

Technology and Industrial Arts

Computer Technology

Junior High

Grade 10

Teacher Guide

Standards-Based



Papua New Guinea

Department of Education

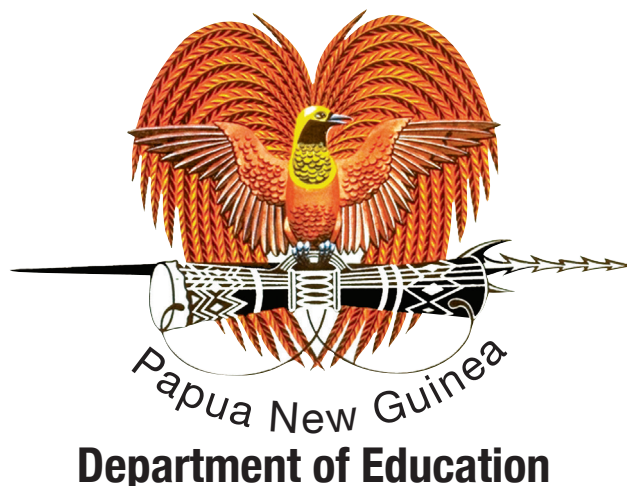
**'FREE ISSUE
NOT FOR SALE'**

Technology and Industrial Arts

**Computer
Technology
Junior High**

**Grade 10
Teacher Guide**

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Issued free to schools by the Department of Education

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Acronyms

AAL	Assessment as Learning
AFL	Assessment for Learning
AOL	Assessment of Learning
BoS	Board of Studies
CDD	Curriculum Development Division
CP	Curriculum Panel
DA	Diagnostic Assessment
IHD	Integral Human Development
GoPNG	Government of Papua New Guinea
OBC	Outcomes-Based Curriculum
OBE	Outcomes-Based Education
PNG	Papua New Guinea
SAC	Subject Advisory Committee
SBA	Standards-Based Assessment
SBC	Standards-Based Curriculum
SBE	Standards-Based Education
SCG	Subject Curriculum Group
STEAM	Science, Technology, Engineering, Arts and Mathematics
TIA	Technology and Industrial Arts

Secretary's Message

The ultimate aim of Standards-Based Education in Papua New Guinea (PNG) is to prepare students for careers, higher education, and citizenship. Education will therefore focus on providing students with careers, higher education, and citizenship preparedness knowledge, skills, values, and attitudes that they can use to work, study and live in the 21st century. Education must also aim to motivate and prepare students to pursue Science, Technology, Engineering, Arts, and Mathematics (STEAM) courses in higher education institutions and pursue careers in STEAM related fields.

Technology & Industrial Art is a significant curriculum framework for teaching students and enabling them to progressively develop proficiency on fundamental ideas of Food Technology, Textile Technology, Construction Technology, Communication Technology and Computer Technology. This curriculum addresses Computer Technology Strand skills and processes that enable students to visualise abstract concepts, participate in rigorous simulations, gather data via scientific probes, analyse and manipulate data, and compose initiatives. It promotes the idea of Computer Science as well as STEAM and global technology awareness.

Thus, students will be able to make informed decisions, problem – solving and management knowledge, skills, values and attitudes in Computer Technology Strand. This enables them to function effectively in the work and higher education environments as productive and useful citizens of a culturally diverse and democratic society in an interdependent world.

Computer Technology Strand teachers are expected to effectively plan, teach, and assess these knowledge, skills, values, and attitudes. The Computer Technology Strand teacher guide describes what teachers are expected to know and do to enable all their students to effectively learn and demonstrate the expected levels of proficiency in all the grade level.

I approve and commend this Computer Technology Strand Teacher Guide to be used by Grade 10 Teachers in all High Schools throughout Papua New Guinea.

.....
UKE W. KOMBRA, PhD
 Secretary for Education

Introduction

Computer Technology Strand Teacher Guide aims to provide a meaningful pedagogical framework for teaching and learning essential and in demand knowledge, skills, values, and attitudes that are required for the preparation of students for careers, higher education and citizenship in the 21st century.

Students should be prepared to gather and understand information, analyze issues critically, learn independently or collaboratively, organize and communicate information, draw and justify conclusions, create new knowledge, and act ethically.

Students' employability will be enhanced through the study and application of STEAM principles. STEAM is an integral component of the core curriculum. All students are expected to study STEAM and use STEAM related skills to solve problems relating to both the natural and the physical environments. The aim of STEAM education is to create a STEAM literate society. It is envisioned that the study of STEAM will motivate students to pursue and take up academic programs and careers in STEAM related fields. STEAM has been embedded in the Technology & Industrial Art curriculum. Computer Technology Strand plays a major role in STEAM education as it promotes the use of computers and appropriate technology skills to use when solving problems in this digital era. Equal opportunities should be provided for all students to learn, apply and master STEAM principles and skills.

Time allocation for Technology & Industrial is 200 minutes for grade 9 to 10 in a week.

Structure of the Teacher Guide

The Computer Technology Strand Teacher Guide comprises four main sections that provide essential information that all teachers should know and do to effectively implement the Computer Technology curriculum.

1. General Information of the Subject/Strand

The general information section of the Teacher Guide informs teachers on the Computer Technology Strand under the following headings below;

- Introduction of the Strand Teacher Guide
- Structure of the Strand Teacher Guide
- Purpose of the Strand Teacher Guide
- How to use the Strand Teacher Guide

2. Teaching and Learning Section

The teaching and learning section of the Teacher Guide informs and guides teachers to apply the teaching and learning theories, principles, pedagogies and practices in planning, programing, teaching and assessing students. They are outlined in the headings bulleted below;

- Syllabus and Teacher Guide Alignment
- Learning and Performance Standards
- Core Curriculum
- Science Technology Engineering Arts Mathematics (STEAM)
- Curriculum Integration
- Essential Knowledge, Skills, Values and Attitudes
- Teaching and Learning Strategies
- Strands, Units and Topics
- Sample SBC Lesson Plans

3. Assessment Section

The assessment section of the Teacher Guide informs and guides teachers to plan and program assessment activities, formulate assessment rubrics and apply assessment strategies to assess studies. This section also guides teachers to monitor and report students' progress of learning and performances of the attainment of standards.

4. Glossary, References and Appendices Sections

These sections guide teachers to refer to terms and definitions of the strand/subject content, references outlined to guide the development of this teacher guide. The appendices section provides essential information to guide teachers on the content and the delivery of this strand/subject.

Purpose of the Teacher Guide

This teacher guide describes what all teachers should know and do to effectively plan, teach, and assess Grade 9 and 10 Computer Technology Strand content to enable all students to attain the required learning and proficiency standards. The overarching purpose of this teacher guide is to help teachers to effectively plan, teach, assess, evaluate, report and monitor students' learning and mastery of national and grade-level expectations. That is, the essential knowledge, skills, values and attitude described in the content standards and grade-level benchmarks, and their achievement of the national and grade-level proficiency standards.

Ample information with thorough guidelines is provided for the teacher to use to achieve the essential KSAV embedded in the set national content standards and grade level benchmarks. Thus, the teacher is expected to:

- understand the significance of aligning all the elements of Standards-Based Curriculum (SBC) as the basis for achieving the expected level of education quality;
- effectively align all the components of SBC when planning, teaching, and assessing students' learning and levels of proficiency;
- effectively translate and align the Technology and Industrial Arts syllabi and Computer Technology Strand teacher guide to plan, teach and assess different Computer Technology Strand units and topics, and the KSVAs described in the grade-level benchmarks;
- understand the Computer Technology Strand national content standards, grade-level benchmarks, and evidence outcomes;
- effectively make sense of the content (KSVAs) described in the Computer Technology Strand national content standards and the essential components of the content described in the grade-level benchmarks;
- effectively guide students to progressively learn and demonstrate proficiency on a range of Computer Technology Strand skills, processes, concepts, ideas, principles, practices, values and attitudes.
- confidently interpret, translate and use Computer Technology Strand content standards and benchmarks to determine the learning objectives and performance standards, and plan appropriately to enable all students to achieve these standards;
- embed the core curriculum in their Computer Technology Strand lesson planning, instruction, and assessment to permit all students to learn and master the core KSVAs required of all students;
- provide opportunities for all students to understand how STEAM has and continues to shape the social, political, economic, cultural, and environment contexts and the consequences, and use STEAM principles, skills, processes, ideas and concepts to inquire into and solve problems relating to both the natural and physical (man-made) worlds as well as problems created by STEAM;
- integrate cognitive skills (critical, creative, reasoning, decision-making, and problem-solving skills), high level thinking skills (analysis, synthesis and evaluation skills), values (personal, social, work, health, peace, relationship, sustaining values), and attitudes in

lesson planning, instruction and assessment;

- meaningfully connect what students learn in Computer Technology with what is learnt in other subjects to add value and enhance students' learning so that they can integrate what they learn and develop in-depth vertical and horizontal understanding of subject content;
- formulate effective SBC lesson plans using learning objectives identified for each of the topics;
- employ SBC assessment approaches to develop performance assessments to assess students' proficiency on a content standard or a component of the content standard described in the grade-level benchmark;
- effectively score and evaluate students' performance in relation to a core set of learning standards or criteria, and make sense of the data to ascertain students' status of progress towards meeting grade-level and nationally expected proficiency standards, and use evidence from the assessment of students' performance to develop effective evidence-based intervention strategies to help students' making inadequate or slow progress towards meeting the grade-level and national expectations to improve their learning and performance.

How to the Use the Teacher Guide

The Teacher Guide provides essential information about what the teacher needs to know and do to effectively plan, teach and assess students' learning and proficiency on learning and performance standards. The different components of the teacher guide are closely aligned with SBC principles and practice, and all the other components of PNG SBC. It should be read in conjunction with the syllabus in order to understand what is expected of teachers and students to achieve the envisaged quality of education outcomes.

