

Information and Communication Technology

Curriculum Framework

Class IV to XII



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INTRODUCTION

ICT education in Bhutanese schools started in a modest way in the late 1980s with Gateway computers received under the Overseas Development Agency (ODA) funding. An attempt was then made to expose students to basic mouse and keyboarding skills, and a form of word processing tool to the extent allowed by the limited hardware capability of Intel 286/386 machines.

In the nineties, powerful computers with better graphics capability facilitated the use of graphical-based software for various purposes. People started using computers at work as well as in few homes. Some schools also started providing Computer Science based on India's ICSE and ISC curriculum as an optional subject from classes 9 to 12. The optional subject had a very strong emphasis on programming.

However, there was a mismatch between the computer skills provided in schools and the computer skills used outside the schools. The demand within the country was more for people with ICT skills in productivity tools than programming. A new curriculum was then developed and implemented in 2002 to equip students with skills relevant to the world of work. This was a shift from earlier programming-centric curriculum to productivity-based applications.

Over the years, new technologies have emerged, the world has become more connected and the way people work has changed. 21st century learning requires an additional literacy apart from traditional literacy such as reading, writing and numeracy. Literacy with ICT will allow the learners to respond to evolving ideas, changing attitudes and emerging technologies in the connected world. The current ICT curriculums offered in the schools do not provide adequate skills and



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competencies to adapt in the knowledge society. Having an organized ICT education framework will provide clear, logical sequencing of knowledge and skills and avoid overlaps as currently seen between the literacy curriculum, provided as the Chiphen Riggel Programme, and the ICT optional subject offered from classes 9 to 12.

The ICT curriculum framework is also aligned with the National Education Policy and the Education ICT Master Plan, iSherig. The National Education Policy mandates equipping students with ICT skills and using them extensively to enhance teaching and learning. The iSherig recommended the need to review and develop elective ICT curriculum for classes 11 and 12 as well as to develop comprehensive curriculum for ICT literacy. This framework document provides a single coherent foundation to the literacy programme from classes 4 to 10 as well as the elective programme for classes 11 and 12.

The framework document introduces ICT from class 4 for two reasons. Sigman (2007) agrees with the value of educational software for attainment of educational goals but argues that early introduction of technology to children “can subvert the development of cognitive skills”, such as sustained attention span. He recommends introducing ICT to children when they are at least nine years. According to Piaget’s developmental theory, this is also the stage when children are generally ready to transit from three dimensional real world to abstract world of technology.

In a move towards preparing our students to be adept, productive and responsible in the knowledge society, the curriculum framework is conceived with the view of what they can do at the end of each class and key stage. While



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theoretical underpinnings will always be the integral part of understanding the concepts and acquiring the skills, strong emphasis is on the student learning outcomes. Living in knowledge society requires one to be critical consumer of knowledge. Equally important, however, is being able to create knowledge, content and tools through problem-solving using logic, patterns and algorithms.

This curriculum framework is designed on outcome-based standards. The outcomes are geared towards achieving the goals of ICT education through four connecting themes or strands. The four strands are Technology Operations and Concepts, Communication and Collaboration, Digital Citizenship, and Computational Thinking. These four strands run across all classes from IV to XII in varying extent and depth of coverage. The Learning Outcomes for each class and the Key Stage Outcomes for each key stage provide the standards against which students' performances will be measured for ongoing feedback and support. The overall design and development of the framework is shaped and influenced by six overarching principles, some impacting directly and some implicitly.

GOALS

ICT helps our future generations of young people to explore their skills and knowledge to become responsible citizen in the digital world. It has become the tool for learning in the 21st century (McKenzie, 2013). Therefore, ICT is not only the future of our children's education, it is the present; and we need to make the investment in ICT now (Lockhart, 2013).With the investment made in this ICT curriculum, we expect:

- » Students to have functional ICT knowledge and skills to perform productively and responsibly in knowledge society.
- » Students to have foundational knowledge and skills to pursue potential postsecondary educational and work opportunities in the field of ICT.
- » Students to engage in formulating efficient solutions to problems through logical reasoning and algorithmic thinking.

GUIDING PRINCIPLES

The ICT curriculum should provide sound knowledge, skills, values and attitudes for our students to excel in the digital world. The following guiding principles will provide overall direction to the framework throughout its operation to align with the national ICT goals and global trend in ICT.



A. Gross National Happiness (GNH)

Gross National Happiness as a guiding principle in ICT education is important for the learners to acquire appropriate and necessary skills, values and attitudes to live harmoniously and use technology responsibly in the digital society.

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Technology is becoming an integral part of people's life, influencing the ways of working and thinking. Younger generation should be sensitized on how technology impacts the lives of people personally and globally. Therefore, ICT curriculum framework should create awareness on the legal and ethical responsibilities of using technology, understand the impact of technology and use technology to enhance learning.

B. 21st Century Skills

Acquiring isolated knowledge and skills will not be enough to face the challenges of 21st century. The students must be equipped with 'the 21st Century skills' to lead a responsible and happy life.

