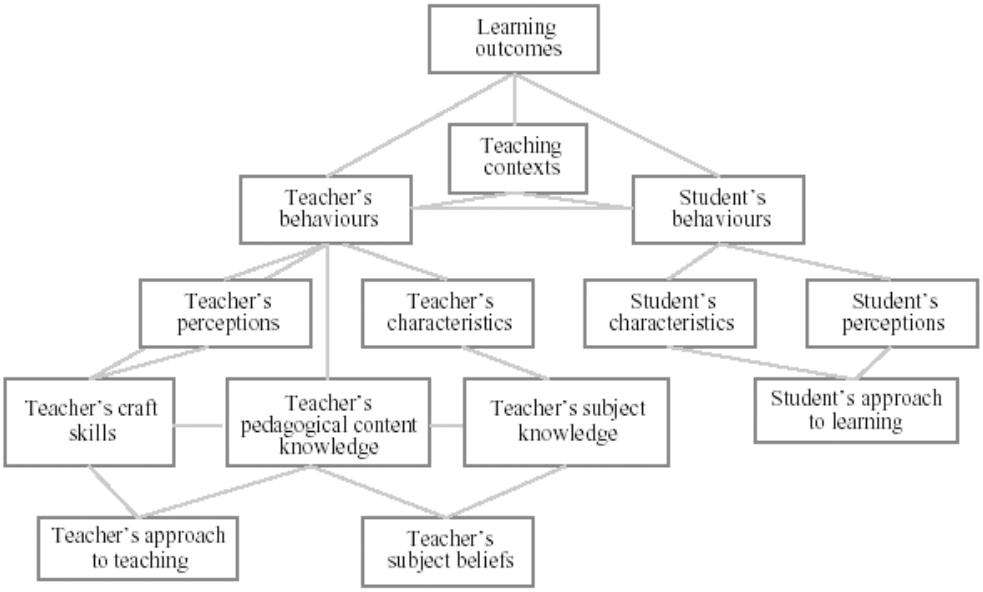


Figure 2.1 An Interactive Model of Teaching and Learning
(Moseley, D. et. Al. 1999. Ways forward with ICT: Effective Pedagogy using Information and Communication Technology for Literacy and Numeracy in Primary Schools.)

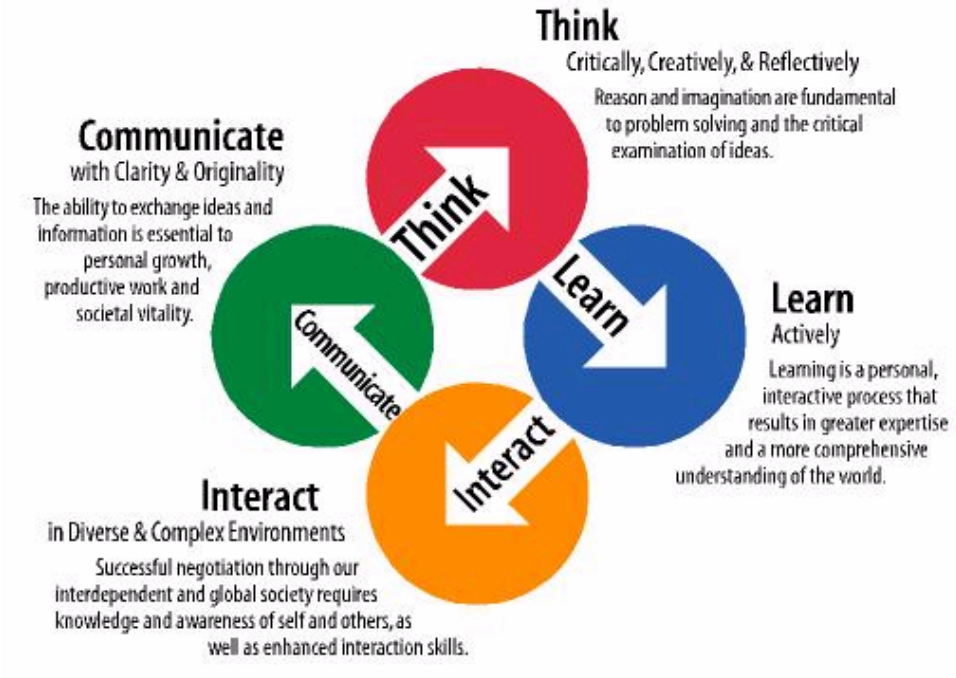


Figure 2.2 Learning Outcomes Diagram.
(http://www.cascadia.ctc.edu/teaching_and_learning/diagram.htm)

  - Engage in learning, both individually and with others, through reading, listening, observing and doing;
  - Take responsibility for learning.

- **Think Critically, Creatively and Reflectively -** Reason and imagination are fundamental to problem solving and critical examination of self and others.
  - Create, integrate and evaluate ideas across a range of contexts, cultures and areas of knowledge;
  - Recognise and solve problems using creativity, analysis and intuition;
  - Examine one's attitudes, values and assumptions, and reflect on their implications and consequences.

- **Communicate with Clarity and Originality -** The ability to exchange ideas and information is essential to personal growth, productive work, and societal vitality.
  - Organise and articulate ideas for a range of audiences and purposes;
  - Use written, spoken and symbolic forms to convey concepts creatively;
  - Use technology to gather, process and communicate information.

- **Interact in Diverse and Complex Environments -** Successful negotiation through our increasingly complex, interdependent and global society requires knowledge and awareness of others as well as enhanced interaction skills.
  - Build interpersonal skills through knowledge of diverse ideas, values and perspectives;
  - Collaborate with others in complicated, dynamic and ambiguous situations;
  - Practice civility, empathy, honesty and personal responsibility.

2.5 Type of Learning Outcomes

In education environments, learning outcomes and objectives are often loosely sorted into three groups, called domains:

- **Cognitive domain** - encompasses intellectual or thinking skills.
- **Psychomotor domain** - encompasses physical skills or the performance of actions.
- **Affective domain** - encompasses attitudes and values.

Competency in ICT requires development of skills within all three of these domains.

2.6 Process for Developing Learning Outcomes

There are three main approaches to the development of Learning Outcomes:[7]

2.6.1 A Cycles Approach

Developing outcomes can be viewed as a recursive process involving four cycles of activities:

- Gathering Outcomes Information
- Evaluating Outcomes Information
- Implementing Improvements Based on Evaluation of Outcomes Information
- Developing Programs and Procedures for Implementing Improvements

2.6.2 A Step-By-Step Approach

Developing outcomes can also be viewed as a more linear process that involves moving from the abstract to the concrete:

- **Mission Statement** - Determine guiding philosophical principles for the program in terms of stated mission statement.
- **Goals** - For each principle of the mission, identify the key concepts and competencies that students of the program should know or be able to do.
- **Objectives** - For each goal, state the objectives that are concrete and specific enough to be measured and evaluated as well as the level of achievement that is expected.
- **Measures** - For each objective, identify the specific instruments and measures that will be used to determine if the objectives were achieved.
- **Outcomes** - For each measure, determine how well objectives have been met.
- **Implementation Procedures** - Establish a timeline for each step of the plan, including a timeframe and method for reporting the assessment results formally and for drafting recommendations to improve instruction.

2.6.3 A Course Portfolio Approach

Outcomes can be also developed in the context of compiling a course portfolio in terms of three components:

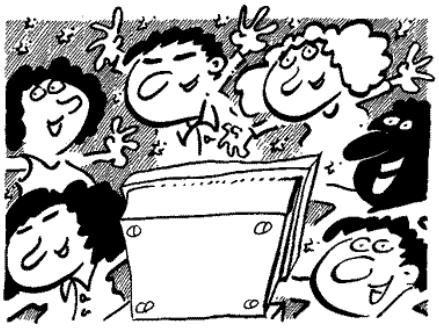
- **Design** – the overall course vision
- **Enactment** – methods for implementation
- **Results** – learning outcomes

The ICT Learning Outcomes contained in this document use a combination of these approaches and include outcomes in all three of the domains outlined in Section 2.5.

[7] Extracted from: Student Learning Outcomes (http://pandora.cii.wwu.edu/guide/learning_outcomes.htm)

3. Developing ICT Skills

The ability to use Information and Communication Technology effectively and appropriately is now seen as essential to allow students to acquire and exploit information within every sphere of human activity. ICT offers great potential to improve standards of attainment in literacy and mathematics. [8]



3.1 What is ICT and why is it Important?

Information and Communication Technology is generally regarded as the overlap of computer information and telecommunications technologies, and their applications. [9] In this document the term ICT is used to indicate the whole range of technologies involved in information processing and electronic communications, including the Internet, electronic mail and videoconferencing.

In recent years ICT has had, and is continuing to have, an increasingly significant impact on all aspects of society. There are few areas of life, at home, at school and in work, where this new technology has not made an impact. ICT expands our access to, and understanding of, the world at large. It allows people in all areas of life to benefit from the power of computer systems as personal tools; to collaborate in groups; and to communicate locally and globally.

In addition to developing ICT knowledge and skills for both individuals and society at large, ICT also offers the education process one of the most potentially powerful learning tools available. Not only can computers support learning across the whole curriculum, but communication networks also provide the student with fast and searchable access to vast amounts of information. In addition to this, ICT supports a wide range of broader educational objectives including independent learning, collaboration with others and communication skills.

[8] Moseley, D. et. Al. 1999. Ways forward with ICT: Effective Pedagogy using Information and Communication Technology for Literacy and Numeracy in Primary Schools.
9 Extracted from: Information and Communication Technology: 5-14 National Guidelines (http://www.ngflscotland.gov.uk/5-14/guidelines/guidelines/ict/)

Ultimately the educational purpose of ICT should be to assist students to play their full part in society. They should be well informed about the current and potential applications of ICT and be skilled and effective in using them. They must be able to evaluate the effectiveness of the resources provided by ICT and determine when it is most appropriate to use them.

3.2 ICT as a Learning Tool

ICT is the perfect tool for helping children do things, review them, learn them and apply them. This 'do/review/learn/apply' sequence has long been recognised as the learning cycle as illustrated in Figure 3.1[10]

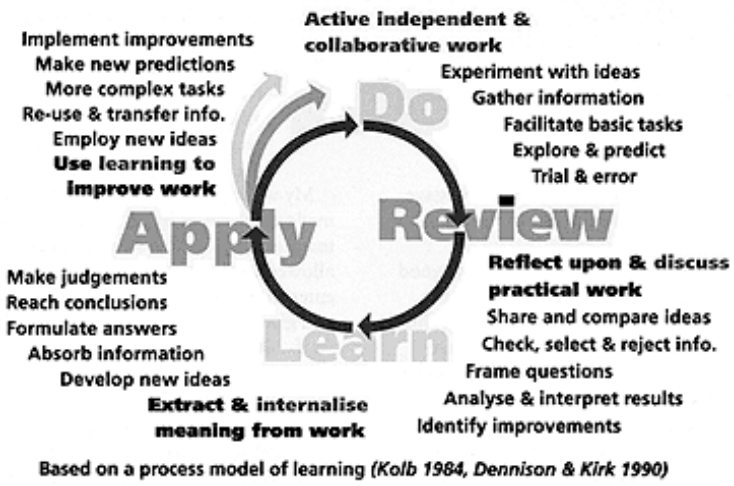


Figure 3.1 ICT as a Tool for Active Learning – The Learning Cycle

Students carry out (do) a range of activities. They reflect upon and discuss (review) their action in order to internalise and make sense of (learn) what they have done. They will use (apply) what they have learned in developing their work and also in future learning contexts. In carrying out tasks, students may work their way around this cycle many times, rethinking ideas, discussing possibilities, receiving advice and improving outcomes. There are many ways in which ICT can scaffold each stage of this process and support the use of language.

Do - editing and arranging information

In the do stage of the learning cycle, ICT is a vehicle for independent or collaborative work, where students can experiment with ideas. General-purpose software such as word processors, graphics packages and data-handling tools allow ideas to be entered, edited and shaped easily. Used effectively it allows students to develop their work and thoughts directly into the machine, offering them the ultimate thinking tool. There are many programmes and techniques that can help students think and write into the computer. Talking word processors and word/phrase banks can improve vocabulary and spelling. Mind-mapping software

10 Phil Taylor, 2000. Managing ICT in the Secondary School.

and outlining tools can help students to structure their written work. The use of templates as writing frames can help to overcome the 'blank page' problem when the creative potential offered by the software is initially too daunting. More specific software, for example role-play simulations, can lead to valuable discussion, decision-making and action.

Review - reading and sifting information
This stage might involve the careful consideration of information that has been gathered, checking for relevance and validity, and rejecting information that is not useful. This is particularly important with resources such as the Internet, where much of the information is of unknown or dubious origin. Students need to learn how to search for information they require, sift through it, acknowledge what is helpful, synthesise it with other ideas and information, and discard the rest. Basic tasks that have been accomplished quickly through using ICT allow more time for key questions to be posed: why did that happen? what does this mean/show? how can I describe this? what conclusions can be drawn? how can I improve this work? Most importantly, by reviewing their work students can look for improvements, with assistance from others, identifying gaps in their understanding as a result of trial and error.

Learn - using understanding
The learn stage of the learning cycle involves some sort of internalisation of meaning. Having developed and shared ideas a student might be expected to build on these, develop new ones, and use their understanding to question new information. For example, a graph, produced quickly using ICT, might lead to the question: “why is there an upward trend?” The students could use what they have learned in order to find a way of answering this question, moving quickly to analysis and not spending too much time producing the graph.

Apply - communicating learning
Students can apply their learning by communicating it to others, using PowerPoint-style presentations, web pages and e-mail. The transfer of learning between tasks is not always straightforward, but generic ICT skills can be applied in many contexts. Also, information that has been collected, sifted and stored for one task can easily be retrieved for re-use for another. Above all, when applying what they have learned students are able to implement improvements to their work, demonstrating higher levels of skill and better understanding.

3.3 ICT Experiences In The Early Years

ICT skills developed during secondary stages of education should be regarded as part of a longer-term development of important core skills. This starts during the pre-school stage and continues through the remaining secondary school years, with ongoing progression through further/higher education, the world of work and in adult life. [11]

[11] Extracted from: Information and Communication Technology: 5-14 National Guidelines (http://www.ngflscotland.gov.uk/5-14/guidelines/guidelines/ict/)

Children's lives are full of technologies of every kind, and they gradually develop a variety of relationships with a whole range of tools.[12] In the broadest sense, technology literacy begins at an early age, in an informal way, long before students begin to use computers. Even before children arrive in a pre-school environment many of them will have had experience of the uses of ICT within their own home and in the wider community. Whether they are banging on pots and pans to make music or inventing new games with sticks and string, young children spend much of their time developing their tool-using capacities. This early exposure to technology provides an important context for children's emotional, personal and social development.

It is however important to remember that children have to be taught how to use the technology or software before they can make effective use of ICT. This basic first step can be a big challenge for teachers as it takes time and may not have a clear literacy or mathematics focus.[13] Furthermore, technological developments in ICT are very rapid. Technological knowledge quickly becomes obsolete and new technology has to be frequently mastered. Smooth adaptation is only possible when understanding of ICT is based on invariant, stable concepts. [14]

3.4 Defining ICT Literacy

Students cannot make "appropriate and effective use of ICT" without information literacy. What it means to be literate will continue to change as visual and electronic media become more and more dominant as forms of expression and communication. As recently as one hundred years ago, literacy meant the ability to recall and recite from familiar texts and to write signatures. Even twenty years ago, concepts of literacy were linked almost exclusively to print materials. The vast spread of technology and media has broadened our concept of literacy.[15]

Technology is best learned within the context of applications. Activities, projects and problems that replicate real-life situations are effective resources for learning technology. Through this approach students will learn:

- that, although technology is often complex, it is simply "a way of doing things"
- about the impact of technologies in their lives and workplaces
- how to determine which processes, tools and techniques to use, and when to use them
- how to use and apply a variety of information and communication technologies to problem solving, decision making, inquiring and researching in the context of other subject matter.

[12] Technolgy Literacy: Educating Children to Create Their Own Future. (http://google.com/url?sa=U&start=1&q=http://www.allianceforchildhood.net/projects/downloads/chapter4.pdf&e=42)
[13] Moseley, D. et. Al. 1999. Ways forward with ICT: Effective Pedagogy using Information and Communication Technology for Literacy and Numeracy in Primary Schools.
[14] Extracted from: UNESCO/IFIP Curriculum – Information and Communication Technology in Secondary Education (http://wwwedu.ge.ch/cptic/prospective/projets/unesco/en/ict.html)
[15] Building Information Literacy. http://www.edu.pe.ca/bil/bil.asp?ch1.s1.gdtx

ICT literacy is therefore synonymous with knowing how to learn. This means the ability to process and use information effectively is more than a basic tool for the empowerment of school students: it is in fact the basic survival for those who wish to be successful members of the 21st century.[16]

3.4.1 The ICT Literate Student

The goal of integrating ICT into curricula is to help students develop the abilities to use, manage, and understand information. It is important that students develop these abilities throughout the learning process in all curriculum areas.

Information technology-literate students should be able to

- develop knowledge, ability, and responsibility in the use of information technology;
- acquire, organise, analyse, evaluate, and present information using appropriate information technology;
- use ICT to expand their range and effectiveness of communication;
- solve problems, accomplish tasks, and express creativity, both individually and collaboratively, using information technology;
- understand the role and impact of information technology and apply ethical, responsible, and legal standards in its use.

These skills are seen to encompass much more than the use of the Internet or computers but as ones, which are essential in all areas of the curriculum, and as preparation for life after secondary school.

3.5 Categories of ICT

ICT includes the calculator and extends to the whole range of audiovisual aids, including audiotape, video film and educational broadcasts. ICT can be used in various ways to support teaching and motivate children's learning. For the purpose of simplification, information technologies are often grouped by categories such as those presented in Table 3.1. Some examples of the specific information technologies included in each category are also provided.[17]

[16] School Library of New Zealand and Aotearoa (SLANZA) Te Puna Whare Matauranga a Kura. 2001. Draft ICT Strategy For Schools 2002-2004

[17] Manitoba Education and Training. 1998. Technology as a foundation skill area: a journey toward information technology literacy: a resource for curriculum developers, teachers, and administrators. ISBN 0-7711-2152-0

Table 3.1 Categories of ICT

Category	Examples
Tool Hardware	Digital camera Graphing calculator Multimedia computer Probes Scanner Video camera Videodisc player CD player DVD player Multimedia projector
Tool Software	Word processor Spreadsheet Database Computer-aided design (CAD) Computer-aided manufacturing (CAM) Concept mapping Data mining Drafting
Telecommunications	Audio conferencing E-mail Fax Internet Radio Telephone Television Videoconferencing
Production/Presentation/ Authoring Applications	Animation Desktop publishing Graphics Hypermedia Hypertext mark-up language (HTML) Musical instrument digital interface (MIDI) Video
Interactive Multimedia	Computer-guided learning (CGL) Multimedia books Multimedia encyclopaedias Simulation Virtual reality
Programming and Controlled Devices	Logo Robots

3.6 General ICT Learning Outcomes for Lower Secondary School

The ICT Learning Outcomes provide a broad perspective on the nature of technology, how to use and apply a variety of technologies, and the impact of ICT on self and society. The Learning Outcomes are therefore statements of what students in the lower forms of secondary schools are expected to know and do in terms of ICT in the broad context.

At the lower secondary level students should focus on studying the functions of, and relationships between, the main computer hardware and software components as well as applying a range of techniques, equipment and processes to efficiently produce information that meets the needs of various audiences.[18]

3.6.1 Organisation

The ICT Learning Outcomes are grouped into three broad categories which are then further subdivided into six content standards specifying what a student should know and be able to do. Standards within each category are to be introduced, reinforced, and mastered by students. Teachers can use these standards as guidelines for planning technology-based activities in which students achieve success in learning, communication, and life skills. The first broad category (Information Literacy) focuses on technology use and information processing skills. The latter two categories (Independent Learning and Social Responsibility) build upon these by adding performance standards that deal with attitudes, appreciation, teamwork skills, and personal and social responsibility.

The ICT content standards may be summarised as follows:

A. Information Literacy - Students access, evaluate, and apply information efficiently and effectively from a variety of sources in print, nonprint, and electronic formats to meet personal and academic needs. They use media and technology to access, organise, create, and communicate information for solving problems and constructing new knowledge, products, and systems.

A.1 Technology Fundamentals - Basic Operations, Knowledge and Concepts

- Students demonstrate a sound understanding of the nature and operation of technology systems.
- Students are proficient in the use of technology.

A.2 Technology Productivity Tools

- Students use technology tools to enhance learning, increase productivity, and promote creativity.
- Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.

[18] Victorian Curriculum and Assessment Authority 2001

A.3 Technology Communications Tools

- Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
- Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

B. Independent Learning - Students apply technological and information skills to issues of personal and academic interest by actively and independently seeking information; demonstrating critical and discriminating reading, listening, and viewing habits; and, striving for personal excellence in learning and career pursuits.

B.1 Technology Research Tools

- Students use technology to locate, evaluate, and collect information from a variety of sources.
- Students use technology tools to process data and report results.
- Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.

B.2 Technology Problem-Solving And Decision-Making Tools

- Students use technology resources for solving problems and making informed decisions.
- Students employ technology in the development of strategies for solving problems in the real world.

C. Social Responsibility - Students demonstrate the ability to work collaboratively in teams or groups, use information and technology in a responsible manner, respect intellectual property rights, and recognise the importance of intellectual freedom and access to information in a democratic society.

C.1 Social, Ethical, And Human Issues

- Students understand the ethical, cultural, and societal issues related to technology.
- Students practice responsible use of technology systems, information, and software.
- Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.

Each content standard is followed by general learning outcomes that tell how students will show that they are meeting the content standard. Each general learning outcome includes specific outcomes, activities for Mathematics and Language Arts and resources that detail how students will demonstrate proficiency in a particular performance area. When students demonstrate proficiency in these learning outcomes and indicators, they will have mastered ICT skills that are basic to success in the world of the 21st century.

The ICT Learning Outcomes are detailed in **Section 3.6.3**.

3.6.2 Summary

The standards, general and specific ICT outcomes are summarised as follows:

A. INFORMATION LITERACY

A.1 Technology Fundamentals - Basic Operations, Knowledge and Concepts
- A.1.1 Student will use common media and technology terminology and equipment
- A.1.2 Student will identify and use common media formats, technology systems, resources, and services.
- A.1.3 Students will practise the concepts of ergonomics and safety when using technology.

A.2 Technology Productivity Tools
- A.2.1 Student will use a computer and productivity software to organise and create information.
- A.2.2 Student will use media and technology to create and present information
- A.2.3 Student will evaluate the use of media and technology in a production or presentation.
- A.2.4 Students will integrate various applications.

A.3 Technology Communication Tools
- A.3.1 Student will use a computer and communications software to access and transmit information.

B. INDEPENDENT LEARNING

B.1 Technology Research Tools
- B.1.1 Student will locate and access information sources
- B.1.2 Student will record and organise information
- B.1.3 Student will research, create, publish and present curriculum-related projects both inside and outside the classroom.

B.2 Technology Problem-solving and Decision Making
- B.2.1 Students will use technology to investigate and/or solve problems.
- B.2.2 Students will seek alternative viewpoints, using information technologies.

C. SOCIAL RESPONSIBILITY

C.1 Social, Ethical and Human Issues
- C.1.1 Student will participate productively in workgroups or other collaborative learning environments
- C.1.2 Students will demonstrate a moral and ethical approach to the use of technology.
- C.1.3 Student will use information, media, and technology in a responsible manner
- C.1.4 Student will practice legal and ethical behaviour when using information and technology.

3.6.3 Information and Communication Technology Learning Outcomes Matrix

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
A. INFORMATION LITERACY				
A.1 Technology Fundamentals - Basic Operations, Knowledge and Concepts By the end of Year (Level) 3 students will . . .				
A.1.1 Use common media and technology terminology and equipment	(a) identify and define computer and networking terms (b) demonstrate the correct operation of a computer system on a network (c) demonstrate touch keyboarding skills at acceptable speed and accuracy levels (suggested range 20-25 wpm) (d) organise and backup files on a computer disk, drive, server, or other storage device (e) recognise and solve routine computer hardware and software problems (f) use basic content-specific tools/probes (g) scan, edit , and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment (h) use simple graphing calculator functions to solve a problem	• Students should be familiar with terms such as modem, file server, client station, LAN, Internet/Intranet, data storage device, etc. • Write a "survival guide" for a first-time computer user, such as a fellow student or a parent. • Create a presentation welcoming new students to the school.	• Students should be familiar with terms such as modem, file server, client station, LAN, Internet/Intranet, data storage device, etc. • Relate technology terms to Mathematics. • Use a graphing calculator efficiently and appropriately.	• Microsoft Word • Microsoft Publisher • Microsoft PowerPoint • Hyperstudio • Digital camera • Video camera • Scanner • Typing Tutor, e.g. Ultrakeys, Mavis Beacon

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
A.1.2 Identify and use common media formats, technology systems, resources, and services.	(a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) (b) identify the various organizational patterns used in different kinds of reference books (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) (d) identify and use the basic types of learning software (e.g., drill and practice, tutorial, simulation) (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) (g) identify common integrated software packages or applications suites.	• Select and use appropriate technological tools for assignments. • Select and use suitable multimedia software to present projects. • Learn the uses of various tools such as scanner, digital camera, computer projector and CD-writer.	• Select and use appropriate technological tools for assignments. • Select and use suitable multimedia software to present projects.	• Chart with computer parts • Chart with proper use and care • Puzzlemaker.com website • Digital camera • Chart with detailed power on and shut down procedures posted • Printers • Scanner • Courseware
A.1.3 Students will practise the concepts of ergonomics and safety when using technology.	(a) identify risks to health and safety that result from improper use of technology (b) identify and apply safety procedures required for the technology being used.	• Student practice good posture when using computer systems.	• Student practice good posture when using computer systems.	• Suitable Videos • Ultra Keys

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
A.2 Technology Productivity Tools By the end of Year (Level) 3 students will . . .				
A.2.1 Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum.	(a) explain the use of basic word processing functions (e.g., menu, tool bars, dialog boxes, radio buttons, spell checker, thesaurus, page layout, headers and footers, word count, tabs) (b) use the spell checker and thesaurus functions of a word processing program (c) move textual and graphics data from one document to another (d) use graphics software to import pictures, images, and charts into documents (e) classify collected data and construct a simple database by defining fields, entering and sorting data, and producing a report (f) construct a simple spreadsheet, enter data, and interpret the information (g) plot and use different types of charts and graphs (e.g., line, bar, stacked, scatter diagram, area, pie charts, pictogram) from a spreadsheet program	• Students use word processing features during prewriting strategies, including activities involving outlining, webbing, visual grouping, cause and effect, and linear sequencing. • Students create sustained written pieces focusing on a main thesis. E.g. critical, persuasive, informative or personal essay. • Students experiment with paragraph order for various effects. E.g. Order of paragraphs for a persuasive essay as opposed to an informative essay. • Students compose a class report using advanced text formatting and layout styles (e.g., single and double spacing, different size and style of fonts, indents, headers and footers, pagination, table of contents, bibliography)	• Use computer software such as graphical analysis programs, database programs, and spreadsheets to solve real life problems. • Choose the best tool to analyse real life data	• Microsoft Word • Microsoft Publisher • Print Artist • Digital camera • Laser/inkjet printer

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
A.2.2 Use media and technology to create and present information	(a) use draw, paint, or graphics software to create visuals that will enhance a class project or report (b) design and produce a multimedia program (c) plan and deliver a presentation using media and technology appropriate to topic, audience, purpose, or content (d) capture, edit, and combine video segments using a multimedia computer with editing software	• Students compose original text and design graphics to convey increasingly complex messages. • Students use various graphics programs to enhance specialized formats of communication. E.g. design compact disc covers or publicity packages for fictional entertainers. • Students create and maintain a classroom website	• Students determine mean, median, mode, range and quartiles as they solve problems related to these measures. • Students explore patterns and trends by automating and graphically displaying results of a series of repetitive calculations. • Students design web pages, VRML objects, applets and other Internet products to convey information or to allow others to explore and solve problems online. • Create a scatter plot and determine the line of best fit.	• Graphing calculator • Web page editor, e.g. Dreamweaver, Microsoft FrontPage • Paint Shop Pro • Digital camera

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
A.2.3 Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations.	(a) determine the purpose of a specific production or presentation (b) describe the effectiveness of the media and technology used in a production or presentation (c) identify criteria for judging the technical quality of a production or presentation (d) judge how well the production or presentation meets identified criteria (e) recommend ways to improve future productions or presentations	• Students explore visual and oral communication and their potential effects by developing multimedia products. • Use scanner and digital camera to import pictures and graphics. Create newsletters, brochures, pamphlets, newspapers, books, technical reports (charts and graphs) and multimedia presentations.	• Students use 3-D modelling or CAD programs to assist in visualization and to aid in problem solving related to shape and space. • Students use specialized statistics software to construct box-and-whisker plots, find lines of best fit and perform other statistical calculations. • Students view and/or construct models demonstrating geometric proof of the Pythagorean theorem. • Use a graphing calculator efficiently and appropriately. • Use a data collection device to collect and analyse real-world data. • Use a spreadsheet program to solve problems and display data. • Use tools such as scanners, digital cameras and multimedia projectors to create electronic portfolios.	• Scanner • Digital camera • Software programs – spreadsheet, word processor, presentation software (PowerPoint, Hyperstudio), desktop publishing software (Microsoft Publisher, Print Master, Picture It, Photo Studio, PrintShop) • Multimedia Projector