The first thing teachers should do is to read and understand each of the sections of the teacher guide to help them understand the key SBC concepts and ideas, alignment of PNG SBC components, alignment of the syllabus and teacher guide, setting of content standards and grade-level benchmarks, core curriculum, STEAM, curriculum integration, essential knowledge, skills, values and attitudes, strands, units and topics, learning objectives, SBC lesson planning, and SBC assessment. A thorough understanding of these components will help teachers meet the teacher expectations for implementing the SBC curriculum, and therefore the effective implementation of Grade 9 and 10 Computer Technology Strand Curriculum. Based on this understanding, teachers should be able to effectively use the teacher guide to do the following:

Determine Learning Objectives and Lesson Topics

Topics and learning objectives have been identified and described in the Teacher Guide. Lesson objectives are derived from topics that are extracted from the grade-level benchmarks. Lesson topics are deduced from the learning objectives. Teachers should familiarise themselves with this process as it is essential for lesson planning, instruction and assessment. However, depending on the context and students' learning abilities, teachers would be required to determine additional learning objectives and lesson topics. Teachers should use the examples provided in this teacher guide to formulate additional learning objectives and lesson topics to meet the educational or learning needs of their students.

Identify and Teach Grade Appropriate Content

Grade appropriate content has been identified and scoped and sequenced using appropriate content organisation principles. The content is sequenced using the spiraling sequence principles. This sequencing of content will enable students to progressively learn the essential knowledge, skills, values and attitudes as they progress further into their schooling. What students learn in previous grades is reinforced and deepens in scope with an increase in the level of complexity and difficulty in the content and learning activities. It is important to understand how the content is organised so that grade appropriate content and learning activities can be selected, if not already embedded in the benchmarks and learning objectives, to not only help students learn and master the content, but ensure that what is taught is rigorous, challenging, and comparable.

Integrate the Core Curriculum in Lesson Planning, Instruction and Assessment

Teachers should use this teacher guide to help them integrate the core curriculum – values, cognitive and high level skills, 21st century skills, STEAM principles and skills, and reading, writing, and communication skills in their lesson planning, instruction and assessment. All students in all subjects are required to learn and master these skills progressively through the education system.

Integrate Cognitive, High Level, and 21st Century Skills in Lesson Planning, Instruction and Assessment

Teachers should integrate the cognitive, high level and 21st century skills in their annual teaching programs, and give prominence to these skills in their lesson preparation, teaching and learning activities, performance assessment, and performance standards for measuring students' proficiency on these skills. Computer Technology addresses the Technology skills processes of geography, civic and cultural literacy, historical and economical literacy and global awareness. Thus, students will be able to make informed decisions, problem – solving and management knowledge, skills, values and attitudes in Computer Technology. This enables them to function effectively in the work and higher education environments as productive and useful citizens of a culturally diverse and democratic society in an interdependent world.

In addition, it envisaged all students attaining expected proficiency levels in these skills and will be ready to pursue careers and higher education academic programs that demand these skills, and use them in their everyday life after they leave school at the end of Grade 12. Teachers should use the teacher guide to help them to effectively embed these skills, particularly in their lesson planning and in the teaching and learning activities as well as in the assessment of students' application of the skills.

Integrate Technology values and attitudes in Lesson Planning, Instruction and Assessment

In Computer Technology Strand, students are expected to learn, promote and use work, relationship, peace, health, social, personal, family, community, national and global values in the work and study environments as well as in their conduct as community, national and global citizens. Teachers should draw from the information and suggestions provided in the syllabus and teacher guide to integrate values and attitudes in their lesson planning, instruction, and assessment. They should report on students' progression towards internalising different values and attitudes and provide additional support to students who are yet to reach the internalisation stage to make positive progress towards this level.

Integrate Science, Technology, Engineering, Arts and Mathematics (STEAM) Principles and Skills in Lesson Planning, Instruction and Assessment

Teachers should draw from both the syllabus and teacher guide in order to help them integrate STEAM principles and skills, and methodologies in their lesson planning, instruction and assessment. STEAM teaching and learning happens both inside and outside of the classroom. Effective STEAM teaching and learning requires both the teacher and the student to participate as core investigators and learners, and to work in partnership and collaboration with relevant stakeholders to achieve maximum results. Teachers should use the syllabus, teacher guides and other resources to guide them to plan and implement this and other innovative and creative approaches to STEAM teaching and learning to make STEAM principles and skills learning fun and enjoyable and, at the same time, attain the intended quality of learning outcomes.

Identify and Use Grade and Context Appropriate, Innovative, Differentiated and Creative Teaching and Learning Methodologies

SBC is an eclectic curriculum model. It is an amalgam of strengths of different curriculum types, including behavioural objectives, outcomes, and competency. Its emphasis is on students attaining clearly defined, measurable, observable and attainable learning standards, i.e., the expected level of education quality. Proficiency (competency) standards are expressed as performance standards/criteria and evidence outcomes, that is, what all students are expected to know (content) and do (application of content in real life or related situations) to indicate that they are meeting, have met or exceeded the learning standards. The selection of grade and contextually appropriate teaching and learning methodologies is critical to enabling all students to achieve the expected standard or quality of education. Teaching and learning methodologies must be aligned to the content, learning objective, and performance standard in order for the teacher to effectively teach and guide students towards meeting the performance standard for the lesson. They should be equitable and socially inclusive, differentiate, student-centred, and lifelong. They should enable STEAM principles and skills to be effectively taught and learned by students. Teachers should use the teacher guide to help them make informed decisions when selecting the types of teaching and learning methodologies to use in their teaching of the subject content, including STEAM principles and skills.

Plan Standards-Based Lessons

SBC lesson planning is quite difficult to do. However, this will be easier with more practice and experience over time. Effective SBC lesson plans must meet the required standards or criteria so that the learning objectives and performance standards are closely aligned to attain the expected learning outcomes. Teachers should use the guidelines and standards for SBC lesson planning and examples of SBC lesson plans provided in the teacher guide to plan their lessons. When planning lessons, it is important for teachers to ensure that all SBC lesson planning standards or criteria are met. If standards are not met, instruction will not lead to the attainment of intended performance and proficiency

standards. Therefore, students will not attain the national content standards and grade-level benchmarks.

Use Standards-Based Assessment

Standards-Based Assessment has a number of components. These components are intertwined and serve to measure, evaluate, report, and monitor students' achievement of the national and grade-level expectations, i.e., the essential knowledge, skills, values and attitudes they are expected to master and demonstrate proficiency in. Teachers should use the information and examples on standards-based assessment to plan, assess, record, evaluate, report and monitor students' performance in relation to the learning standards.

Make informed Judgments About Students' Learning and Progress Towards Meeting Learning Standards

Teachers should use the teacher guide to effectively evaluate students' performance and use the evidence to help students to continuously improve their learning as well as their classroom practice.

It is important that teachers evaluate the performance of students in relation to the performance standards and progressively the grade-level benchmarks and content standards to make informed judgments and decisions about the quality of their work and their progress towards meeting the content standards or components of the standards. Evaluation should not focus on only one aspect of students' performance. It should aim to provide a complete picture of each student's performance.

The context, inputs, processes, including teaching and learning processes, and the outcomes should be evaluated to make an informed judgment about each student's performance. Teachers should identify the causal factors for poor performance, gaps in students' learning, gaps in teaching, teaching and learning resource constraints, and general attitude towards learning. Evidence-based decisions can then be made regarding the interventions for closing the gaps to allow students to make the required progress towards meeting grade-level and national expectations.

Prepare Students' Performance Reports

Reporting of students' performance and progress towards the attainment of learning standards is an essential part of SBC assessment. Results of students' performance should be communicated to particularly the students and their parents to keep them informed of students' academic achievements and learning challenges as well as what needs to be done to enable the students' make positive progress towards meeting the proficiency standards and achieve the desired level of education quality. Teachers should use the information on the reporting of students' assessment results and the templates provided to report the results of students' learning.

Monitor Students' Progress Towards Meeting the National Content Standards and Grade-Level Benchmarks

Monitoring of student's progress towards the attainment of learning standards is an essential component of standards-based assessment. It is an evidence-based process that involves the use of data from students' performance assessments to make informed judgments about students' learning and proficiency on the learning standards or their components, identify gaps in students' learning and the causal factors, set clear learning improvement targets, and develop effective evidence-based strategies (including preplanning and re-teaching of topics), set clear timeframes, and identify measures for measuring students' progress towards achieving the learning targets.

Teachers should use the teacher guide to help them use data from students' performance assessments to identify individual students' learning weaknesses and develop interventions, in collaboration with each student and his/her parents or guardians, to address the weaknesses and monitor their progress towards meeting the agreed learning goals.

Develop additional Benchmarks

Teachers can develop additional benchmarks using the examples in the teacher guide to meet the learning needs of their students and local communities. However, these benchmarks will not be nationally assessed as these are not comparable. They are not allowed to set their own content standards or manipulate the existing ones. The setting of national content standards is done at the national level to ensure that required learning standards are maintained and monitored to sustain the required level of education quality.

Avoid Standardisation

The implementation of the Computer Technology curriculum must not be standardised. SBC does not mean that the content, lesson objectives, teaching and learning strategies, and assessment are standardised. This is a misconception and any attempt to standardise the components of curriculum without due consideration of the teaching and learning contexts, children's backgrounds and experiences, and different abilities and learning styles of children will be counterproductive. It will hinder students from achieving the expected proficiency standards and hence, high academic standards and the desired level of education quality. That is, they should not be applied across all contexts and with all students, without considering the educational needs and the characteristics of each context. Teachers must use innovative, creative, culturally relevant, and differentiated teaching and learning approaches to teach the curriculum and enable their students to achieve the national content standards and grade-level benchmarks. And enable all students to experience success in learning the curriculum and achieve high academic standards.

What is provided in the syllabus and teacher guide are not fixed and can be changed. Teachers should use the information and examples provided in the syllabus and the teacher guide to guide them to develop, select, and use grade, context, and learner appropriate content, learning

objectives, teaching and learning strategies, and performance assessment and standards. SBC is evidence-based hence decisions about the content, learning outcomes, teaching and learning strategies, students' performance, and learning interventions should be based on evidence. Teaching and learning should be continuously improved and effectively targeted using evidence from students' assessment and other sources.

Syllabus and Teacher Guide Alignment

The Grade 10 Communication Technology Strand Teacher Guide are closely aligned and complementary to Technology and Industrial Art Syllabus.

They are the essential focus points for teaching and learning the essential knowledge, skills, values and attitudes.