The 21st Century Skills can be broadly put under four categories (Binkley, Erstad, Herman, Raizen, Ripley, & Rumble, 2014):

i. **Ways of thinking:**

They will have the ability to reason effectively and critically as appropriate to the situation to overcome complex problems based on analyzed and evaluated evidences, arguments, claims and beliefs. They will demonstrate originality and inventiveness in work and explore alternative in adopting new ideas.

ii. **Ways of Working:**

They will demonstrate high level of professionalism at work with ability to articulate thoughts and ideas effectively. They can collaborate effectively and respectfully with diverse teams and make necessary compromises to reach common goals.

iii. **Tools for Working: ICT and Information Literacy**

They can use technology as a tool to research, organize, evaluate, create and communicate information successfully in a knowledge economy with strong understanding of ethical and legal issues.

iv. **Skills for Living in the World: Citizenship, life and Career, and Social & Personal Responsibility**

They will have the ability to live meaningfully in the changing world with mutual respect to diverse setting. They will demonstrate sound understanding of global issues and their implication on local lives. They will collaborate with open mind in all fields and make civic decisions and deal with differences creatively. They will be productive both professionally and personally with fine entrepreneur skills.

C. Effective Pedagogy

In the 21st century learning, knowledge is no more imparted to the students, rather it is co-constructed. The students need to engage actively in the complex and interconnected world to make meaning of what they learn. The traditional methods of teaching and learning is far from reaching the needs of our 21st century learning where students need critical and creative thinking, communication and collaboration skills, and digital citizenship knowhow. This demands the curriculum framework to consider the pedagogy which provides more of hands-on, authentic and self-directed learning to promote skills of 21st century amongst our students.

D. Rationale for ICT in Education

In most researches, the ICT policy focuses on the educational sector since education is the central organization to pursue and attain the objectives of the ICT policy when the other sectors are expected to benefit indirectly from this approach. This curriculum is also expected to infuse skills like creativity, critical thinking, informed decision making, problem solving, etc.

This ICT curriculum has been designed keeping Hawkridge's (1990) four dominant rationales as the driving factor which includes broader implication areas.

- » ***an economic rationale***: the development of ICT skills is necessary to meet the need for a skilled work force, as learning is related to future jobs and careers;
- » ***a social rationale***: this builds on the belief that all pupils should know about and be familiar with computers in order to become responsible and well-informed citizens;
- » ***an educational rationale***: ICT is seen as a supportive tool to improve teaching and learning;
- » ***a catalytic rationale***: ICT is expected to accelerate educational innovations.

E. Developmental Appropriateness

The concept of developmental appropriateness has two dimensions: Age appropriateness and individual appropriateness.

1. ***Age Appropriateness***. Human development research indicates that there are universal, predictable sequences of growth and change that occur in

children during the first nine years of life. These predictable changes occur in all domains of development – physical, emotional, social, and cognitive. Knowledge of typical development of children provides a framework from which teachers prepare the learning environment and plan appropriate experiences.

2. ***Individual appropriateness.*** Each child is a unique person with an individual pattern and timing of growth, as well as individual personality, learning style, and family background. Both the curriculum and adults' interactions with children should be responsive to individual differences. Learning in young children is the result of interaction between the child's thoughts and experiences with materials, ideas, and people. Piaget (1952) asserts that "these experiences should match the child's developing abilities, while also challenging the child's interest and understanding."

F. Lifelong Learning

Lifelong learning is an important area to consider in education. The passion for lifelong learning must be promoted. Nordstrom (1990) clearly states the numerous benefits of lifelong learning for students to:

- » help fully develop natural abilities;
- » open the mind;
- » create a curious and hungry mind;
- » increase wisdom;

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- » make the world a better place;
- » help adapt to change.

ICT curriculum framework should provide space and avenue for the students to cultivate passion and develop positive attitude for lifelong learning to perform better in life.

STRANDS

Strands represent major categories of knowledge of a subject. ICT education is imparted through four connecting strands. The four strands are as follows :

- Strand A : Technology Operations and Concepts
- Strand B : Communication and Collaboration
- Strand C : Digital Citizenship
- Strand D : Computational Thinking

Strands also show logical flow of learning, starting from the technology operations and concepts to computational thinking. These four strands run across all classes from IV to XII in varying extent and depth of coverage.

A. Technology Operations and Concepts

The Technology Operations and Concepts strand broadens the students' understanding of computer as a system and the basic principles on which computer works. Students become familiar with the concepts and elements of modern computer, devices and networks. They recognize common, similar features and functions in digital environments and independently apply those to new technology experiences. With this strand students are also exposed to efficient operations of technology and management of their products.

B. Communication and Collaboration

The Communication and collaboration strand prepares students to work together to create innovative solutions to real world problems and communicate their solutions with others. As they carry out their investigations and projects, they

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must access, analyze, and use the information they need to complete the learning tasks. While working through the task, students build important life and career skills by learning to manage their time, to become self-directed learner and to collaborate effectively with others. Using appropriate technology tools to complete their task, students discover the most effective and efficient ways to access and manage the world of digital information that is available.

C. Digital Citizenship

The concept of digital citizenship relates to the responsible, ethical and safe use of ICT by students as a member of connected global 21st century society (Manitoba, 2006). This strand prepares the students to evaluate the various positive and negative impacts of computers on society and demonstrate the understanding of ethical, cultural and societal issues related to technology. They practice responsible use of technology systems and information; and develop positive attitudes towards technology uses that support lifelong learning (International Society for Technology in Education 14).