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
A.2.4 Integrate various applications.	(a) integrate information from a database into a text document (b) integrate database reports into a text document (c) emphasize information, using placement and colour (d) incorporate database and spreadsheet information (e.g., charts, graphs, lists) in word-processed documents	• Students use advanced word processing features to accomplish a task. E.g. import tables or graphs from other documents and insert into research reports. • Students work with publishing formats with increasing sophistication. e.g. newspaper format, complete with textual diversity and graphics. • Publish a quarterly classroom literary magazine.	• Students produce documents that incorporate a combination of written explanations, tables, graphs, diagrams or mathematical expressions in order to communicate mathematical understanding.	• Scanner • Digital camera • Software programs – spreadsheet, word processor, presentation software (PowerPoint, Hyperstudio), desktop publishing software (Microsoft Publisher, Print Master, Picture It, Photo Studio, PrintShop) • Multimedia Projector
A.3 Technology Communication Tools By the end of Year (Level) 3 students will . . .				
A.3.1 Use a computer and communications software to access and transmit information.	(a) demonstrate proficiency in accessing local area network, wide area network and Internet services, including uploading and downloading text, image, audio and video files (b) define basic on-line searching and Internet terminology (e.g., website, HTML, home page, hypertext link, bookmark, URL address) (c) send an e-mail message with an attachment to several persons simultaneously	• Students appreciate the origin and variety of words available. E.g. Through understanding of etymology of technology terms, through use of thesaurus. • Students use electronic mail to access and retrieve information solicited from outside sources.	• Students access current and realistic data for use in classroom activities. • Communicate with web pals through e-mail, work on class projects with other classes, teleconference with others (including experts, authors, etc.), share and publish work.	• Internet • Teleconferencing • Equipment • CD-writer • Internet Connectivity

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
A.3.1 Use a computer and communications software to access and transmit information. *(continued)*	(d) access information using a modem or network connection to the Internet or other on-line information services (e) view, print, save, and open a document from the Internet or other on-line sources (f) use basic search engines and directories to locate resources on a specific topic (g) demonstrate efficient Internet navigation (h) organise World Wide Web bookmarks by subject or topic	• Communicate with web pals through e-mail, work on class projects with other classes, teleconference with others (including experts, authors, etc.), share and publish work. • Collaborate with students at another school or in another country via e-mail to work on a common project, such as collecting and combining data. • Investigate a topic through visiting websites and through search engines.	• Collaborate with students at another school or in another country via e-mail to work on a common project, such as collecting and combining data. • Investigate a topic through visiting websites and through search engines.	
B. INDEPENDENT LEARNING				
B.1 Technology Research Tools By the end of Year (Level) 3 students will . . .				
B.1.1 Locate and access information sources	(a) identify the classification system used in the school library media centre, public library, and other local libraries (b) locate materials using the classification systems of the school library media centre and the public library (c) use an on-line catalogue and other databases of print and electronic resources (d) recognise differences in searching bibliographic records, abstracts, or full text databases	• Students access current information about a variety of research and personal-interest topics using CD-ROM's and teacher-selected online sources. • Students select preferred authors through a specific search system in a library online public access catalogue.	• Students access current information about a variety of research and personal-interest topics using CD-ROM's and teacher-selected online sources.	• Internet • CDs

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
B.1.1 Locate and access information sources *(continued)*	(e) search for information by subject, author, title, and keyword (f) use Boolean operators with human or programmed guidance to narrow or broaden searches (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats (h) use a search engine to locate appropriate Internet or Intranet resources (i) determine when to use general or specialized print and electronic reference tools (j) compare, evaluate, and select appropriate Internet search engines and directories	• Students develop research strategies for locating information in hyper-linked environments, e.g. search engines, Boolean search strategies, browsing, hierarchical and direct location.		
B.1.2 Record and organise information	(a) select information clearly related to the problem or question (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting (c) follow standardized note taking processes and compile bibliographic information in an approved format (d) credit sources for all quotations, visuals, major ideas, and specific facts or data using accepted citation formats	• Students identify various purposes for communication by categorizing web sites according to purpose: advertising, personal, community, corporation, government, and fee-for-use sites. • Students respond to, interpret and analyse various literary forms.	• Students maintain a journal of mathematical concepts, terms and personal reflections about mathematics. • Students collect, organise and display data in a variety of ways including circle graphs and scatter plots. They also search for trends and patterns in the data.	• Microsoft Word • Microsoft Excel • Microsoft Access

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
B.1.2 Record and organise information *(continued)*	(e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) (f) organise information in systematic manner for unity, coherence, clarity, and emphasis (g) compile a bibliography in a format stipulated by an accepted manual of style	• Write a "consumer report" article on the best prices for students' favourite things to buy, such as CDs, athletic shoes, and video games		
B.1.3 Research, create, publish and present curriculum-related projects both inside and outside the classroom.	(a) determine the audience and purpose for communicating the information (b) compare strengths and weaknesses of possible presentation methods and products (c) select the most appropriate format for the product or presentation (d) develop a product or presentation that utilizes the strengths of the medium and supports the conclusions drawn in the research effort	• Students publish on-line projects to contribute to existing bodies of knowledge. • Students enhance functional and expository writing such as research reports and step-by-step procedures. • Design and publish a guide for families new to the community. • Develop a virtual tour of a historic or cultural landmark in your country.	• Students solve complex problems by designing appropriate computer models and examining a variety of "what if" scenarios. Built in "solver" functions may also be utilized for a similar purpose.	• Yahoo.com • Northernlight.com • Dogpile.com • Microsoft Word • Hyperstudio • Microsoft PowerPoint • Microsoft FrontPage • Netscape Composer • Macromedia Dreamweaver • Macromedia Flash • Macromedia Freehand
B.2 Technology Problem-Solving and Decision Making By the end of Year (Level) 3 students will . . .				
B.2.1 Students will use technology to investigate and/or solve problems.	(a) interpret new information to formulate ideas which address the question or problem using comparison, evaluation, inference, and generalization skills	• Students choose, define and refine research questions.	• Students participate in collaborative on-line problem solving activities.	• Yahoo.com • Altavist.com • Google.com • AskJeeves.com • Microsoft

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
B.2.1 Students will use technology to investigate and/or solve problems. *(continued)*	(b) synthesize new ideas, evidence, and prior knowledge to address the problem or question (c) draw conclusions and support them with credible evidence (d) participate in decisions about group and classroom projects and learning objectives (e) identify and select topics of personal interest to expand classroom learning projects (f) recommend criteria for judging success of learning projects (g) establish goals and develop a plan for completing projects on time and within the scope of the assignment (h) evaluate progress and quality of personal learning (i) establish personal goals in pursuit of individual interests, academic requirements, and career paths	• Students construct personal knowledge and meaning through research on a variety of topics. • Research a contemporary, real-world issue that has at least three different viewpoints	• Students use various types of simulation software to practice problem solving, reasoning and pattern recognition and to explore complicated relationships at an intuitive level. • Students explore relationships between perimeter and area of various geometric shapes and model and solve problems • Use technology to collect, organise, and display real-world data in graphs or charts. Analyse, explain and make predictions from the data. Construct a graphic organiser to summarise the key points of your ongoing research involving these concepts.	PowerPoint • Hyperstudio • Laser/Inkjet printer • Microsoft Excel • Microsoft Word • Inspiration • Simulation software, such as *Sim City*, Caesar III, Civilization 3 and *Logo*,
B.2.2 Seek alternative viewpoints, using information technologies.	(a) access diverse viewpoints on particular topics by using appropriate technologies (b) assemble and organise different viewpoints in order to assess their validity (c) use information technology to find facts that support or refute diverse viewpoints	• Students compare and analyse information from various sources. • Students assess the reliability of information sources and communicate with other researchers regarding sources.	• Students compare and analyse information from various sources. • Students assess the reliability of information sources and communicate with other researchers regarding sources.	• Internet • CDs

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
B.2.2 Seek alternative viewpoints, using information technologies. *(continued)*	(d) evaluate the authority and reliability of electronic sources (e) evaluate the relevance of electronically accessed information to a particular topic			
C. SOCIAL RESPONSIBILITY				
C. 1 Social, Ethical and Human Issues By the end of Year (Level) 3 students will . . .				
C.1.1 Participate productively in workgroups or other collaborative learning environments	(a) collaborate with others to identify information needs and seek solutions (b) demonstrate acceptance to new ideas and strategies from workgroup members (c) determine workgroup goals and equitable distribution of individual or subgroup responsibilities and tasks (d) plan for the efficient use and allocation of time (e) complete workgroup projects on time (f) evaluate completed projects to determine how the workgroup could have functioned more efficiently and productively	• Students collaborate during the writing process in a networked environment. • Students consult with electronic writers-in-residence for feedback and suggestions about their writing. • Students develop a broader sense of global community through exploration of sites such as virtual museums and tourism information sites.	• Students collaborate during the writing process in a networked environment. • Students develop a broader sense of global community through exploration of sites such as virtual museums and tourism information sites.	• Internet • CDs

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
C.1.2 Demonstrate a moral and ethical approach to the use of technology.	(a) use time and resources on the network wisely (b) explain the issues involved in balancing the right to access information with the right to personal privacy (c) understand the need for copyright legislation (d) cite sources when using copyright and/or public domain material (e) download and transmit only materials that comply with the established network use policies and practices (f) model and assume personal responsibility for ethical behaviour and attitudes and acceptable use of information technologies and sources in local and global contexts	• Research and report on the steps required to obtain a patent, copyright, or trademark.		• AskJeeves.com • Yahoo.com • http://www.uspto.gov

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
C.1.3 Use information, media, and technology in a responsible manner	(a) return all borrowed materials on time (b) identify the school's rules on student use of the Internet and other resources (c) demonstrate use of the Internet and other on-line sources consistent with the school's acceptable use policy (d) employ proper etiquette in all forms of communication (e) recognise that altering or destroying another person's program or file constitutes unacceptable behaviour (f) differentiate between copying and summarizing (g) recognise that using media and technology to defame another person or group constitutes unacceptable behaviour (h) recognise the need for privacy of personal information	• Discuss privacy, password and sharing personal information issues. Survey parent and community leaders for their input. Develop and make videos of skits designed to demonstrate the importance of specific ethical behaviour.	• Discuss privacy, password and sharing personal information issues. Survey parent and community leaders for their input. Summarise in a spreadsheet.	• E-mail program • Video camera

General Learning Outcomes	Specific Learning Outcomes	Language Arts-related Activities	Mathematics-related Activities	Tools and Resources
C.1.4 Practice legal and ethical behaviour when using information and technology, e.g. respect intellectual property rights	(a) explain the concept of intellectual property rights (b) describe how copyright protects the right of an author or producer to control the distribution, performance, display, or copying of original works (c) recognise that the copying of commercial or licensed media is a violation of the copyright law (d) identify violations of the copyright law as a crime for which there are serious consequences (e) explain why the use of all or parts of another person's work requires prior permission or citation (f) recognise that a quoted work must be stated in the author's exact words (g) list sources quoted verbatim and visuals used in a presentation (h) recognise that reports or articles they write must be put in their own words	• Students use correct bibliographic format for citing electronic information sources. • Understand plagiarism and copyright guidelines and their misuse.	• Students use correct bibliographic format for citing electronic information sources. • Understand plagiarism and copyright guidelines and their misuse.	• CD ROM • Electronic Encyclopaedias • TV programs • Internet • Documentation Standards

3.7 Aligning ICT Learning Outcomes to Mathematics and Language Arts

The ICT Learning Outcomes are designed to be integrated into the various content and skill areas of the school curriculum. The focus is on learning ***with*** information and communication technology rather than learning ***about*** information and communication technology. This integration will be varied and diverse based on the curricula of individual schools and school systems.

Curriculum Alignment Worksheets were developed to facilitate the process of aligning the ICT Learning Outcomes to the local curriculum[19]. These Worksheets present a listing of the ICT Learning Outcomes in a table format and can be used in two ways:

1. They can provide a tool for Ministries of Education to assess what ITC competencies are being taught in the present instructional program, where they are being taught (in what subject areas), and at which levels. A four-point rating scale allows Ministries to also assess how well the various competencies are being covered currently. The tabulation of this information from the worksheets can then assist in the development of a matrix for the infusion of the ITC Learning Outcomes in a more systematic and consistent manner across the entire school system in the region.

2. Ministries can also use the worksheets as tools to assign the various ITC Learning Outcomes to specific content areas and levels. Alternatively, they may be used them as a table or curriculum map to identify where specific competencies should to be introduced, mastered and reinforced within the Lower Secondary School Curriculum.

A sample of a Curriculum Alignment worksheet is included in Section 8.1.

The information obtained from the worksheets was used to prepare the curriculum matrices for Language Arts and Mathematics presented in Sections 4.4 and 5.4 respectively.

3.8 Educational Software and Tools

There are several tools that can be used in support of the ICT Learning Outcomes. These include productivity tools for production of documents and presentation; and instructional tools for teaching and assessing students. There is also a wide range of hardware and peripherals that can be used in the education arena.

[19] Adapted from Wisconsin's Model Academic Standards for Information and Technology Literacy

3.8.1 Productivity Tools

Productivity software includes any software that can be used as a tool and helps users produce documents, spreadsheets, a database, or other products. Also included in the productivity category are the "Authoring" programs. These authoring programs help users develop computer programs in computer languages that can be otherwise quite difficult to learn.

Several computer-based productivity tools may be used in support of the ICT Learning Outcomes. These include:

- Word Processing – Microsoft Word, WordPerfect
- Database – Microsoft Access
- Spreadsheet – Microsoft Excel
- Draw/Paint/Graphics Applications – Microsoft Paint, CorelDraw, Adobe Photoshop, Paint Shop Pro, Corel Paint Shop
- Desktop Publishing – Microsoft Publisher, Print Artist
- Internet Browser – Internet Explorer, Netscape Navigator
- Email – Outlook, Outlook Express
- Multimedia Applications – Microsoft PowerPoint
- Authoring Tools – Macromedia Dreamweaver, Flash, Shockwave, Freehand, Hyperstudio.

3.8.2 Instructional Tools

There are six main types of instructional software that will allow teachers to integrate technology into the classroom. These are generally considered to be; Drill and Practice; Tutorial; Simulation; Problem Solving; Educational Games; and GroupWare.

Drill & Practice

Drill and Practice programs are those that present material to be learned through repetition. This type of program is valuable when teachers wish to drill on topics that will give immediate feedback. This type of software is often used to enhance lessons in mathematics or factual material. During Drill and Practice exercises the computer can keep track of errors, report scores, track error patterns, and repeat with further examples of the problems answered incorrectly.

Tutorial

Tutorial software is able to present material that has been previously taught or present new material learned in an individual setting. In essence, a Tutorial program will provide an opportunity to enhance previous learning or create new learning based on the curriculum objective. A good Tutorial offers help screens to give further explanation or further illustration. It will also be able to interpret the amount of information to present and how to present it. When we evaluate Tutorials, we need to evaluate if the Tutorial is not only able to present information, but must be able to interpret wrong answers. When it interprets wrong answers it should have the ability to continue the lesson from that point by providing feedback on the misunderstood information before continuing with new information.

Simulations

Simulation software provides users with the ability to implement settings that may not be possible through another means. A simulation can afford opportunities to test skills in real applications by creating situations that allow students to act in that situation. Simulations are used to teach procedural knowledge: such as learning how to fly a plane or drive a car. Good simulation programs can provide an environment for practice situations that are not possible in the classroom or may put the student at risk in a true environment. For example: a student could test a dangerous chemistry experiment without using real chemicals or dissecting a frog for biology without using a scalpel or animal. It is true that they cannot replace the true experience, but it provides procedural learning when it is either too dangerous or not possible to be in a true setting.

Problem Solving

Problem solving software presents problems for students to solve based on skills they have previously acquired. They provide applications of basic problem solving strategies, means-end analysis, searching a problem space, brainstorming, working backward, and incubation. Problem solving software will help students to create and improve their problem solving strategies.

Instructional & Educational Games

Instructional or Educational Games are software packages that create skills in a game environment. The game is provided as a motivational tool and makes the student go through elaborate game procedures to master a number of skills. This is by far the most difficult software type to evaluate because it is questionable whether the skills used in the games are able to transfer to other concepts. It will be important that the goal for the use of this type of software is congruent with the curriculum objectives.

GroupWare

This software is designed to be used for groups of students. The computer is viewed by a cooperative group of students or projected to the entire class.

Some of the instructional tools, which may be used in support of the ICT Learning Outcomes, include:

- Electronic Encyclopaedias – Microsoft Encarta, World Book Encyclopaedia
- Critical Thinking – Inspiration, Decisions Decisions
- Typing Tutors – Ultrakeys, Mavis Beacon

3.8.3 Evaluating Educational Software

Being aware of the types of educational software available on the market today and having some strategies for making decisions about the quality of that software will allow teachers to use it more effectively as a tool in their instructional plans. Many teachers who are new to using technology make the mistake of assuming that if a piece of software that claims to teach Mathematics, for example, they can put students in front of the computer for a large portion of their Mathematics instruction. It is however important to note that software developers are not familiar with the each student's particular levels or needs. Any one piece of software may or may not be helpful to students in accomplishing their individual goals in the manner that best works for them. As professionals, teachers must always be sure that any instructional tool, is the best way to teach a particular concept to a particular student or group of students. Software will never replace teachers - the professional, human, decision-making abilities of caring teachers will always be required to guide students' learning. A sample Software Evaluation Form can be found in section 8.2.

3.8.4 Hardware for Education

Several types of hardware could conceivably be used in a school network. Desktop computers generally provide the most networking flexibility and computing power, but if mobility is more important, notebook computers also may make sense. Most recently, handheld devices are entering the classroom. They generally offer a lower-cost alternative to notebooks for teachers wanting basic mobile data entry capability. Teachers can use the handheld system to "take notes" during class, for example, and later upload or "synchronise" their data with a desktop computer.

Secondary school students also need tools that help them to produce polished, professional-looking academic work. In addition to the computer systems, a technology-rich classroom should also be equipped with other peripherals such as:

- Printing devices – ink jet and laser jet printers
- Imaging devices – scanners, digital cameras, video cameras
- Storage devices – floppy, hard, optical and other removable disks
- Presentation devices – multimedia projects, electronic whiteboard.

3.8.5 Web-based Resources

There is an extensive number of web sites with educational content. However, not all sources on the Internet are equally valuable or reliable. Individual sites are not screened or standardised in any way to determine if the information they provide is accurate or useful. As with educational software, teachers should thoroughly evaluate these resources before incorporating them into their instructional plans. A sample Web Site Evaluation Form can be found in section 8.3. A concise list of web-based resources is also included in section 8.9.

4. ICT Learning Outcomes for Language Arts

Much of what we expect students to be able to do at the end of their formal education is introduced as early as early childhood years. Students listen, read, speak, write, use language, and enjoy literature at all levels and grades. The difficulty of the materials, the complexity of what students do with them, and the sophistication of their skills change as they grow older. In practice, teachers build on what students have already achieved at one level to help them meet higher standards at the next level.

In terms of Language Arts, there are many benefits to using ICT in the teaching of literacy skills:

- It allows the teacher to produce and modify resources quickly and easily.
- It allows access to a wide range of information in different formats.
- Teachers can use different drafts to assess how work is progressing and what input is needed.
- Some software is able to assess the student's work and provide useful information.
- Using a large screen or overhead projector the teacher can focus the student's attention on different aspects of the text.

Using information technology will also assist students in the achievement of many of the expectations in the Language Arts curriculum:

- Information technology helps students in their written work and in the analysis of literary and informational texts.
- Students should use word processing to draft, organise, revise, edit, and format written work.
- In their research, students should use multimedia resources to find, process, and reorganise information and ideas.
- Presentation software and audio-visual technologies will enhance the effectiveness of oral and visual presentations.

4.1 ICT Benefit to Literacy in Students

ICT has the potential to make a significant contribution toward the development of literacy skills in students by helping them to:[20]

1. **engage with texts in ways that would not be possible through paper-based activity.** When writing, students can delete words or phrases, try out alternative vocabulary or move a paragraph around as they reorganise the points they are making, all without having to rewrite their previous work. Over a period of time students can craft and polish their writing. For reading, ICT can provide information in combinations of text, still and moving images and sound, and enable it to be accessed in different layers through hypertext or multimedia**.** ICT allows literacy skills to be extended beyond reading and writing of chronological and linear text;

2. **appreciate the inter-related nature of the language modes** – reading, writing, speaking and listening. With it's emphasis on paired and small group work, the use of computers encourages focused talk and precise oral communication of ideas and decisions, e.g. when drafting using a word processor, particularly if they are working collaboratively, students consistently reread aloud what they have written, and read aloud to one another as they revise what they have written and plan the next few words. ICT provides students with a very effective resource to support oral presentations of their own work, e.g. in a plenary session where a small group might make use of an audio tape, an overhead projector or a presentation package;

3. **focus on the content of their writing at word, sentence and text level.** Students can make use of whole word processors, voice processors or spell-checkers as a start to their own editing. They can analyse words, manipulate text and edit to a high level of sophistication without the need to rewrite. The enhanced presentation of their writing in familiar, correct and consistent letter shapes allows students to bring their visual memory into use effectively to check spellings, in a way that they may not be able to do with their own handwriting;

4. **enhance basic reading and writing activities** with the facility to include other dimensions, e.g. increasing challenge and pace in a timed session through the use of a real time computer simulation or participation in an on-line newspaper day, both of which require students to receive, act upon and respond in a specified time; through more direct contact with real or wider audiences, e.g. through using fax or the Internet, by providing access to a wider range and more up-to-date learning resources than would normally be available through the school library;

5. **emphasise the link between the writer and the audience** by allowing the text to be presented in a variety of ways, extending the range of options available to writers in ways which could not easily be attained using pen and

[20] Taken from 'The Use of ICT in Subject Teaching - Identification of Training Needs, Primary', Foreword and Section 1, produced by the Teacher Training Agency (TTA).

paper, e.g. students can edit their work to meet the requirements of a particular text type, such as a newspaper report through right justifying the text, presenting it in narrow column format, copying and pasting key phrases to use as sub-headings, increasing or reducing by a few words to meet the editor's required number of words for the space allocated. In the same way, it allows students to adapt the presentation and organisation of their writing to meet the needs of different audiences, e.g. presenting information about the school to the wider community through constructing a web page using text, graphics and possibly sound.

4.2 Areas of Language Arts

In our Caribbean language context the development of language skills extends beyond proficiency in listening, speaking, reading and writing to provide a foundation for personal, social and intellectual growth. Students should therefore be exposed to a range of activities that aim to develop their competence in Standard English while maintaining an informed perspective on the appropriate use of the native language.[21]

The Language Arts Curriculum can be broken down into four broad areas:

- Listening & Speaking
- Reading/Information Processing
- Writing

4.2.1 Listening & Speaking

The spoken word, essential to our individual and social development, remains a central means of communication. Whether in informal interactions or more formal settings, speakers are required to communicate clearly in a manner that befits the occasion. Similarly, listening is the most used and least understood of all communication skills. We spend approximately 45 percent of all communication time and as much as 57 percent of school instruction time listening. The ability to listen and to follow instructions is highly prised in the workplace.

4.2.2 Reading/Information Processing

Reading is a complex, interactive process that continues to be a primary means of acquiring and using information. Society regards reading as essential to daily living. Because reading is fundamental to the mastery of other school subjects, students at all levels must learn to understand what they read. They must know and use various strategies - ways of unlocking the meaning of words and larger blocks of text - to become successful readers.

Students should be challenged to read literature and other materials that reflect and stimulate their interests and intellectual abilities. They should read a wide

[21] Ministry of Education, Youth Affairs and Culture, Barbados. 2001. Language Arts Syllabus, Secondary School, Level 1&2.

variety of materials, including fiction, non-fiction, poetry, drama, and other written works that reveal the richness and diversity of our heritage, afford opportunities to acquire new information, refine perspectives, respond to the needs and demands of society and the workplace, and provide for personal fulfilment.

Students acquire a wide range of abilities and tools for raising questions, investigating ideas, and solving problems. Research involves posing interesting and important questions, using multiple sources of information, analysing and relating facts and concepts, and arriving at conclusions or new understandings.

4.2.3 Writing

Written communication skills are central to learning. Whether in academic life, in the workplace, or in personal life, they offer a powerful advantage in a world in which people must constantly learn new information. To become confident and effective writers, students need to learn how to write for various purposes and audiences. They need to try different approaches and to reconsider what they have written through revision and editing. To ensure that their writing is understood and well-received, students need a working knowledge of language as well as grammatical structures, diction and usage, punctuation, spelling, layout, and presentation. This knowledge is also invaluable for discussing, critiquing, revising, and editing written communication in almost any form.

4.3 Structure of Modular Arrangement of Language Arts Learning Outcomes

The following modules may be identified for the Language Arts Learning Outcomes in the Eastern Caribbean.

Module No.	Module Title	
1	Listening and Speaking	
2	Vocabulary	
3	Comprehension	
4	Library and Research	
5	Literature	
6	Writing	Descriptive
		Narrative
		Expository
		Argumentative and Persuasive
		Sentence Construction
		Paragraph Development
7	Drama	

4.4 ICT Learning Outcomes for Lower Secondary School Language Arts

ITC Learning Outcomes were developed for each module in the Language Arts syllabus by compiling the information collected from the Curriculum Alignment Worksheets. These outcomes answer the question: 'What should students know and be able to do as an outcome of their learning at this level?'

The learning outcomes:

- reflect the breadth, depth and complexity of the curriculum
- are stated in terms that are measurable using a variety of assessment techniques.

The matrix that follows in Section 4.4.1 – 4.4.3 shows the relationship between the objectives in the Language Arts Curriculum Guide for Dominica and the ICT Learning Outcomes. In the left-hand column are the learning outcomes for Language Arts. The right-hand column provides the related learning outcomes for ITC. It is hoped that this table will help classroom teachers to determine where ITC Learning Outcomes might best be integrated into specific curricular areas.

Section 8.4 provides examples of how the learning outcomes may be incorporated into classroom instruction. Section 8.5 and 8.6 provide templates for the development of technology-rich lesson plans.