Syllabus and Teacher Guide Alignment	
Syllabus	Teacher Guide
Outlines the ultimate aim and goals, and what to teach and why teach it	Describes how to plan, teach, and assess students' performance
• Overarching and SBC principles • Content overview • Core curriculum • Essential knowledge, skills, values and attitudes • Strands and units • Evidence outcomes • Content standards and grade-level benchmarks • Overview of assessment, evaluation, and Reporting	• Determine topics for lesson planning, instruction and assessment • Formulate learning objectives • Plan SBC lesson plans • Select teaching and learning strategies • Implement SBC assessment and evaluation • Implement SBC reporting and monitoring

The syllabus outlines the ultimate aim and goals of SBE and SBC, what is to be taught and why it should be learned by students, the underlying principles and articulates the learning and proficiency standards that all students are expected to attain. On the other hand, the teacher guide expands on what is outlined in the syllabus by describing the approaches or the how of planning, teaching, learning, and assessing the content so that the intended learning outcomes are achieved.

This teacher guide should be used in conjunction with the syllabus. Teachers should use these documents when planning, teaching and assessing Grade 9 and 10 Computer Technology Strand content.

Teachers will extract information from the syllabus (e.g., content standards and grade-level benchmarks) for lesson planning, instruction and is for measuring students' attainment of a content standard as well as progress to the next grade of schooling.

Learning and Performance Standards Alignment

Content Standards, Benchmarks, Learning Objectives, and Performance Standards are very closely linked and aligned (see figure 3). There is a close linear relationship between these standards. Students' performance on a significant aspect of a benchmark (KSVA) is measured against a set of performance standards or criteria to determine their level of proficiency using performance assessment. Using the evidence from the performance assessment, individual student's proficiency on the aspect of the benchmark assessed and progression towards meeting the benchmark and hence the content standard are then determined.

Standards Alignment	
Standards in Syllabus	Standards in Teacher Guide
• SBC Aims and Goals • Content Standard • Benchmarks • Evidence Outcomes	• Learning Objectives • Lesson Objectives • Essential Knowledge, Skills, Values and Attitude • Performance Standard

Standard Alignment

Standard Alignment shows the link between different standards in the Syllabus and Teacher Guide. It begins with SBC Aims and Goals which are National Standards in which the Syllabus Standard are derived from. The Content Standards or Subject Standards are expanded into Benchmarks which are Achievable Benchmarks for particular Grade Levels and are translated into the Teacher Guide as Teaching and Learning Standards and Assessment Standards. And they become the components of Unit of Work.

The Unit of Work (UOW) consists of the Achievable Standards for a particular Grade Level and is translated into Teaching and Learning Activities and Assessment Tasks.

It is essential that teachers know and can do standards alignment when planning, teaching, and assessing students' performance so that they can effectively guide their students towards meeting the grade-level benchmarks (grade expectations) and subsequently the content standards (national expectations).

Below is a diagram to show the relationship between Standards in the Syllabus and the Teacher Guide.

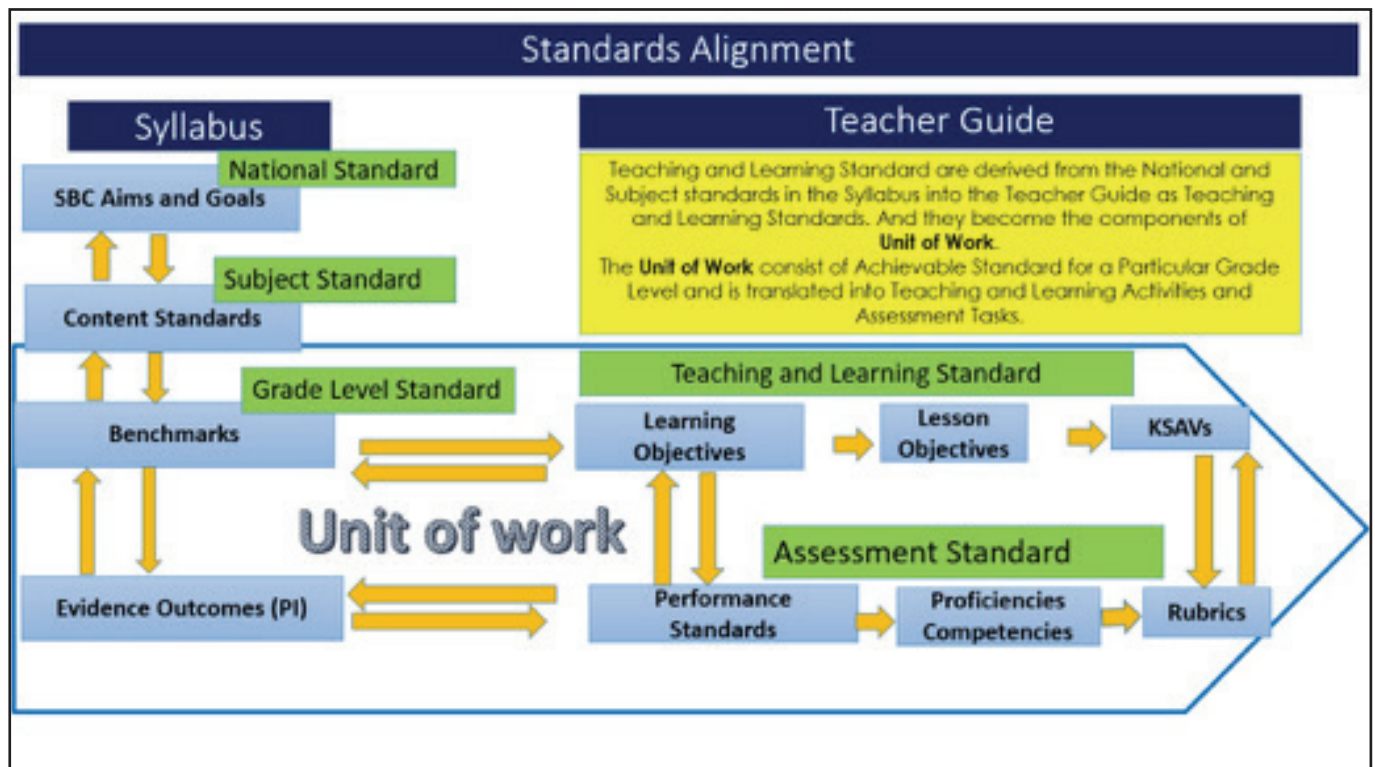


Figure 3: Standards Alignment that shows the alignment of standards in the syllabus and teacher guide

Learning and Performance Standards

What Teachers Should Know

Standards-Based Education (SBE) and SBE are underpinned by the notion of quality. Standards define the expected level of education quality that all students should achieve at a particular point in their schooling. Students' progression and achievement of education standard(s) are measured using performance standards or criteria to determine their demonstration or performance on significant aspects of the standards and therefore their levels of proficiency or competency. When they are judged to have attained proficiency on a content standard or benchmark or components of these standards, they are then deemed to have met the standard(s) that is, achieved the intend level of education quality.

Content standards, benchmarks, and learning objectives are called learning standards while performance and proficiency standards (evidence outcomes) can be categorised as performance standards. These standards are used to measure students' performance, proficiency, progression and achievement of the desired level of education quality. Teachers are expected to understand and use these standards for lesson planning, instruction and assessment

Content Standards

Content standards are evidence-based, rigorous and comparable regionally and globally. They have been formulated to target critical social, economic, political, cultural, environment, and employable skills gaps identified from a situational analysis. They were developed using examples and experiences from other countries and best practice, and contextualised to PNG contexts.

Content standards describe what **(content - knowledge, skills, values, and attitudes)** all students are expected to know and do **(how well students must learn and apply what is set out in the content standards)** at each grade-level before proceeding to the next grade. These standards are set at the national level and thus cannot be edited or changed by anyone except the National Subject-Based Standards Councils. Content Standards:

- are evidenced-based;
- are rigorous and comparable to regional and global standards;
- are set at the national level;
- state or describe the expected levels of quality or achievement;
- are clear, measurable and attainable;
- are linked to and aligned with the ultimate aim and goals of SBE and SBC and overarching and SBC principles;
- delineate what matters, provide clear expectations of what students should progressively learn and achieve in school, and guide lesson planning, instruction, assessment;
- comprise knowledge, skills, values, and attitudes that are the basis for quality education;
- provide teachers a clear basis for planning, teaching, and assessing lessons;

- provide provinces, districts, and schools with a clear focus on how to develop and organise their instruction and assessment programs as well as the content that they will include in their curriculum.

Benchmarks

Benchmarks are derived from the content standards and benchmarked at the grade-level. Benchmarks are specific statements of what students should know (i.e., essential knowledge, skills, values or attitudes) at a specific grade-level or school level. They provide the basis for measuring students' attainment of a content standard as well as progress to the next grade of schooling.

Grade-level benchmarks:

- are evidenced-based;
- are rigorous and comparable to regional and global standards;
- are set at the grade level;
- are linked to the national content standards;
- are clear, measurable, observable and attainable;
- articulate grade level expectations of what students are able to demonstrate to indicate that they are making progress towards attaining the national content standards;
- provide teachers a clear basis for planning, teaching, and assessing lessons;
- state clearly what students should do with what they have learned at the end of each school-level;
- enable students' progress towards the attainment of national content standards to be measured, and
- enable PNG students' performance to be compared with the performance of PNG students with students in other countries.

Approach for Setting National Content Standards and Grade-Level Benchmarks

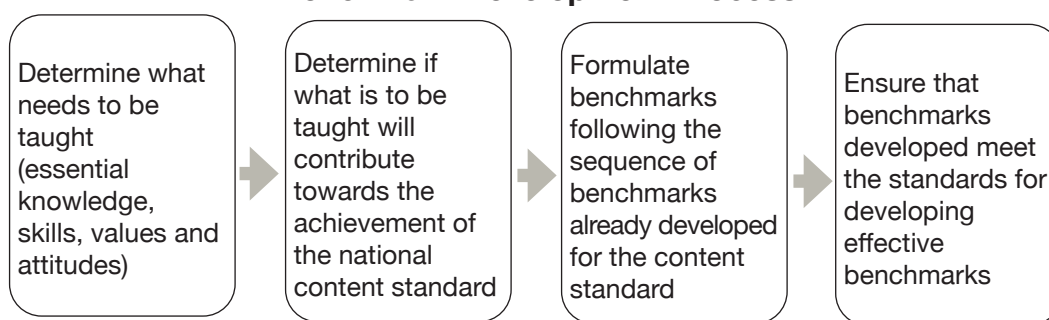


What Teachers Should Do

Development of Additional Benchmarks

Teachers should develop additional benchmarks to meet the learning needs of their students. They should engage their students to learn about local, provincial, national and global issues that have not been catered for in the grade-level benchmarks but are important and can enhance students' understanding and application of the content. However, it is important to note that these benchmarks will not be nationally examined as they are not comparable. Only the benchmarks developed at the national level will be tested. This does not mean that teachers should not develop additional benchmarks. An innovative, reflective, creative and reflexive teacher will continuously reflect on his/her classroom practice and use evidence to provide challenging, relevant, and enjoyable learning opportunities for his/her students to build on the national expectations for students. Teachers should follow the following process when developing additional grade-level benchmarks.