D. Computational Thinking

Computational thinking is an approach to solving problem in a way that can be implemented with the computer. The study of Computational Thinking enables student to better conceptualize, analyse, and solve complex problems by selecting and applying appropriate strategies and tools, both virtually and in real world (Barr and Stephenson, 2011). They use set of concepts, such as abstraction, recursion, and iteration, to process and analyse data, and to create real and virtual

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artefacts. Students with sound computational thinking skills become not merely tool users but tools builders, where they demonstrate critical and logical thinking skills to research, plan and develop innovative products.

Diagram showing the Four Strands in ICT curriculum

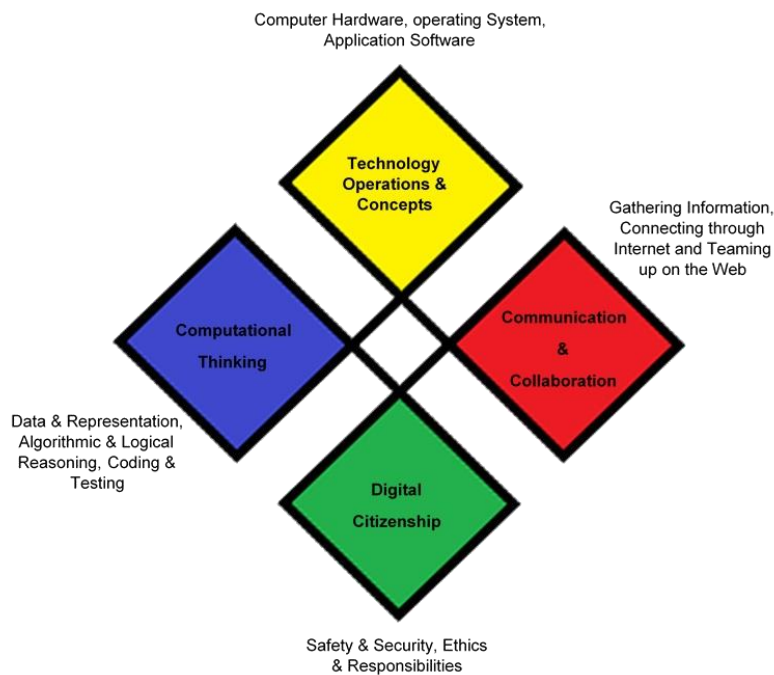
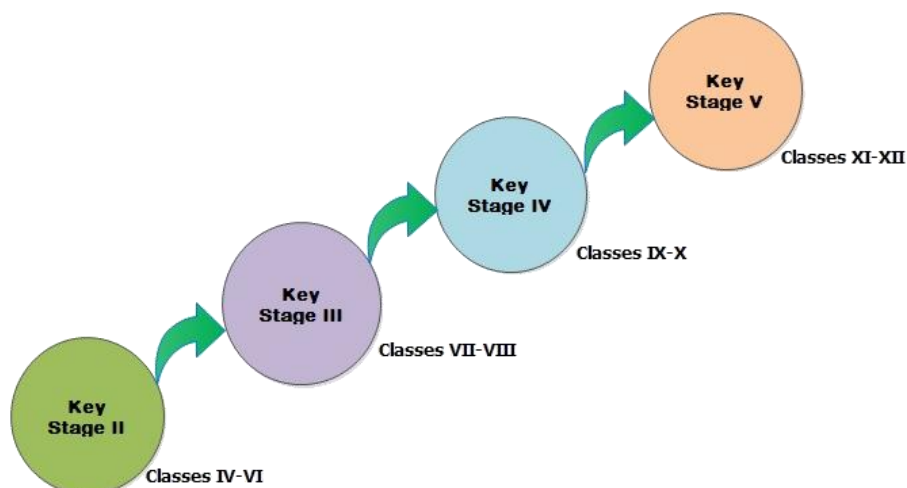
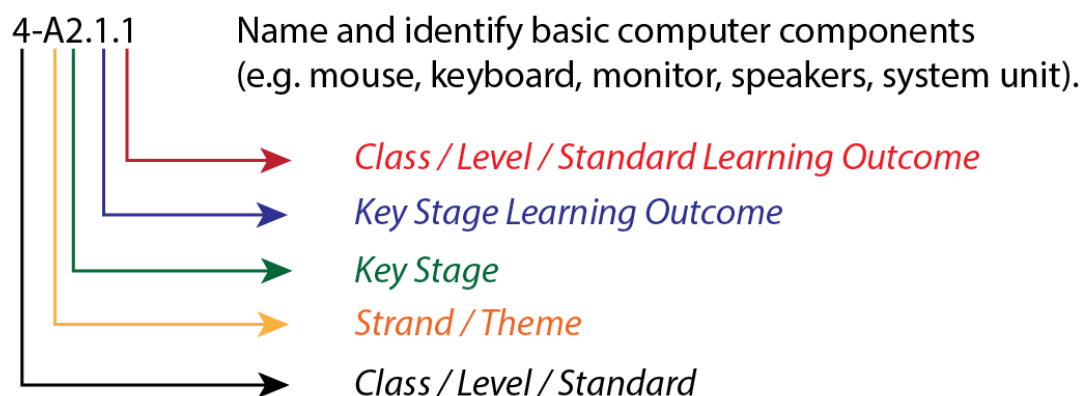


Diagram showing the Key Stages



Significance of characters used in the numbering of learning outcomes:



KEY STAGES

Key Stage 2 (Class 4-6)

By the end of the stage, students will be able to:

Strand A – Technology Operations and Concepts

- A2.1 *Describe the functions of different types of computer hardware components.*
- A2.2 *Explain how a computer system works.*
- A2.3 *Use the basic functions of Operating system correctly.*
- A2.4 *Produce properly formatted word processing document.*

Strand B – Communication and Collaboration

- B2.1 *Use the Internet to search for information.*
- B2.2 *Communicate online and perform simple collaborative task.*

Strand C – Digital Citizenship

- C2.1 *Use Computer safely and responsibly.*
- C2.2 *Protect data using secure password.*
- C2.3 *Acknowledge ownership of creative work.*

Strand D – Computational Thinking

- D2.1 *Create basic animation using programming tools.*

Class 4: Learning Outcomes

By the end of class 4, students will be able to :

Strand A – Technology Operations and Concepts

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- 4-A2.1.1 *Identify basic computer components.*
- 4-A2.2.1 *Understand and navigate the Operating System.*
- 4-A2.3.1 *Create and open files.*
- 4-A2.4.1 *Develop mouse and keyboard skills.*

Strand B – Communication and Collaboration

- 4-B2.1.1 *Understand what Internet is.*
- 5-B2.1.1 *Explore internet independently.*

Strand C – Digital Citizenship

- 4-C2.1.1 *Follow correct sequence to start and shutdown computers.*
- 4-C2.1.2 *Adopt correct body postures while using computer.*
- 4-C2.1.3 *Demonstrate an understanding of computer laboratory rules.*

Strand D – Computational Thinking

- 4-D2.1.1 *Complete logical games and puzzles.*
- 4-D2.1.2 *Know the basic components in Programming Environment.*
- 4-D2.1.3 *Use simple instructions in the program.*

Class 5: Learning Outcomes

By the end of class 5, students will be able to :

Strand A – Technology Operations and Concepts

- 5-A2.1.1 *Describe the functions of computer components and peripheral devices.*

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- 5-A2.2.1 *Explain the working principle of a computer (IPO cycle).*
- 5-A2.2.2 *Categorize devices into input and output devices.*
- 5-A2.3.1 *Use basic file management techniques.*
- 5-A2.4.1 *Create, redraft and present ideas using text editing features.*
- 5-A2.4.2 *Type in Dzongkha using a word processor.*

Strand B – Communication and Collaboration

- 5-B2.1.2 *Use navigation buttons.*
- 5-B2.1.3 *Use search engine to find information.*
- 5-B2.2.1 *Communicate on a local area network.*

Strand C – Digital Citizenship

- 5-C2.2.1 *Explain the importance of using strong and secure password.*
- 5-C2.2.2 *Make their login password secure.*
- 5-C2.3.1 *Assert ownership of their own work.*

Strand D – Computational Thinking

- 5-D2.1.1 *Write linear sequence of steps to solve the identified problem.*
- 5-D2.1.2 *Modify the properties and behaviour of objects.*
- 5-D2.1.3 *Create program to implement the algorithm.*

Class 6: Learning Outcomes

By the end of class 6, students will be able to:

Strand A – Technology Operations and Concepts

- 6-A2.1.1 *Describe the functions of basic internal hardware components.*
- 6-A2.3.1 *Manage files and folders.*

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6-A2.4.1 *Present ideas using table and objects.*

Strand B – Communication and Collaboration

6-B2.1.1 *Describe Internet.*

6-B2.1.3 *Interpret web address.*

6-B2.1.4 *Find information on Internet.*

6-B2.2.3 *Collaborative using simple online tools.*

Strand C – Digital Citizenship

6-C2.1.1 *Describe health issues related to use of computer.*

6-C2.2.1 *Secure documents with passwords.*

6-C2.3.1 *Acknowledge source of online information.*

Strand D – Computational Thinking

6-D2.1.2 *Execute programs consisting of two or more sequence of instructions.*

6-D2.3.1 *Plan and write algorithm to solve identified problems.*

Key Stage 3 (Class 7-8)

By the end of the stage, students will be able to:

Strand A – Technology Operations and Concepts

- A3.1 *Exhibit the understanding of the Software.*
- A3.2 *Identify different types of data storage.*
- A3.3 *Identify types of monitors and external ports.*
- A3.4 *Enhance the performance of Operating system.*
- A3.5 *Use word processing features to communicate and share ideas.*
- A3.6 *Prepare effective presentations using some multimedia components.*
- A3.7 *Edit images and audio clips using simple tools.*

Strand B – Communication and Collaboration

- B3.1 *Archive web addresses.*
- B3.2 *Evaluate online contents.*
- B3.3 *Exchange files and folders on the internet.*
- B3.4 *Collaborate on social networks.*

Strand C – Digital Citizenship

- C3.1 *Describe techniques to secure data from malware.*
- C3.2 *Behave appropriately when online.*
- C3.3 *Identify importance of acknowledging online resources.*

Strand D – Computational Thinking

- D3.1 *Use programming tools to create interactive models.*

Class 7: Learning Outcomes

By the end of class 7, students will be able to:

Strand A – Technology Operations and Concepts

- 7-A3.1.1 *Categorize software into system software and application software.*
- 7-A3.3.1 *Identify the types of computer monitors.*
- 7-A3.3.2 *Identify the types of computer external ports.*
- 7-A3.4.1 *Use system utility tools to enhance the performance of operating system.*
- 7-A3.5.1 *Use collaborative tools in word processor to edit and restructure a document.*
- 7-A3.6.1 *Create a presentation using basic features of a presentation software.*
- 7-A3.7.1 *Explain the basic concepts of multimedia.*
- 7-A3.7.2 *Edit a picture using an image editing software.*