4.4.1 Language Arts – Year 1

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
A. LISTENING AND SPEAKING	
1.A.1 Engage in exploratory communication to share personal experiences and discover their own interpretations.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.2 (a) select information clearly related to the problem or question • A.1.1 (a) identify and define computer and networking terms • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **A.3.1** Use a computer and communications software to access and transmit information.
1.A.2 Experiment with new forms of self-expression.	
1.A.3 Use language to discuss a variety of ideas and concerns.	• B.1.2 (a) select information clearly related to the problem or question

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	• A.1.1 (e) recognise and solve routine computer hardware and software problems • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • A.1.2 (g) identify common integrated software packages or applications suites • **C.1.1** Participate productively in workgroups or other collaborative learning environments
1.A.4 Speak for a variety of purposes.	• A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing)
1.A.5 Understand and use different types of talk, e.g. discussing, informing.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • A.1.2 (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation)
1.A.6 Speak and listen for various purposes: inform, apply, analyse, and evaluate.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.2 (f) organise information in systematic manner for unity, coherence, clarity, and emphasis • A.1.1 (a) identify and define computer and networking terms • A.1.1 (b) demonstrate the correct operation of a computer system on a network • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box)

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	• A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • A.1.2 (g) identify common integrated software packages or applications suites • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **C.1.1** Participate productively in workgroups or other collaborative learning environments
1.A.7 Value speaking for personal, professional and social relationships.	• **C.1.1** Participate productively in workgroups or other collaborative learning environments
1.A.8 Understand and apply the conventions of oral discourse.	
B. READING/INFORMATION PROCESSING	
1.B.1 Make connections between previous experiences, and a variety of texts.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.1 (h) use simple graphing calculator functions to solve a problem • **B.2.1** Students will use technology to investigate and/or solve problems.
1.B.2 Use comprehension strategies appropriate to the type of text and purpose.	• A.1.1 (f) use basic content-specific tools/probes • A.1.1 (h) use simple graphing calculator functions to solve a problem
1.B.3 Use a variety of strategies to remember ideas – (concept mapping, mental rehearsals)	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.1 (f) use basic content-specific tools/probes • A.1.3 (a) identify risks to health and safety that result from improper use of technology

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	• A.1.3 (b) identify and apply safety procedures required for the technology being used
1.B.4 Use different cueing systems – syntactic, semantic graphophonics) to construct and confirm meaning and interpret texts.	• A.1.1 (f) use basic content-specific tools/probes
1.B.5 Expand knowledge of words and word relationships, e.g. homonyms, antonyms, synonyms using a variety of sources.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • A.1.1 (a) identify and define computer and networking terms • A.1.1 (f) use basic content-specific tools/probes • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing)
1.B.6 Set individual purposes for reading and adapt reading styles and speed to chosen purpose.	• B.1.2 (a) select information clearly related to the problem or question • **B.2.1** Students will use technology to investigate and/or solve problems.
1.B.7 Read to include and move beyond literal understanding and respond creatively to the printed message.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • A.1.1 (f) use basic content-specific tools/probes
1.B.8 Develop appropriate use of correct technical vocabulary for subject areas in the curriculum.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats. • A.1.1 (a) identify and define computer and networking terms • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (c) define the basic types of learning software (e.g., drill and

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	practice, tutorial, simulation) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing)
1.B.9 Understand and use the reading/writing connections.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • A.1.1 (g) scan, edit, and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment • A.1.2 (b) identify the various organizational patterns used in different kinds of reference books • **A.3.1** Use computer and communications software to access and transmit information.
1.B.10 Locate, interpret and organize information.	• B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • B.1.1 (h) use a search engine to locate appropriate Internet resources • B.1.1 (i) determine when to use general or specialized print and electronic reference tools • B.1.1 (j) compare, evaluate, and select appropriate Internet search engines and directories • B.1.2 (a) select information clearly related to the problem or question • B.1.2 (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting • B.1.2 (d) credit sources for all quotations, visuals, major ideas, and specific facts or data using accepted citation formats • B.1.2 (f) organise information in systematic manner for unity, coherence, clarity, and emphasis • A.1.1 (b) demonstrate the correct operation of a computer system on a network

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	• A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.1 (f) use basic content-specific tools/probes • A.1.2 (b) identify the various organizational patterns used in different kinds of reference books • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information • A.1.2 (g) identify common integrated software packages or applications suites • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **C.1.1** Participate productively in workgroups or other collaborative learning environments
1.B.11 Apply study skills in new situations.	• B.1.1 (a) identify the classification system used in the school library media centre, public library, and other local libraries • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • B.1.1 (h) use a search engine to locate appropriate Internet or Intranet resources • B.1.1 (i) determine when to use general or specialized print and electronic reference tools • B.1.1 (j) compare, evaluate, and select appropriate Internet search engines and directories • A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.1 (f) use basic content-specific tools/probes • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes,

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	and catalogues to retrieve and select information • **A.3.1** Use computer and communications software to access and transmit information.
C. WRITING	
1.C.1 Evaluate their work and others' work using appropriate criteria.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.3 (b) compare strengths and weaknesses of possible presentation methods and products • A.1.1 (e) recognise and solve routine computer hardware and software problems • **C.1.1** Participate productively in workgroups or other collaborative learning environments
1.C.2 Show understanding of the writing process.	• **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
1.C.3 Enhance their writing with figures of speech, e.g. simile, metaphor, personification.	
1.C.4 Select appropriate words and sentence patterns during revising to enhance clarity.	• B.1.2 (f) organise information in systematic manner for unity, coherence, clarity, and emphasis • A.1.2 (b) identify the various organizational patterns used in different kinds of reference books
1.C.5 Demonstrate the use of appropriate discourse features of expository writing: essay writing, reports, and research projects.	• B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.2 (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	• B.1.2 (c) follow standardized note taking processes and compile bibliographic information in an approved format • B.1.2 (f) organise information in systematic manner for unity, coherence, clarity, and emphasis • B.1.2 (g) compile a bibliography in a format stipulated by an accepted manual of style • B.1.3 (c) select the most appropriate format for the product or presentation • B.1.3 (d) develop a product or presentation that utilizes the strengths of the medium and supports the conclusions drawn in the research effort • A.1.1 (b) demonstrate the correct operation of a computer system on a network • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information
1.C.6 Represent and transform experiences, moods and feelings or emotions.	• A.1.1 (g) scan, edit , and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment
1.C.7 Demonstrate and understanding of collaboration in writing.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • **C.1.1** Participate productively in workgroups or other collaborative learning environments • **A.3.1** Use computer and communications software to access and transmit information.
1.C.8 Express ideas, understanding of relationships and insights into the ways people feel, think and act by converting words into pictures.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts) • B.1.3 (b) compare strengths and weaknesses of possible presentation methods and products • A.1.1 (g) scan, edit, and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	• A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **C.1.1** Participate productively in workgroups or other collaborative learning environments
1.C.9 Write with increasing competence in a variety of forms.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.2 (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting • A.1.1 (c) demonstrate touch keyboarding skills at acceptable speed and accuracy levels (suggested range 20-25 wpm) • A.1.1 (g) scan, edit , and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment
1.C.10 Use narrative and non-narrative writing.	• A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • A.1.2 (g) identify common integrated software packages or applications suites
1.C.11 Demonstrate through their writing and increased awareness of audience.	• B.1.2 (d) credit sources for all quotations, visuals, major ideas, and specific facts or data using accepted citation formats • B.1.3 (a) determine the audience and purpose for communicating the information
1.C.12 Develop sensitivity to good writing and the joy in producing their own creative texts.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts) • B.1.2 (f) organise information in systematic manner for unity, coherence, clarity, and emphasis • A.1.1 (c) demonstrate touch keyboarding skills at acceptable speed

Language Arts Learning Objectives *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
	and accuracy levels (suggested range of 20-25 wpm) • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
D. KNOWLEDGE OF LANGUAGE	
1.D.1 Demonstrate increasing competence in the rules of English grammar.	• A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing)
1.D.2 Apply the appropriate rules and conventions of English spelling and punctuation.	• A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing)
1.D.3 Demonstrate sufficient knowledge of language to being the process of editing/proof reading.	
1.D.4Write legibly to communicate information to others.	• B.1.2 (c) follow standardized note taking processes and compile bibliographic information in an approved format • A.1.1 (c) demonstrate touch keyboarding skills at acceptable speed and accuracy levels (suggested range 20-25 wpm) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • A.1.2 (g) identify common integrated software packages or applications suites • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used
1.D.5 Understand the basic differences between local varieties of language and Standard English.	

4.4.2 Language Arts – Year 2

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
A. LISTENING AND SPEAKING	
2.A.1 Engage in exploratory communication to share personal experiences and discover their own interpretations.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.2 (a) select information clearly related to the problem or question • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **A.3.1** Use computer and communications software to access and transmit information.
2.A.2 Experiment with new forms of self-expression.	
2.A.3 Use language to discuss a variety of ideas and concerns.	• B.1.2 (a) select information clearly related to the problem or question • A.1.1 (e) recognise and solve routine computer hardware and software problems • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used **C.1.1** Participate productively in workgroups or other collaborative learning environments
2.A.4 Listen for various purposes – inform, apply, analyse, evaluate.	• A.1.1 (b) demonstrate the correct operation of a computer system on a network • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box)

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	• A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • A.1.2 (g) identify common integrated software packages or applications suites • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **C.1.1** Participate productively in workgroups or other collaborative learning environments
2.A.5 understand and apply the conventions of oral discourse.	• **C.1.1** Participate productively in workgroups or other collaborative learning environments
2.A.6 Explore in talk of a diverse nature to develop conclusions, opinions and understandings.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • **C.1.1** Participate productively in workgroups or other collaborative learning environments
2.A.7 Clearly articulate and explain personal points of view.	• **C.1.1** Participate productively in workgroups or other collaborative learning environments • **B.2.2** Seek alternative viewpoints, using information technologies.
2.A.8 Arrange and re-arrange ideas and information in order to clarify and expand on information.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • A.1.2 (g) identify common integrated software packages or applications suites • **C.1.1** Participate productively in workgroups or other collaborative learning environments

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	• **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum.
2.A.9 Ask questions to clarify certain previously held beliefs.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • A.1.1 (a) identify and define computer and networking terms • **C.1.1** Participate productively in workgroups or other collaborative learning environments • **B.2.2** Seek alternative viewpoints, using information technologies.
2.A.10 Listen critically to gain and evaluate information.	• **C.1.1** Participate productively in workgroups or other collaborative learning environments • **B.2.2** Seek alternative viewpoints, using information technologies.
2.A.11 Listen carefully to receive instructions/advice.	• **C.1.1** Participate productively in workgroups or other collaborative learning environments.
2.A.12 Listen to clarify and organize ideas and information.	• A.1.2 (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) • **C.1.1** Participate productively in workgroups or other collaborative learning environments.
2.A.13 Listen to follow arguments.	• **C.1.1** Participate productively in workgroups or other collaborative learning environments. • **B.2.2** Seek alternative viewpoints, using information technologies.
2.A.14 Demonstrate appreciation for the appropriate use of various genres according to purpose, audience and context.	
2.A.15 Listen to distinguish between fact and fiction.	**B.2.2** Seek alternative viewpoints, using information technologies.
B. READING/INFORMATION PROCESSING	
2.B.1 Make connections between previous experiences, and a variety of texts.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	narrow or broaden searches • A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.1 (h) use simple graphing calculator functions to solve a problem • B.2.1 Students will use technology to investigate and/or solve problems.
2.B.2 Use comprehension strategies appropriate to the type of text and purpose.	• A.1.1 (f) use basic content-specific tools/probes • A.1.1 (h) use simple graphing calculator functions to solve a problem
2.B.3 Use a variety of strategies to remember ideas – (concept mapping, mental rehearsals)	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.1 (f) use basic content-specific tools/probes • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used
2.B.4 Use different cueing systems – syntactic, semantic graphophonics) to construct and confirm meaning and interpret texts.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • A.1.1 (f) use basic content-specific tools/probes
2.B.5 Use textual cues, e.g. organizational features of narrative and expository texts, points of view, themes and conclusions to construct and confirm meaning and interpret text.	• A.1.1 (h) use simple graphing calculator functions to solve a problem • A.1.2 (b) identify the various organizational patterns used in different kinds of reference books
2.B.6 Relate previous experiences and prior knowledge to different texts in order to apply them in new situations.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • A.1.1 (h) use simple graphing calculator functions to solve a problem • A.1.2 (g) identify common integrated software packages or applications suites.

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	• B.2.1 Students will use technology to investigate and/or solve problems.
2.B.7 use a range of comprehension strategies, e.g. adjusting reading rate, summarizing the main ides, SQ3R – to make sense of both familiar and unfamiliar texts as well as to retain ideas.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information
2.B.8 Understand texts from a variety of genres.	
2.B.9 Locate, transcribe, organize and recall printed information.	• B.1.1 (a) identify the classification system used in the school library media centre, public library, and other local libraries • B.1.1 (b) locate materials using the classification systems of the school library media centre and the public library • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • B.1.1 (h) use a search engine to locate appropriate Internet or Intranet resources • B.1.1 (i) determine when to use general or specialized print and electronic reference tools • B.1.1 (j) compare, evaluate, and select appropriate Internet search engines and directories • B.1.2 (a) select information clearly related to the problem or question • B.1.2 (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting • B.1.2 (c) follow standardized note taking processes and compile bibliographic information in an approved format • B.1.2 (d) credit sources for all quotations, visuals, major ideas, and specific facts or data using accepted citation formats • A.1.1 (b) demonstrate the correct operation of a computer system on a network

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	• A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.2 (b) identify the various organizational patterns used in different kinds of reference books • A.1.2 (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information • A.1.2 (g) identify common integrated software packages or applications suites • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • C.1.1 Participate productively in workgroups or other collaborative learning environments • A.3.1 Use computer and communications software to access and transmit information. • B.2.1 Students will use technology to investigate and/or solve problems.
2.B.10 Read for a variety of purposes.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • C.1.1 Participate productively in workgroups or other collaborative learning environments • A.3.1 Use computer and communications software to access

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	and transmit information.
2.B.11 Use literature for pleasure and information.	• A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information
C. WRITING	
2.C.1 Evaluate their work and others' work using appropriate criteria.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.3 (b) compare strengths and weaknesses of possible presentation methods and products • A.1.1 (e) recognise and solve routine computer hardware and software problems • **C.1.1** Participate productively in workgroups or other collaborative learning environments
2.C.2 Demonstrate increased understanding of the writing process.	• **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
2.C.3 Enhance their writing with figures of speech, e.g. simile, metaphor, personification.	
2.C.4 Demonstrate the use of appropriate discourse features of expository wiring: essay writing, reports and research projects.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.2 (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting • B.1.2 (c) follow standardized note taking processes and compile bibliographic information in an approved format

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	• B.1.2 (f) organise information in systematic manner for unity, coherence, clarity, and emphasis • B.1.2 (g) compile a bibliography in a format stipulated by an accepted manual of style • B.1.3 (b) compare strengths and weaknesses of possible presentation methods and products • B.1.3 (c) select the most appropriate format for the product or presentation • B.1.3 (d) develop a product or presentation that utilizes the strengths of the medium and supports the conclusions drawn in the research effort • A.1.1 (b) demonstrate the correct operation of a computer system on a network • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information
2.C.5 Demonstrate an understanding of collaboration in writing.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • C.1.1 Participate productively in workgroups or other collaborative learning environments • A.3.1 Use computer and communications software to access and transmit information.
2.C.6 Write with increasing competence in a variety of forms.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.2 (a) select information clearly related to the problem or question • B.1.2 (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting • A.1.1 (c) demonstrate touch keyboarding skills at acceptable speed and accuracy levels (suggested range 20-25 wpm) • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
2.C.7 Develop sensitivity to good writing and the joy of producing their own creative texts.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • A.1.1 (c) demonstrate touch keyboarding skills at acceptable speed and accuracy levels (suggested range 20-25 wpm) • A.1.1 (g) scan, edit , and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment
2.C.8 Use the writing process to produce creative pieces.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • A.1.1 (g) scan, edit , and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment • **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
2.C.9 Create original texts – descriptions, journals, reports, diaries, narrative.	• B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • A.1.1 (g) scan, edit, and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	• **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
2.C.10 Identify and use creative and original language in popular culture – commercials, advertisements.	• B.1.1 (h) use a search engine to locate appropriate Internet or Intranet resources • B.1.1 (i) determine when to use general or specialized print and electronic reference tools • B.1.1 (j) compare, evaluate, and select appropriate Internet search engines and directories • A.1.1 (g) scan, edit , and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used
2.C.11 Develop expressiveness and confidence in the use of written language.	
2.C.12 Write with increasing competence for a variety of audiences.	• B.1.2 (d) credit sources for all quotations, visuals, major ideas, and specific facts or data using accepted citation formats • B.1.3 (a) determine the audience and purpose for communicating the information • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used
2.C.13 Use narrative and non-narrative writing.	• A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation,

Language Arts Learning Objectives *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
	communication, drawing, desktop publishing)
D. KNOWLEDGE OF LANGUAGE	
2.D.1 Demonstrate increasing competence in the use of Standard English.	• A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing)
2.D.2 Apply the appropriate rules and conventions of English spelling and punctuation.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing)
2.D.3 Demonstrate sufficient knowledge of language to being the process of editing/proof reading.	
2.D.4Write legibly to communicate information to others.	• B.1.2 (c) follow standardized note taking processes and compile bibliographic information in an approved format • A.1.1 (c) demonstrate touch keyboarding skills at acceptable speed and accuracy levels (suggested range 20-25 wpm) • A.1.2 (g) identify common integrated software packages or applications suites • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used
2.D.5 Understand the basic differences between local varieties of language and Standard English.	
2.D.6 Explore factors that influence word families and the evolution of language.	

4.4.3 Language Arts – Year 3

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
A. LISTENING AND SPEAKING	
3.A.1 Question and reflect on personal responses and interpretations. Apply	

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
personal points of view to diverse situations or circumstances.	
3.A.2 Acknowledge the value of others' ides and opinions in exploring and extending personal interpretations and viewpoints.	• **C.1.1** Participate productively in workgroups or other collaborative learning environments • **B.2.2** Seek alternative viewpoints, using information technologies.
3.A.3 Use memorable language effectively and experiment with characters (i.e. personae) for dynamic and dramatic expression.	• A.1.1 (e) recognise and solve routine computer hardware and software problems
3.A.4 Consider opinions of a diverse nature, explore ambiguities and assess whether new information clarifies understanding.	• B.1.2 (a) select information clearly related to the problem or question • **C.1.1** Participate productively in workgroups or other collaborative learning environments • **B.2.2** Seek alternative viewpoints, using information technologies.
3.A.5 Develop awareness of and demonstrate critical listening behaviours.	• B.1.2 (a) select information clearly related to the problem or question • **C.1.1** Participate productively in workgroups or other collaborative learning environments • **B.2.2** Seek alternative viewpoints, using information technologies.
3.A.6 Suggest how word choice and supporting details in spoken and written texts affect purpose and audience.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats
3.A.7 Engage in exploratory communication to share personal experiences and discover their own interpretations.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **C.1.1** Participate productively in workgroups or other collaborative learning environments • **A.3.1** Use a computer and communications software to access and transmit information.
3.A.8 Understand and apply the conventions of oral discourse.	
3.A.9 Engage in exploratory communication to share personal experiences and discover their own interpretations.	
3.A.10 Understand and apply the	

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
conventions of oral discourse.	
3.A.11 Explore in talk of a diverse nature to develop conclusions, opinions and understandings.	• A.1.1 (b) demonstrate the correct operation of a computer system on a network • A.1.2 (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) • A.1.2 (g) identify common integrated software packages or applications suites • **C.1.1** Participate productively in workgroups or other collaborative learning environments
B. READING/INFORMATION PROCESSING	
3.B.1 Use comprehension strategies appropriate to the type of text and purpose.	• B.1.1 (d) recognise differences in searching bibliographic records, abstracts, or full text databases • A.1.1 (f) use basic content-specific tools/probes • A.1.1 (h) use simple graphing calculator functions to solve a problem
3.B.2 Use textual cues and organizational patterns in texts to construct and confirm meaning and interpret texts.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • A.1.1 (h) use simple graphing calculator functions to solve a problem • A.1.2 (b) identify the various organizational patterns used in different kinds of reference books • **B.2.1** Students will use technology to investigate and/or solve problems.
3.B.3 Formulate questions to set a purpose for listening and reading.	• **B.2.1** Students will use technology to investigate and/or solve problems.
3.B.4 Read and respond at various levels to different types of literature.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (d) recognise differences in searching bibliographic records, abstracts, or full text databases • A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device
3.B.5 Use a variety of strategies to remember ideas, e.g. concept mapping, mental rehearsals.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
	• A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.1 (f) use basic content-specific tools/probes • A.1.2 (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used
3.B.6 Relate previous experience to different texts in order to apply then in new situations.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • A.1.2 (g) identify common integrated software packages or applications suites
3.B.7 Locate, transcribe, organize and recall printed information.	• B.1.1 (a) identify the classification system used in the school library media centre, public library, and other local libraries • B.1.1 (b) locate materials using the classification systems of the school library media centre and the public library • B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • B.1.1 (h) use a search engine to locate appropriate Internet or Intranet resources • B.1.1 (i) determine when to use general or specialized print and electronic reference tools • B.1.1 (j) compare, evaluate, and select appropriate Internet search engines and directories • B.1.2 (a) select information clearly related to the problem or question • B.1.2 (b) use data-gathering strategies that include summarizing,

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
	paraphrasing, comparing, and quoting • B.1.2 (c) follow standardized note taking processes and compile bibliographic information in an approved format • B.1.2 (d) credit sources for all quotations, visuals, major ideas, and specific facts or data using accepted citation formats • A.1.1 (b) demonstrate the correct operation of a computer system on a network • A.1.1 (d) organise and backup files on a computer disk, drive, server, or other storage device • A.1.1 (f) use basic content-specific tools/probes • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **C.1.1** Participate productively in workgroups or other collaborative learning environments • **A.3.1** Use a computer and communications software to access and transmit information.
3.B.8 Read for a variety of purposes.	• B.1.1 (a) identify the classification system used in the school library media centre, public library, and other local libraries • B.1.1 (b) locate materials using the classification systems of the school library media centre and the public library • B.1.1 (c) use an on-line catalogue and

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
	other databases of print and electronic resources • B.1.1 (d) recognise differences in searching bibliographic records, abstracts, or full text databases • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • B.1.2 (a) select information clearly related to the problem or question • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **C.1.1** Participate productively in workgroups or other collaborative learning environments • **A.3.1** Use a computer and communications software to access and transmit information.
C. WRITING	
3.C.1 Develop and use strategies for accessing, collecting and evaluating information from a variety of sources.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (e) search for information by subject, author, title, and keyword • B.1.1 (f) use Boolean operators with human or programmed guidance to narrow or broaden searches • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • A.1.1 (h) use simple graphing calculator functions to solve a problem • **C.1.1** Participate productively in workgroups or other collaborative learning environments
3.C.2 Prepare and record summarise of given information.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
	resources • A.1.1 (h) use simple graphing calculator functions to solve a problem • A.1.2 (a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information • A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications. • C.1.3 (f) differentiate between copying and summarizing
3.C.3 Use different methods to choose and develop ideas for oral and written discourse.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) • B.1.3 (b) compare strengths and weaknesses of possible presentation methods and products
3.C.4 Review and revise previous drafts so as to facilitate communication and improve self-expression.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
	multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
3.C.5 Prepare compositions, reports, presentations and research projects with clarity and meaning to facilitate understanding.	• B.1.1 (c) use an on-line catalogue and other databases of print and electronic resources • B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • B.1.1 (h) use a search engine to locate appropriate Internet or Intranet resources • B.1.1 (i) determine when to use general or specialized print and electronic reference tools • B.1.1 (j) compare, evaluate, and select appropriate Internet search engines and directories • B.1.2 (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting • B.1.2 (c) follow standardized note taking processes and compile bibliographic information in an approved format • B.1.2 (f) organise information in systematic manner for unity, coherence, clarity, and emphasis • B.1.2 (g) compile a bibliography in a format stipulated by an accepted manual of style • B.1.3 (c) select the most appropriate format for the product or presentation • B.1.3 (d) develop a product or presentation that utilizes the strengths of the medium and supports the conclusions drawn in the research effort • A.1.1 (b) demonstrate the correct operation of a computer system on a network • A.1.1 (g) scan, edit, and save a

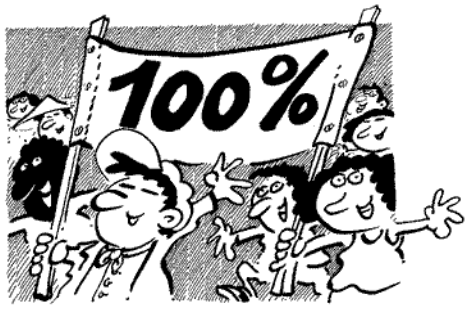
Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
	graphic or video using a scanner, digital camera, video camera or other digitising equipment • A.1.2 (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information • **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
3.C.6 Experiment with different types of sentences and literary devices so as to improve clarity and artistry of expression.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • B.1.3 (b) compare strengths and weaknesses of possible presentation methods and products
3.C.7 Edit for sentence variety, word choice, and appropriateness of tone to audience and purpose.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • B.1.3 (a) determine the audience and purpose for communicating the information • A.1.1 (e) recognise and solve routine computer hardware and software problems • A.1.1 (g) scan, edit , and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment • **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
	support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
3.C.8 Apply selling rules, capitalization and punctuation conventions in their editing and proofreading activities.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats • A.1.1 (e) recognise and solve routine computer hardware and software problems • A.1.1 (g) scan, edit, and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment • **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
3.C.9 Write legibly to communicate information to others.	• B.1.2 (c) follow standardized note taking processes and compile bibliographic information in an approved format • A.1.1 (c) demonstrate touch keyboarding skills at acceptable speed and accuracy levels (suggested range 20-25 wpm) • A.1.2 (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) • A.1.2 (e) use electronic encyclopaedias, almanacs, indexes,

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
	and catalogues to retrieve and select information • A.1.2 (g) identify common integrated software packages or applications suites • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used • **C.1.1** Participate productively in workgroups or other collaborative learning environments • **A.3.1** Use computer and communications software to access and transmit information.
3.C.10 Demonstrate understanding of the features of the different types and genres of text.	
3.C.11 Demonstrate an understanding of the features of the differences types and genres of text.	
3.C.12 Use capitalization and punctuation conventions when editing and proofreading.	• **A.2.1** Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. • **A.2.2** Use media and technology to create and present information • **A.2.3** Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations. • **A.2.4** Integrate various applications.
D. KNOWLEDGE OF LANGUAGE	
3.D.1 Demonstrate increased competence in the rules of English grammar.	• A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) • A.1.3 (a) identify risks to health and safety that result from improper use of technology • A.1.3 (b) identify and apply safety procedures required for the technology being used

Language Arts Learning Objectives *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
3.D.2 Understand the basic differences between local varieties of language and Standard English.	• A.1.2 (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing)
3.D.3 Explore the factors that influence the evolution of language.	• B.1.2 (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting
3.D.4 Demonstrate sufficient knowledge of language to being the process of editing and proofreading.	• B.1.1 (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats

5. ICT Learning Outcomes for Mathematics



Some teachers in the Caribbean have been using ICT to support the development of mathematics for years. They have traditionally used a range of software to reinforce mathematical concepts; focus on the development of specific mathematical concepts; and to demonstrate mathematical knowledge and understanding through problem solving. Others (in Barbados, Jamaica, Trinidad and Guyana) have used Integrated Learning Systems (ILS) to help in developing mathematical skills in their students.

All too often ICT has been seen as the tool that does 'the teaching'. Children have been placed in front of a computer screen and left to work their way through particular exercises or programs with little or no intervention from the teacher. This might contribute in some limited way towards the children's ICT entitlement but it does little to raise standards in mathematics.[22]

Children do not acquire mathematics skills and strategies by magic. They need to be taught how to work things out in their heads, how to check whether their answers are reasonable and how to plan ahead when solving mathematical problems. They need opportunities to discuss their ideas with their teacher and their peers, to test things out and to listen to how other children arrived at their solutions. This interaction is vital for developing mathematical ideas and understanding.

Teachers should therefore use computer software in their daily mathematics lesson only if it is the most efficient and effective way to meet their lesson's objectives. For example, an aimless exploration of an 'adventure game', or repetitive practice of number bonds already mastered, is not good use of lesson time. Similarly, it is time-consuming for children to develop their understanding of addition and subtraction by taking turns to instruct a floor robot to move along a number track; a much quicker way of achieving the same mathematical objective is for as many children as possible to walk up and down the track, and to observe others doing so.

22 Using ICT to support mathematics (http://www.standards.dfee.gov.uk/numeracy/teaching_resources/?sec=4&up_id=288&atcl_id=2554&ovrsz=0)

Technology helps to make students more powerful students by giving them the means to explore mathematical concepts more easily and quickly. In the time gained by using technology, students can study fundamental ideas in greater depth, and can concentrate their effort in the areas of data collection, data analysis, simulations, and complex problem solving. Whereas student investigators once relied solely on their creativity and their sophistication in the use of largely paper-and-pencil methods to guide them in the solution of problems, they can now turn to technology, which provides capabilities that alter both the form and the means of solution. [23]

The use of spreadsheets and symbolic manipulators permits students to explore without excess algebraic manipulation. Calculators save students time in performing complex arithmetic calculations. Graphing utilities enable students to visualise relationships and test hypotheses. Statistical packages and scientific probes allow students to collect and analyse real data from real experiments. The use of technology in learning and doing mathematics also gives students excellent opportunities to develop their abilities in algorithmic thinking, for example, by creating templates in spreadsheets or by writing sequences of instructions in application programs as part of a problem-solving process.

The presence of technology as part of learning mathematics makes many new things possible, but it also places an increasing importance on the ability of students to make mental judgements about expected results. For example, the student who uses a calculator to perform an arithmetic calculation should have the habit of using estimation to judge the reasonableness of the answer produced. Similarly, the student who produces a graph using technology should be capable of creating a mental approximation of the graph as a verification of the image on the screen.

5.1 Areas of Numeracy

Mathematics should be viewed as a unified whole made up of connected, big ideas rather than as a disjointed collection of meaningless, abstract ideas and skills. Learning is easier when students see the connections between various concepts and procedures, and between the various branches of mathematics. Students should also be aware of the connections between, and applications of, mathematics and other disciplines, such as the sciences, art, music, business, medicine, and government.

5.1.1 Number Operations And Relationships

People use numbers to quantify, describe, and label things in the world around them. It is important to know the many uses of numbers and various ways of representing them. Number sense is a matter of necessity, not only in one's occupation but also in the conduct of daily life, such as shopping, cooking, planning a budget, or analysing information reported in the media. When

[23] Ontario Secondary School Curriculum, Grades 9 and 10. 1999.

computing, an educated person needs to know which operations (e.g., addition, multiplication), which procedures (e.g., mental techniques, algorithms*), or which technological aids (e.g., calculator, spreadsheet) are appropriate.

From doing repetitive calculations to showing patterns in certain number manipulations, spreadsheets can play an important role in mathematics at most levels. Spreadsheets can manipulate variables or parameters to see certain effects that can be more clearly and quickly demonstrated with the use of spreadsheets. Students can also request various types of charts to be plotted from values entered into a spreadsheet.

5.1.2 Geometry

Geometry and its study of shapes and relationships is an effort to understand the nature and beauty of the world. While the need to understand our environment is still with us, the rapid advance of technology has created another need - to understand ideas communicated visually through electronic media. For these reasons, educated people in the 21st century need a well-developed sense of spatial order to visualize and model real world problem situations.

5.1.3 Measurement

Measurement is the foundation upon which much technological, scientific, economic, and social inquiry rests. Before things can be analysed and subjected to scientific investigation or mathematical modelling, they must first be quantified by appropriate measurement principles. Measurable attributes include such diverse concepts as voting preferences, consumer price indices, speed and acceleration, length, monetary value, duration of an Olympic race, or probability of contracting a fatal disease.

5.1.4 Statistics And Probability

Dramatic advances in technology have launched the world into the Information Age, when data are used to describe past events or predict future events. Whether in the business place or in the home, as producers or consumers of information, citizens need to be well versed in the concepts and procedures of data analysis in order to make informed decisions.