Benchmark Development Process



Learning Objectives

Learning or instructional Objectives are precise statements of educational intent. They are formulated using a significant aspect or a topic derived from the benchmark, and are aligned with the educational goals, content standards, benchmarks, and performance standards. Learning objectives are stated in outcomes language that describes the products or behaviours that will be provided by students. They are stated in terms of measurable and observable student behaviour. For example, students will be able to identify all the main towns of PNG using a map.

Performance Standards

Performance Standards are concrete statements of how well students must learn what is set out in the content standards, often called the “be able to do” or “what students should know and be able to do.”

Performance standards are the indicators of quality that specify how competent a students’ demonstration or performance must be. They are explicit definitions of what students **must do to demonstrate proficiency or competency at a specific level on the content standards.**

Performance standards:

- measure students’ performance and proficiency **(using performance indicators)** in the use of a specific knowledge, skill, value, or attitude in real life or related situations
- provide the basis **(performance indicators)** for evaluating, reporting and monitoring students’ level of proficiency in use of a specific knowledge, skills, value, or attitude
- are used to plan for individual instruction to help students not yet meeting expectations **(desired level of mastery and proficiency)** to make adequate progress towards the full attainment of benchmarks and content standards
- are used as the basis for measuring students’ progress towards meeting grade-level benchmarks and content standards

Proficiency Standards

Proficiency standards describe what all students in a particular grade or school level can do at the end of a strand, or unit. These standards are sometimes called evidence outcomes because they indicate if students can actually apply or use what they have learnt in real life or similar situations. They are also categorized as benchmarks because that is what all students are expected to do before exiting a grade or are deemed ready for the next grade.

Core Curriculum

What Teachers Should Know

A core set of common learnings (knowledge, skills, values, and attitudes) are integrated into the content standards and grade-level benchmarks for all subjects. This is to equip all students with the most essential and in-demand knowledge, skills, and dispositions they will need to be successful in modern/postmodern work places, higher-education programs and to be productive, responsible, considerate, and harmonious citizens. Common set of learnings are spirally sequenced from Preparatory - Grade 9 to deepen the scope and increase the level of difficulty in the learning activities so that what is learned is reinforced at different grade levels.

The core curriculum includes:

- cognitive (thinking) skills (Refer to the syllabus for a list of these skills);
- reasoning, decision-making and problem-solving skills
- high level thinking skills (analysis, synthesis and evaluation skills);
- 21st century skills (Refer to illustrative list in the Appendix);
- reading, writing and communication skills;
- STEAM principles and skills;
- essential values and attitudes (Core personal and social values, and sustaining values), and
- spiritual values and virtues

The essential knowledge, skills, values and attitudes comprising the core curriculum are interwoven and provide an essential and holistic framework for preparing all students for careers, higher education and citizenship.

All teachers are expected to include the core learnings in their lesson planning, teaching, and assessment of students in all their lessons. They are expected to foster, promote and model the essential values and attitudes as well as the spiritual values and virtues in their conduct, practice, appearance, and their relationships and in their professional and personal lives. In addition, teachers are expected to mentor, mould and shape each student to evolve and possess the qualities envisioned by society.

Core values and attitudes must not be taught in the classroom only; they must also be demonstrated by students in real life or related situations inside and outside of the classroom, at home, and in everyday life. Likewise, they must be promoted, fostered and modeled by the school community and its stakeholders, especially parents. A whole school approach to values and attitudes teaching, promoting and modeling is critical to students and the whole school community internalising the core values and attitudes and making them habitual in their work and school place, and in everyday life. Be it work values, relationship values, peace values, health values, personal and social values, or religious values, teachers should give equal prominence to all common learnings in their lesson planning, teaching, assessment, and learning interventions. Common learning must be at the heart of all teaching and extracurricular programs and activities.

Science, Technology, Engineering, Arts and Mathematics

STEAM education is an integrated, multidisciplinary approach to learning that uses science, technology, engineering, arts and mathematics as the basis for inquiring about how STEAM has and continues to change and impact the social, political, economic, cultural and environmental contexts and identifying and solving authentic (real life) natural and physical environment problems by integrating STEAM-based principles, cognitive, high level and 21st century skills and processes, and values and attitudes.

Computer Technology is focused on both goals of STEAM rather than just the goal of problem-solving. This is to ensure that all students are provided opportunities to learn, integrate, and demonstrate proficiency on all essential STEAM principles, processes, skills, values and attitudes to prepare them for careers, higher education and citizenship.

Objectives

Students will be able to:

- i. examine and use evidence to draw conclusions about how STEAM has and continues to change the social, political, economic, cultural and environmental contexts.
- ii. Investigate and draw conclusions on the impact of STEAM solutions to problems on the social, political, economic, cultural and environmental contexts.
- iii. Identify and solve problems using STEAM principles, skills, concepts, ideas and process.
- iv. Identify, analyse and select the best solution to address a problem.
- v. build prototypes or models of solutions to problems.
- vi. replicate a problem solution by building models and explaining how the problem was or could be solved.
- vii. test and reflect on the best solution chosen to solve a problem.
- viii. collaborate with others on a problem and provide a report on the process of problem solving used to solve the problem.
- ix. use skills and processes learnt from lessons to work on and complete STEAM projects.
- x. demonstrate STEAM principles, skills, processes, concepts and ideas through simulation and modeling.
- xi. explain the significance of values and attitudes in problem-solving.

Content Overview

STEAM is a multidisciplinary and integrated approach to understanding how science, technology, engineering, arts and mathematics shape and are shaped by our material, intellectual, cultural, economic, social, political and environmental contexts. And for teaching students the essential in demand cognitive, high level and 21st century skills, values and attitudes, and empower them to effectively use these skills and predispositions to identify and solve problems relating to the natural and physical environments as well as the impact of STEAM-based solutions on human existence and livelihoods, and on the social, political, economic, cultural, and environmental systems.

STEAM disciplines have and continue to shape the way we perceive knowledge and reality, think and act, our values, attitudes, and behaviours, and the way we relate to each other and the environment. Most of the things we enjoy and consume are developed using STEAM principles, skills, process, concepts and ideas. Things humans used and enjoyed in the past and at present are developed by scientists, technologists, engineers, artists and mathematicians to address particular human needs and wants. Overtime, more needs were identified and more products were developed to meet the ever changing and evolving human needs. What is produced and used is continuously reflected upon, evaluated, redesigned, and improved to make it more advanced, multipurpose, fit for purpose, and targeted towards not only improving the prevailing social, political, economic, cultural and environmental conditions but also to effectively respond to the evolving and changing dynamics of human needs and wants. And, at the same time, solutions to human problems and needs are being investigated and designed to address problems that are yet to be addressed and concurred. This is an evolving and ongoing problem-solving process that integrates cognitive, high level, and 21st century skills, and appropriate values and attitudes.

STEAM is a significant framework and focal point for teaching and guiding students to learn, master and use a broad range of skills and processes required to meet the skills demands of PNG and the 21st century. The skills that students will learn will reflect the demands that will be placed upon them in a complex, competitive, knowledge-based, information-age, technology-driven economy and society. These skills include cognitive (critical, synthetic, creative, reasoning, decision-making, and problem-solving) skills, high level (analysis, synthesis and evaluation) skills and 21st century skills (see Appendix 4). Knowledge-based, information, and technology driven economies require knowledge workers not technicians. Knowledge workers are lifelong learners, are problem solvers, innovators, creators, critical and creative thinkers, reflective practitioners, researchers (knowledge producers rather than knowledge consumers), solutions seekers, outcomes oriented, evidence-based decision makers, and enablers of improved and better outcomes for all.

STEAM focuses on the skills and processes of problem solving. These skills and processes are at the heart of the STEAM movement and approach to not only problem solving and providing evidence-based solutions but also the development and use of other essential cognitive, high level and 21st century skills. These skills are intertwined and used simultaneously to gain a broader understanding of the problems to enable creative, innovative, contextually relevant, and best solutions to be developed and implemented to solve the problems and attain the desired outcomes. It is assumed that by teaching students STEAM-based problem-solving skills and providing learning opportunities inside and outside the classroom will motivate more of them to pursue careers and academic programs in STEAM related fields thus, closing the skills gaps and providing a pool of cadre of workers required by technology, engineering, science, and mathematics-oriented industries.

Although, STEAM focuses on the development and application of skills in authentic (real life) contexts, for example the use of problem-solving skills to identify and solve problems relating to the natural and physical worlds, it does not take into account the significant influence values and attitudes have on the entire process of problem solving. Values and attitudes are intertwined with knowledge and skills. Knowledge, skills, values and attitudes are inseparable. Decisions about skills and processes of skills development and application are influenced by values and attitudes (mindset) that people hold. In the same light, the use of STEAM principles, processes and skills to solve problems in order to achieve the outcomes envisaged by society are influenced by values and the mindset of those who have identified and investigated the problem as well as those who are affected by the problem and will benefit from the outcome.

STEAM Problem-Solving Methods and Approaches

Problem-solving involves the use of problem-solving methods and processes to identify and define a problem, gather information to understand its causes, draw conclusions, and use the evidence to design and implement solutions to address it. Even though there are many different problem-solving methods and approaches, they share some of the steps of problem-solving, for example:

- identifying the problem;
- understanding the problem by collecting data;
- analyse and interpret the data;
- draw conclusions;
- use data to consider possible solutions;
- select the best solution;
- test the effectiveness of the solution by trialling and evaluating it, and
- review and improve the solution.

STEAM problem solving processes go from simple and technical to advanced and knowledge-based processes. However, regardless of the type of process used, students should be provided opportunities to learn the essential principles and processes of problem solving and, more significantly, to design and create a product that addresses a real problem and meets a human need.

The following are some of the STEAM problem solving processes

Engineering and Technology Problem Solving Methods and Approaches

Engineering and technology problem-solving methods are used to identify and solve problems relating to the physical world using the design process. The following are some of the methods and approaches used to solve engineering and technology related problems.