Strand B – Communication and Collaboration

- 7-B3.1.1 *Use address archiving features of browser (online bookmarks, history).*
- 6-B2.2.1 *Create an e-mail account.*
- 6-B2.2.2 *Manage emails.*
- 7-B3.3.1 *Upload and download e-mail attachments (compressing files and folders).*
- 7-B3.4.1 *Publish pictures and text on social network (e.g. Ning, Flickr, Instagram).*

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Strand C – Digital Citizenship

- 7-C3.1.1 *Describe the importance of data backup (e.g. definition, why backup?).*
- 7-C3.1.2 *Backup data using viable procedures (e.g. backup in CD/HDD/USB drive).*
- 7-C3.2.1 *Follow ways to protect personal data on the Internet (e.g. not sharing personal details to avoid identity theft, setting privacy tools in social network sites).*
- 7-C3.2.2 *Follow a general Acceptable Use Policy (AUP) when they are online (e.g. appropriate websites, use of language, trolling, cite sources, observe etiquettes in communication).*

Strand D – Computational Thinking

- 7-D3.1.1 *Use different data in the program.*
- 7-D3.1.2 *Write programs using basic operators and conditions.*

Class 8: Learning Outcomes

By the end of class 8, students will be able to:

Strand A – Technology Operations and Concepts

- 8-A3.2.1 *Explain the concept of computer memory and storage capacity.*
- 8-A3.4.1 *Install and uninstall simple application software.*
- 8-A3.6.1 *Enhance a presentation using animations and multimedia elements.*
- 8-A3.7.1 *Record sound using simple recording software.*
- 8-A3.7.2 *Edit audio using an audio editing software.*

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Strand B – Communication and Collaboration

- 8-B3.2.1 *Use standard verification criteria to assess the accuracy and relevancy of information on the Internet.*
- 8-B3.4.1 *Share audio resources on audio podcast (Sound cloud).*

Strand C – Digital Citizenship

- 8-C3.1.1 *Adopt measures to prevent malware infection (e.g. types of malware and anti- virus, scanning, updating Anti-virus).*
- 8-C3.2.1 *Identify strategies to avoid exploitation of private information (e.g. risk of stranger danger, distinguish between real friends and online friends, Share past examples on stranger danger).*
- 8-C3.3.1 *Distinguish between Copyright and Creative Commons (define, symbols, license, ISBN).*
- 8.C3.3.2 *Describe different types of software piracy (e.g. Internet piracy, bootlegging, counterfeiting, hard disk loading).*
- 8.C3.3.3 *Exhibit legal and ethical behaviours while using the Internet and discuss the consequences of inappropriate use.*

Strand D – Computational Thinking

- 8-D3.1.1 *Use appropriate variables and functions.*
- 8-D3.1.2 *Subdivide a program into functions to solve a complex problem through abstraction.*
- 8-D3.1.4 *Make programs efficient and dynamic through use of variables and events.*

Key Stage 4 (Class 9-10)

By the end of the stage, students will be able to:

Strand A – Technology Operations and Concepts

- A4.1 *Use spreadsheet to automate various tasks and analyse data.*
- A4.2 *Create short video clips on a given topic/theme.*
- A4.3 *Troubleshoot simple network problems.*
- A4.4 *Exhibit the understanding of hardware needs of a user.*
- A4.5 *Describe assistive technology interventions to maximize computer access.*

Strand B – Communication and Collaboration

- B4.1 *Identify the technology and procedure behind the Internet connectivity.*
- B4.2 *Use an e-learning platform.*
- B4.3 *Collaborate online to share multimedia resources.*
- B4.4 *Secure data in online space.*

Strand C – Digital Citizenship

- C4.1 *Deal with unethical online behaviour in a responsible way.*
- C4.2 *Acknowledge online resources.*
- C4.3 *Act responsibly in use of ICT in society.*

Strand D – Computational Thinking

- D4.1 *Design website with proper structure using HTML and CSS.*

Class 9: Learning Outcomes

By the end of class 9, students will be able to:

Strand A – Technology Operations and Concepts

- 9-A4.1.1 *Manipulate data using basic features of spreadsheet.*
- 9-A4.1.2 *Use operators to perform basic calculation in spreadsheet.*
- 9-A4.2.1 *Use simple video recording tools to record videos (e.g. Webcam).*
- 9-A4.2.2 *Create a short video using a video editing software (e.g. Windows Movie Maker).*
- 9-A4.3.1 *Examine different types of networks.*
- 9-A4.3.2 *Identify common networking devices.*

Strand B – Communication and Collaboration

- 9-B4.1.1 *Explain the technological structure of the Internet (protocols, ISP, modem, web server).*
- 9-B4.1.2 *List down various ways of connecting to the Internet.*
- 9-B4.2.1 *Recognize basic features of e-Learning platform (forum, downloading materials, uploading assignments, assessment tools).*
- 9-B4.2.2 *Complete simple tasks on e-Learning Platform.*
- 9-B4.3.1 *Share video resources on Video podcast sites (YouTube).*