Using suitable software tools takes the pain of hours of calculation out of statistics and provides students with the means to analyse results.

5.1.5 Algebra

Algebra is the language of mathematics. Much of the observable world can be characterised as having patterned regularity where a change in one quantity results in changes in other quantities. Through algebra and the use of variables

and functions, mathematical models can be built which are essential to personal, scientific, economic, social, medical, artistic, and civic fields of inquiry.

Students can use simple modelling packages, to gain insight into mathematical functions. Also the graphic calculator can be used for this purpose. We should be aware of the fact that this feature of ICT will change – some say completely – the curriculum of mathematics itself. It gives students access to easy to use tools for skills they themselves had to learn before these tools where available. This implies a shift from drawing graphs for functions to interpreting graphs drawn by ICT-tools.

Modelling and simulation can also be used in special software for geometry and stereometry; which will give the students a better understanding of figures in plane and space.

5.2 The Role of Calculators

The calculator is a powerful and efficient tool. It has a strong part to play in subjects such as geography, history and science, since it allows children of primary age to make use of real data - often numbers with several digits - that they have gathered in their research or experiments, perhaps to work out a percentage, or to compare totals or proportions.

In the primary years, the calculator's main role in mathematics lessons is not as a calculating tool, since children are still developing the mental calculation skills and written methods that they will need throughout their lives. But it does offer a unique way of learning about numbers and the number system, place value, properties of numbers, and fractions and decimals. For example, you could use an overhead projector calculator for whole-class demonstration purposes so that the class can predict what happens when they multiply by 10 or divide by 10, or individual children might use a calculator to find two consecutive numbers with a given product and then discuss their different approaches.

If children are to use the basic facilities of a calculator constructively and efficiently, they need to be taught the technical skills they will require: the order in which to use the keys; how to enter numbers such as sums of money, measurements or fractions; how to interpret the display; how to use the memory; etc. Children need to learn when it is, and when it is not, appropriate to use a calculator, and their first-line strategy should involve mental calculations wherever possible. They should also have sufficient understanding of the calculation in front of them to be able to decide which method to use - mental, pencil and paper, or calculator. When they do use a calculator they should be able to draw on well established skills of rounding numbers and calculating mentally to gain a sense of the approximate size of the answer and have strategies to check and repeat the calculation if they are not sure whether it is right.[24]

24 VTC. The role of calculators in primary mathematics.

5.3 Structure of Modular Arrangement of Mathematics Learning Outcomes

The following modules may be identified for the Mathematics Learning Outcomes in the Eastern Caribbean.

Year (Level) 1

Term	Module No.	Module Title
1	01	Sets
1	02	Number Theory
2	03	Algebra
2	04	Measurement and Geometry
3	05	Consumer Arithmetic and Statistics

Year (Level) 2

Term	Module No.	Module Title
1	01	Computation and Consumer Arithmetic
1	02	Number Theory and Sets
2	03	Statistics
2	04	Geometry
3	05	Algebra
3	06	Measurement

Year (Level) 3

Term	Module No.	Module Title
1	01	Measurement
1	02	Algebra
1	03	Geometry and Trigonometry
2	04	Transformation Geometry; Relations, Functions and Graphs
2	05	Number Theory and Computation
3	06	Statistics and Probability
3	07	Sets
3	08	Consumer Arithmetic

5.4 ICT Learning Outcomes for Lower Secondary School Mathematics

ITC Learning Outcomes were developed for each module in the Mathematics syllabus by compiling the information collected from the Curriculum Alignment Worksheets. These outcomes answer the question: 'What should students know and be able to do as an outcome of their learning at this level?'

The learning outcomes:

- reflect the breadth, depth and complexity of the curriculum
- are stated in terms that are measurable using a variety of assessment techniques.

Students are expected to use calculators or computers to perform operations that are lengthier or more complex than those covered by the pencil-and-paper expectations. When students use calculators and computers to perform operations, they are expected to apply their mental computation and estimation skills in predicting and checking answers. Students will also use calculators and computers in various experimental ways to explore number patterns and to extend problem solving.

The matrix that follows in Section 5.4.1 – 5.4.3 shows the relationship between the Harmonized Curriculum for Lower Secondary School Mathematics and the ICT Learning Outcomes. In the left-hand column are the learning outcomes for Mathematics. The right-hand column provides the related learning outcomes for ITC. It is hoped that this table will help classroom teachers to determine where ITC Learning Outcomes might best be integrated into specific curricular areas.

The following ICT Learning Outcomes can be used across the entire spectrum of the Lower Secondary School Mathematics Curriculum:

- **A.1.2 (c)** define the basic types of learning software (e.g., drill and practice, tutorial, simulation)
- **A.1.2 (d)** identify and use the basic types of learning software (e.g., drill and practice, tutorial, simulation)
- **A.1.3 (b)** identify and apply safety procedures required for the technology being used
- **B.1.2** Locate and access information sources
- **B.2.1 (d)** participate in decisions about group and classroom projects and learning objectives
- **B.2.1 (e)** identify and select topics of personal interest to expand classroom learning projects
- **B.2.1 (f)** recommend criteria for judging success of learning projects
- **B.2.1 (g)** establish goals and develop a plan for completing projects on time and within the scope of the assignment

The following Learning Outcomes may be used across specific modules

Mathematics Module	ICT Learning Outcomes
Computation, Statistics and Data Management Modules	**A.2.1 (f)** construct a simple spreadsheet, enter data, and interpret the information
Geometry, Sets and Measurements	**A.2.2 (a)** use draw, paint, or graphics software to create visuals that will enhance a class project or report
Problem Solving	**B.1.2 (a)** select information clearly related to the problem or question
Statistics	**B.2.1 (c)** draw conclusions and support them with credible evidence

Section 8.4 provides examples of how the learning outcomes may be incorporated into classroom instruction. Section 8.5 and 8.6 provide templates for the development of technology-rich lesson plans.

5.4.1 Mathematics – Year 1

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
MODULE #1. SETS AND ALGEBRA	
1.1.1 Concept of a Set a. Recognize relationship among groups of objects. b. Identify examples of sets in real life. c. Define a set. d. Identify examples and non-examples of a given set.	
1.1.2 Set Notation a. Express a set using various notations - listing members; describing b. List the elements of a set given in descriptive form and vice versa. c. Identify and use correct notation in expressing a set, e.g. use capital letters to name sets; separate listed members with commas; use braces to open and close sets. d. Use the symbol '$\in$' to represent 'is an element of' e.g. 2 $\in$ {2, 4, 6, 8}.	
1.1.3 Types of Sets a. Identify examples of the empty/null sets. b. Use correct symbols to represent the empty/null set {or $\varnothing$ NOT {$\varnothing$} c. Distinguish between finite and infinite sets. d. Use correct set notation to list	

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
elements of finite and infinite sets. E.g. {2, 4, 6, 8} {2, 4, 6, 8, . . . 24} Finite {2, 4, 6, 8…} Infinite { . . . –3, -2, -1, 0, 1, 2 . . .}	
1.1.4 Set Relationships a. Identify equal sets. b. Identify and give examples of equivalent sets. c. Recognize the difference between equal and equivalent sets. (Equal sets have the exact same elements, not necessarily in the same order. E.g. {a, b, c} to {c, a, b} Equivalent sets have the same number of elements. E.g. {a, b, c,} is equivalent to {1, 2, 3}.\ d. Equal sets are also equivalent	
1.1.5 Subsets a. Identify and construct subsets of a given set. b. Recognize that every set is a subset of itself. c. Recognize that the empty set is a subset of every set. d. Use the correct symbol to express a set as a subset of another set. E.g. {2, 4, 6} {2, 4, 6, 8….}	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.1.6 Venn Diagrams a. Use Venn diagram notation to: - List elements of a set. - Show a set as a subset of another set.	
MODULE #2. NUMBER THEORY	
1.2.1 History of Numbers a. Selected number systems: i. Egyptian ii. Mayas/Aztecs iii. Hindu/Arabic iv. Roman	
1.2.2 Writing numerals a. Outline the development of number systems in a variety of civilizations. b. Describe the characteristics of the number systems. c. Compare the efficiency the various selected systems for representing numbers. d. Identify the symbols used in the number systems. e. Write numerals to represent	

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
numbers. f. Identify and write Roman numerals to represent numbers up to 2010. g. List the present –day uses of the Roman numeral system.	
1.2.3 Place Value a. Explain the role of place value in writing numbers in the decimal system. b. Explain the meaning of the term, 'place value'. c. Identify the base that is used in the decimal numeration system. d. Identify the place value of the digits in a numeral. e. State the value of the digits in a numeral. f. Use decimal notation for tenths and hundredths in everyday activities (e.g. money measurement in the metric system). g. Order decimal numbers in a variety of ways (e.g. on a number line, in ascending or descending order). h. Round numbers with one or two decimal places to the nearest whole number or tenth. i. Write numbers up to 9 999 999 in expanded form. j. Write numbers up to 9 999 999 when given in expanded form.	
1.2.4 Number Bases 2, 5, 8 a. Explain how numerals in bases other than 10 are written. b. Identify the place value of a digit in a numeral written in a base other than 10. c. State the value of a digit in a numeral written in a base other than 10. d. Convert numerals in base 10 to another base and vice versa.	
1.2.5 Types of Numbers a. Define the terms: factors, multiples, prime, composite, odd, even, etc. b. List the factors and multiples of given numbers. c. Classify numbers in a variety of ways, using number concepts such as prime, composite, odd,	

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
even, square numbers. d. Write numbers as a product of primes. e. Calculate the LCM & HCF of a set of no more than three numbers. f. Identify the patterns in sequences based on any of the four operations on whole numbers. g. Compose sequences of whole numbers. h. Identify the missing term(s) in sequences of whole numbers that are based on any one of the four basic operations on whole numbers.	
1.2.6 Fractions, Decimals & Percentages a. Represent fractions, decimals, and percent in a variety of ways: diagrams, pictures, number line etc. b. Generate fractions that are equivalent to a given fraction. c. Represent a given quantity as a fraction, decimal, and/or percent. d. Convert fractions to decimals, percents and vice versa. e. Compare quantities expressed as a fraction, decimal or percent. f. Explain the meaning of percent.	
1.2.7 Ratio and Proportion a. Explain the concept of ratio. b. Represent a ratio using objects, pictures/diagrams and numerals. c. Reduce a ratio to its simplest form. d. Generate ratios that are equivalent to a given ratio. e. Compare ratios using the symbols =, f. Explain the concept of proportion. g. Compare quantities using proportions	
MODULE #3. ALGEBRA	
1.3.1 Using letters/symbols to represent numbers a. Identify areas in Mathematics where letters and symbols are used to represent numbers. b. Recognise the significance of the use of letters and symbols in algebra.	
1.3.2 Like and Unlike Terms a. Differentiate between like and	

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
unlike terms.	
1.3.3 Concepts: Expressions and equations a. Create algebraic expression by using letters to represent unknown numbers, using real-life situation e.g. John has some mangoes. His brother Jim has two more. Write an algebraic expression to show how many mangoes Jim has. b. Write an algebraic expression to show three time a certain number plus five. c. Differentiate between an algebraic expression and an equation. d. Create simple equation using letters to represent unknown numbers, (in real-life situation). E.g.: A certain number plus five is equal to eight. Write an equation to represent the above.	
1.3.4 Simplifying Simple expression: a. Simplify algebraic expression by combining the like terms e.g. 3a + b + a = 4a + b. b. Find the numerical value of a given expression by substituting numbers for letters. e.g. if *x* = 2 and y = 4 then 4 *x* + y = (4 *x* 2) + 4 = 12.	
1.3.5 Equations a. Solve simple one-step equation with one unknown. *e.g.* $2x = 12$ $x = \frac{12}{2} = 6$ b. Solve simple two-step equations with one unknown *e.g.* $3x + 5 = 11$ $3x = 11 - 5 = 6$ $\frac{3x}{3} = \frac{6}{3}$ $x = 2$	
MODULE #4. MEASUREMENT AND GEOMETRY	
1.4.1 Metric System a. Recognize the need for scales in measurement b. Recognize the need for standard units of measurement c. Compare metric and imperial units	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
1.4.2 SI Units a. Measure area and record measurement using SI units. b. Measure volume and record measurement using SI units. c. Measure mass and record measurement using SI units. d. Measure temperature and record measurement using SI units. e. Measure time and record measurement using SI units.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.4.3 Length a. Find the relationships among mm, cm and m. b. Solve simple conversion problems involving mm, cm, and m.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.4.4 Time a. Find relationship among seconds, minutes and hours. b. Solve simple problems involving time. c. Solve problems involving distance, speed and time.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.4.5 Money a. Appreciate/recognize importance of money in everyday life. b. Recognize the various coins and notes. c. Solve problems involving money.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.4.6 Mass a. Find the relationship between mg and g. b. Find the relationship between g and kg. c. Find the relationship between mg and kg. d. Find the relationship among mg, g, and kg. e. Apply knowledge of mg, g, and kg in solving problems. f. Use tonne to describe mass of very large or heavy object.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.4.7 Capacity a. Find relationship between ml and cl. b. Find relations between cl and l. c. Find relationship between ml and l. d. Find relationship among m., cl, and l. e. Apply knowledge of ml, cl and l to find capacity of containers.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
1.4.8 Points, rays, line segments, lines a. Explain the concept of a point. b. Sort the fundamental geometric objects: line, plane, ray, line segment c. Distinguish between parallel lines and non-parallel lines. d. Distinguish between perpendicular and non-perpendicular pairs of lines. e. Represent/symbolize fundamental geometric objects: line, line segment, ray, curved lines, planes	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.4.9 Angles a. Sort different types of angles. b. Establish properties of the various types of angles. c. Use appropriate instruments to construct angles. d. Use appropriate instruments to measure angles.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.4.10 Polygons a. Sort different types of triangles with reference to their angular properties. b. Sort different types of triangles with reference to their linear properties. c. Classify triangles using their angular and linear properties. d. Use instruments to construct various types of triangles. e. Sort different types of quadrilaterals with reference to their angular properties. f. Sort different types of quadrilaterals with reference to their linear properties. g. Classify quadrilaterals using their angular and linear properties. h. Use instruments to construct various types of quadrilaterals.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.4.11 Circles a. Use instruments to construct circles of various sizes.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
MODULE #5. CONSUMER ARITHMETIC AND STATISTICS	
1.5.1 Profit and Loss a. Explain the meaning of the terms: profit, loss, cost price and selling	• A.2.1 (e) classify collected data and construct a simple database by defining fields, entering and sorting

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
price. b. Calculate the profit or loss given the cost price and selling price of an object. c. Calculate the cost price of an object given the selling price and profit or loss as an amount of money (or as a percent). d. Calculate the selling price of an object given the cost price and the profit or loss as an amount of money or as a percent. e. Express profit and loss as a percent of the cost price.	data, and producing a report • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.5.2 Discounts and Sales a. Explain the meaning of the terms: marked price, sale price and discount. b. Calculate the actual discount given the sale price and marked price. c. Calculate discount as a percent of the marked price. d. Calculate the sale price given the marked price and the discount as an amount of money or as a percent.	• A.1.1 (h) use simple graphing calculator functions to solve a problem • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.5.3 Currency Conversion a. Define the term, currency. b. Outline the need for foreign currency. c. Identify the common foreign currencies that are used in the OECS. d. Read and interpret amounts of money in common foreign currency. e. Explain the concept of exchange as it related to monetary currencies. f. Given the exchange rate, convert from the home currency to a foreign currency and vice versa.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.5.4 Sales Tax a. Explain the meaning of the terms, sales tax and value-added tax. b. Calculate the total cost of an object given the selling price and sales tax. c. Calculate the actual sales tax, given the total cost and selling price of an object. d. Calculate the sales tax as a percent of the selling price.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)

Mathematics Learning Outcomes *By the end of Year 1 students will:*	**ICT Learning Outcomes** *Students will:*
1.5.5 Bills a. Read and interpret simple bills, e.g. shopping bills, restaurant bills and utility bills. b. Solve problems that are based on shopping, restaurant and utility bills.	• A.1.1 (h) use simple graphing calculator functions to solve a problem • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.5.6 Data-gathering procedures a. Recognize the importance of data management in making decisions. b. Recognize the importance of data-gathering procedures. c. Collect data on every-day phenomena. d. Analyse data to make decisions.	
1.5.7 Data presentation a. Draw and use pie charts. b. Draw and use bar charts. c. Draw and use line graphs. d. Draw and use proportionate bar graphs.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.5.8 Average a. Recognize situations in which the mean, median or mode is the most applicable measure of central tendency. b. Calculate the mean for a set of discrete data. c. Calculate the median for a set of discrete data. d. (d) Identify the mode for a set of discrete data.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.5.9 Range of a Distribution a. Explain “range” as applied to a set of data. b. (b) Represent “range” for a set of data as an equation.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
1.5.10 Making Inferences a. Make simple inferences, decisions and judgments based on observed trends and patterns in data.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)

5.4.2 Mathematics – Year 2

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
MODULE #1. COMPUTATION AND CONSUMER ARITHMETIC	
2.1.1 Negative and positive integers a. Add or subtract any two negative or positive integers.	
2.1.2 Negative and positive integers a. Add or subtract any two negative or positive integers.	
2.1.3 Percentages a. Calculate a specified percentage of a given quantity as a percentage of another. b. Express one quantity as a percentage of another.	
2.1.4 Estimation a. Estimate sums and products of whole numbers to the nearest hundreds and to the nearest thousands.	
2.1.5 Sequences a. Identify patterns in number sequences.	
2.1.6 Ratios a. More involved problems.	
2.1.7 Direct Proportion a. More involved problems	
2.1.8 Calculation of profit/loss, cost price, selling price a. Solve problems involving profit/loss. b. Calculate the profit/loss on a transaction as an amount of money or as a percent. c. Calculate the selling price of an article, given the cost price and the profit/loss as an amount of money or as a percent. d. Calculate the cost price of an article, given the selling price and profit/loss as an amount of money.	
2.1.9 Discount a. Use the following terms to describe transactions involving discounts: discount, discount price, marked price, sale price and selling price. b. Solve problems involving discounts. c. Calculate the value of a discount as (a) an amount of money and	

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
(b) a percent of the marked price. d. Calculate the sale/discount price of an article given the marked price and the discount as (a) an amount of money or (b) a percent. e. Calculate the marked price of an article given the sale/discount price and the discount as an amount of money.	
2.1.10 Currency a. Read and interpret exchange rates. b. Solve problems involving currency conversion. c. Convert from home currency to foreign currency and vice versa.	
2.1.11 Wages/Salaries a. Use appropriate terms to describe situations related to payment for employment: e.g., wage, salary, basic wage, hourly wage, hourly rate, overtime, time and a half, double time etc. b. Solve problems involving salaries and wages. c. Calculate basic wages. d. Calculate over-time wages. e. Calculate total wages/salaries for a given time period. f. Calculate hourly/weekly rates.	
2.1.12 Bills a. Use vocabulary associated with bills, e.g. total cost, unit cost, sales tax, service charge. b. Solve problems that are based on shopping bills, restaurant bills, utility bills. c. Calculate the total cost of items. d. Calculate sales tax and service charges. e. Calculate the discount to be deducted from bills, given the discount as a percent. f. Calculate the unit cost of items.	
MODULE #2. NUBER THEORY AND SETS	
2.2.1 Sets of numbers: Whole, rational, real, integers a. Define the set of real numbers. b. Identify different subsets of the real number system. c. Identify the relationship between the different subsets of real	

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
numbers. d. Arrange integers according to size on a number line. e. Compare integers using inequalities symbols. f. Define the laws of indices g. Use the laws of indices of simplify expressions with integral indices	
2.2.2 Number Properties: Commutative Property, Associative property and distributive property a. Identify and differentiate between the order of operations (BOMDAS). b. Define the number properties. c. Apply the laws in performing the four basic operations. d. Use the properties to carry out computation in problem-solving situations.	
2.2.3 Bases: 2, 5, and 8 a. Identify the place value of the digits in bases 2, 5 and 8. b. Perform simple operations in addition and subtraction in bases 2, 5 and 8.	
2.2.4 Set Notation a. Build universal sets, given a series of subsets. b. Identify subsets of a given universal set. c. Use the correct symbols to represent the Universal set (U/$\in$) d. Identify members and non-members of a particular named subset in a given universal set. e. Identify and list the members of the complement of a set. i. Use correct notation for the complement of a set. ii. Use shaded region in Venn diagram to show the complement of a set. f. Identify the elements found in the intersection of two sets. g. Use the correct symbol for intersection of sets. h. Use shaded regions in Venn diagrams to show intersection of set. i. Identify the elements found in the union of two sets. j. Use correct symbol for union of	

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
sets. k. Use shaded regions on Venn diagram to represent union of sets. l. Determine elements of intersection and elements of union of set from information given on Venn diagram. m. Use Venn diagram to show union and intersection of sets. n. Determine the number of elements in any given finite set. o. Use correct notation to represent the number of elements in a set n(B) = 4 means number of elements in set B=4. p. Use the number line to show graphical representation of inequalities. q. Use set builder notation to represent simple inequalities: Example: x = x: $x < 4$, $x \in N\}$ a. Or $x = \{x / x > 2\}$	
2.2.5 Types of sets a. Differentiate between finite and infinite sets. b. Use set notation to list members of finite and infinite sets.	
2.2.6 Set Relationship a. Identify sets that are joint and disjoint. b. Give examples of sets which are disjoint. c. Use symbols to show that the intersection of a disjoint set is an empty set. (If set A and set B are disjoint, the A ^ B = Ø	
2.2.7 Subsets a. List subsets of sets of up to four elements. b. Identify patterns found in listing subsets of sets with up to 4 elements and use these patterns to form and test conjectures. c. Determine the number of subsets in a set of no more than five elements. (Number of subsets = 2^n, where n = number of elements in the set). d. Identify proper subsets of a given set. e. Use correct notation to represent proper subsets. (proper subsets – C)	

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
(all subsets – C) (All subsets except the set itself are considered proper subsets). f. Use Venn diagrams to solve problems involving two sets.	
MODULE #3. STATISTICS	
2.3.1 Data Gathering a. Construct instruments for data gathering b. Plan statistical investigation. c. c) Use instruments to gather data.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
2.3.2 Data presentation a. Select appropriate graphic mode of presenting data. b. Organize data for presentation. c. Construct appropriate graph to display data.	• A.1.1 (h) use simple graphing calculator functions to solve a problem • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
2.3.3 Data Interpretation a. Interpret data displayed on bar charts, pie charts, line graph, pictograms, tables. b. Identify trends in graphs.	• A.1.1 (h) use simple graphing calculator functions to solve a problem • A.2.1 (c) move textual and graphics data from one document to another • A.2.1 (d) use graphics software to import pictures, images, and charts into documents • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
2.3.4 Frequency Distributions a. Construct frequency distribution tables from raw data. b. Interpret frequency distribution tables.	• A.1.1 (h) use simple graphing calculator functions to solve a problem • A.2.1 (c) move textual and graphics data from one document to another • A.2.1 (d) use graphics software to import pictures, images, and charts into documents • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
2.3.5 Measures of Central Tendency a. Calculate the arithmetic mean for given sets of data. b. Identify the median and mode for given sets of data. c. Explain the relative advantage of mean, median and mode. d. Explain or describe types of distributions that are formed when the mean, mode e. And median occupy different	• A.1.1 (h) use simple graphing calculator functions to solve a problem • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
positions in a distribution.	
MODULE #4. GEOMETRY	
2.4.1 Points, rays, line segments, lines. a. Review points, rays, line segments, lines (parallel and perpendicular). b. Manipulate set squares to draw parallel lines. c. Construct the perpendicular bisector of a line, using pair of compasses.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
2.4.2 Angles a. Identify different types of related angles formed when sets of parallel lines are cut by transversals b. alternate, corresponding, vertically opposite c. supplementary, interior, adjacent d. Explain the relationship between alternate, corresponding, vertically opposite, supplementary, interior and adjacent angles formed when a set of parallel lines is cut by a transversal. e. Find missing angles given various linear relationships. f. Identify different types of angles in the environment. g. Link reflex angle to acute, right angle, obtuse and straight angles h. Draw and measure reflex angles. i. Bisect given lines using geometric instruments. j. Construct angles of 60 degrees. k. (Constructions should be done using straight edges and pair of compasses only)	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
2.4.3 Circles a. Review attributes of a circle (radius, diameter, circumference). Explain the b. relationship between diameter and circumference. c. Calculate the circumference of a circle, given its diameter or radius. d. Calculate the radius of a circle, given the circumference. e. Solve problems involving circumference, diameter and radius.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
MODULE #5. ALGEBRA	
2.5.1 Use letters/symbols to represent numbers a. Express simple verbal phrases and statements using algebraic symbols. Create simple verbal phrases and statements to represent given algebraic expressions or equations. b. Simplify algebraic expressions involving addition and subtraction (using like and unlike terms). c. Simplify and expand algebraic expressions using the distributive law: (e.g. x (2 + y) – 2x 2 x + xy – 2x = xy d. Simplify algebraic fractions involving multiplication and division only. e.g. $\frac{2x}{2} = x$ $\frac{5x^2}{8x} = \frac{5x}{8}$ e. Find the L.C.D. of simple algebraic fractions. e.g.: 4 and 2x L.C.D. = 4x x 4 3 and 5x L.C.D. = 8x 2x 8 f. Factorize simple algebraic expressions using the distributive law. e.g.: (a) 2 x + 6 = 2 (x + 3) (b) 4x + 6y + 8x + 9 = 12x + 6y + 9 = (4x + 2y + 3) g. Substitute numbers for variables in algebraic expressions and find numeric value of these expressions. (Expression should contain more than one operation and build on work done in Form 1). h. Use laws of indices to simplify algebraic expressions with positive integral indices. (Use multiplication, division and powers only).	

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
i. Laws of indices: $a^x \times a^y = a^{x+y} \longrightarrow a^2 \times a^3 = a^{2+3} = a^5$ $a^x \div a^y = a^{x-y} \longrightarrow a^3 \div a^2 = a^{3-2} = a^1$ $(a^x)^y = a^{xy} \longrightarrow (a^3)^2 = a^{3x2} = a^6$	
2.5.2 Linear Equation a. Write linear equations with one unknown from given verbal/written statements. b. Solve and write linear inequalities with one unknown.	
MODULE #6. MEASUREMENT	
2.6.1 Length a. Calibrate instruments for measuring length b. Make corrections for zero errors when using defective instruments. c. Determine perimeter of regular two-dimensional shapes (quadrilaterals, and circles). d. Determine perimeter of composite shapes. e. Solve word problems involving lengths and perimeters of 2-D shapes. f. Convert units of length within the SI and imperial systems.	
2.6.2 Area a. Calculate the area of common two-dimensional shapes. b. Construct cube using squares (cut-outs) c. Construct cuboid using cut-outs of squares and rectangles. d. Dissect cube to form nets. e. Dissect cuboids to form nets. f. Construct cylinders using cut-outs of rectangles and circles. g. Dissect cylinders to form nets. h. Calculate surface area of cubes, cuboids and cylinders by adding areas of component 2-D shapes.	
2.6.3 Volume a. Recognize the relationship between volume and capacity. b. Calculate volume of regular solids –cubes, cuboids and cylinders. c. Measure volume of irregular solids. d. Solve problems involving volume of regular and irregular solids.	

Mathematics Learning Outcomes *By the end of Year 2 students will:*	**ICT Learning Outcomes** *Students will:*
2.6.4 Time a. Use stop-watch to time various events. b. Convert intervals in days to months, months to years etc and vice versa. c. Solve problems involving distance, time and speed (use graphs).	
2.6.5 Temperature a. Convert units of temperature from ^{o}C to ^{o}F and vice versa. b. Solve problems involving temperature changes.	
2.6.6 Mass a. Estimate mass in SI and imperial units. b. Convert units of mass within the SI and imperial system (large to small and vice versa) c. Pose/construct problems involving mass. d. Solve problems involving mass.	