Parts Substitution

It is the most basic of the problem-solving methods. It simply requires the parts to be substituted until the problem is solved.

Diagnostics

After identifying a problem, the technician would run tests to pinpoint the fault. The test results would be used either as a guide for further testing or for replacement of a part, which also needs to be tested. This process continues until the solution is found and the device is operating properly.

Troubleshooting

Troubleshooting is a form of problem solving, often applied to repair failed products or processes.

Reverse Engineering

Reverse engineering is the process of discovering the technological principles underlying the design of a device by taking the device apart, or carefully tracing its workings or its circuitry. It is useful when students are attempting to build something for which they have no formal drawings or schematics.

Divide and Conquer

Divide and conquer is the technique of breaking down a problem into sub-problems, then breaking the sub-problems down even further until each of them is simple enough to be solved. Divide and conquer may be applied to all groups of students to tackle sub-problems of a larger problem, or when a problem is so large that its solution cannot be visualised without breaking it down into smaller components.

Extreme Cases

Considering “extreme cases” – envisioning the problem in a greatly exaggerated or greatly simplified form, or testing using extreme conditions – can often help to pinpoint a problem. An example of the extreme-case method is purposely inputting an extremely high number to test a computer program.

Trial and Error

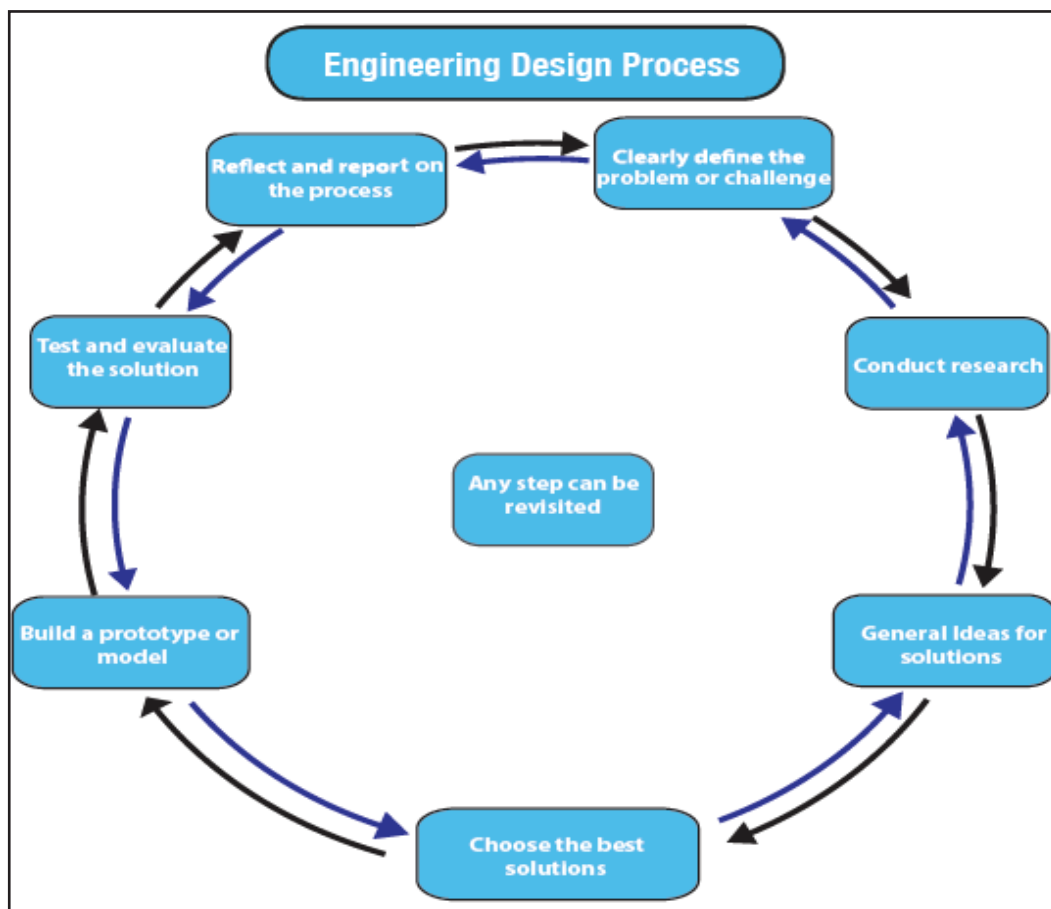
The trial and error method involves trying different approaches until a solution is found. It is often used as a last resort when other methods have been exhausted.

Engineering Design Process

Technological fields use the engineering design process to identify and define the problem or challenge, investigate the problem, collect and analyse data, and use the data to formulate potential solutions to the problem, analyse each of the solutions in terms of its strengths and weaknesses, and choose the best solution to solve the problem. It is an open-ended problem-solving process that involves the full planning and development of products or services to meet identified needs. It involves a sequence of steps such as the following:

- Analyse the context and background, and clearly define the problem.
- Conduct research to determine design criteria, financial or other constraints, and availability of materials.
- Generate ideas for potential solutions, using processes such as brainstorming and sketching.
- Choose the best solution.

- Build a prototype or model.
- Test and evaluate the solution.
- Repeat steps as necessary to modify the design or correct faults.
- Reflect and report on the process.



The Scientific Method and Approach to Problem-Solving

Science uses predominantly the quantitative-scientific inquiry process to investigate, understand, and make informed decisions about problems relating to the natural world. The steps in the process vary, depending on the purpose of the inquiry and the types of questions asked.

There are six basic science process skills:

1. Observation
2. Communication
3. Classification
4. Measurement
5. Inference
6. Prediction

These processes are at the heart of the scientific inquiry and problem-solving process.

The steps above should be taught and demonstrated by students separately and jointly before they implement the inquiry process. Students should be guided through every step of the process so that they can explain it and its importance, and use the steps and the whole process proficiently to identify, investigate and solve problems. A brief explanation

and examples of each step are provided below to help teachers plan and teach each step. Students should be provided with opportunities to practice and reflect on each step until they demonstrate the expected level of proficiency before moving on to the next one.

Step 1: Identify and describe the problem

Problems are identified mainly from observations and the use of the five senses – smell, sight, sound, touch and taste. Students should be guided and provided opportunities to identify natural and physical environment problems using their five senses and describe what the problem is and its likely causes.

*Example: **Observation***

When I turn on a flashlight using the on/off switch, light comes out of one end.

Step 2: Formulate research question

After the problem is identified and described, the question to be answered is then formulated. This question will guide the scientist in conducting research and experiments.

*Example: **Question***

What makes light come out of a flash light when I turn it on?

Step 3: Review literature

It is more likely that the research problem and question have already been investigated and reported by someone. Therefore, after asking the question, the scientist spends some time reading and reviewing papers and books on past research and discussions to learn more about the problem and the question to prepare her for his own research. Conducting literature review helps the scientist to better understand his/her research problem, refine the research question and decide on experiment/research approach before the experiment is conducted,

*Example: **Literature review***

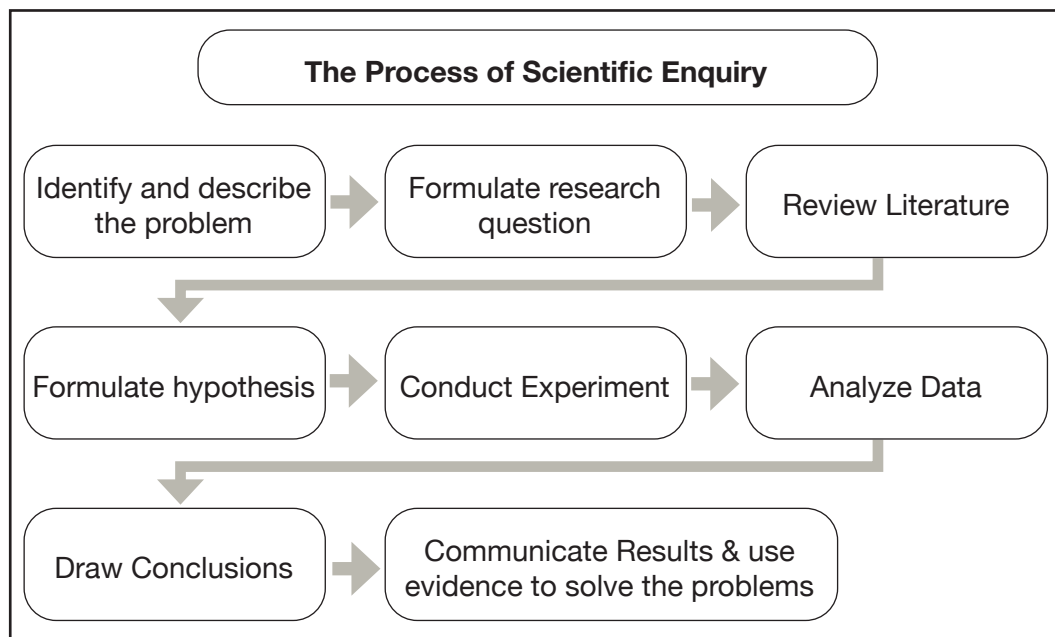
The scientist may look in the flashlight's instruction manual for tips or conduct online search on how flashlights work using the manufacturer's or relevant websites. Scientists may even analyse information and past experiments or discoveries regarding the relationship between energy and light.

Step 4: Formulate hypothesis

With a question in mind, the researcher decides on what he/she wants to test (The question may have changed as a result of the literature review). The research will clearly state what he/she wants to find out by carrying out the experiment. He/She will make an educated guess that could answer the question or explain the problem. This statement is called a **hypothesis**. A hypothesis guides the experiment and must be testable.

*Example: **Hypothesis***

The batteries inside a flashlight give it energy to produce light when the flashlight is turned on.



Step 5: Conduct experiment

This step involves the design and conduct of experiments to test the hypothesis. Remember, a hypothesis is only an educated guess (a possible explanation), so it cannot be considered valid until an experiment verifies that it is valid.