Strand C – Digital Citizenship

- 9-C4.1.1 *Identify and cope up with cyber bullying situation.*
- 9-C4.2.1 *Follow standard citation to acknowledge other's works.*

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Strand D – Computational Thinking

- 9-D4.1.1 *Use appropriate tags and attributes to present content in a web page.*
- 9-D4.1.2 *Create navigation in web pages.*
- 9-D4.1.3 *Create web pages using basic html elements.*

Class 10: Learning Outcomes

By the end of class 10, students will be able to:

Strand A – Technology Operations and Concepts

- 10-A4.1.1 *Analyse and automate data in spreadsheet.*
- 10-A4.3.1 *Handle simple network problems.*
- 10-A4.4.1 *Compare types of computing devices based on storage, memory, processors, and utilities.*
- 10-A4.5.1 *Explain the concept of assistive technology.*
- 10-A4.5.2 *Identify available ATL tools (Braille keyboards, touch screens, talking calculator, JAWS).*

Strand B – Communication and Collaboration

- 10-B4.3.1 *Share information on personal blogs (create a blog and share multimedia resources such as text, pictures, audio and video).*
- 10-B4.3.2 *Collaborate using cloud features (Google Docs).*
- 10-B4.4.1 *Use an online storage space to backup data.*

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Strand C – Digital Citizenship

- 10-C4.3.1 *Create awareness on responsible use of technology (through creating and sharing poster, brochure, pamphlet, online groups).*
- 10-C4.3.2 *Use ICT to facilitate their career choice (ICT in education, medicine, engineering, commerce, media).*
- 10-C4.3.3 *Assess the impact of using ICT towards community and country (e.g. digital divide, e-waste, e-commerce).*

Strand D – Computational Thinking

- 10-D4.1.1 *Plan an outline of website with proper structure.*
- 10-D4.1.2 *Use Cascading Style Sheet (CSS) to improve the presentation of web pages.*

Key Stage 5 (Class 11-12)

By the end of the stage, students will be able to:

Strand A – Technology Operations and Concepts

A5.1 *Create a well-designed document for publication.*

Strand B – Communication and Collaboration

B5.1 *Maintain ePortfolio.*

B5.2 *Identify different types of mobile apps.*

Strand C – Digital Citizenship

C5.1 *Describe the ways to protect data from cyber intruders.*

C5.2 *Explain the role of computer forensic to trace cyber activities.*

Strand D – Computational Thinking

D5.1 *Create dynamic webpages.*

D5.2 *Develop programs using object oriented concepts in text based interface.*

D5.3 *Demonstrate ability to use data types and structures in computer program.*

Class 11: Learning Outcomes

By the end of class 11, students will be able to:

Strand A – Technology Operations and Concepts

11-A5.1.1 *Design for publication using a desktop publishing software.*

Strand B – Communication and Collaboration

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- 11-B5.1.1 *Customize blog/site using templates, HTML, JavaScript, CSS, widgets and other visual web authoring tools (e.g. Google sites).*
- 11-B5.1.2 *Aggregate resources using blog as a platform.*
- 11-B5.2.1 *Explain the concept of mobile apps and identify different communication, educational and productivity apps (e.g. Viber, WeChat, Skype, Khan Academy, dictionary, scanner).*

Strand C – Digital Citizenship

- 11-C5.1.1 *Explain the role of biometric technology to control access to data (identification types, identification devices).*
- 11-C5.1.2 *Explain the impact of hacking and the ways to reduce it (define hacking, types of hackings, consequences of hacking, measures to prevent hackers).*

Strand D – Computational Thinking

- 11-D5.1.1 *Use client side scripting to create interactive webpages.*
- 11-D5.2.1 *Write algorithm for identified tasks.*
- 11-D5.2.2 *Develop programs to solve problems using basic programming concepts.*
- 11-D5.2.3 *Apply good programming practices such as testing, debugging documentations.*
- 11-D5.3.1 *Use appropriate data types in a program.*
- 11-D5.3.2 *Use operators in correct precedence in an expression.*
- 11-D5.3.3 *Apply Boolean algebra in developing logical flow of program.*

Class 12: Learning Outcomes

By the end of class 12, students will be able to:

Strand C – Digital Citizenship

- 12-C5.2.1 *Explain the use of digital footprints to trace online activities (computer forensic, scope of computer forensic).*

Strand D – Computational Thinking

- 12-D5.1.1 *Develop application using object oriented concepts.*
- 12-D5.1.2 *Use server side scripting to manipulate database in web application.*
- 12-D5.2.1 *Decompose a problem by defining new functions and classes.*
- 12-D5.3.1 *Create database for web application using SQL.*
- 12-D5.3.2 *Explain various number systems used in computer.*