5.4.3 Mathematics – Year 3

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
MODULE #1. MEASUREMENT	
3.1.1 Length a. At the beginning of Year Three the following should be reviewed and extended: - Select appropriate units for measuring lengths and distances. - Measure lengths in SI and Imperial units. - Estimate lengths and distances to the nearest mm, cm, m. - Convert units of length within the SI system. - Make corrections for zero errors when using defective measuring instruments. b. Convert measurement on maps and scale diagrams to real lengths and distances. c. Cuboids, cylinders and prisms. Solve problems involving perimeter of composite shapes.	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
3.1.2 Area a. Explore development of formulae for calculating the area of rectangles, circles, triangles. b. Determine the area of pentagons and hexagons. c. Determine/calculate areas of parallelogram, trapezium and composite shapes. d. Calculate surface area of simple solids – cubes, cubicles, cylinders and prisms.	
3.1.3 Volume a. Recognise volume as a measure of capacity. b. Calculate volume of cubes, cuboids. c. Calculate volume of cylinders d. Calculate volume of prisms.	
3.1.4 Mass a. Recognize mass as a measure of the amount of matter. b. Estimate mass of objects in SI and Imperial units. c. Measure mass of objects using calibrated scales. d. Convert units of mass within the SI system (large to small and vice versa). e. Solve problems involving mass.	
3.1.5 Time a. Review the following: - operations involving, days, months, years - time on the 24-hour and 12-hour clocks. b. Construct simple distance – time graphs. c. Interpret simple distance-time graphs. d. Solve problems involving distance, time and average speed. e. Solve problems using distance-time graphs. f. Use protractors to construct model clocks. g. Solve problems involving angles formed by hands of a clock at various times.	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
MODULE #2. ALGEBRA	
3.2.1 Expressions a. Use symbols to represent numbers operation and variables in relations. - Focus on meaning of operations with symbols. Ensure the short cuts in operations are clearly understood. - Operations should also include simple binary operation, where other symbols are used for standard operations. Example: a o b means a x b + 2. b. Explain laws of operations and apply these to algebraic situations. *Example: Commutative* *2a + a = 3a and a + 2a = 3a* *but 2a – a = a; a – 2a = -a.* *Example: Distributive* *3 (x + y) = 3 x + 3 y* *Example: Associative* *(a + 2a) + 3a = a + (2a + 3a) = 6a* Identity for addition and multiplication Inverse for addition and multiplication. c. Distinguish between 'like' and 'unlike' terms. - This should included power/indices. Therefore some review of how indices operate would be necessary. Teacher should also help students to avoid incorrect or premature generalizations, and application of incorrect rules. *Examples:*	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
$2a^2 + 5a^2 = 7a^2$ (like terms); *But, $2a^2 + 3a + a^3$ (cannot be simplified since all terms are unlike.)* d. Express mathematical statements using algebraic symbols and vice versa. *Example:* *seven times a number (x)* *plus another number (y)* *(7x + y)* e. Simplify algebraic expressions involving the four basic mathematical operations. Simplification should begin with single operations with positive answers and progress gradually to four operations with negative components. *Example:* *$3x^2 – 5y^2 + 2z^2 – x^2 – 3y^2 – 8z^2$* *$= 2x^2 – 8y^2 – 6z^2$* Laws of operations should be used here to help students to simplify the expressions. f. Simplify algebraic expressions by regrouping (expanding and factorizing). *Example:* *ab + ac + bp + cp* *= (ab + bp) + (ac + cp)* *b (a + p) +c (a + p)* *= (b + c) (a + p)* *or (ab + ac) + (bp + cp)* *= a (b + c) + p (b + c)* *(a + p) (b + c)* Teachers should recognize and encourage a variety of ways of regrouping which alternately lead to same answer. Commutability of multiplication needs to be appreciated also. Special emphasis must be placed	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
on effect or negative sign before the bracket or the contents of the brackets. *Example:* *4 px – 4 py – 3qx + 3qy* *Rearrange terms where necessary* *4 px = 3 qx – 4 py + 3 qy* *= (4 px – 3 qx) – (4py – 3 qy)* *= x (4 p – 3 q) – y (4 p – 3 q)* *= (x – y) (4 p – 3 q)* g. Use laws of indices to manipulate expressions with integral indices. (Link to objective 3). Integral indices include positive and negative indices. h. Find the H.C.F. of algebraic expressions and use it to factorize expression completely. Example: $10x^3 y^2 + 5 x^2 y^5 – 15xy^3$ H.C.F. = $5 x y^2$ Can be factorized to give $x y^2 (2 x^2 + xy^3 – 3y)$ i. Apply distributive law to insert and remove bracket in algebraic expressions. *Example: 49 p^2 + 7 p* *= 7 p (7 p + 1)* *5x (2 + y – z)* *= 10 x + 5xy – 5 x z* j. Find numerical values for algebraic expressions by substituting numbers for the variables. Focus on multiple operations in one expression to build on work done in Form 2. *Example:* *(2 x – y)/ (z + 3)* *where x = 5, y = 2, z = 1*	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
3.2.2 Equations: a. Write and solve linear equations with one unknown. b. Write simple inequalitics and find their solution sets. *Example:* *x– 3 > 4* *x> 4 + 3* *x > 7* c. Change the subject of simple inequalities and linear equations. *Example:* *ax = b = > x = b/a* *x + y <9* *y < 9 – x* d. Solve simple word problems involving linear equations. e. Create suitable word problems to represent given linear equations. f. Solve simultaneous equations involving two unknowns. *Example:* *3x + y = 18* *+ 2 x – y = 7* *5x = 25* *By elimination* *x = 5* *2 x – y = 7* *(2 x 5) – y = 7* *10 – y = 7* *y = 3* *or by substitution* *y = 18 – 3x* *2x – (18-3x) = 7* *2x – 18 + 3 x = 7* *5x – 18 = 7* *5x = 25 (7 + 18)* *x = 5* *y = 18 – 3 x* *y - 18 – (3 x 5)* *y = 3*	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
MODULE #3. GEOMETRY AND TRIGONOMETRY	
3.3.1 The Circle and Pi a. Review the properties of a circle. b. Determine an approximate value of Pi through investigation of the relationship between the circumference and the diameter. c. Discuss the value of Pi and common approximations which are used for convenience e.g. 22 d. 7 e. Derive the method for calculating the area of a circle by subdividing circle into small sectors and fitting to form rectangle. f. Solve problems involving relationships in the circle (e.g. circumference, diameter, area, radius).	
3.3.2 Solids a. Sketch cross-section of simple solids (prism, cylinder, pyramid and cone). b. Sketch solids c. Use properties of solids in solving problems.	
3.3.3 Pythagoras Theorem a. Demonstrate the Pythagoras' rule using concrete materials. b. Explain the Pythagoras' rule. c. Explain the relationship among the squares formed on the sides of right- angled triangles. d. Use calculators to investigate the Pythagoras' triples. e. Use calculators to investigate Pythagoras' primitive triples. f. Use relationships among sides to solve problems involving right-angled triangles. g. Change the subject of the formula in the Pythagoras Theorem ($a^2 = b^2 + c^2$). h. Identify instances for applications of Pythagoras' rule.	
3.3.4 Trigonometric Ratios a. Label the sides and angles of right-angled triangles in conventional manner. b. Formulate the relationships between the lengths of sides and the angles in a right-angled triangle.	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
c. Label the sides of the right-angled triangle as hypotenuse, opposite and adjacent. d. Explain and demonstrate that the angle is directly proportional to the ratio of the sides. e. Explain the term, sine of an angle.	
MODULE #4. TRANSFORMATION GEOMETRY, RELATIONS, FUNCTINS AND GRAPHS	
3.4.1 There are some words associated with transformations that should be known: a. Object – the original shape before anything is done to it. b. Image – the shape after a transformation has been carried out. c. Map or mapped – the word often used instead of 'move' or 'transformed'. d. Displacement – the amount a shape has been moved. e. Congruent – the object and image are congruent if they are exactly the same size and shape.	
3.4.2 Translation a. Demonstrate the translation of 2-D shapes (concretely, pictorially and abstractly). b. Explain the relationship between an object and its image on a coordinate plane. c. Construct column vectors. d. Explain the function of the upper and lower numbers with respect to the direction. e. Use column vectors to translate from an object to its image in a coordinate plane. f. List the properties of a translation.	A.1.1 (h) use simple graphing calculator functions to solve a problem *[covers objectives c & d]*
3.4.3 Reflection a. Identify shapes that have line symmetry. b. Reflect a simple object using a mirror line. c. Explain the relationship between an object and image of a reflection. d. Establish the line of reflection. e. Write the equation of the line of reflection given the object-image relationship.	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
f. List the properties of a reflection. g. Given the coordinates of an object and a rule for the line of reflection, find the image.	
3.4.4 Rotation a. Explain and demonstrate what is meant by a "rotation". b. Differentiate between counter clockwise and clockwise rotations. c. Identify the standard direction of rotation. d. Identify the three cases of rotation; centre of rotation: - outside the shape - on the shape - inside the shape. e. List the properties of a rotation. f. Identify shapes which have rotational symmetry. g. State the order of rotational symmetry. h. Identify shapes which are asymmetrical. i. Given the object, centre and angle of rotation, find the position of the image. j. Given the image, the centre and angle of rotation, find the original position of the object.	
3.4.5 Enlargement a. Explain and demonstrate what is meant by an enlargement. b. Explain and demonstrate what is meant by a reduction. c. Explain and demonstrate what is meant by scale factor. d. Explain the effect of scale factor. e. Recognise that enlargements result in similar figures but not congruent ones. f. Construct the image of an object, given the centre of enlargement and the scale factor. g. Find the scale factor, given an object and its enlargement. h. Find the centre of an enlargement given an object and its image after enlargement. i. Identify the three cases of enlargement. - centre of enlargement outside the shape - centre of enlargement on	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
the shape - centre of enlargement inside the shape. j. Use the ray method to construct enlargement of objects in the plane or on the plane. k. Use the concept of similar figures to calculate the length of sides in an object and its image under an enlargement.	
3.4.6 Mappings a. Using correctly the terminology related to mappings and relations e.g. domain, co-domain, range, image, b. Determine and use the four types of mapping. - Teacher should use real-life situations to establish these mappings. *Example:* *Mark is the only son of Mr. Smith (I-I)* *(I-M) Mrs. Vidal has many students.* *Many subjects are studied by one student . (M-I).* *(M-M) Many students belong to more than one club in school.* c. Draw mapping diagrams, given the domain and the rule. d. Find the rule of the mapping, given the co-domain and the domain. e. Write out a mapping as an ordered pair, given the co-domain and rule. *Note: The range and co-domain are the same only when all the members of the range belong to the co-domain. The set of numbers under consideration would form the range. However, the co-domain would be only those numbers which satisfy the relation.*	
3.4.7 Relationship a. Identify the classifications of mappings which are functions. - one to one and many to one mappings are functions. - Identify the relations which are functions.	• A.2.2 (a) use draw, paint, or graphics software to create visuals that will enhance a class project or report *[covers objective (a)]*

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
b. Use the various forms of functional notations f: $x \longrightarrow x + 3$ (Read f is the function which maps x into $x + 3$) f (x) = $x + 3$ c. Plot points on a Cartesian plane using ordered pairs (relations) that represent linear equations. d. Determine the function, given a set of ordered pairs or points on the Cartesian plan. *Note: A relation is a function if no x – co-ordinate in the set of ordered pairs is repeated.* *For a relation to be a function a vertical line can only cut the graph of the function in one place.* *Only one-to-one and many-to-one mappings are functions.* *- A mapping is an arrow graph where each member of the first set (domain) has at least one image in the second set (co-domain).* *- A relation is an array of ordered pairs.*	
MODULE #5. NUMBER THEORY AND COMPUTATION	
3.5.1 Estimation and Accuracy a. Make intelligent estimations of physical quantities (length, mass, capacity, time). b. Measure and record quantities using table/chart (SI units only).	
3.5.2 Place Value a. Round off any decimal number to indicated number of decimal places. b. Write any decimal whole number to a given number of decimal places. c. Indicate decimal place on a number line.	
3.5.3 Significant figures a. Define the concept of significant figures. b. Write numbers to a given number of significant figures.	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
c. Apply estimation to problems to determine the reasonability of solutions. d. Round off decimals and whole numbers to indicate the number of significant figures.	
MODULE #6. STATISTICS AND PROBABILITY	
3.6.1 Statistical Terms - Population, sample a. Explain the terms, population and sample. b. Differentiate between the terms population and sample	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
3.6.2 Data Collection and Representation of data a. Collect and classify statistical data b. Tabulate statistical data using simple tables and simple group frequency distribution c. Construct and use simple frequency distributions (frequency table). d. Construct and use statistical diagrams (bar charts, both simple and compound pie charts, and pictograms) e. Read, interpret and draw simple inferences.	• A.1.1 (h) use simple graphing calculator functions to solve a *problem [covers objectives (b) –(e)]* • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
3.6.3 Measures of Central Tendency a. Mean, median, mode, modal class b. Use data given in simple tables and diagrams to calculate the mean, median, mode and modal class. c. Use data given in simple table to make inferences.	• A.1.1 (h) use simple graphing calculator functions to solve a problem *[covers objectives b & c]]* • A.2.1 (c) move textual and graphics data from one document to another • A.2.1 (d) use graphics software to import pictures, images, and charts into documents • B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
3.6.4 Sample space, events, outcomes a. Use a number of experiments to identify the sample space. b. Identify a sample space, given an experiment. c. Identify events given a sample space. d. Use diagrams and tables to represent the outcomes of ideal experiments.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
3.6.5 Experimental Probability a. Calculate the probability of event A, P(A), as the number of successful outcomes of A divided by the total number of possible outcomes. b. Calculate the probability of a single event as a fraction or decimal.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
3.6.6 Theoretical Probability a. Calculate the probability of event A, P (A) as the number of successful outcomes of A divided by the total number of possible outcomes. b. Calculate the probability of a single event as a fraction or decimal.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
MODULE #7. SETS	
3.7.1 Set Notation (Review) a. List the members of a set, given set description and vice versa. b. Use correct notation and symbols for listing and describing sets. c. Write mathematical expressions using correct set notation.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
3.7.2 Venn Diagrams a. Represent given proposition in Venn diagrams. b. Use Venn diagrams of propositions to draw valid conclusions. c. Use words to describe shaded regions in Venn diagrams. d. Interpret Venn diagrams involving two or three intersecting sets. e. Use Venn diagrams to show the relationship between two and three sets. f. Solve problems involving two intersecting sets. g. Use formulae. n (A B) = n (A) + n (B) – n (A u B) and n (A u B) = n (A) + n (B) – n (A B) for any two sets of A and B to find number of elements in particular regions.	• B.1.2 (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs)
MODULE #8. CONSUMER ARITHMETIC	
3.8.1 Profit, Loss, Discount a. Calculate the sale price when cost price and percentage profit, loss or discount are given. b. Calculate the cost price when	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
given the selling price and the profit/loss as a percent. c. Calculate the marked price when given the cost price, the discount, and the profit/loss as a percent. d. Calculate the marked price, given the cost price and profit, loss or discount as a percent.	
3.8.2 Simple Interest a. Use the following terms to describe situations involving the use of money: simple interest, rate, principal, time, amount. b. Use the simple interest formula (or otherwise) to calculate the simple interest. c. Calculate the amount of money that accrues from an investment over a given period of time. d. Use the simple interest formula to calculate the principal, time, or rate related to an investment.	
3.8.3 Hire Purchase a. Use vocabulary related to hire purchase: for example, deposit, regular price, cash price, instalment, interest, monthly/weekly payment, outstanding balance. b. Calculate the total amount to be paid on a hire purchase transaction. c. Calculate the value of each instalment of a hire purchase transaction. d. Calculate the interest payable on a hire purchase transaction as (a) an amount of money (b) a percentage of the regular price. e. Compare two or more hire purchase plans for buying a product.	
3.8.4 Currency Conversion a. Convert from the home currency to another currency. b. Convert from one currency to another. c. Solve problems involving currency conversion.	
3.8.5 Taxes a. Read and interpret simple income tax schemes. b. Calculate NIS contributions to be paid on a given salary/wage.	

Mathematics Learning Outcomes *By the end of Year 3 students will:*	**ICT Learning Outcomes** *Students will:*
c. Use simple income tax schemes to: - calculate the total allowances for a given salary/wage - Calculate the taxable income for a given salary. - Calculate the income tax that should be deducted from a given salary/wage	
3.8.6 Hire Purchase a. Let students find out from stores, banks and various companies the different ways in which consumers can pay for goods. b. Let students collect examples of hire purchase agreements and advertisements. c. Analyse the agreements and advertisements. d. Identify the relevant vocabulary. Discuss the meanings of terms as given in the various examples. e. Invite resource persons from companies that offer goods on hire purchase to talk to students about how they develop the various hire purchase plans. f. Calculate the various amounts, for example, number of instalments, amount of instalments, the hire purchase price. g. Have students take notes during the talk or write a summary of the presentation. h. Use their notes/summary to develop procedures for performing calculations related to hire purchase. i. Practice exercise should be based on information obtained from local companies, for example, their flyers and advertisements.	

6. Implementation Strategies

The goal of integrating and implementing ICT within all curricula is to help students on their journey toward information literacy through the use, management, and understanding of information technology. Curriculum developers, teachers, and administrators play a significant role in working toward achievement of this goal. Strategies for the integration and implementation of ITC, developed with an understanding of its use and historical impact, will help facilitate positive change in the classroom and lead to information technology-literate students.

6.1 The Challenge

As small developing nations respond to the technological revolution, they also face a major educational challenge in terms of improving literacy and numeracy across the board. Added to this, our economies are often characterised by rapidly changing technologies and increasing international economic competition, for provision of good, services and skilled workers. Success as a sub-region will depend substantially on our students' ability to acquire the skills and knowledge necessary for high-technology work and informed citizenship.

Through the use of ICT, learning can also be qualitatively different. The process of learning in the classroom can become significantly richer as students have access to new and different types of information, can manipulate it on the computer through graphic displays or controlled experiments in ways never before possible, and can communicate their results and conclusions in a variety of media to their teacher, students in the next classroom, or students around the world.

6.1 Teaching and Learning in a Knowledge-Based Society

Successful integration into the curriculum depends on teachers being convinced of the relevance of ICT as a means of providing access to a richer range of resources for themselves and students. The emphasis must be on using appropriate technologies to enhance and support effective learning.

Learning how to learn within this information and technology-rich environment requires skill and experience. Learners need teachers who understand this and are willing to learn with their students. Today's and tomorrow's teachers are also learning new strategies and skills, and are developing a new understanding of what it means to be "literate" in this new world.[25]

As our global society has shifted from an industrial age, based on the production of goods and the exploitation of resources, to an "information age," more frequently termed a "knowledge-based economy" or "knowledge society," our economy is also more based on service and the exchange or use of information. Implications for teachers are clear; students can no longer be expected to learn a finite body of knowledge.

With the so-called "information explosion," there is more data available than ever before. Knowing how to ask the right questions has become the essence of the learning process. The principal task for teachers is to teach young minds how to deal with ideas (not just data or worse, opinions) ... and how to evaluate and analyse, then apply, and synthesize these new ideas into knowledge.

Information technologies have the potential to provide physical access to a broad range of information, but it is the equity of access to (information skills instruction) that will produce information literate students prepared to live and work in the 21st century.

ICT therefore has the potential to offer valuable support to the teacher by: [26]

1. **Providing a flexible and time saving resource** that can be used in different ways at different times without repetition of the teacher's input, e.g. the same piece of text can be used for different students in different ways by changing the font size, reducing sentence length, using synonyms for less familiar vocabulary or highlighting key words to support reading;

2. **Allowing the teacher to respond to different stages in a student's writing** by, e.g. shaping the drafting process by inserting comments and suggestions at draft stage. Some software packages provide the teacher with summative or diagnostic information about students performance, others will allow edit to be tracked;

[25] Building Information Literacy. http://www.edu.pe.ca/bil/bil.asp?ch1.s1.gdtx
[26] Taken from 'The Use of ICT in Subject Teaching - Identification of Training Needs, Primary', Foreword and Section 1, produced by the Teacher Training Agency (TTA).

3. **Allowing the teacher to focus directly on texts at different levels, using different strategies** to clarify and model the reading/writing processes for students, e.g. during shared reading and writings sessions, or as part of guided work with a smaller group, the teacher can focus on a word, a phrase or a sentence by highlighting, italicising, underlining, using bold font.

6.1.1 The Teacher as Facilitator

In an technology-enhanced classroom, the teacher's role is that of a facilitator, rather than expert. As facilitators, teachers

- assist students as they navigate through the information made available by information technology and other sources
- direct students as they gather, organise, analyse, and present their findings
- help students develop, focus, refine, consolidate, and extend their abilities

Teaching styles are varied and it's up to each individual teacher to find a way of integrating ICT into teaching and learning that compliments his or her teaching style.

6.2 Developing ICT Capabilities in Students

In developing students' ICT capability, the quality of interaction between teacher and students is fundamental.

Characteristics of effective teaching and learning in ICT include:

- the quality of the teaching process
- the quality of students learning
- meeting students' needs.

6.2.1 Quality of the teaching process

Teachers have to allocate time to teach and consolidate ICT capability. In a successful session involving ICT the teacher will:

- be well prepared and have included planned structured activities
- have identified clear and appropriate objectives for ICT skills and/or curricular aspects and have included steps to ensure equality of opportunity
- use a variety of strategies to stimulate students
- ensure appropriate use of relevant technical vocabulary
- take due account of what students are learning at home or outwith the classroom setting generally to develop their ICT capability.

6.2.2 Quality of Students' Learning

In a successful session involving ICT, students are:

- motivated, challenged and required to think for themselves
- encouraged to be independent and confident users of technology
- set tasks that encourage cooperation and collaboration and to solve given problems.

6.2.3 Meeting students' needs

In a successful session involving ICT teachers will:

- provide appropriate challenges to all students based on their prior attainment
- provide variety, including good use of available technology
- assist students' learning by making connections with other areas of the curriculum in meaningful ways
- make good use of appropriate specialist and other support staff, such as classroom assistants or school librarians, to facilitate learning.

6.3 Approaches to ICT Development

Looking for similarity in diversity in earlier experiences with the introduction of ICT in curricula one can identify specific approaches to ICT in secondary education. These approaches are related to the situation in a particular school across all areas that related to the growth of ICT in their system. [27]

6.3.1 Emerging

This approach is linked with a school in the beginning stages of ICT development. The school begins to purchase, or has had donated, some equipment and software. In this initial phase, administrators and teachers are just starting to explore the possibilities and consequences of adding ICT for school management and the curriculum. The school is still firmly grounded in traditional, teacher-centred practice.

In this approach an ICT-curriculum is indicated that increases the basic skills and awareness of the uses of ICT. This curriculum assists movement to the next approach if so desired.

[27] Extracted from: UNESCO/IFIP Curriculum – Information and Communication Technology in Secondary Education (http://wwwedu.ge.ch/cptic/prospective/projets/unesco/en/ict.html)

6.3.2 Applying

This approach is linked with a school in which new understanding of the contribution of ICT to learning has developed. In this approach administrators and teachers use ICT for tasks already carried out in school management and in the curriculum. Teachers largely dominate the learning environment.
In this approach the school best chooses an ICT-curriculum that increases the use of ICT in various subject areas with specific tools and software. This curriculum assists movement to the next approach if so desired.

6.3.3 Integrating

This approach is linked with a school that now has a range of technologies both in laboratories, classrooms and administrative offices. The staff explore new ways in which ICT changes their personal productivity and professional practice. The ICT curriculum begins to merge subject areas to reflect real-world applications.

6.3.4 Transforming

This approach is linked with a school that has used ICT to creatively rethink and renew school organisation. ICT becomes an integral though invisible part of daily personal productivity and professional practice. The focus of the curriculum is now student-centred and integrates subject areas in real-world applications. ICT is taught as subject area at the professional level and incorporated into all vocational areas. The school has become a centre of learning for the community.

Section 8.7 provides a model for producing a School Information & Communications Technology Strategy for schools at different point on the development continuum.

6.4 ICT and Learning Environments

The use of ICT has the potential to enhance student learning outcomes. However, ICT can only contribute substantially to the improvement of schooling if it is appropriately embedded in powerful and interactive learning environments. Such environments are characterised by:[28]

- a good balance of discovery learning and personal exploration on the one hand, and systematic teaching and guidance on the other
- the taking into account of individual differences in abilities, needs, and motivation between students
- the provision of explicit links to the student's prior knowledge and skills

[28] Extracted from: Information Technology and Learning Environments (http://www.edna.edu.au/sibling/learnit/itlearn.html)

- cooperative learning activities through the appropriate use of small groups
- situations and tools that stimulate students to make maximum use of their own cognitive potential
- strategies that enable students to take control of their learning
- teaching strategies that show students how to transfer skills between domains
- opportunities for contact with and observation of experts
- just-in-time learning - students and teachers accessing information and learning resources when and where they need them.

However, these characteristics must be placed into the broader context of pedagogy, curriculum and school organisation. Each school needs a clearly articulated IT policy which sets out its IT goals, expected outcomes, performance indicators and a strategy on how it is to be implemented. School structures and culture will play an important role in setting expectations, providing access and encouraging innovative approaches to learning using IT. Principals and school executives play an important part in moving school communities towards effective use of new technologies.

6.5 Preparing Teachers for Use of ICT in the Curriculum

To improve outcomes for students it is equally important to support staff using and integrating ICT by providing quality professional development.

Teachers and schools are already at different stages of ICT development. Some have moved ahead while others have remained more cautious, aware as they are of the many other competing pressures on limited funds. They will vary in their needs and in their readiness to embark on ICT training. It is important, therefore, that training opportunities for practising teachers remain flexible enough to cope with the varying pace of development.

Similarly, it is important that there is ongoing provision for staff development to enable teachers to move on once they have acquired the basic technical skills that many still feel they need and so that they can keep pace with the introduction of new resources into school.

Teachers need to be encouraged to integrate self-development of ICT skills and knowledge within their normal development planning.[29]

Section 8.8 provides a model for technology competencies for Teachers adopted from the ISTE National Education Technology Standards (NETS) and Performance Indicators For Teachers.

29 The School of Information and Media, The Faculty Of Management. Teachers' ICT skills and knowledge needs Final Report to SOEID

Table 6.1 Implementing ICT In School: Action Points – Ideas For Getting Stated

1. **Find out where the school is now.**
   - What is the current provision in curriculum resources, for training, and for other needs?

2. **Find out where the school needs to be.**
   - What do I know of national developments for ICT?
   - What do I know of the Ministry's local plan for ICT?
   - What are the implications for the school library?
   - Will ICT be used to enable community access and contribution?

3. **Decide how the school will get there.**
   - How does one involve the whole school community, and gain its commitment and support?
   - What are the expectations for all staff?
   - What are the particular expectations for promoted staff?
   - What are the particular expectations for classroom and department management?
   - How will the school introduce the guidelines to parents and communicate with parents?
   - What about students' ICT experiences outside of school?
   - What about students' stages of learning within your school?
   - What about liaison with associated schools?

4. **Create an ICT section in the school development plan.**
   - Decide how developments will be led, managed and coordinated.
   - Publish and share the school development plan with the school community.
   - Action Planning.

5. **Conduct a staff training ICT needs assessment.**

6. **Review the curriculum, building in ICT Learning Outcomes.**

7. **Consider approaches to teaching and the structuring of tasks.**

8. **Consider how ICT can have impact on a range of learning approaches.**
   - The quality of students' learning
   - Improving attainment
   - Meeting students' needs

9. **Consider how the ICT present learning environment and what is needed to deliver the curriculum.**
   - Consider the need for resources including technical support.
   - Coordinate the provision of staff development and training with the available resources at the school.

10. **Determine how assessment, recording and reporting for ICT will be done.**

11. **Consider developing a policy statement for ICT across the school.**
    - Access issues
    - Undesirable material
    - Copyright
    - Information ethics
    - Acceptable use
    - Responsible use
    - Informed use

12. **Determine how monitoring and evaluation of ICT will be carried out.**
    - Conduct monitoring and evaluation and review progress.
    - As a result of the review amend ICT school development plans as appropriate.
    - Consider how ICT will be applied to management and administration.

7. Summary

As Ministries of Education throughout the Caribbean embark on curriculum reform exercises they have been faced with the twin challenges of revising not only the learning outcomes for the core curricular areas of Mathematics and Language Arts, but also incorporating new teaching methodologies and Information and Communication Technology concepts and skills into the curriculum.

The ICT Learning Outcomes for Mathematics and Language Arts allows curriculum development teams to easily identify where ICT competencies fit best into the various content areas of the curriculum in the lower forms of secondary school. As teachers construct their lesson plans and learning activities, they will be able to take advantage of the abundance of learning resources that exist today and the many forms of instructional technology available.

With ICT concepts and skills built into learning activities, students will learn how to access, evaluate, and use information and technology along with developing knowledge and skills in the content areas.

Technology is a powerful tool in education. When used appropriately, technology may help students develop the skills, knowledge, and insight necessary to meet rigorous content standards in all subject areas and make a successful transition to the world beyond school. The challenge for teachers, parents, and policymakers is to ensure that technology supports, but is not a substitute for, the development of quantitative reasoning, problem-solving and critical thinking skills.

Finally, it is important to recognise that achieving many of the learning outcomes listed here will require access to technology by individual students or student workgroups. It is believed that these learning outcomes can be achieved with a strong commitment to a technological infrastructure including sufficient equipment, materials and staffing; appropriate technical support; and a comprehensive, ongoing program of teacher training and staff development.

8. Resources

The Information and Communication Technology Learning Outcomes were designed to be integrated into the curriculum content areas. Collaboration between library media specialists, curriculum coordinators, instructional technology coordinators and teachers is a key factor if this integration is to occur.

Several resources are included in this section to facilitate these efforts. They may be customised to meet the needs of the instructional teams. As the collaborative roles evolve, teachers will develop many more helpful tools to guide students in developing information literacy and higher order thinking skills.

- **Curriculum Alignment Worksheets**
  These can provide a tool for Ministries of Education to facilitate the process of aligning the ICT Learning Outcomes to the local curriculum. A four-point rating scale allows Ministries to also assess how well the various competencies are being covered currently.

- **Software Evaluation Form**
  This is a very basic evaluation form that can be modified for many software types and target audiences. Use the form as a general guide for your software evaluations.

- **ICT Illustrative Examples**
  To support the ICT curriculum, a set of illustrative examples were developed by Alberta Learning to further clarify the intent of the technology outcomes and to convey how students might demonstrate their competencies in a variety of contexts and across all grade levels.