Example: **Experimental Procedure**

- Remove the batteries from the flashlight, and try to turn it on using the on/off switch.
Result: The flashlight does not produce light
- Reinsert the batteries into the flashlight, and try to turn it on using the on/off switch.
Result: The flashlight does produce light.
- Write down these results

In general, it is important to design an experiment to measure only one thing at a time. This way, the researcher knows that his/her results are directly related to the one thing he/she changed. If the experiment is not designed carefully, results may be confusing and will not tell the researcher anything about his/her hypothesis. Researchers collect data while carrying out their experiments. Data are pieces of information collected before, during, or after an experiment. To collect data, researchers read the measuring instruments carefully. Researchers record their data in notebooks, journals, or on a computer.

Step 6: Analyse data

Once the experiment is completed, the data is then analysed to determine the results. In addition, performing the experiment multiple times can be helpful in determining the credibility of the data.

Example: **Analysis**

- Record the results of the experiment in a table.
- Review the results that have been written down.

Step 7: Draw conclusions

If the hypothesis was testable and the experiment provided clear data, scientists can make a statement telling whether or not the hypothesis was correct. This statement is known as a conclusion. Conclusions must always be backed up by data. Therefore, scientists rely heavily on data so they can make an accurate conclusion.

If the data support the hypothesis, then the hypothesis is considered correct or valid.

If the data do not support the hypothesis, the hypothesis is considered incorrect or invalid.

Example: Valid Hypothesis

The flashlight did not produce light without batteries. The flashlight did produce light when batteries were inserted. Therefore, the hypothesis that batteries give the flashlight energy to produce light is valid, given that no changes are made to the flashlight during the experiment.

Example: Invalid Hypothesis

The flashlight did NOT produce light when the batteries were inserted. Therefore, the hypothesis that batteries give the flashlight energy to produce light is invalid. In this case, the hypothesis would have to be modified to say something like, “The batteries inside a flashlight give it energy to produce light when the batteries are in the correct order and when the flashlight is turned on.” Then, another experiment would be conducted to test the new hypothesis.

An invalid hypothesis is not a bad thing! Scientists learn something from both valid and invalid hypotheses. If a hypothesis is invalid, it must be rejected or modified. This gives scientists an opportunity to look at the initial observation in a new way.

They may start over with a new hypothesis and conduct a new experiment. Doing so is simply the process of scientific inquiry and learning.

Step 8: Communicate findings

Scientists generally tell others what they have learned. Communication is a very important component of scientific progress and problem solving. It gives other people a chance to learn more and improve their own thinking and experiments. Many scientists’ greatest breakthroughs would not have been possible without published communication or results from previous experimentation.

Every experiment yields new findings and conclusions. By documenting both the successes and failures of scientific inquiry in journals, speeches, or other documents, scientists are contributing information that will serve as a basis for future research and for solving problems relating to both the natural and physical worlds. Therefore, communication of investigative findings is an important step in future scientific discovery and in solving social, political, economic, cultural, and environmental problems.

Example: Communication of findings

Write your findings in a report or an article and share it with others, or present your findings to a group of people. Your work may guide someone else's research on creating alternative energy sources to generate light, additional uses for battery power, etc.

Artistic Design

Artistic Design is the process of beautifying a product. The design process begins with identifying a precise problem and ends with an evaluation. The design process usually consists of a series of steps that designers, engineers, architects or scientists follow to produce a solution to a specific problem. The scope of solutions they come up with are required to meet the criteria specified in the definition of the problem or perform a specific task.

7 steps of the design process

The design process begins by asking a few questions regarding the pain point you're trying to solve. This is crucial to defining the specific need in order to come up with a viable solution. The general steps of a design process should resemble the ones below, customized to your project:

1. Define the problem

Identify what the need is and why you should solve it.

2. Conduct research

Research on similar projects and take note of the weak points and positive outcomes. Develop research questions to guide you.

3. Brainstorming and conceptualisation

Once you have defined the basis for your project and its specification ideas will begin to form. Brainstorm and compare ideas to decide on the best features for your product.

4. Create a prototype

Testing your ideas means creating a prototype that simulates the finished product. Your outline will begin to take shape and throughout your prototype process you will likely to discover new areas for improvements as well as validating your experience.

5. Build and market your product

This phase requires you to consider all the feedback you gathered from your feedback from the prototype testing to build the final product.

6. Product analysis

When a product is bought, used and reviewed. Feedbacks can be used to develop the next version of the product.

7. Troubleshooting

Problems encountered during marketing, design or functionality are opportunities for improvement and growth to maximise future market of the product.

The equipping and enabling of students to become proficient in a broad range of STEAM skills, processes and predispositions can also lead to the attainment of many other societal goals, including national and global development goals and aspirations. These goals include:

- sustainability goals;
- peaceful related goals;
- work related goals;
- academic goals;
- relationship goals;
- health goals;
- adoption and internalisation of values and attitudes accepted by society, and
- improved social, political, economic outcomes.

Even though the original purpose and the drive of STEAM was to develop a pathway to engage students in learning about, experiencing, and applying STEAM skills in real life situations to motivate and hopefully get them to pursue careers in STEAM related fields and undertake STEAM related higher education programs to meet the demand for STEAM workers, STEAM education can also be used to teach and engage students in study more broadly the impact of STEAM on the social, economic, political, intellectual, cultural and environmental contexts. This line of inquiry is more enriching, exciting, empowering and transformative.

What Teachers Should Do

STEAM-Based Lesson Planning

Effective STEAM lesson planning is the key to the achievement of the expected outcomes. STEAM Skills can be planned and taught using separate STEAM-based lesson plans or integrated into the standards-based lesson plans. To effectively do this, teachers should know how to write effective standards and STEAM-based lesson plans.

Developing STEAM-based Lesson Plans

An example of a standards-based lesson is provided below. Teachers should use this to guide them to integrate STEAM content and teaching, learning and assessment strategies into their standards-based lesson plans.

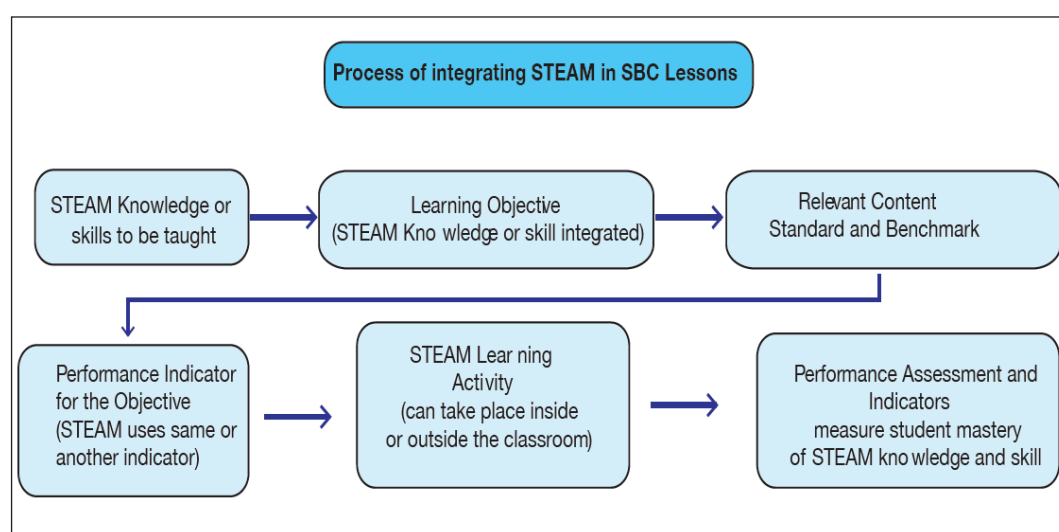
Integration of STEAM problem-solving skills into standards-based lesson plans

Knowing how to integrate STEAM problem-solving skills, principles, values and attitudes as well as STEAM teaching, learning, and assessment strategies into standards-based lesson plans is essential for achieving the desired STEAM learning outcomes. When integrating STEAM problem-solving skills into the standards-based lesson plans, teachers should ensure that these skills are not only effectively aligned to the learning objective and performance standards, they must also be effectively taught and assessed.

STEAM principles and problem-solving skills are integrated into the content standards and grade-level benchmarks. A list of these skills, including 21st century skills, is provided in the Technology and Industrial Arts syllabus. Teachers should ensure that these skills are integrated in their standards-based lesson plans, taught and assessed to determine students' level of proficiency on each skill or specific components of the skill. Teachers should use the following process as a guide to integrate STEAM principles and problem-solving skills into the standards-based lesson plans.

Teachers are expected to integrate the essential STEAM principles, processes, skills, values and attitudes described in the grade 9 and 10 benchmarks when formulating their standards-based lesson plans. Opportunities should be provided inside and outside of the classroom for students to learn, explore, model and apply what they learn in real life or related situations. These learning experiences will enable students to develop a deeper understanding of STEAM principles, processes, skills, values and attitudes and appreciate their application in real life to solve problems.

Process for Integrating STEAM Principles and Problem-Solving Skills into Standards-Based Lessons



Teachers should follow the steps given below when integrating STEAM problem-solving principles and skills into their standards-based lesson plans.

Step 1: Identify the STEAM knowledge or skill to be taught (From the table of KSAVs for each content standard and benchmark). This could be already being captured in the learning objective stated in the standards-based lesson plan.

Step 2: Develop and include a performance standard or indicator for measuring student mastery of the STEAM knowledge or skill (e.g. level of acceptable competency or proficiency) if this is different from the one already stated in the lesson plan.

Step 3: Develop student learning activity (An activity that will provide students the opportunity to apply STEAM knowledge or skill specified by the learning objective and appropriate statement of standards). Activity can take place inside or outside the classroom and during or after school hours.

Step 4: Develop and use performance descriptors (standards or indicators) to analyze student STEAM related behaviors or products (results or outcomes), which provide evidence that the student has acquired and mastered the knowledge or skill of the learning objective specified by the indicator(s) of the standard(s).

STEAM Teaching Strategies

STEAM education takes place in both formal and informal classroom settings. It takes place during and after school hours. It is a continuous process of inquiry, data analysis, making decisions about interventions, and implementing and monitoring interventions for improvements.

There are a variety of STEAM teaching strategies. However, teaching strategies selected must enable teachers to guide students to use the engineering and artistic design processes to identify and solve natural and physical environment problems by designing prototypes and testing and refining them to effectively mitigate the problems identified. The following are some of the strategies that could be used to utilize the STEAM approach to solve problems and come up with technological solutions.

1. Inquiry-Based Learning
2. Problem-Based Learning
3. Project-based learning
4. Collaborative Learning

Collaborative learning involves individuals from different STEAM disciplines and expertise in a variety of STEAM problem solving approaches working together and sharing their expertise and experiences to inquire into and solve a problem.