ASSESSMENT

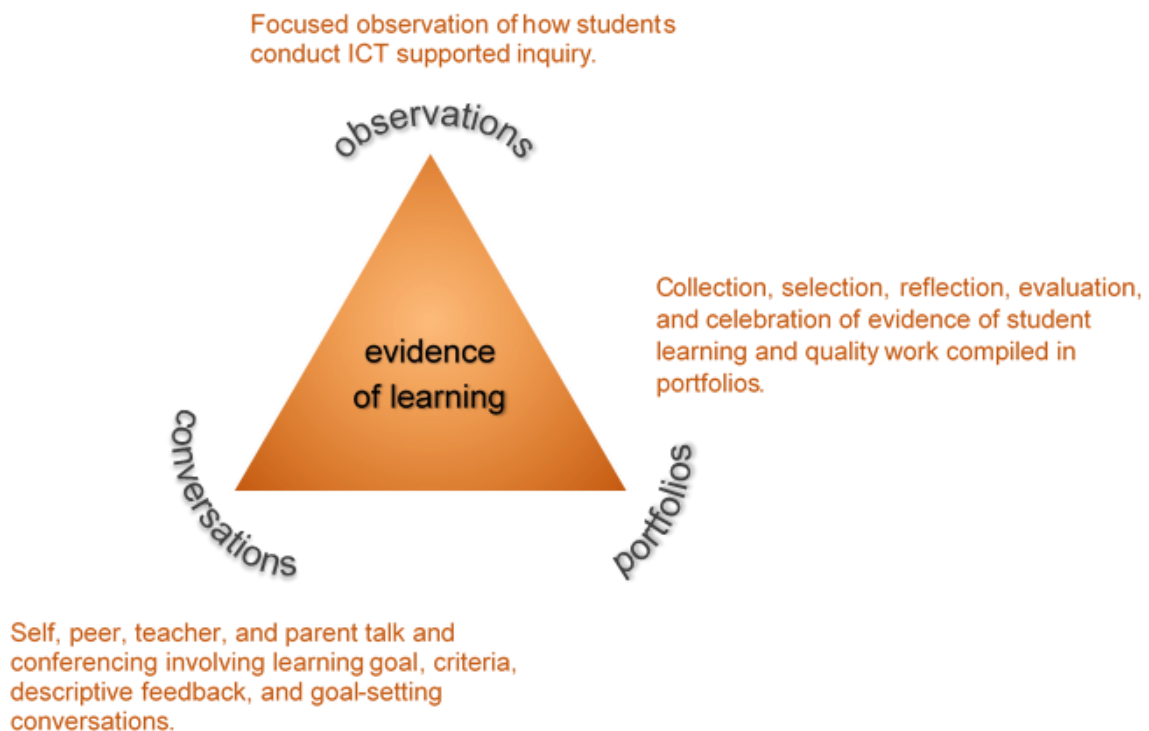
Assessment is an integral part of learning for it provides the ongoing feedback necessary for effective learning and teaching. It is the process of gathering evidence of learning, usually in measurable terms, with respect to knowledge, skills and attitudes. Gathering evidence of learning requires the use of a variety of assessment methods to assess students' products and performances during and after the learning. The evidence of learning informs instruction by providing information about the learning to the learner, the teacher, and the parent. The goal of assessment ultimately is to develop self-directed learners who regularly monitor and assess their own progress.

Assessment is often divided broadly into two categories: formative and summative. Summative assessment takes place at the end of the assessment of the learning and summarizes the development of learners at a particular time. A standardized summative assessment at the conclusion of a unit or a theoretical chapter is a unit test. Formative assessment on the other hand is a range of formal and informal assessment methods used during the learning process, usually by teachers. It helps to modify learning and teaching activities to monitor what students know and improve their achievements. In short, summative assessment is used to judge the student's achievements at the end of a programme of study whereas formative assessment aims to gather evidence about the student's learning in order to influence teaching methods and priorities.

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One of the important objectives of this ICT curriculum is to equip our learners with 21st century skills, and the formative assessment is understood to be a central feature of the learning environment of the 21st century (Harrison, 2014). 21st century learners need substantial and meaningful feedbacks regularly to assess their progress and influence future lessons and teaching strategies. Thus, the assessment of student learning in this curriculum lays more emphasis on formative assessment than summative assessment. A listing of some assessment tools are provided in Appendix A along with exemplars of how ICT tools could be used for assessment.

The assessment of student learning in the curriculum is based on the evidences of learning, which are examined through three ways of how the evidences are assessed: *observations*, *conversations*, and *portfolios*.



Manitoba Education, Citizenship and Youth. Figure 7

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APPENDIX A

Sl No	Tools	Description	ICT Tools
1	Interview	An interview is structured or unstructured dialogue between teacher and students, and or among students in which the students response to one or more questions. Questions will focus on a specific task or to a topic catering to range of student's ability. Interview will assess students based on the responses given to each questions. It can be useful in determining student's depth of understanding of ICT concepts.	Chat platforms Video conferencing like Skype More Video Interview tools on http://interviewingsoftware.com/

2	Survey	<p>A survey is a planned series of questions or statements to assess student’s performance. Survey can be conducted in different ways (paper, oral, electronic) using various delivery methods (face-to-face, telephone, mail, Internet). It will determine student’s prior knowledge and additional experiences they have gained over the course.</p>	<p>https://docs.google.com</p> <p>www.zoomerang.com</p> <p>www.surveymonkey.com</p>
3	Quiz	<p>A quiz is a quick way of gathering information on how well the students are meeting their learning objectives. Quizzes assess students for factual information, concepts and discrete skill. There is usually a single best answer for quiz.</p> <p>Quizzes can be used at the beginning to assess what the students already know and clear up misconceptions. It can be also used end to assess students learning. It can be conducted both online and offline.</p>	<p>Online Tools</p> <p>http://challenge.zoho.com</p> <p>https://docs.google.com/forms</p> <p>http://www.proprofs.com/quiz-school/</p> <p>http://www.quizrevolution.com/</p> <p>http://www.thatquiz.org/</p> <p>Offline Tools</p> <ul style="list-style-type: none"> • Hotpotato • PowerPoint