- **Technology Integration Lesson Plan Template**
  Two different formats are included. These templates act as a framework to identify the various roles, resources, and assessment strategies associated with the delivery of a technology-rich lesson plan.

- **Producing a School Information & Communications Technology Strategy**
  A model on the way in which an ICT strategy can be developed and managed for an educational institution.

- **ISTE National Education Technology Standards (NETS) and Performance Indicators For Teachers**
  Model teacher technology competencies developed by the International Society for Technology in Education

- **General Internet-based References**
  A listing on online resources that can be used for further information.

- **Concise Glossary of ICT Terms**
  Definitions of general Information and Communication Technology terms including those used in this document.

8.1 Curriculum Alignment Worksheet

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
A. INFORMATION LITERACY				
A.1 Technology Fundamentals - Basic Operations, Knowledge and Concepts By the end of Year (Level) 3 students will . . .				
A.1.1 Use common media and technology terminology and equipment	(a) identify and define computer and networking terms (b) demonstrate the correct operation of a computer system on a network (c) demonstrate touch keyboarding skills at acceptable speed and accuracy levels (suggested range 20-25 wpm) (d) organise and backup files on a computer disk, drive, server, or other storage device (e) recognise and solve routine computer hardware and software problems (f) use basic content-specific tools/probes (g) scan, edit , and save a graphic or video using a scanner, digital camera, video camera or other digitising equipment (h) use simple graphing calculator functions to solve a problem			
A.1.2 Identify and use common media formats, technology systems, resources, and services.	(a) describe the operating and file management software of a computer (e.g., desktop, file, window, folder, directory, pull-down menu, dialog box) (b) identify the various organizational patterns used in different kinds of reference books (c) define the basic types of learning software (e.g., drill and practice, tutorial, simulation) (d) identify and use the basic types of learning software (e.g., drill and practice, tutorial, simulation)			

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
	(e) use electronic encyclopaedias, almanacs, indexes, and catalogues to retrieve and select information (f) describe the various applications of productivity software programs (e.g., word processing, database, spreadsheet, presentation, communication, drawing, desktop publishing) (g) identify common integrated software packages or applications suites			
A.1.3 Students will practise the concepts of ergonomics and safety when using technology.	(a) identify risks to health and safety that result from improper use of technology (b) identify and apply safety procedures required for the technology being used			
A.2 Technology Productivity Tools By the end of Year (Level) 3 students will . . .				
A.2.1 Use a computer and productivity software to organise and create information, e.g. apply and use the appropriate productivity and multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum.	(a) explain the use of basic word processing functions (e.g., menu, tool bars, dialog boxes, radio buttons, spell checker, thesaurus, page layout, headers and footers, word count, tabs) (b) use the spell checker and thesaurus functions of a word processing program (c) move textual and graphics data from one document to another (d) use graphics software to import pictures, images, and charts into documents (e) classify collected data and construct a simple database by defining fields, entering and sorting data, and producing a report (f) construct a simple spreadsheet, enter data, and interpret the information (g) plot and use different types of charts and graphs (e.g., line, bar, stacked, scatter diagram, area, pie charts, pictogram) from a spreadsheet program			

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
A.2.2 Use media and technology to create and present information	(e) use draw, paint, or graphics software to create visuals that will enhance a class project or report (f) design and produce a multimedia program (g) plan and deliver a presentation using media and technology appropriate to topic, audience, purpose, or content (h) capture, edit, and combine video segments using a multimedia computer with editing software			
A.2.3 Evaluate the use of media and technology in a production or presentation, e.g. select and use a variety of technological tools and formats for class assignments, projects and presentations.	(a) determine the purpose of a specific production or presentation (b) describe the effectiveness of the media and technology used in a production or presentation (c) identify criteria for judging the technical quality of a production or presentation (d) judge how well the production or presentation meets identified criteria (e) recommend ways to improve future productions or presentations			
A.2.4 Integrate various applications.	(a) integrate information from a database into a text document (b) integrate database reports into a text document (c) emphasize information, using placement and colour (d) incorporate database and spreadsheet information (e.g., charts, graphs, lists) in word-processed documents			

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
A.3 Technology Communication Tools By the end of Year (Level) 3 students will . . .				
A.3.1 Use a computer and communications software to access and transmit information.	(a) demonstrate proficiency in accessing local area network, wide area network and Internet services, including uploading and downloading text, image, audio and video files (b) define basic on-line searching and Internet terminology (e.g., website, HTML, home page, hypertext link, bookmark, URL address) (c) send an e-mail message with an attachment to several persons simultaneously (d) access information using a modem or network connection to the Internet or other on-line information services (e) view, print, save, and open a document from the Internet or other on-line sources (f) use basic search engines and directories to locate resources on a specific topic (g) demonstrate efficient Internet navigation (h) organise World Wide Web bookmarks by subject or topic			
B. INDEPENDENT LEARNING				
B.1 Technology Research Tools By the end of Year (Level) 3 students will . . .				
B.1.1 Locate and access information sources	(a) identify the classification system used in the school library media centre, public library, and other local libraries (b) locate materials using the classification systems of the school library media centre and the public library (c) use an on-line catalogue and other databases of print and electronic resources (d) recognise differences in searching bibliographic records, abstracts,			

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
	or full text databases (e) search for information by subject, author, title, and keyword (f) use Boolean operators with human or programmed guidance to narrow or broaden searches (g) use biographical dictionaries, thesauri, and other common reference tools in both print and electronic formats (h) use a search engine to locate appropriate Internet or Intranet resources (i) determine when to use general or specialized print and electronic reference tools (j) compare, evaluate, and select appropriate Internet search engines and directories			
B.1.2 Record and organise information	(a) select information clearly related to the problem or question (b) use data-gathering strategies that include summarizing, paraphrasing, comparing, and quoting (c) follow standardized note taking processes and compile bibliographic information in an approved format (d) credit sources for all quotations, visuals, major ideas, and specific facts or data using accepted citation formats (e) analyse and relate information using a variety of relational techniques (e.g., graphic organisers, database reports, spreadsheet charts, graphs) (f) organise information in systematic manner for unity, coherence, clarity, and emphasis (g) compile a bibliography in a format stipulated by an accepted manual of style			

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
B.1.3 Research, create, publish and present curriculum-related projects both inside and outside the classroom.	(a) determine the audience and purpose for communicating the information (b) compare strengths and weaknesses of possible presentation methods and products (c) select the most appropriate format for the product or presentation (d) develop a product or presentation that utilizes the strengths of the medium and supports the conclusions drawn in the research effort			
B.2 Technology Problem-Solving and Decision Making By the end of Year (Level) 3 students will . . .				
B.2.1 Students will use technology to investigate and/or solve problems.	(a) interpret new information to formulate ideas which address the question or problem using comparison, evaluation, inference, and generalization skills (b) synthesize new ideas, evidence, and prior knowledge to address the problem or question (c) draw conclusions and support them with credible evidence (d) participate in decisions about group and classroom projects and learning objectives (e) identify and select topics of personal interest to expand classroom learning projects (f) recommend criteria for judging success of learning projects (g) establish goals and develop a plan for completing projects on time and within the scope of the assignment (h) evaluate progress and quality of personal learning (i) establish personal goals in pursuit of individual interests, academic requirements, and career paths			

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
B.2.2 Seek alternative viewpoints, using information technologies.	(a) access diverse viewpoints on particular topics by using appropriate technologies (b) assemble and organise different viewpoints in order to assess their validity (c) use information technology to find facts that support or refute diverse viewpoints (d) evaluate the authority and reliability of electronic sources (e) evaluate the relevance of electronically accessed information to a particular topic			
C. SOCIAL RESPONSIBILITY				
C. 1 Social, Ethical and Human Issues By the end of Year (Level) 3 students will . . .				
C.1.1 Participate productively in workgroups or other collaborative learning environments	(a) collaborate with others to identify information needs and seek solutions (b) demonstrate acceptance to new ideas and strategies from workgroup members (c) determine workgroup goals and equitable distribution of individual or subgroup responsibilities and tasks (d) plan for the efficient use and allocation of time (e) complete workgroup projects on time (f) evaluate completed projects to determine how the workgroup could have functioned more efficiently and productively			

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
C.1.2 Demonstrate a moral and ethical approach to the use of technology.	(a) use time and resources on the network wisely (b) explain the issues involved in balancing the right to access information with the right to personal privacy (c) understand the need for copyright legislation (d) cite sources when using copyright and/or public domain material (e) download and transmit only materials that comply with the established network use policies and practices (f) model and assume personal responsibility for ethical behaviour and attitudes and acceptable use of information technologies and sources in local and global contexts			
C.1.3 Use information, media, and technology in a responsible manner	(a) return all borrowed materials on time (b) identify the school's rules on student use of the Internet and other resources (c) demonstrate use of the Internet and other on-line sources consistent with the school's acceptable use policy (d) employ proper etiquette in all forms of communication (e) recognise that altering or destroying another person's program or file constitutes unacceptable behaviour (f) differentiate between copying and summarizing (g) recognise that using media and technology to defame another person or group constitutes unacceptable behaviour (h) recognise the need for privacy of personal information			

CURRICULUM ALIGNMENT WORKSHEET **[Rating Key: 0** = not covered in local curriculum, **1** = covered slightly, **2** = covered moderately, & **3** = covered well]				**Subject:**
General Learning Outcomes	**Specific Learning Outcomes**	**Level**	**Rating**	
C.1.4 Practice legal and ethical behaviour when using information and technology, e.g. respect intellectual property rights	(a) explain the concept of intellectual property rights (b) describe how copyright protects the right of an author or producer to control the distribution, performance, display, or copying of original works (c) recognise that the copying of commercial or licensed media is a violation of the copyright law (d) identify violations of the copyright law as a crime for which there are serious consequences (e) explain why the use of all or parts of another person's work requires prior permission or citation (f) recognise that a quoted work must be stated in the author's exact words (g) list sources quoted verbatim and visuals used in a presentation (h) recognise that reports or articles they write must be put in their own words			

8.2 Software Evaluation Form

Evaluator:
Software Title:
Publisher:
Type of Software: ☐ Drill & Practice ☐ Tutorial Simulation ☐ Educational Game ☐ Problem Solving ☐ Management System ☐ Groupware ☐ Other:
Platform (type of computer and system requirements):
Subject Area(s):
Objectives:
Possible Grouping Arrangements (Check all applicable descriptions): ☐ Individual ☐ Small Group ☐ Large group ☐ Other:

③ Strongly Agree, ② Agree, ① Disagree, ⓪ Strongly Disagree, N/A = Not Applicable

Evaluation Criterion	Rating
DOCUMENTATION & SUPPLEMENTARY MATERIALS	
Necessary technical documentation is included	③ ② ① ⓪ NA
Objectives are clearly stated	③ ② ① ⓪ NA
Learning activities that facilitate integration into curriculum are suggested	③ ② ① ⓪ NA
Materials for enrichment and remedial activities are provided	③ ② ① ⓪ NA
PROGRAM CONTENT	
Instruction matches stated objectives	③ ② ① ⓪ NA
Instructional strategies are based on current research	③ ② ① ⓪ NA
Instruction addresses various learning styles and intelligences	③ ② ① ⓪ NA
Information is current and accurate	③ ② ① ⓪ NA
Program is free of stereotypes	③ ② ① ⓪ NA
PRESENTATION	
Information is presented in a developmentally appropriate and logical way	③ ② ① ⓪ NA
Examples and illustrations are relevant	③ ② ① ⓪ NA
There is appropriate variety in screen displays	③ ② ① ⓪ NA
Text is clear and printed in type suitable for target audience	③ ② ① ⓪ NA
Spelling, punctuation, and grammar are correct	③ ② ① ⓪ NA

Evaluation Criterion	Rating
EFFECTIVENESS	
Students are able to recall and use information presented following program use	③ ② ① ⓪ NA
Program prepares students for future real-world experiences	③ ② ① ⓪ NA
Students develop further interest in topic from using program	③ ② ① ⓪ NA
This is an appropriate use of instructional software	③ ② ① ⓪ NA
AUDIENCE APPEAL & SUITABILITY	
Program matches interest level of indicated audience	③ ② ① ⓪ NA
Expected input is appropriate for indicated audience	③ ② ① ⓪ NA
Reading level is appropriate for indicated audience	③ ② ① ⓪ NA
Examples and illustrations are suitable for indicated audience	③ ② ① ⓪ NA
Required time is compatible with student attention	③ ② ① ⓪ NA
Program branches to remediation or enrichment when appropriate	③ ② ① ⓪ NA
PRACTICE/ASSESSMENT/FEEDBACK	
Practice is provided to accomplish objectives	③ ② ① ⓪ NA
Practice is appropriate for topic and audience	③ ② ① ⓪ NA
Feedback is relevant to student responses	③ ② ① ⓪ NA
Feedback is immediate	③ ② ① ⓪ NA
Feedback is varied	③ ② ① ⓪ NA
Feedback gives remediation	③ ② ① ⓪ NA
Reinforcement is positive and dignified	③ ② ① ⓪ NA
Assessment is aligned with objectives	③ ② ① ⓪ NA
Open-ended responses and/or portfolio opportunities are promoted	③ ② ① ⓪ NA
Collaborative learning experiences are provided for	③ ② ① ⓪ NA
EASE OF USE	
User can navigate through program without difficulty	③ ② ① ⓪ NA
Screen directions are consistent and easy to follow	③ ② ① ⓪ NA
Help options are comprehensive and readily available	③ ② ① ⓪ NA
Program responds to input as indicated by directions	③ ② ① ⓪ NA
Title sequence is brief and can be bypassed	③ ② ① ⓪ NA
User can control pace and sequence	③ ② ① ⓪ NA
User can exit from any screen	③ ② ① ⓪ NA
Only one input is registered when key is held down	③ ② ① ⓪ NA
USER INTERFACE AND MEDIA QUALITY	
Interface provides user with an appropriate environment	③ ② ① ⓪ NA
Graphics, audio, video, and/or animations enhance instruction	③ ② ① ⓪ NA
Graphics, audio, video, and/or animations stimulate student interest	③ ② ① ⓪ NA
Graphics, audio, video, and/or animations are of high quality	③ ② ① ⓪ NA

Evaluation Criterion	Rating
SUPPORT MATERIAL	
Teacher's guide included	☐Yes ☐ No
Manual included	☐Yes ☐ No
Worksheets included	☐Yes ☐ No
Lesson plans suggested	☐Yes ☐ No
Follow-up activities suggested	☐Yes ☐ No
OVERALL RATING	
Kindly give an overall rating for the software package	⑤ ④ ③ ② ① ⓪

ADDITIONAL COMEMNTS:

8.3 Web Site Evaluation Form[30]

Title of site:
URL (address):
Subject of site:
Considered for use with (class & grade level):
Specific objective for using this site:
Notes on possible uses of this site and URL's for individual site pages:

Evaluate the Web site you are considering for instructional use according to the criteria described below. Circle the number which you feel the site deserves for each category: 5 = Excellent and 1 = Poor.

Evaluation Criterion	Rating
SPEED	
The home page downloads efficiently enough to use during whole class instruction.	⑤ ④ ③ ② ① ⓪
The home page downloads efficiently enough to keep students on task during independent/small group study.	⑤ ④ ③ ② ① ⓪
FIRST IMPRESSION - GENERAL APPEARANCE	
The home page is designed attractively and will entice my students to further exploration.	⑤ ④ ③ ② ① ⓪
The home page is designed clearly enough to be successfully manipulated by my intended users.	⑤ ④ ③ ② ① ⓪
EASE OF SITE NAVIGATION	
My students will be able to move from page to page, link to link, item to item with ease, without getting lost or confused.	⑤ ④ ③ ② ① ⓪
All links are clearly labelled and serve an easily identified purpose.	⑤ ④ ③ ② ① ⓪
Links provided to other pages and sites operate efficiently enough to keep my students on task.	⑤ ④ ③ ② ① ⓪
USE OF GRAPHICS/SOUNDS/VIDEOS	
The graphics/sounds/videos are clearly labelled, clearly identified.	⑤ ④ ③ ② ① ⓪
The graphics/sounds/videos serve a clear purpose appropriate for my intended audience.	⑤ ④ ③ ② ① ⓪
The graphics/sounds/videos will aid my students in reaching the desired objectives for using this site.	⑤ ④ ③ ② ① ⓪
CONTENT/INFORMATION	
This site offers a wealth of information related to my stated objectives.	⑤ ④ ③ ② ① ⓪
The information is clearly labelled and organised, and will be easily understood by my students.	⑤ ④ ③ ② ① ⓪

[30] Adapted from WWW CyberGuide Ratings for Content Evaluation

The content of linked sites is worthwhile and appropriate for my intended audience.	⑤ ④ ③ ② ① ⓪
The content of linked sites adds to the value of this site for achieving my instructional goals.	⑤ ④ ③ ② ① ⓪
The information providers are clearly identified.	⑤ ④ ③ ② ① ⓪
The information providers are reliable.	⑤ ④ ③ ② ① ⓪
The content is free of bias, or the bias will be clearly recognised by my students.	⑤ ④ ③ ② ① ⓪
This site provides interactivity that increases its instructional value.	⑤ ④ ③ ② ① ⓪
CURRENCY	
The site was recently revised.	⑤ ④ ③ ② ① ⓪
AVAILABILITY OF FURTHER INFORMATION	
A contact person or address is readily available.	⑤ ④ ③ ② ① ⓪
OVERALL RATING	
Kindly give an overall rating for the software package	⑤ ④ ③ ② ① ⓪

ADDITIONAL COMMENTS

8.4 ICT Illustrative Examples

To support the ICT curriculum, a set of illustrative examples were developed by Alberta Learning to further clarify the intent of the technology outcomes and to convey how students might demonstrate their competencies in a variety of contexts and across all grade levels.[31]

8.4.1 Illustrative Examples for Language Arts - Level (Year) 1

Background

The Internet provides us with a limitless source of information. But, as we "surf the net", how do we evaluate the reliability and quality of the web sites that we visit? Refer to: for information on evaluating resources.

Student Task

In small groups or as a whole class, brainstorm a list of the top news stories from the past month from television, radio, magazines, newspapers and other media. Choose one current event or issue, and conduct an Internet search for that topic.

As you read the information from each site, keep a point form list of any discrepancies. What, if any, differences are there in how the facts are presented? What different opinions are expressed? Which site(s) is right and which one(s) is not completely accurate? How do you know? What strategies do you use to separate fact from opinion? How do you know the difference between a reliable web site and one that is of lesser quality and/or trustworthiness?

In small groups, compile a list of factors that you consider when judging the reliability of materials that you find on the Internet. Combine your ideas with those of other groups in your class to create a set of guidelines for researching on the Internet.

Returning to your computer, conduct a search on evaluating web sites. You may need to try several different key words. Keep a list of the key words that lead you to relevant sites. Share that information with classmates by writing the successful words on the blackboard.

As you find other examples of ideas on evaluating web sites, print out hard copies. Compare the ideas of others to your own. If necessary, modify the class guidelines to make your list stronger. Proofread and edit your work for spelling, grammar, choices of words, and punctuation. Once you have finalized your work, consider how to display it for quick and easy reference.

As a follow-up activity, write an essay considering the following questions: As a source of information, what does the Internet mean for society? What are some possible advantages and disadvantages of this technology?

[31] Alberta Learning (http://ednet.edc.gov.ab.ca/ict/ie.asp)

Scoring Guide

- Score – 4
  - clearly demonstrates, throughout the activity, an understanding that media ~ television, newspapers, radio, magazines the Internet ~ transmit information and opinion
  - considers, critically, the societal impact of having open access to Internet information and opinion; shows insight into the potential impact of technology on communication; is able to identify several significant positive and negative societal implications of Internet technology
  - conducts a highly efficient search; retrieves and prints only relevant pieces
  - models responsible citizenship consistently, while using the Internet
  - makes significant contributions to group work; has several ideas or skills for critically analysing and evaluating the authority, reliability and relevance of information found on the Internet; demonstrates ability to critically assess the quality of individual web sites

- Score – 3
  - demonstrates an understanding that media ~ television, newspapers, radio, magazines, the Internet ~ transmit information and opinion
  - is beginning to critically consider the societal impact of having open access to Internet information and opinion; shows insight into the potential impact of technology on communication; is able to identify two or more significant positive and negative societal implications of Internet technology
  - conducts an effective search; retrieves and prints largely relevant pieces
  - models responsible citizenship consistently, while using the Internet
  - contributes to group work; is clearly developing skills for critically analysing and evaluating the authority, reliability and relevance of information found on the Internet; demonstrates ability to assess the quality of individual web sites

- Score – 2
  - demonstrates an awareness that media ~ television, newspapers, radio, magazines, the Internet ~ transmit information and opinion
  - models responsible citizenship, usually, while using the Internet
  - is beginning to consider the societal impact of having open access to Internet information and opinion; shows some awareness of the potential impact of technology on communication; is able to identify one or two positive and negative societal implications of Internet technology
  - conducts a search with some difficulty; may retrieve and print some irrelevant pieces
  - contributes somewhat to group work; is developing an awareness of the need for critically analysing and evaluating authority, reliability and relevance of information found on the Internet; is approaching ability to independently assess the quality of individual web sites

- Score – 1
  - demonstrates a general awareness that media — television, newspapers, radio, magazines, the Internet transmit — information and opinion
  - models responsible citizenship, occasionally, while using the Internet
  - has given superficial consideration to the societal impact of having open access to Internet information and opinion; shows limited awareness of the potential impact of technology on communication; may not be able to identify positive and negative societal implications of Internet technology
  - conducts a search with difficulty; may require assistance to locate relevant sites

- makes limited contributions to group work; has limited awareness of the need for critically analysing and evaluating authority, reliability and relevance of information found on the Internet; would have great difficulty in independently assessing the quality of individual web sites

Related ICT Learning Outcomes

- evaluate the authority and reliability of electronic sources
- demonstrate an understanding that information can be transmitted through a variety of media
- evaluate the relevance of electronically accessed information to a particular topic
- demonstrate proficient use of various information retrieval technologies
- make inferences regarding future trends in the development and impact of communication technologies
- model and assume personal responsibility for ethical behaviour and attitudes and acceptable use of information technologies and sources in local and global contexts
- analyse and assess the impact on society of having limitless access to information

8.4.2 Illustrative Examples for Language Arts - Level (Year) 2

Student Task

Using a scanner or the Internet, your teacher has acquired an image that can convey a message of two different meanings, depending on which part of the image is viewed. Using presentation software, your teacher has created two slides/screens. The first slide presents a partial image. The second slide presents the complete image. **Note**: If available, consider using software that can morph images.

View the first, partial, image presented on the screen. Answer the following:
(a) What is your impression of the image on the screen?
(b) If the image is expanded, predict what else you might see on the screen.
(c) On your own, select an image and use software to alter it. Note how the change affects how you view the image.

Now, view the second image. Answer the following questions:
(a) What is your impression of the expanded image?
(b) How has your perspective changed from viewing the first image?

Discuss the following issues:
(a) What strategies can be used to assist in evaluating the validity of information and images gathered from such electronic sources as the Internet? Refer to for information on evaluating sources.
(b) Technology allows us to manipulate or alter images and audio files. What advantages and disadvantages do you perceive for such use of technology?

Scoring Guide

- Score – 4
  - recognises and articulates, clearly, the ability of technology to manipulate images, thereby potentially altering the message
  - identifies a variety of strategies to critically evaluate the authority and reliability of the data retrieved from electronic sources
- Score – 3
  - recognises and articulates, adequately, the ability of technology to manipulate images, thereby potentially altering the message
  - identifies some strategies to critically evaluate the authority and reliability of the data retrieved from electronic sources

- Score – 2
  - has a very general insight into the possibility of technology to manipulate image files
  - identifies one or two strategies to evaluate the authority and reliability of the data retrieved from electronic sources; demonstrates a basic understanding of the necessity of critical viewing

- Score – 1
  - has a superficial understanding of the possibility of technology to manipulate image files; has a limited grasp of how data manipulation can alter meaning
  - is unable to independently identify strategies for evaluation of the authority and reliability of the data from electronic sources

Related Tech Outcomes

- evaluate the authority and reliability of electronic sources
- recognise that the ability of technology to manipulate images and sound can alter the meaning of a communication

---

8.4.3 Illustrative Examples for Language Arts - Level (Year) 3

Background

This task could be revised for use in a film study unit.

Student Task

As part of a novel study or an independent reading assignment, select a book, by an author of your choice, which, to your knowledge has not been made into a film. After reading the book, design a movie poster that will attract new readers, by accurately portraying the book without simply retelling the story.

The movie poster should include the following:

- a front that conveys a good sense of the movie/book theme
- a brief description/blurb of the movie/book theme
- appropriate quotes from respected critics

- your personal responses to the work
- interesting design symbolism to capture a major idea in the work
- use of colour
- current actors you believe would suit the characters.

Outline your strategy for locating the relevant information, and provide information about the author.

Use a variety of information sources, including electronic sources, to research the book and author. Use the capabilities of desktop publishing or other software to prepare the movie poster.

Scoring Guide

- Score – 4
  - uses an appropriate search strategy that accesses pertinent and current sources
  - selects information thoughtfully from the sources used
  - creates a well-designed poster, with illustrations and text, in order to communicate the content accurately and effectively

- Score – 3
  - uses a search strategy that finds sufficient relevant information
  - selects information
  - creates a poster, with appropriate illustrations and text, in order to communicate the content accurately

- Score – 2
  - identifies generalized rather than specific terms for the search
  - locates some of the information that is required
  - creates a poster with basic information and illustration

- Score – 1
  - has difficulty in identifying appropriate search terms and sources
  - selects information that is not relevant to the task
  - creates a poster that is incomplete

Related Tech Outcomes

- use appropriate strategies to locate information to meet personal needs
- select and use the appropriate technologies to communicate effectively with a targeted audience
- apply principles of graphic design to enhance meaning and audience appeal
- respect ownership and integrity of information
- current, reliable information sources from around the world

8.4.4 Illustrative Examples for Mathematics - Level (Year) 1

Background

Use the Internet to search for foreign currency rates. Demonstrate how to check the accuracy or reliability of the source of information.

Student Task

Imagine you are going on a world tour and you want to know what you will receive in the local currency in exchange for 100 EC dollars. Create a spreadsheet to calculate foreign currencies to EC dollars, and Canadian dollars to foreign currencies. Calculate the exchange for several countries. Using the spreadsheet, demonstrate the calculation change if the exchange rate increases by 5%.

Extension: Check the currency rates over ten days, and create a graph to illustrate the increase or decrease in exchange rate. The following Internet source for currency rates can be used:

Scoring Guide

- Score – 4
  - analyses and synthesizes the information, by creating a clearly labelled spreadsheet with correct formulas to calculate Canadian and foreign currencies using various exchange rates
  - uses the Internet independently to access and retrieve information about exchange rates in the world
  - includes, for the solution, a verification of the data collected from the Internet

- Score – 3
  - can label and include correct formulas in a spreadsheet to calculate Canadian and foreign currencies using various exchange rates
  - uses the Internet, with guidance, to access and retrieve information about exchange rates in the world
  - includes verification of some of the collected data

- Score – 2
  - includes some calculations with errors in the spreadsheet
  - uses the Internet, with direct guidance, to access and retrieve information about exchange rates in the world
  - attempts to verify data that has been collected

- Score – 1
  - does not solve the problem and some calculations are incorrect
  - has difficulty accessing information about exchange rates, using the Internet
  - does not attempt to verify any data

Related Tech Outcomes

- evaluate the authority and reliability of electronic sources

- design, create and modify a spreadsheet for a specific purpose, using functions such as SUM, PRODUCT, QUOTIENT and AVERAGE
- access and retrieve information through the electronic network
- use a scientific calculator or a computer to solve problems involving rational numbers
- analyse and synthesize information to create a product

8.4.5 Illustrative Examples for Mathematics - Level (Year) 2

Student Task

You have $10 000 to invest in a minimum of three stocks. Research information about stocks, using the Internet and newspapers, and discuss your choices with outside experts. After making your selections, use a spreadsheet to record the weekly closing price for each stock for a minimum of eight weeks. Determine the profit gain or loss for each stock.

Once the recording period has ended, graphically display profit gain/loss for all eight weeks, using a bar graph for each stock. Insert the graphs in a text document and analyse the results. You may compare or contrast the growth, downward trends, acute fluctuations or constant growth. Using the word processor, write a one-page summary analysing the data and summarizing the results; e.g., acute fluctuations due to sharp decline in stock market in week three. Did you profit or lose from your total investment?