Teachers should plan to provide students opportunities to work in collaboration and partnership with experts and practitioners engaged in STEAM related careers or disciplines to learn first-hand about how STEAM related skills, processes, concepts, and ideas are applied in real life to solve problems created by natural and physical environments. Collaborative learning experiences can be provided after school or during school holidays to enable students to work with STEAM experts and practitioners to inquire and solve problems by developing creative, innovative and sustainable solutions. Providing real life experiences and lessons, e.g., by involving students to actually solve a scientific, technological, engineering, or mathematical, or Arts problem, would probably spark their interest in a STEAM career path. Developing STEAM partnerships with external stakeholders e.g., high education institutions, private sector, research and development institutions, and volunteer and community development organizations can enhance students' learning and application of STEAM problem solving principles and skills.

1. Participatory Learning
2. Group-Based Learning
3. Task Oriented Learning
4. Action Learning
5. Experiential Learning
6. Modeling
7. Simulation

STEAM Learning Strategies

Teachers should include in their lesson plans STEAM learning activities. These activities should be aligned to principle or a skill planned for students to learn and demonstrate proficiency at the end of the lesson to expose students to STEAM and give them opportunities to explore STEAM-related concepts, they will develop a passion for it and, hopefully, pursue a job in a STEAM field. Providing real life experiences and lessons, e.g., by involving students to actually solve a scientific, technological, engineering, or mathematical, or arts problem, would probably spark their interest in a STEAM career path. This is the theory behind STEAM education.

STEAM-Based Assessment

STEAM-based assessment is closely linked to standards-based assessment where assessment is used to assess student's level of proficiency or competency of a specific knowledge, skill, value or attitude taught using a set of performance standards (indicators or descriptors). The link also includes the main components such as the purpose, the assessment principles and assessment strategies and tools.

In STEAM-based assessment, assessment is designed for what the students should know and be able to do. In STEAM learning students are assessed in a variety of ways including portfolios, project/problem-based assessment, backward designs, authenticity assessment, or other students centered approaches. When planning and designing the assessment, teachers should consider the authenticity of the assessment by designing an assessment that relates to a real world task or discipline specific attributes (such as simulation, role play, placement assessment, live projects, debates) should make the activity meaningful to the student, and therefore be motivating as well as developing employability skills and discipline specific attributes.

Effective STEAM-Based Assessment strategies

The following six sections describe six assessment tools and strategies shown to impact teaching and learning as well as help teachers foster a 21st century learning environment in their classrooms.

1. Rubrics
2. Performance-based assessment (PBAs)
3. Portfolios
4. Student self-assessment
5. Peer-assessment
6. Students response system (SRS)

Although the list does not include all innovative assessment strategies, it includes what we think are the most common strategies, and ones that may be particularly relevant to the educational context of developing countries in this 21st century. Many of the assessment strategies currently use fit under one or more of the categories discussed. Furthermore, it is important to note that strategies also connect in a variety of ways.

1. Rubrics

Rubrics are both a tool to measure students' knowledge and ability as well as an assessment strategy. A rubric allows teachers to measure certain skills and abilities not measurable by standardised testing systems that assess direct knowledge at a fixed moment in time. Rubrics are also frequently used as part of other assessment strategies (portfolios, performances, projects, peer-review and self-assessment), they will be discussing in those sections as well.

2. Performance- Based Assessments

Performance- Based Assessments (PBA), also known as authentic assessment are generally used as a summative evaluation strategy to capture not only what students know about a topic, but if they have the skills to apply that knowledge in a; real-world' situation by asking them to create an end product. PBA pushes students to synthesize their knowledge and apply their skills to a potentially unfamiliar set of circumstances that is likely to occur beyond the confines of a controlled classroom setting.

The implementation of performance-based assessment strategies can also impact other instructional strategies in the classroom.

3. Portfolio Assessment

Portfolios are a collection of student work gathered over time that is primary used as a summary evaluation method. The most salient characteristic of the portfolio assessment is that rather than being a snapshot of a student's knowledge at one point in time (like a single standardized test) it highlights student effort, development, and achievement over a period of time; portfolios measure as student's ability to apply knowledge rather than simply regurgitate. They are considered both student-centered and authentic assessment of learning.

4. Self-Assessment

Its main purpose is for students to identify their own strengths and weakness and to work to make improvements to meet specific criteria. Self-assessment occurs when students judge their own work to improve performance as they identify discrepancies between current and desired performance. In this way, self-assessment aligns well with standards-based education because it provides clear targets and specific criteria against which students or teachers can measure learning.

Self-assessment is used to promote self-regulation to help students reflect on their progress and to inform revisions and improvements on a project or paper in order for self-assessment to be truly effective, four

conditions must be in place, the self-assessment criteria, criteria is negotiated between the teachers and students, students are taught how to apply the criteria, students receive feedback on their self-assessments and teachers help students use assessment data to develop an action plan.

5. Peer Assessment

Peer assessment, much like self-assessment, is a formative assessment strategy that gives students a key role in evaluating learning. Peer assessment approaches can vary greatly but, essentially it is a process for learners to consider and give feedback to other learners about the quality or value of their work. Peer assessments can be used for a variety of products like papers, presentations, projects and or other skills behaviors. Peers assessment is understood as more than only a grading procedure and is also envisioned as teaching strategy since engaging in the process develops both the assessor and the assesses skills and knowledge.

The primary goal for using peer assessment is to provide feedback to the learners. This strategy may be particularly relevant in the classrooms with many students per teacher since student time will be more plentiful than teacher time, although any single student's feedback may not be rich or in-depth as teachers feedback, the research suggests that peer assessment can improve learning.

6. Students Response system

Students response system (SRS), also known as classroom response (CRS), audience response system (ARS) is general term that refers to a variety of technology-based formative assessment tools that can be used to gather student- level data instantly in the classroom. Through the combination of hardware, (voice recorders, PC, internet connection, projector and screen) and software.

Teachers can ask students a wide range of questions (both closed and open ended), where students can respond quickly and anonymously, and the teacher can display the data immediately and graphically. The use of technology also includes a use of video which examines how a range of strategies can be used to assess students understanding.

The value of SRS comes from the teachers analyzing information quickly and then devising real-time instructional solutions to maximize students learning. This includes a suggested approach to help teachers and trainers assess learning.

Curriculum Integration

What is Curriculum Integration?

Curriculum integration is making connections in learning across the curriculum. The ultimate aim of curriculum integration is to act as a bridge to increase students' achievement and engage in relevant curriculum. (Susan M. Drake and Rebecca C. Burns)

Teachers must develop intriguing curriculum by going beyond the traditional teaching of content based or fragmented teaching to one who is knowledge based and who should be perceived as a 21st Century innovative educator. Curriculum integration is a holistic approach to learning thus curriculum integration in PNG SBC will have to equip students with the essential knowledge, skills, values and attitudes that are deemed 21st Century.

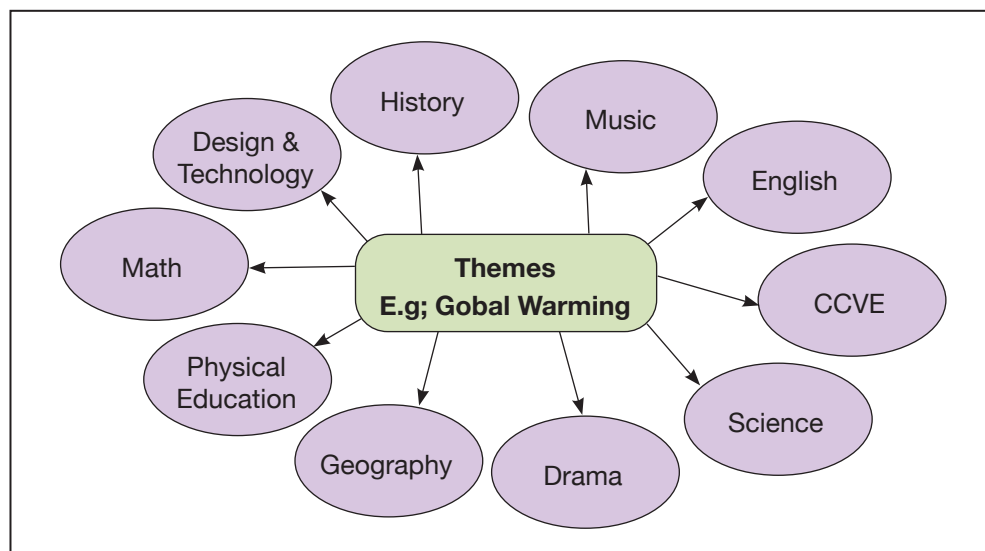
There are three approaches that PNG SBC will engage to foster conducive learning for all its children whereby they all can demonstrate proficiency at any point of exit. Adapting these approaches will have an immense impact on the lives of these children thus they can be able to see themselves as catalyst of change for a competitive PNG. Not only that but they will be comparable to the world standards and as global citizens.

Engaging these three approaches in our curriculum will surely sharpen the knowledge and ability of each child who will foresee themselves as assets through their achievements thus contribute meaningfully to their country. They themselves are the agents of change. Integrated learning will bear forth a generation of knowledge based populace who can solve problems and make proper decisions based on evidence.

Thus, PNG can achieve its goals like the Medium Term Development Goals (MTDG) and aims such as the Vision 2050 for a happy, healthy and wealthy society whereby, all its citizens should have access and fair distribution to income, shelter, health, education and general good and services improving the general standard of living for PNG in the long run.

1. Multidisciplinary Approach

In this approach learning involves a theme or concept that will be taught right across all subject area of study by students. That is, content of a particular theme will be taught right across all subjects as shown in the diagram below. For instance, if the theme is global warming, subject areas create lessons or assessment as per their subjects around this theme. Social Science will address this issue, Science and all other subject likewise.