4	Rubric	<p>A rubric is a scoring tool with a set of criteria that explicitly represent the performance expectations for a piece of work. It divides the assigned work into component parts and provides clear descriptions of the characteristics of the work associated with each component, at varying levels of mastery.</p> <p>It can be used as a tool to assess different assessment strategies such as projects, presentations, posters, debate etc.</p>	<p>Online Tools</p> <p>http://rubistar.4teachers.org/</p> <p>http://www.rcampus.com/indexrubric.cfm</p> <p>http://rubrix.com/</p> <p>Offline</p> <ul style="list-style-type: none">• MsExcel• Ms Word
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5	Exit Slip	<p>Exit Slip is a short diagnostic activity in which teacher let students write down a few words about the lesson on a piece of paper or using a digital tool at the end of the class. It will provide important evidence of knowledge gained and knowledge gaps.</p> <p>An exit card can contain sentence starters that guide students to provide information about their understanding. Exit card can also carry a short quiz, or a few simple questions, and students give them to you as they leave your class. The goal is to use the exit slip to give a quick review of the lesson and guide the way forward.</p>	<p>Google Drive Class Blog or Wiki www.polleverywhere.com www.surveymonkey.com www.Twitter.com www.poll daddy.com www.edmodo.com www.todaysmeet.com www.socrative.com www.zoomerang.com www.linoit.com</p>
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6	Polling	<p>Polling is a process of collecting opinions from the mass through voting using simple paper ballot or online tools.</p> <p>Poll can be conducted during or after the lesson to check on the general understanding of a concept or to fetch opinions from the mass. It helps in involving everybody in decision making. Polls are generally done anonymously and therefore have the advantage of receiving honest feedback but there are tools that can assist in conducting non-anonymous polls.</p>	<p>www.surveymonkey.com</p> <p>http://polldaddy.com</p> <p>www.polleverywhere.com</p>
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7	Role Play	<p>Role Play is to act and speak as if you are the character you're portraying. This strategy can be used in finding out if students have grasped the content and be able to express it creatively.</p> <p>Role play is an excellent means of evaluating decision-making and interpersonal communication skills in professional environment. Participants undertake authentic tasks in an authentic context. The task involves substantial in-role interaction with other roles for collaboration, negotiation and debate.</p>	
8	Poster	<p>It is a combination of text and graphics to present a work in a way that is visually interesting and accessible. It stimulates curiosity and learning in students and encourages exploration and integration of concepts.</p>	<p>www.postermywall.com / www.befunky.com/ www.artskills.com www.musythoughts.com www.posterini.com</p>
9	Journal	<p>It is a personal record containing written, reflective response to material a student is reading, viewing, listening to or discussing. It can be used to assess student's progress and growth over time.</p>	<p>Blogs and Wikis</p>

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10	Debate	<p>A Debate is a formal discussion or an argument on a particular matter. Debate can be used on certain controversial topics to let students settle differences. Students can also learn from each other and can make better informed decisions.</p>	<p>Social Forums</p> <p>http://www.pbworks.com</p>
11	Presentation	<p>Presentation is a method where students individually or in group gather, create, organize, and illustrate ideas to deliberate on a selected concept. It facilitate research, collaborate and innovation.</p>	<p>www.prezi.com www.sliderocket.com www.slideshare.net</p>
12	Checklist	<p>Checklist states specific criteria and allow teachers and students to keep track of their progress towards objectives.</p> <p>It gathers information for making judgments about what students know and should do in achieving the outcomes. It can be used as a tool in various assessment strategies.</p>	<p>www.skybuffer.com www.pearltrees.com</p>

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13	Think-Pair –Share	Asking students to think on something independently then pair up with another student to exchange their thoughts and finally return to the full-class context to share. This method engages everybody into thinking and collaboration thus increases the quality of responses.	https://drive.google.com www.socrative.com
14	Digital Storytelling	Digital storytelling is a form of storytelling using digital technology. It enables students to tell their stories dynamically with videos, photos, art, music, narration, and sound effects using simple multimedia publishing tools. It provides opportunities for students to enhance the expression of their stories, thoughts and ideas in creative and engaging ways, across a diverse range of learning contexts.	www.digitalfilms.com www.kerpoof.com
15	Portfolio	<p>It is a collection of students' works, both digital and print form, which can be used in evaluating their work progress and to celebrate their achievements.</p> <p>It can be maintained online, offline or print form.</p>	<p>Blogs and Wikis</p> <p>Google drive</p> <p>http://electronicportfolios.org/</p>

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16	Exhibition	Students showcase artefacts on selected topics during which they explain and demonstrate the achievement of a specific skill and concept in a creative way.	Blogs and Wikis
17	Conferencing	Conference refers to a formal or informal meeting between the teacher and a student or amongst the students for the purpose of exchanging information or sharing ideas. A conference might be held to assess the student's level of understanding of a particular concept or procedure; and review, clarify, and extend what the student has already accomplished.	www.Skype.com www.Facebook.com www.Liniot.com Google hangout Google docs
18	Project	A project is any piece of activity, individual or group, involving the study and solution to selected problems, planned and carried out with teacher's guidance.	Google docs Blogs and Wikis