Scoring Guide

- Score – 4
  - uses advanced menu features to insert graphs in a word processing document and includes an analysis consistent with the graphical information
  - plans and conducts a search independently, using the Internet or other electronic source to access and retrieve information about stocks
  - designs, creates and modifies a clearly labelled spreadsheet to calculate correctly the profit or loss of stock investments
  - uses graphing tools to draw and clearly label a chart displaying the development of the investment

- Score – 3
  - designs, creates and modifies a spreadsheet to calculate the profit or loss of stock investments
  - uses graphing tools to draw a chart displaying the development of the investment
  - includes an analysis that shows small errors with the graphical information
  - plans and conducts a search, using the Internet or other electronic source to access and retrieve information about stocks

- Score – 2
  - creates a spreadsheet and graphs that may not be clearly labelled
  - retrieves information about stocks, with some direction
  - requires assistance to design, create and modify a spreadsheet to calculate the profit or loss of stock investments
  - uses graphing tools to draw a chart displaying the development of the investment

- Score – 1
  - creates a spreadsheet that contains missing or incorrect calculations and that cannot be used to solve the problem
  - does not include an analysis or includes an illogical one
  - has difficulty retrieving information about stocks

Related Tech Outcomes

- plan and conduct a search, using a wide variety of electronic sources
- identify and apply safety procedures required for the technology being used
- use advanced word processing menu features to accomplish a task; for example, insert a table, graph or text from another document
- design, create and modify a spreadsheet for a specific purpose, using functions such as SUM, PRODUCT, QUOTIENT and AVERAGE
- use a variety of technological graphing tools to draw graphs for data involving one or two variables
- access and retrieve information through the electronic network
- use a scientific calculator or a computer to solve problems involving rational numbers

---

8.4.6 Illustrative Examples for Mathematics - Level (Year) 3

Background

Janet has decided to start an investment account at the local bank and selects a savings account that currently pays 5% per annum, compounded monthly. She initially invests the $500 she received as an income tax rebate. She also plans to add $100 per month to her account. The initial investment is to be made on April 1 of this year. The additional monthly $100 investments are automatically made on the first day of each successive month. The monthly interest is deposited into the account on the last day of each month.

Student Task

1. Create a spreadsheet, using a predeveloped template, which will illustrate the growth of Janet's account over a twelve-month period — April to March. The spreadsheet must contain the column headings: Month, Opening Balance, Interest Rate, Interest Earned, Additional Investment and Closing Balance. Print a copy of your spreadsheet.

2. Modify and print your spreadsheet to illustrate a change in the interest rate to 4.5% on November 1.

3. Janet received a raise in pay in July. Modify and print the spreadsheet developed in the first assignment to reflect a change in monthly investments from $100 to $150 beginning August 1.

Scoring Guide

- Score – 4
  - completes the assignment accurately in the time allocated
  - prints a copy of the spreadsheet that displays the data accurately and clearly, with columns labelled appropriately
  - modifies the spreadsheet correctly to reflect the changes in interest rate and deposit amounts

- Score – 3
  - completes the assignment on time, with some assistance
  - prints a copy of the spreadsheet that displays correct data in table form, with columns labelled appropriately
  - modifies the spreadsheet correctly, with assistance, to reflect the changes in interest rate and deposit amounts

- Score – 2
  - completes the assignment in more than the allotted time and/or with considerable assistance
  - prints a copy of the spreadsheet that displays correct data for part 1) but incorrect data for part 2) and part 3)
  - cannot modify the spreadsheet to reflect the change in interest rate or increase in deposits

- Score – 1
  - completes part 1) of the assignment
  - cannot modify the spreadsheet to reflect the change in interest rate or increase in deposits
  - prints a display of the data for part 1), but it contains many errors

Related Tech Outcomes

- manipulate and present data through the selection of appropriate tools, such as scientific instrumentation, calculators, databases and/or spreadsheets
- analyse and synthesize information to determine patterns and links among ideas
- solve mathematical and scientific problems by selecting appropriate technology to perform calculations and experiments
- demonstrate an understanding of the general concepts of computer programming and the algorithms that enable technological devices to perform operations and solve problems

8.5 Technology Integration Lesson Plan Template

Name:	**School:**
Email:	**School Phone:**

Subject Area(s)	**Level**	**Lesson or Project Duration**
Technology Required	*What software and hardware are needed for this lesson or project?*	
Technology Level	Teacher: Novice ☐ Intermediate ☐ Advanced ☐	Student: Novice ☐ Intermediate ☐ Advanced ☐
Lesson or Project Topic	*What is the topic? What is the title?*	
Critical Question Addressed	*What specific question(s) will be answered?*	
Lesson or Project Goals and Objectives	*What will students experience and be able to do as a result of this lesson or project?*	
Curriculum Connections	*What specific curriculum learning outcomes will be addressed in this lesson or project?*	
Research Quest Connections	*What aspects of the research process will be addressed in this lesson or project?*	
Technology Connections/Opportunities	*What technology skills and/or goals will be addressed in this lesson or project?*	
Lesson or Unit Starter	*What will you do to introduce the lesson or project? Are the connections to the curriculum, technology, and the research process clear?*	
Student-focused activities	*What activities will your students do during this lesson or project? Have you identified the technology and research process activities the students are to participate in?*	
Resources	Hardware, Software, Web, CD ROM	Other (Print, Human, etc)
Student Assessment	*How will you assess the extent to which the students have achieved the goals and objectives (including the curriculum, research quest and technology connections)?*	

Assessment Rubric:			
Minimal	**Basic**	**Proficient**	**Advanced**
Author Name:		**Author E-Mail:**	
Teacher Notes:			

Technology Integration Lesson Plan Template – Blank

Name:	**School:**
Email:	**School Phone:**

Subject Area(s)	**Level**	**Lesson or Project Duration**
Technology Required		
Technology Level	Novice ☐ Intermediate ☐ Advanced ☐	Novice ☐ Intermediate Advanced ☐
Lesson or Project Topic		
Critical Question Addressed		
Lesson or Project Goals and Objectives		
Curriculum Connections		
Research Quest Connections		
Technology Connections/Opportunities		
Lesson or Unit Starter		
Student-focused activities		
Resources	Hardware, Software, Web, CD ROM	Other (Print, Human, etc)
Student Assessment		

Assessment Rubric:			
Minimal	**Basic**	**Proficient**	**Advanced**
Author Name:		**Author E-Mail:**	
Teacher Notes:			

8.6 Collaborative Lesson/Unit Planning Template

Teacher _____ Course Title _____ Level _____

Unit _____ Today's Date _____

Beginning Date _____ Due Date _____

Student's Assignment (brief summary)

Classroom Teacher's role:

Media Specialist/Technology Specialist's role: (check what is applicable)

Introduce	Review		"How to" Sheets	Assessment (Rubrics, etc.)
☐	☐	Online Catalogue	☐	☐
☐	☐	Reference Books	☐	☐
☐	☐	Non-fiction Books	☐	☐
☐	☐	CDs	☐	☐
☐	☐	Internet	☐	☐
☐	☐	Multimedia Software	☐	☐
☐	☐	Word Processing Software	☐	☐
☐	☐	Spreadsheet Software	☐	☐
☐	☐	Data Base Software	☐	☐
☐	☐	Graphics Software	☐	☐
☐	☐	Other software programs	☐	☐

Assessment Strategies: (Circle)

Journaling Conferencing Rubric
Checklist

Describe how the needs of different students will be accommodated:

Time Management Calendar (deadlines, etc.)

Evaluation (Complete after teaching this unit.)
What changes need to be made?

8.7 Producing a School Information & Communication Technology Strategy[32]

Revising the ICT Policy

The school ICT policy will:

- have been developed in consultation with the whole staff and in particular with those members of staff with particular areas of curriculum responsibility.
- give clear guidance as to how the school addresses the requirements for Information and Communication Technology to be implemented such that it both supports individual subject areas and enables the development of specific ICT skills by students.
- address issues of potential concern – e.g. protecting students from unsuitable materials and health and safety.
- reflect the ethos of the whole school.

Philosophy

This should be a reasonably brief paragraph that expresses the school's rationale for Information and Communication Technology. It usually begins *'We believe that.....'* The paragraph should contain references to:

- The need for students to adapt to a society that is served by an ever-increasing use of ICT related processes.
- The need for equal and appropriate access to ICT resources.
- The need for students to develop a set of coherent ICT skills such that they may, in time, be able to use ICT effectively, creatively and autonomously across the whole range of the curriculum.
- The need for students to be able to take advantage of ICT opportunities to promote learning outside of the classroom.
- The need for students to develop an awareness of their personal responsibilities when using ICT resources to access wider resources and when communicating with others.

Aims

The stated aims within the policy document are statements of the general outcomes. For ICT a set of statements might include the following:

- To promote learning and experiences with ICT and to promote the development of ICT skills in all students in accordance with their individual capabilities.
- To promote learning opportunities which conform to the National Curriculum guidelines
- To produce programmes of work that enable continuity and progression of ICT capability throughout the broad range of curriculum experiences offered to students in the core and foundation subjects.

[32] These guidelines for schools are designed to build on the support materials originally provided by the Bedfordshire Advisory service in 1995 as part of the 'Curriculum Guidelines for Schools'.

Outcomes

In this section more student-specific outcomes should be listed that indicate the school's intention to:

- Use ICT to specifically support literacy and numeracy programmes within the school. This may be through the use of dedicated integrated learning systems, specialist targeted resources and programs or a structured focus on these areas of learning and key skills.
- To develop learning which promotes the communication of ideas and information in a variety of ways using ICT capabilities where appropriate, such as word-processing, use of electronic mail, desktop publishing and design, using text and symbols.
- To develop learning which promotes the collection, classification, storage and retrieval, modification and interpretation of information using ICT capabilities where appropriate, such as information handling and presentation.
- To develop learning which promotes the use of appropriate modern communications technology to access primary and other sources of information and promotes communications between students, their peers and others, both locally and internationally.
- To develop learning which promotes the use of ICT models or simulations to explore real and imaginary situations, for example adventure games, simulated experiments, financial modelling.
- To develop learning which promotes the use of ICT to measure and control external events, such as measuring environmental variables and controlling motors, valves etc.
- To develop learning which promotes an awareness and understanding of the use of ICT systems in working life and society. This will include its effect on the individual, and developing a critical awareness in students of the positive and negative aspects of ICT which may result from its use and misuse respectively.
- To enable students to develop their ICT capabilities in a range of situations which help to promote group activities as well as independent learning skills.

Implementation

The first stage in implementing an ICT strategy is an audit of current practice and resource provision. Thus the school should produce statements as to how this might be carried out. The school should review both the provision of ICT as a cross-curricular process and as a foundation subject within the National Curriculum. It should also demonstrate how ICT may be used effectively to raise standards - particularly in Literacy and Numeracy. It should include a review of:

- Students' progress and continuity
- Staff INSET requirements
- Resource ramifications
- Programmes of work
- Current assessment, recording and reporting
- Liaison

This will lead to the following year's implementation strategy. There should be statements therefore indicating that this will:

- Build on the previous year's achievements
- Strengthen those aspects of ICT capability which were found to be weak
- Extend the ICT themes to include new ICT capabilities in the programmes of work
- Include targets and outcomes that are consistent with the NGFL consultation.

Teaching and Learning

The strategy needs to give clear statements relating to the range of teaching and learning methods which will be employed for developing ICT capability for students and in using ICT effectively to support other curriculum areas. It will state:

- How students will use ICT in a variety of appropriate curriculum areas.
- How staff will use a range of teaching styles with ICT i.e. whole class, small group and individual use of ICT equipment.
- How differentiation in assessing ICT capability will be planned into the tasks set as well as by assessing the outcomes.
- What provision will be made for fully developing the potential of the ICT capable child as well as that for the less able student?

Training

There are four distinct areas for consideration for training needs when developing a school strategy:

- Curriculum training
- Technical support and training for teachers
- Administrative user support
- Management of ICT within the classroom environment

Resources

The effective use of ICT within the curriculum requires that students have *appropriate* access to a range of ICT equipment. The policy should indicate how:

- It is proposed that equipment is made available to the students in a way that meets their curriculum needs. This may require that a variety of equipment deployment strategies be used including: single computers in classroom, clusters and dedicated computer suites. The use of learning resources based in libraries or resource centres should also be included.
- It is proposed to maintain and update the equipment as required. This should include reference to the financial planning linked to IT resources and any strategies, currently in use or planned, such as fund-raising activities, access to central LEA or DFEE schemes and leasing. There should also be a programme to ensure the replacement of obsolete computer equipment which does not wholly meet the requirements of the National Curriculum. (see Appendix 2A for LEA computer hardware recommendations).
- It is proposed to improve the access by students to electronic communications resources over a period of time to maximise the access by students to this important new resource.
- Maximum access to ICT resources will be achieved. This should link to any provision by the school of additional learning opportunities offered through out-of-school and cross-phase liaison.

Management

The effective management of ICT presents a school with a number of challenges. The awareness of the school to the issues involved should be evident within the strategy document. There should be details to ensure that:

- schools propose strategies for the use of ICT in administration and curriculum that demonstrate complementarity. This does not mean that systems are

required to be identical or share software platforms. However care must be taken to ensure best value for money in the purchase of ICT resources.

- schools demonstrate clearly how they make effective use of the information provided through the authority's school profiling programme to assess their effectiveness and to identify areas of potential development.
- schools identify areas of their administration and management information processes which may be enhanced further by the appropriate use of ICT. This would include areas as use of secure electronic mail and secure file transfer facilities.
- the existence of an ICT co-ordinator post within the school that will be used to oversee the development of all curriculum aspects for ICT.
- for larger schools, middle and secondary, an ICT steering group including its link to the senior management team for the school.
- the dynamic nature of ICT and the increasing range of opportunities and applications for its use across the curriculum create an on-going INSET requirement for staff. There should be statements outlining that the school acknowledges this need, and plans indicating how the school will meet its commitments.
- although the authority will ensure that the Internet service provider offers protection to students and staff from the unsuitable material present on the Internet, the school should demonstrate clearly how it will supervise and monitor users and employ suitable systems compliant with authority guidelines when accessing the Internet or using Electronic mail.
- the school subscribes to virus protection software for all systems, both curricular and administration.
- the school makes use of the software provided by the authority to check for year 2000 compliance by all systems. (This will not be an issue for Acorn computers but will be required for all PC systems)

Assessment Recording and Reporting

Schools may employ a range of strategies for the assessment recording and reporting of ICT. The document should indicate which strategies are to be used.

- The programmes of work should identify clear opportunities for the monitoring and recording of the students' progress in the topic or subject.
- A clear recording mechanism should be used.
- For Primary Schools, programmes of work will include related tasks that will assist the teacher to assess the students' ICT capabilities.
- At Key Stage 3 it should be clear if ICT capability is to be assessed across the curriculum or within specific ICT lessons.
- How children with very high levels of ICT capability, or special needs will be assessed.

Management Matrix

The Matrix shows the process of change as divided into five identifiable developmental stages. In practice these stages need to be seen as part of a continuing process which extends over a very much wider time frame. As schools progress in their implementation of IT, they move from one stage to another, and eventually on to fresh cycles of development in which early issues and obstacles are encountered again in different forms.

Managing ICT in Secondary Schools

Categories	Factors	Stage 1: Localised	Stage 2: Coordinated	Stage 3: Transformative	Stage 4: Embedded	Stage 5: Innovative	Next Stage
Management	Principal	Individual staff are given the freedom to experiment with IT, and to make decisions about its use.	Encourages uses of IT to fulfill an agreed or accepted pattern of activities across subject and curriculum areas. Senior management lead by example, or use IT in the same ways as others at this stage.	Staff are encouraged to offer ideas about outcomes of IT use, gaps in provision, and future potential uses. Senior managers use their experiences as well as those of others, to review immediate future uses of ICT.	Staffing needs and responsibilities are considered in terms of implications for ICT use. Learning needs and networking needs are covered appropriately.	Senior management are concerned to find the most appropriate ways for ICT to support school development. Future developments are considered in terms of present contexts.	External changes and developments in technology have impacts upon the technology which schools purchase and use, and therefore have implications for the developments at school levels. Certain fundamental technological shifts, which occur every few years, have profound effects upon school developments. Currently communication technologies are providing a new set of challenges for school development. The stages of the cycle of development described in this table so far, refer mainly to IT uses and applications across the curriculum. The next cycle of development is likely to be that of integrating communication technologies into whole school practice.
	IT Coordinator	The coordinator acts largely in isolation. Certain staff are supported in particular ways, but coordinated IT use across the school is very limited.	Identifies those uses which already exist, and supports those which are identified as being in need of development.	The coordinator shifts focus from individual uses towards wider access and deployment issues.	Co-ordination is increasingly a shared responsibility, with some roles now being taken on by other teachers and senior managers.	The coordinator is concerned with identifying and exploring ICT uses that have future potential for school developments.	
	Library Resources Management	Library assistants or personnel are restricted to maintaining book stocks and recording use.	The roles of library staff are reviewed, particularly regarding support for students when using IT resources in the library.	Computerised stock records are available to facilitate subject searches. Library staff support IT use in the library.	Library staff enable ICT use to fulfill research and project needs of students. There is feedback to senior management about outcomes.	Library staff are concerned in maintaining the range of IT facilities to meet student needs. Internet access and distributed libraries become a focus.	
	IT Policy	The policy is one which states intentions, is generally written by one or a few individuals, and is circulated to other staff for their agreement.	The policy identifies existing practice to an increasing extent. There is a mixture of intention and practice in policy documents.	Individual subject policies contain reference to IT uses. The IT policy covers developing applications.	Increasingly policies identify outcomes, and the IT policy focuses on new ideas for future consideration.	The IT policy becomes a more intentional document, as it focuses upon future potential and intended outcomes.	

Categories	Factors	Stage 1: Localised	Stage 2: Coordinated	Stage 3: Transformative	Stage 4: Embedded	Stage 5: Innovative	Next Stage
	Integration of Curriculum and Administration	Experimental use may be happening in either area, but without any linking.	Office staff and a few senior managers use management information systems for administrative purposes.	Form teachers begin to look at IT to support their administrative needs.	Teachers use IT for their own administrative purposes, but also access management information.	Administration and management data are used to support school aims and information needs. Ideas of how data can be put together in alternative ways to inform future thinking begin to emerge.	
Staff Development	Staff Development	Some staff put themselves forward for development training dependent upon their own personal interests.	Where common needs exist across the staff, support is provided to satisfy generic IT uses.	A planned programme of staff development is agreed by staff one year ahead of its implementation.	Staff development is a shared activity. Departments contribute their own expertise as well as identifying their needs.	Staff development is planned to cover all anticipated future needs.	
Curriculum Administration	Teaching and Learning Styles	IT is used in a limited range of bolt-on exercises, added to the main core of curriculum activities.	Some staff look to use IT in appropriate curriculum activities. Others are beginning to experiment with its use.	Senior management and staff identify the need for IT to be integrated into a learning policy and schemes of work.	Learning outcomes are reviewed by subject areas, and IT use is focused where particular gains or gaps are identified.	New uses and applications of IT are chosen to meet particular learning needs. Future impacts upon teaching and learning are more easily planned for.	
	IT Skills	IT skills are considered in isolation. Assessment is undertaken by certain staff at particular times.	IT skills are provided through core lessons. As generic skills, they are undertaken in appropriate subject contexts.	There is recognition of the ways in which the curriculum supports basic IT skills, as well as newly developing ones.	Students are empowered to develop skills to meet their own needs. This can go beyond a recognised minimum.	Where new uses and applications are possible, the range of IT skills needed are considered in advance.	
Resources	IT Technical Support	Technical support is considered as needs arise. Ad hoc solutions are created in crisis situations.	When technical problems occur, at least one person is able to consider IT needs as a priority.	Technical personnel are called on by individual teachers to support their needs as they arise.	Technical support is covered in a range of possible ways. The need to support staff in the classroom is given priority.	Technical support is strengthened when new applications are introduced, so that more direct on-hand support is available.	
	Funding	Earmarked funding is made available at irregular intervals, perhaps once every five years.	Funding for IT is given equal priority with other curriculum areas.	The balance between funding physical resources and staff development is reviewed carefully each year.	The funding for maintaining provision is considered alongside the need to finance new initiatives.	The funding needs of a new innovation are recognised in the light of previous experience. Funding for support is carefully built into overall budgets.	

Categories	Factors	Stage 1: Localised	Stage 2: Coordinated	Stage 3: Transformative	Stage 4: Embedded	Stage 5: Innovative	Next Stage
	Physical Resources	Generally there is an IT room where IT teaching occurs, and departments bid for equipment if they show interest.	Resources are deployed according to both school needs and individual subject needs.	Deployment is reviewed by many staff regularly, as is provision in open access areas, subject areas, and staff areas.	Provision enables students and staff to access equipment in a range of different ways, e.g. the loan of school equipment.	Equipment is deployed in a flexible manner, that allows the school to react to changing circumstances.	
External Links	School and Community Links	Individuals create informal links with little reference to what others are achieving.	The ways in which the community can support the school in IT terms are considered and reviewed.	The school considers how it can use IT to support the community, perhaps through training or accreditation.	Feedback from the community about IT needs is considered strategically important for future development.	Support for and from the community is always considered when any new initiative or application is undertaken.	
Evaluation	Ethos	Individual teachers and departments are allowed to develop their own practices.	Outcomes of IT uses by subject departments are reviewed, and are made more widely available where these contribute to school needs as a whole.	There are regular opportunities for staff to inform and be informed. This is achieved by both informal and formal structures.	Staff are encouraged to review their own achievements and to identify their needs.	Staff reflect on previous successes and developments to help inform forward planning, but also find knowledge of past failures useful to their further planning.	
	Monitoring and Record-Keeping	Where records are kept, these are maintained by individual teachers.	Individual records are entered and retained centrally.	Records are maintained centrally, but staff contribute to these as well as accessing them regularly.	Equipment provision enables staff to access, use and create records at home as well as in school.	When new applications and initiatives are considered, account is taken of data required for records, and how these can be utilised in the future.	
	Evaluation and Assessment	External educational requirements, e.g. OFSTED and National Curriculum needs, drive evaluation and assessment.	Current development practice is compared against that in other schools.	The means to evaluate and assess are considered and agreed by a range of staff.	Evaluation using external reviews is encouraged and helps to focus direction and attention to detail.	Ongoing evaluation and assessment is built into future planning, and each initiative undertaken.	

Becta 1999

8.8 ISTE Standards and Performance Indicators For Teachers

All classroom teachers should be prepared to meet the following standards and performance indicators. [33]

Technology Operations and Concepts

Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:

- Demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Educational Technology Standards for Students).
- Demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

Planning and Designing Learning Environments and Experiences

Teachers plan and design effective learning environments and experiences supported by technology. Teachers:

- design developmentally appropriate learning opportunities that apply technology-enhanced instruct6ional strategies to support the diverse needs of students.
- apply current research on teaching and learning with technology when planning learning environments and experiences.
- identify and locate technology resources and evaluate them for accuracy and suitability.
- plan for the management of technology resources within the context of learning activities.
- plan strategies to manage student learning in a technology-enhanced environment.

Teaching, Learning, and the Curriculum

Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:

- facilitate technology-enhanced experiences that address content standards and student technology standards.
- use technology to support student-centred strategies that address the diverse needs of students.
- apply technology to develop students' higher order skills and creativity.
- manage student learning activities in a technology-enhanced environment.

[33] Reprinted from: National Educational Technology Standards (NETS) for Teachers, published by the International Society for Technology in Education (ISTE), NETS Project.

Assessment and Evaluation

Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:

- apply technology in assessment student learning of subject matter using a variety of assessment techniques.
- use technology resources to collect and analyse data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
- apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.

Productivity and Professional Practice

Teachers use technology to enhance their productivity and professional practice. Teachers:

- use technology resources to engage in ongoing professional development and lifelong learning.
- continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning.
- apply technology to increase productivity.
- use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning.

Social, Ethical, Legal, and Human Issues

Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK-12 schools and apply that understanding in practice.

Teachers:

- model and teach legal and ethical practice related to technology use.
- apply technology resources to enable and empower students with diverse backgrounds, characteristics, and abilities.
- identify and use technology resources that affirm diversity.
- promote safe and healthy use of technology resources.
- facilitate equitable access to technology resources for all students.

8.9 General Internet-based References

1. **Educational technology content standards**. (1999). Office of Accountability and School Instructional Support/School Renewal Group, Department of Education State of Hawaii. Honolulu, Hawaii, USA. Available: http://www.hcps.k12.hi.us/

2. **Information and communication technology**. (1999). In The National Curriculum for England. Department of Education and Employment. London, UK. Available: http://www.nc.uk.net

3. **National educational technology standards for students**. (1998). International Society for Technology in Education (ISTE). Eugene, Oregon, USA. Available: http://www.iste.org

4. **National educational technology standards for teachers**. (2000). International Society for Technology in Education (ISTE). Eugene, Oregon, USA Available: http://www.iste.org

5. **The European computer driving licence – ECDL**. (1997). European Computer Driving Licence Foundation with support of the EU Commission. Available: http:www.ecdl.com/

6. **The review of the national curriculum in England: The consultation materials (1999)**. QCA and DFEE, QCA/99/406, pp 184-195. See http://www.qca.org.uk/publications/

7. **Initial teacher training national curriculum for the use of Information and Communication Technology in subject teaching**. (1998) DfEE, London See: http://www.canteach.gov.uk

8. **2000 and Beyond: A School Odyssey**. Passey (ed) (1998) British Computer Society Schools Committee, Swindon, UK See: http://www.bcs.org.uk

9. **Futures for Learning ? Pedagogic processes and ICT**. Passey (ed) (2001) British Computer Society, Swindon, UK See: http://www.bcs.org.uk

8.10 Concise Glossary of ICT Terms

Abstract. A short summary in which the writer highlights all essential points of an article, book, or media resource.

Academic Standards. Standards that specify what students should know and be able to do (content), what they might be asked to do to give evidence of meeting standards (performance), and how well they must perform (proficiency).

Acceptable Use Policy (AUP). A school or organization's official policy statement regarding the use of the Internet or other computer networks.

Address. A name, group of numbers, or bits used to identify a specific device (e.g., server, printer, computer) on a network.

Agent. A program that does things for a user like filtering e-mail and finding web sites to suit the users interests; also called an expert or intelligent agent.

Analogue. A signal that transmits information by modulating a continuous signal, such as a radio wave (see Digital).

Analogue Signals. Signals that vary continuously by amplitude or frequency. Historically, older transmission systems, like the telephone service, have been analogue, while most newer systems are digital in nature (see Digital).

Analyse. To determine the components of or separate into component parts; to divide into parts and determine the relation of each part to the other parts, or the whole.

Application. A computer or software program a user activates to perform a specific function or functions for the user; applications are often referred to as productivity software.

Artificial Intelligence. Computer software packages that try to emulate human intelligence in order to solve problems using reasoning and learning.

Attachment. A document or file appended or "attached" to an e-mail message. An attachment retains the formatting of the original provided the receiver has the same or compatible software on his/her computer that created the attachment.

Audio Conferencing. A conferencing system employing voice-only communications.

Bandwidth. The amount of the electromagnetic spectrum that a given signal occupies; usually expressed in kilohertz (thousands of hertz, or KHz) or megahertz (millions of hertz or MHz). It may also refer to the amount of data that can be carried by a channel; usually expressed in bits per second.

Baud Rate. The speed of data transmission over telephone lines; approximately equal to bits per second. A measure of a modem's speed in terms of the amount of information that modem can transfer from one computer to another in one second.

BBS (Bulletin Board System). A computer that stores information and allows users to post and retrieve files to it by way of a modem or network connection.

Bibliographic Database. A database listing in which the information is presented as citations that include the author, title, publisher, publication date, and other publication facts.

Bibliographic Record. A listing of information received from a library or electronic database that can be brief (author, title, publisher, etc.) or full (abstract, summary, holdings information, and location).

Bibliography. A list of works such as books, articles, media resources, etc. on a particular subject, usually arranged alphabetically by author.

Binary Code. The base 2 numbering system comprised of the numbers 0 and 1. All computers are based upon this numbering system.

Bitmap. Any picture or image a user sees on a Web page. Bitmaps come in many file formats such as GIF, PICT, JPEG, etc. They can be read and edited by paint programs and image editors. As its name suggests, a bitmap is a map of dots or "pixels."

Bits (short for binary digit). The most basic, or smallest, unit in a computer system. In accordance with binary code, each bit is designated as either a 1 or a 0.

BPS (Bits Per Second). A measure of a modem's speed in terms of the number of bits that modem can transfer in one second; synonymous with baud rate.

Boolean Logic. A logic system used by computers that employs the words AND, OR, and NOT to increase search precision. The use of the word OR expands a search. The use of the words AND and NOT narrows a search.

Boolean Operators. AND, OR, and NOT are the most commonly used operators; used to increase the precision of an on-line or electronic search.

Boot. A term for turning on a computer and having it automatically load a set of software the computer requires to do all of its basic operations; sometimes also referred to as "booting up" a computer.

Bridge. A device similar to a gateway except it connects similar networks to one another and is normally programmed. A major advantage of bridges is that any type of protocols being used on the subnets can be forwarded whether they are TCP/IP packets, OSI packets, or whatever.

Broadcast. Television and radio signals designed to reach a mass audience. In Internet technology, broadcasting (also called "push" technology) is like e-mail. When you log on to a computer there will likely be e-mail waiting for you. Broadcasting uses sophisticated software or "agents" that will operate in the background, search and retrieve information needed by the user, and place that information in a mailbox or directory on the user's computer.

Browser. A software program used to view World Wide Web pages; also called a web browser. Currently, the two most popular web browsers are Netscape Navigator and Microsoft's Internet Explorer.

Byte. A combination of 8 bits. One byte represents a single letter, symbol, or number between 0 and 9. Hard disk and other storage devices and a computer's RAM (random access memory) are measured in thousands of bytes (kilobytes), millions of bytes (megabytes), or billions of bytes (gigabytes).

Cable Modem. A modem that uses two cable TV channels to establish a two-way flow of computer information over the coaxial cables used to bring cable TV into the home or business.

Cache. In a computer or local area network this refers to the amount of RAM (random access memory) set aside to hold data that may be frequently accessed again. Data in a cache will be retrieved much faster than data which must be read from a storage medium or device.

CAD/CAM (Computer Assisted Design/Computer Assisted Manufacturing). A computer software drawing program designed to create visual representations in colour, according to scale, and in multiple dimensions.

Call Number. A unique letter/number combination assigned to each book or media resource in a library used to identify its location on the shelves.

Capture. Saving a file to your computer from a remote system. Capturing data, graphics, sound, or video files allows the user to listen, view, or print on-line data at a later time.

CATV (Cable Television). The term originally stood for community antenna television.

CD-ROM (Compact Disc-Read Only Memory). A computer storage medium similar to the audio CD which can hold more than 600 megabytes of read-only digital information.

Channel. In data communications, a one-way path along which signals can be sent between two or more points. In telecommunications, a transmission path between two or more points provided by a common carrier.

Chat. Communication between members of an on-line service using text. The messages are sent between users in real time as in a conversation by typing in short statements.

Citation. A reference or a note referring to a document or file from which text is quoted.

Classification. The process of arranging and assigning unique codes or numbers to print, non-print, or electronic materials according to their subject, format, or any other legitimate method in a logical sequence.

Client. A software application on a computer or terminal that allows the user to extract some service from a network server.

Codec (Coder/Decoder). An electronic device that converts standard television signals into compressed digital signals for transmission. The same device can convert incoming compressed digital signals back into viewable television signals.

Command. An instruction given by a computer user (most often by pointing at menu options on the monitor screen using a mouse or by typing a certain function key or keyboard sequence) in order to complete a certain task or operation.

Common Carrier. A government-regulated private company that furnishes the public with telecommunications services (e.g., phone companies).

Communication Software. A program that connects you to another computer or network in order to communicate with that computer or network.

Compressed File. A computer file that has been reduced in size through a compression software program. The user must decompress these files before they can be viewed or used.

Compressed Video. A method of sending video signals using less bandwidth than normal by transmitting only changes in moving frames rather than full motion. The reconstituted image exhibits some motion and depending on the available bandwidth and capacity of transmitters and receivers, the motion may appear somewhat irregular. This effect occurs in compressed video technology because the moving areas of the image are only approximated.

Computer Catalogue. A computerised listing that enables users to access the record of holdings of a particular library, library network, or information agency or service.

Concentrator. Another term for a networking hub (see Hub).

Conference. A meeting of individuals for consulting or discussion on topics of common interest.

Connect Time. Usually this term refers to the amount of time that a terminal or computer has been logged on to a computer or server for a particular session.

Content Standard. Refers to what students should know and be able to do.

Contrast Ratio. The ratio of brightness between the white and black areas of an image.

Copyright. The property right granted by a government to the originator (e.g., author, organization) of an intellectual property to reproduce, copy, print, duplicate, publish, sell, and distribute any section or part of an existing original work (e.g., book, article, video program).

Copyright Registration. The process of applying for and obtaining formal U. S. Copyright Office acknowledgment of copyright.

CPU (Central Processing Unit). Another name given to a computer. CPU usually denotes the box that contains the microprocessor, power supply, and disk drives.

Creative Expressions of Information. Creative or artistic works in a variety of media formats or creative or artistic productions and presentations (e.g., plays, exhibitions, concerts).

Curriculum. The program devised by local school districts used to prepare students to meet standards. It consists of activities and lessons at each grade level, instructional materials, and various instructional techniques. Curriculum specifies the details of the day-to-day schooling at the local level.

Cursor. The pointer on the screen whose position you control by moving a mouse or other input device.

Cut, Copy, and Paste. A set of computer commands that allow sections of documents or graphics to be moved from one place to another within a document or from one document to another.

Cyberspace. The collection of computers located on multiple networks that communicate with other computers across the Internet.

Database. A collection or listing of information, usually organised with searchable elements or fields. For example, a library catalogue can be searched by author, title, or subject.

Data Storage Device. A piece of equipment that allows the saving of information for future retrieval. Most often this term refers to a digital device such as a hard drive, an optical drive, or a tape drive.

Dedicated Line. A leased or private line is a communication line used exclusively by one customer.

Default. A setting that a computer system uses automatically, unless otherwise changed by the user.

Definition. The sharpness or resolution of a picture or graphics image.

Descriptor. A synonym for a subject heading or keyword.

Desktop. The background area on a computer screen which usually contains an icon for the hard drive and trash can (used to remove files). Folders, files, applications, and a working document may also appear on the desktop window.

Desktop Conferencing. The process by which an individual or small group uses a personal computer, small video camera, microphone, and special software to "teleconference" or communicate with another individual, individuals, or small group via the monitors and speakers of personal computers.

Desktop Publishing. The process of using a computer and special software to produce a document with complex formatting and layout styles such as newsletters, brochures, and ad copy.

Dial-Up. To open a connection between a user's computer and another computer via a modem.

Dialog Box. A computer screen window that asks a question or allows users to input information.

Digital. Signal based on a binary code in which information is sent as a series of "on" and "off" signals (or 1s and 0s). It is more precise and less subject to interference than an analogue signal (see Analogue).

Digital Camera. Records photographic images in a digital format that can be manipulated with a computer.

Digital Signals. Signals which consist of a series of discrete elements that have only one value at a time. Digital transmission systems are the heart of most modern communication systems (see Analogue).

Directory. A list of files or documents on a computer or a published material that has a listing of names, addresses, phone numbers, and other useful material.

Discussion Group. A group of people who exchange messages about particular topics; often associated with newsgroups.

Distance Learning or Education. Instruction that takes place using telecommunications technologies even though teacher and students are geographically separated. Telecommunications technologies link them on an inter-district, inter-country, intra-country, or international basis.

Document. What a computer user creates with an applications program. Documents store information that the user has inputted using an application software program.

Domain Name. The address or URL of a particular website.

Downlink. The portion of a satellite circuit extending from the satellite to an earth station.

Download. The electronic transferring, or copying, of a file from one computer to another. Files may be downloaded from another connected individual computer, from a computer network, a commercial on-line service, or from the Internet.

Drag. To move a file or folder by holding the mouse button down while simultaneously moving the mouse. Dragging a file or folder provides the computer user with a convenient way to move and organise information.

Drill-and-Practice. A type of computer software meant to supplement the introduction of new material by a classroom teacher. After the introduction of new concepts and ideas, this computer software provides regular review and practice by students of basic concepts and skills.

Driver. A computer program used to control external devices or run other programs. For instance, printers require special driver software programs to control them from a computer.

DVD (Digital Video Disk). A digital storage medium the same physical size as a CD-ROM disk that can store massive amounts of data including graphics and full motion video.

Dynamic Range. The highest and lowest signal levels of a specific audio or video device.

E-Mail (Electronic Mail). A message that is sent electronically from the computer of one person to the computer of another person.

Electronic Literacy. The ability to search, retrieve, organise, employ, and evaluate information derived from electronic information resources.

Encyclopaedia. A general reference source (print, non-print, or electronic) that contains information on all subjects or is limited to a specific subject.

Equity. In the context of instructional technology, refers to the availability of instructional technology to all students regardless of socio-economic status, culture, locale, gender, age, or race.

Ergonomics. Design principles for tools, workstations, furniture, etc., relating to the comfort, efficiency, and safety of users.

Expansion Card. A circuit board or card that when inserted into a computer allows that computer to perform an additional function or functions.

Expansion Slot. Physical slots or sets of pins inside a computer where expansion cards may be installed to enhance a computer's capacity or enable that computer to perform additional functions.

Expert System. A program that does things for a user like filtering e-mail and finding web sites to suit the users interests; also called an intelligent agent or agent.

Facsimile Machine (Fax). An electronic device that transmits written or graphic information over telephone lines to other locations.

Fair Use. Provisions in the U. S. Copyright Code providing for limited use of copyrighted materials for educational purposes.

Fax. A telecommunications device used to send facsimiles of documents over telephone lines to other fax machines or computers. Fax machines use a combination of photocopier and modem technologies (see Facsimile Machine).

Fiber Optics. A technology for transmitting voice, video, and data via light over thin fibers of glass. This technology has much greater bandwidth capacity than conventional cable or copper wire.

Field. A database term for a specific area of a bibliographic or database record containing specific identifying characteristics of an item (e.g., date field, name field, or author field).

File Compression. Software that makes files smaller than their original size so they take up less space on a disk or other storage medium.

File Server. Computers with large storage devices on a network that store files and software that can be shared by users on the network (see Server).

File Sharing. The ability to share files with other computers on the same network.

File. Information, often a document or an application, saved on a disk or other storage medium.

Footer. The bottom portion of a word processing page that typically contains information such as source or destination, page numbers, date, time of origination, etc. (see Header).

Footprint. The region on the earth to which a communications satellite can transmit.

Frame. A single, complete picture in a video recording.

Freeware. Software, usually available via the Internet or other on-line service, that is free to download and use by individual computer owners. Freeware is not always free for organizations or agencies that may want to use the product, however.

Frequency. The number of cycles per second of an electromagnetic transmission, usually described in hertz.

Frequency Response. The frequency range over which signals are reproduced within a specific amplitude range. The frequency response of the human ear, for instance, is from about 20 to 20,000 hertz (Hz).

FTP (File Transfer Protocol). A standard protocol for sending computer files from one computer to another on the Internet.

FTP Site. A computer dedicated to the storage of files, usually organised by subject, that can be accessed through anonymous FTP or e-mail.

Full-Text Database. An electronic information resource or database that contains entire documents.

Gateway. A device connecting two dissimilar networks that adds security, flow control, and protocol conversion. Gateways typically handle protocol conversion operations across a wide spectrum of communications function or layers, and they require software programming and central management.

Genre. A distinctive type or category of literary composition, such as poetry, essay, short story, etc.

GIF (Graphic Interchange Format). A widely used format for image files.

Gigabyte. One billion bytes.

Graphing Calculator. A calculator with a larger than average screen that provides a visual representation of plotted data.

GUI (Graphical User Interface). An alternative to character-based computer interfaces, such as MS-DOS. The Macintosh OS and Microsoft Windows are two popular examples of GUI's.

Hardware. Physical equipment components or devices.

Header. The top portion of a word processing page that typically contains information such as the source or destination, chapter title, length of message, date, time of origination, etc. (see Footer).

Hertz. A unit of frequency equal to one cycle per second (cps). One kilohertz equals 1,000 cps; one megahertz equals one millions cps; one gigahertz equals one billion cps.

Hits (Matches). Terms used to describe the locating of relevant information that corresponds to specific search terms.

Home Page. The first or introductory page that appears when accessing a World Wide Web site. The home page often provides the table of contents to a specific website.

Hotlist. A list of frequently accessed, popular, or best World Wide Web sites on a single topic or subject.

HTML (HyperText Markup Language). The computer language used to design, or write World Wide Web pages or websites.

HTTP (HyperText Transfer Protocol). The means or computer protocol by which people using the World Wide Web and web servers communicate with one another.

Hub. An equipment piece that connects two or more devices together in order for them to communicate on a network.

Hypermedia. A software program that contains dynamic links to other media, such as audio, video, or graphics files. The World Wide Web is made up of hyperlinked web pages.

Hypermedia Program. A software program that provides dynamic links and seamless access to text, graphics, audio, and video images.

Hypertext. A system of writing and displaying text that enables the text to be linked at several levels of detail, and to contain links to related documents or sites. Hypertext is key words or phrases in a WWW page that are "linked" electronically to other websites or pages on the Internet.

Icon. A symbol that provides a visual representation of an action or other information. For example, a representation of an arrow on a computer screen or desktop is often used to denote directional movement (forward or back) in many software programs. Clicking on the arrow with a mouse will take the user in the direction indicated by the arrow.

ILS (Integrated Learning System). A complete software, hardware, and network system used for instruction. In addition to providing the curriculum and lessons organised by level, an ILS usually includes a number of tools such as assessment components, record keeping, and user information files that help to identify student needs, monitor progress, and maintain student records.

Information. Knowledge communicated or received concerning a particular fact or circumstance; facts, data, images, or sounds which may be unorganised or even unrelated.

Information Literacy. The ability to access, evaluate, and use information from a variety of sources.

Initialise. A means of preparing a disk to receive information by organizing its surface into tracts and sectors; same as formatting a disk. Initialising a disk that already holds information will erase the information.

Installer. A program used to update or install software.

Interface. The way in which a computer communicates with external devices or with the user (e.g., printer interface, human interface, user interface).

Intellectual Property Rights. The concept that the creator of an idea or expression of an idea in any format retains ownership of that idea or expression.

Interlibrary Loan. A service provided by many libraries and information agencies that enables a user to obtain copies of articles and borrow books and other media materials from other libraries and information centres.

Internet. The huge world-wide network or "network of networks" of government, business, and university computers. Currently, there is only one Internet, but due to the huge (and growing) numbers of sites coupled with slow access speeds, others are being planned.

Interoperability. The ability to connect to and exchange data with other hardware and software systems.

IP (Internet Protocol). A common layer or protocol used on the Internet to connect dissimilar networks.

Intranet. A private network inside a company or organization that uses the same kinds of software that you would find on the Internet, but that it is only for internal use.

I/O (Input/Output). The processes involved in transferring information into or out of a central processing unit or computer.

ISBN (International Standard Book Number). A 10-digit unique number assigned to each book published to identify the publisher, title, edition, and volume.

ISSN (International Standards Serial Number). A distinctive number assigned to a serial publication.

ISTE (International Society for Technology in Education). A major international professional association for computer and technology teachers, MIS (Management Information Systems) professionals, and technology directors and coordinators.

Journal. A periodical publication that contains scholarly articles written by professionals, researchers, and other experts in a particular field.

JPEG (Joint Photographic Experts Group). A common computer file format for images.

K (Kilobyte). 1,024 bytes (see Byte).

Kilohertz. 1,000 hertz.

Keyword. A significant identifying word from the title, subject, or content of a particular document or file.

Keyword Searching. In a search, using significant words that describe a subject under which entries for all documents or publications on the subject are filed in a catalogue, bibliographic record, or electronic resource.

kHz (Kilohertz). Unit of measurement of frequency or cycles per second; equal to 1,000 hertz.

Knowledge. The acquaintance with facts, truths or principles as the result of a study or investigation; familiarity with a particular subject or branch of learning; an organised body of information or the comprehension or understanding consequent on having acquired or organised a body of facts.

LAN (Local Area Network). A number of computers and other peripheral devices connected to a file server for the purpose of sharing resources, such as software applications, files, peripherals, and services. A LAN usually refers to a network in one room or building.

Laserdisc. A plastic disk or platter that can have text, video, and graphic images encoded in a series of microscopic pits engraved in the disk; also known as a videodisc. Laserdiscs are read by special players which transmit a laser beam onto the disks.

LCD (Liquid Crystal Display). A popular presentation technology in flat panel display systems used in conjunction with overhead projectors (LCD projection panels); also used in laptop computer screens and in video/data projectors.

Limiters. Words or terms that limit or "narrow" a search of an electronic or on-line database or service.

Link. A connection from one place or medium to another. For example, button or underlined print that when clicked on takes you to another website or page on the Internet.

Listserv. A powerful software program for combining and automating mailing lists and discussion groups on a computer network or the Internet. A form of one-to-many communication using e-mail.

Log In or Log On. The process of establishing a connection over a network or modem with a remote computer so that the user's computer may exchange information.

Log Off. The process of terminating a connection to an computer or network.

Logo. A name, symbol, or trademark of a company or publication borne on one printing plate or piece of type. Today, a logo would be created and printed with a computer and graphics or desktop publishing software.

Macro. A program within a program that allows complex functions to take place with a single keystroke or simple combination of keystrokes.

Magazine. A periodic publication which contains articles, news, advertisements, etc.

Manual of Style. A guide prescribing rules for writing papers and reports including the elements and sequence to be used for citations and bibliographies. Recent manuals of style include information on citations for Internet and electronic resources.

MARC (Machine Readable Cataloguing). A standard developed by the Library of Congress and others to define the elements (fields) within a bibliographic record.

Master. The original video or audio recording, as opposed to a dub or copy.

MB (Megabit or Megabyte). 1,000,000 bytes (see Byte).

Media. Formats (e.g., CD-ROM, newspapers, laserdiscs, magazines, films, the Internet) of communication that can be grouped as print, non-print, or electronic.

Media Literacy. The ability to conduct a critical analysis of images and the sounds, special effects, and text that accompany them. Media literacy also aims to provide students with the ability to create media and multimedia products for specific purposes and audiences.

Media Retrieval Network. An audio and video network for sending and receiving analogue audiovisual resources to a remote site, normally a classroom or large group instruction area.

Megabyte. 1 million bytes.

Microfiche. A flat sheet of plastic containing microimage information on a particular subject and requires a microfiche reader or printer for accessing its content.

Microforms. Any materials, film or paper, printed or photographic, containing microimages which are units of information; such as, a page of text or graphics, too small to be read without magnification.

Microwave. High frequency radio waves used for audio, video, and data transmissions; requires clear line of sight between the transmitter and the receiver.

MIDI (Musical Instrument Digital Interface). A standard for communicating information between synthesizers, sequencers, percussion machines, computers, and other electronic musical equipment.

MIPS (Millions of Instructions Per Second). A measure of computer performance.

Modem (Modulator/Demodulator). An electronic device that attaches to a computer and enables it to transmit and receive data from another computer over a telephone line by converting the digital data into sound.

Monitor. A device that is connected to a computer and used to display text and graphics. Monitors are similar to television sets, but use a digital signal rather than an analogue signal like television receivers.

Mouse. A pointing and input device that allows the user to control the movement of the cursor to any area of the monitor screen.

MPEG (Motion Picture Experts Group). A digital video file format commonly used on the World Wide Web.

MS-DOS (Microsoft Disk Operating System). The operating system designed for the original IBM and IBM-compatible personal computers.

Multimedia. A general term that usually refers to non-print media that uses a combination of sound, video, animation, pictures, and text.

Multiplexer or MUX. A device that combines two or more signals into a single composite data stream for transmission on a single channel.

Multitasking. The ability to run more than one program at a time on a computer.

Navigate. To move around on the World Wide Web by following hypertext paths from document to document on different computers linked to the WWW and Internet.

Netiquette. The rules of conduct for on-line or Internet users.

Network. Two or more computers that are interconnected in some fashion so that users can share files and devices (e.g., printers, servers, storage devices).

Newsgroups. A part of the Internet that allows users to "post" and "reply to" messages from other users. Newsgroups are the basic unit of organization on the USENET bulletin board of the Internet. Newsgroups are independent discussions on a specific topic.

Node. A termination point for two or more communications links. In local area networks it also refers to a computer or single PC on a network.

Noise. In audio, electrical interference or unwanted sound. In video, this interference appears as "snow" on a television set or monitor.

Non-print Media. Audio and video formats of communication (e.g., films, video tapes, audio cassettes). The three types of media formats are print, non-print. and electronic.

On-line. The state a computer is in when it is connected to another computer or server via a network; a computer communicating with another computer.

On-line Catalogue. A computerised listing that enables users to access the record of holdings of a particular library, library network, or information agency or service.

Open. A command that makes a file available so that a user can modify its contents, display it on screen, or send its contents to a printer or other network device for output.

Operating System. The program that organises and manages the internal activities and functions of a computer and peripheral devices.

OS (Operating System). The operating system or system management program of a computer (see Operating System).

Packet. A unit of data that is transmitted at the network layer. It is also commonly used to denote an envelope of data bundled with addressing information for transmission over a network.

Password. A secret combination of letters and other symbols needed to log in to a computer system.

Patent. An official document issued by a government granting an inventor (individual or organization) the right to make, produce, and manufacture an invented material for a given number of years.

PC (Personal Computer). Before the arrival of the IBM-PC, most PCs were called microcomputers. After the arrival of the IBM-PC, the term PC came to be applied to all personal computers, even those not produced by IBM.

Performance Standard. Tells how students will show that they are meeting a content standard.

Peripheral Device. A device outside the user's computer (e.g., modem, disk drive, printer) that is connected to and under the computer's control.

Pixel. A single dot or point of an image on a computer screen. Pixel is a contraction of the words “picture element.”

Port. An interface on a computer, terminal, network, or other electronic device for the transferring of data; also a point of access into a communications switch.

Primary Source. First-hand information or information in original or first-published format.

Proficiency Standard. Indicates how well students must perform on a content standard.

Program. A set of instructions describing operations for a computer to perform to accomplish a task. Computer programs are commonly referred to as software (see Software).

Projection System. A large screen system to show video, television, or computer images.

Proprietary. Belonging to a single corporation or agency. In the context of technology, proprietary usually refers to a set of protocols used by only one or a limited number of companies, as opposed to standards that are shared by a large part of a particular industry.

Protocol. A standard set of procedures that regulates how computers communicate and exchange information.

Pull-Down Menu. A menu (commonly found in the menu bar) whose name and/or icon is shown. Essentially, a user pulls down the menu by pointing at, pressing down the mouse button, and dragging the mouse until he/she reaches the option to be selected and then releasing the mouse button.

Pull Technology. In reference to the Internet or other on-line services, pull technology is where users, utilizing software such as a web browser, are required to locate and "pull down" the information for themselves.

Push Technology. In reference to the Internet or other on-line services, push technology is like e-mail. When you log on to a computer there will likely be e-mail waiting for you. Push technology uses sophisticated software and "agents" that will operate in the background, search and retrieve information needed by the user, and place that information in a mailbox or directory on the user's computer. Also known as broadcasting.

QuickTime. An integrated, cross-platform architecture for multimedia production and playback developed by Apple Computer, Inc.

RAM (Random Access Memory). The memory the computer uses to temporarily store information that the microprocessor needs to operate a computer program. The amount of RAM determines the number of programs that can be open on a computer simultaneously.

Real Time. Communication where information is received at (or nearly at) the instant it is being sent.

Receive Site. A location that can receive transmissions from another site for distance learning.

Repeater. A device that boosts an electrical signal thus increasing the transmission distance possible.

Research. Careful study, investigation, and experimentation aimed at discovering or interpreting facts to create new knowledge or understandings on the part of the researcher.

Resolution. The clarity or graininess of a video or computer image as measured by lines (of resolution) or pixels; the smallest resolvable detail in an image.

ROM (Read-Only Memory). ROM stores special instructions that the computer needs in order to operate properly. As the name implies, information stored in ROM is never changed, only read as needed by the computer.

Router. A hardware module and component of a network which receives transmissions and forwards them to their intended destinations by the shortest route possible.

Save. Storing information by transferring it from main memory (RAM) to a disk or other storage medium or device.

Satellite Dish. A dish-like device for sending and/or receiving signals from a satellite.

Scan Rate. The speed with which the electron beam scans the picture tube.

Scanner. A device that converts a printed page or image into an electronic representation that can be viewed and manipulated on a computer. Scanners are often used to convert photographs into electronic representations so that they can be included in documents created on a computer.

Scroll. Using scroll arrows, scroll bars, or scroll boxes allows a computer user to move vertically or horizontally within a window thereby enabling the user to view more of a document or directory.

Search Engine. An Internet site and software program that allows for keyword searching of on-line information.

Search Strategy. The organised plan by which an on-line user conducts a search of an electronic information resource. It usually involves the use of Boolean operators to increase search precision.

Secondary Source. Information contained in, or taken from, general or compiled published sources.

Serial. A publication that is issued in successive pieces and intended by its publishers to continue indefinitely.

Server. A central computer with special software that provides services to other computers on a network (see file server).

Service Provider. An organization that provides network access to users via modem or some sort of high capacity network connected via coaxial or fiber optic cable.

Session. A period during which a connection exists between two points in a network so that commands or data may be exchanged.

Shareware. A category of software usually available over the Internet or other on-line services that is shared by publishers with the general public. Shareware is not free. Publishers ask that if you like the product and plan to use it, you send the author the required fee. The collection of shareware fees is based largely on the honour system.

Signal-to-Noise Ratio. A measurement of noise introduced in an audio component expressed as the difference in decibels between the desired signal and the unwanted noise.

Simulation. A software program that imitates reality, involves a realistic setting, and presents students with a problem or series of problems and choices. The program

presents students with opportunities for inquiries, actions and decisions, and shows them how their actions and decisions change the way the simulation evolves. The best simulations allow students to control events that are realistic, making decisions with consequences that teach them actual, probable outcomes they may encounter in real life.

Software. A set of instructions, procedures, and related documentation on a disk, file, or CD-ROM which when input into a computer cause it to perform certain actions or functions.

Still Frame. A single frame of video information; sometimes called a freeze frame.

Storage Device. An equipment item, like a hard disk drive, in which digital information (voice, video and data) can be recorded and stored for future use.

Storage Medium. A media item, like a diskette, CD-ROM, or laserdisc, on which digital information (voice, video, and data) can be recorded and stored for future use.

Switch. A hardware device that routes packets of information across a network.

Synthesize. To combine the parts or elements so as to form a coherent whole; to combine so as to form a new, complex product.

Synthesizer. An electronic device for creating musical sounds and sound effects.

TCP/IP (Transmission Control Protocol/Internet Protocol). A protocol for the transmission of electronic data from one computer to another. TCP/IP is currently the de facto transmission protocol for the Internet.

Technology. The application of knowledge, tools, and skills to solve practical problems and extend human capabilities. Technology is best described as a process, but it is more commonly known by its products and their effects on society.

Technology Literacy. The ability to use, manage, and understand technology.

Telecommunications. The exchange of voice, video, or data through digital or analogue electromagnetic or electronic signals (e.g., radio, telephone, television, facsimile, computer/modem).

Teleconference. Communication via audio, video, or computer between two or more groups in separate locations.

Throughput. The rate at which data may be transferred from one computer to another via some sort of electronic medium. Usually measured in bits per second, kilobytes per second, or megabytes per second.

Topology. The physical layout of a network. It refers to the way in which transmission technologies are interconnected to form a complete system.

Track. The location or path of a recorded signal on a tape or disk.

Trademark. A name, symbol, word, figure, letter, or mark adopted and used by a manufacturer, business firm, or agency in order to designate the products the firm manufactures or sells and to distinguish them from other products. Any trademark is entitled to be registered under the provisions of a government statute so that it can only be used by the firm who registered it.

Transponder. The equipment on a satellite that receives the signal, amplifies it, and then retransmits it to receiving stations on the earth.

Trees. A visual method of linking information that follows a tree-like pattern with major concepts as trunk, limbs, branches, and leaves as extensions or sub-units of main concepts.

Tutorial. Software that attempts to present new concepts and information to students and then helps them to understand the concepts and develop skill in using them. The program provides periodic checks on a student's progress and will then "branch" them to the appropriate next step in the learning process. Sometimes, this means a student will advance to a higher level, or be sent back in the program to review concepts or skills that should have been previously learned.

Uplink. The portion of a satellite circuit or a satellite dish which transmits signals from a ground station to the satellite.

Upload. To send a file to another computer or server.

URL (Uniform Resource Locator). The address and method used to locate a specific resource or single document on the World Wide Web or Internet.

User ID. A unique number or name or both that is associated with a user name on a server system.

User Interface. The system of computer screen images, devices, and software components that allow the user to interact with and control the computer's operating system. Graphical user interfaces (GUI) allow the user to interact with the OS by manipulating icons or visual menus via a mouse. Command-line interfaces allow user to interact with the OS by entering commands from the keyboard.

VCR. Abbreviation for videocassette recorder, a device used to record and play video programs.

Version. In reference to computer software programs, a number that states a program's chronological position relative to old and new releases of the program.

Video Adapter. A board or card that plugs into a slot connected to the computer's main circuit board and allows the computer to display text and graphics on a monitor.

Video Conferencing. Using video and audio signals to link participants at different and remote locations for a specific purpose.

Virtual Memory. A function that allows a computer to use a specified amount of hard disk space as if it were RAM.

Virtual Reality. Highly realistic computer simulations that use 3-dimensional displays to create the impression of being inside a place.

Virus. A destructive type of computer program that attempts to disrupt the normal operation of a computer, re-write, or delete information from storage devices, and in some cases, cause physical damage to the computer.

Virus Detection Program. A software program to detect, diagnose, and destroy computer viruses.

Visual Literacy. The ability to recognise and understand ideas conveyed through visible actions or images.

WAN (Wide Area Network). A network of LANs (local area networks) linked by backbone cabling for the purpose of electronically connecting several sites or buildings.

WAV. A common sound file format often used in conjunction with the World Wide Web.

Web Page. A single on-line document or screen containing information that can be accessed over the World Wide Web (WWW).

Webbing. A visual method of linking ideas to one another in a web-like pattern.

Website. An entire location or site of a business, agency, organization, or individual on the World Wide Web. A website may consist of several web pages.

Window. A computer monitor's screen or portion of the screen that displays information on the desktop. Windows enable the user to view the contents of disks as well as to create and view documents. Most windows include scroll bars that allow the user to move up and down and right or left in a document and buttons that allow you to close the window or make the window smaller or larger.

Windows. A graphical user interface (operating system) for IBM and IBM-compatible personal computers. Windows is a product of Microsoft Corporation.

Workstation. A device, often a personal computer, that serves as an interface between a user and a file server or host computer.

World Wide Web. A web-like interconnection of millions of pieces of information and documents located on computers around the world. Web documents use a hypertext language which incorporates text, sound, and graphical images and "links" to other documents and files on Internet-connected computers. The WWW allows for "point-and-click" navigation of the Internet.

WPM (Words Per Minute). Refers to the number of words a student can type or keyboard in one minute.