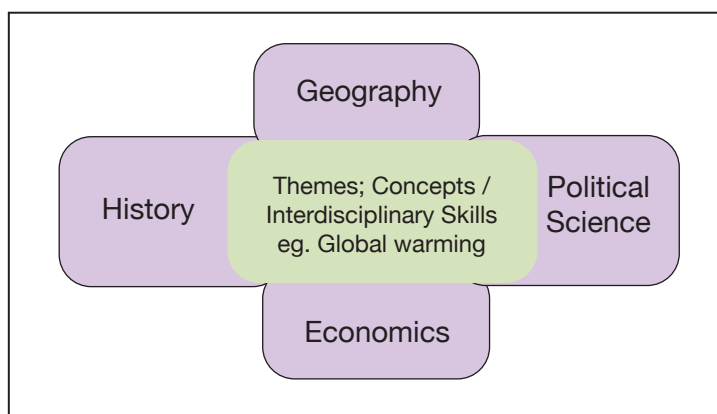


2. Interdisciplinary Approach

This approach addresses learning similarly to the multidisciplinary approach of integrated learning whereby learning takes place within the subject area. However, it is termed interdisciplinary in that the core curriculum of learning is interwoven into each subject under study by the students. For instance; in Social Science under the strand of geography students write essay on internal migration however, apart from addressing the issues of this topic, they are to apply the skill of writing text types in their essay such as argumentative essay, informative, explanatory, descriptive, expository and narrative essay while writing their essay.

They must be able to capture the mechanics of English skills such as grammar, punctuation and so forth. Though these skills are studied under English they are considered as core skills that cut across all subjects under study. For example; if Science students were to write about human development in biology then the application of writing skills has to be captured by the students in their writing. It is not seen as an English skill but a standard essential skill all students must know and do regardless.

Therefore, essential knowledge, skills, values and attitudes comprising the core curriculum are interwoven and provide an essential and holistic framework for preparing all students for careers, higher education and citizenship in this learning.



3. Interdisciplinary Approach

This approach involves teachers integrate sub disciplines within a subject area. For instance, within the subject Social Science, the strands (disciplines) of geography, environment, history, political science and environment will all be captured studying a particular content for Social Science. For example, under global warming, students will study the geographical aspects of global warming, environmental aspect of global warming and likewise for history, political science and economics. Thus, students are well aware of the issues surrounding global warming and can address it confidently at each level of learning.

4. Trans disciplinary Approach

In this approach learning goes beyond the subject area of study. Learning is organized around students' questions and concerns. That is, where there is a need for change to improve lives, students develop their own curriculum to affect these needs. The trans-disciplinary approach addresses real-life situations thus giving the opportunity to students to attain real life skills. This learning approach is more to do with Project-Based Learning also referred to as problem-based learning or place-based learning.

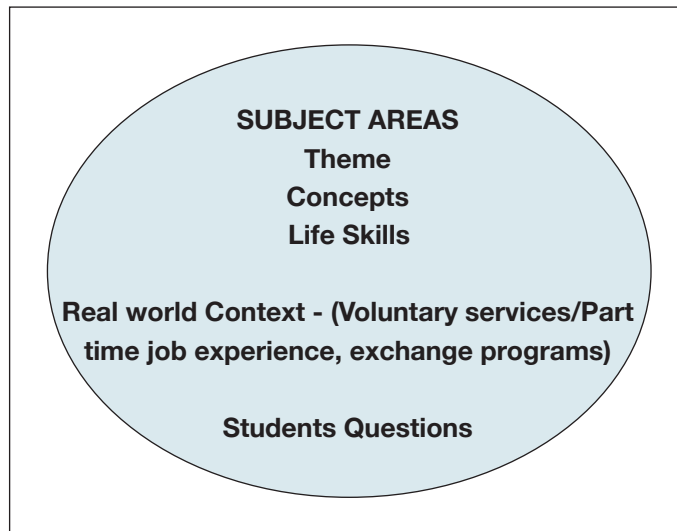
Below are the three steps to planning project based curriculum.

1. Teachers and students select a topic of study based on student interests, curriculum standards, and local resources.
2. The teacher finds out what the students already know and helps them generate questions to explore. The teacher also provides resources for students and opportunities to work in the field.
3. Students share their work with others in a culminating activity. Students display the results of their exploration and review and evaluate the project.

For instance; students may come up with slogans for school programs such as 'Our culture – clean city for a healthier PNG'. The main aim could be to curb betel nut chewing in public areas especially around bus stops and local markets. Here, students draw up their own instructions and criteria for assessment which is they have to clean the nearest bus stop or local market once a week throughout the year. They also design and create posters to educate the general public as their program continues. They can also involve the town council and media to assist them especially to carry out awareness.

Studies (Susan M. Drake and Rebecca C. Burns) have proven that Project based-programs achievements have led to the following:

- Students go far beyond the minimum effort.
- Make connections among different subject areas to answer open-ended questions.
- Retain what they have learnt.
- Apply learning to real-life problems.
- Have fewer discipline problems.
- Lower absenteeism (Curtis, 2002).



These integrated learning approaches will demand for teachers to be more proactive in order to improve students learning and achievements. In order for SBC to serve its purpose fully, these three approaches must be engaged for better learning for the children of Papua New Guinea now and in the future

Essential knowledge, Skills, Values and Attitudes

Students' level of proficiency and progression towards the attainment of content standards will depend on their mastery and application of essential knowledge, skills, values, and attitudes in real life or related situations. Provided here are examples of different types of knowledge, processes, skills, values, and attitudes that all students are expected to learn and master as they progress through the grades. These are expanded and deepened in scope and the level of difficulty and complexity are increased to enable students to study in-depth the subject content as they progress from one grade to the next.

These knowledge, skills, values and attitudes have been integrated into the content standards and benchmarks. They will also be integrated into the performance standards. Teachers are expected to plan and teach essential knowledge, skills, values and attitudes in their lessons, and assess students' performance and proficiency, and progression towards the attainment of content standards.

Types of Knowledge

There are different types of knowledge. These include;	
• Public and private (privileged) knowledge • Specialized knowledge • Good and bad knowledge • Concepts, processes, ideas, skills, values, attitudes • Theory and practice • Fiction and non-fiction • Traditional, modern, and postmodern knowledge	• Subject and discipline-based knowledge • Lived experiences • Evidence and assumptions • Ethics and Morales • Belief systems • Facts and opinions • Wisdom • Research evidence and findings • Solutions to problems

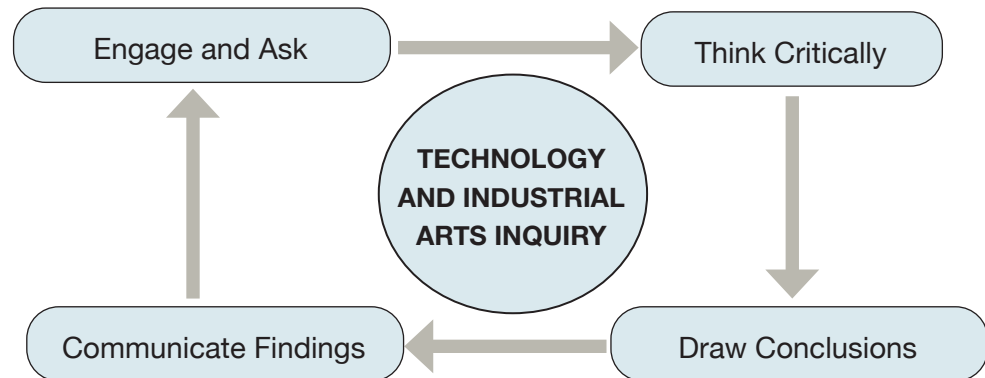
Types of Processes

There are different types of processes. These include;	
• Problem-solving • Logical reasoning • Decision-making • Reflection	• Cyclic processes • Mapping (e.g. concept mapping) • Modeling • Simulating
Technology Inquiry processes include: • Gathering information • Analysing information • Evaluating information • Making judgements • Taking actions	

Inquiry Processes

Engage and Ask	How will I engage my students in the topic and prompt them to ask questions? • Determine the enduring understandings about the topic being studied. • Engage your students with the topic by grabbing their interest with a hook connected to the enduring understandings. • Allow students to generate questions based upon the topic and hook. • Determine what questions will be essential to achieving the enduring understandings. (Student generated or teacher determined). • With students, determine what other information is needed in order to fully answer the questions.
Think Critically	How will students access and analyse information about this topic? • Have students think about where they can find answers to the questions posed about the topic. • Gather and organise multiple primary and secondary sources. • Ensure that sources used expose students to different perspectives and viewpoints about the topic. • Students should use sources to collect, analyse, and interpret data. • Ensure students are analysing sources for credibility, bias, and perspective in order to identify gaps in the research.
Draw Conclusion	How will students synthesise ideas to answer the questions posed based on sources used? • Students should engage in civic discussion to answer the questions posed while respecting diverse opinions. • Engage students in evaluating possible courses of action and their consequences. • Students should make and justify an informed decision or choice and/or design an action plan supported by evidence from sources. • Have students evaluate the consequences of a decision or choice. • Allow students to make revisions based on feedback and further study.
Communicate Findings	How will students demonstrate what they have learned and take action on that learning? • Determine how students will apply what they have learned and share their findings with others. • Explore appropriate audiences for students to present conclusions. • Determine if there is an opportunity for students to take action and influence others to make more informed decisions. • Have students develop strategies to persuade others, including policy makers when applicable. • Prepare students to defend their analysis against alternative.

Below is how the Technology & Industrial Arts Inquiry Process will be taught in the classroom. Be specific as you make notes of the activities or prompts you will use to ensure students will have the opportunity to practice these skills as a requirement in the Grade 9 content standards.



Types of Skills

There are different types of skills. These include:

1. Cognitive (Thinking) Skills)

Thinking skills can be categorized into **critical thinking** and **creative thinking** skills.

i. Critical Thinking Skills

A person who thinks critically always evaluates an idea in a systematic manner before accepting or rejecting it. Critical thinking skills include;

- | | |
|---|---|
| <ul style="list-style-type: none"> • Attributing • Comparing and contrasting • Grouping and classifying • Sequencing • Prioritising • Analysing | <ul style="list-style-type: none"> • Detecting bias • Evaluating • Metacognition (Thinking about thinking) • Making informed conclusions. |
|---|---|

ii. Creative Thinking Skills

A person who thinks creatively has a high level of imagination, able to generate original and innovative ideas, and able to modify ideas and products. Creative thinking skills include;

- | | |
|---|--|
| <ul style="list-style-type: none"> • Generating ideas • Deconstruction and reconstruction • Relating • Making inferences • Predicting • Making generalisations • Visualizing | <ul style="list-style-type: none"> • Synthesising • Making hypothesis • Making analogies • Invention • Transformation • Modeling • Simulating |
|---|--|

2. Reasoning Skills - Reason is a skill used in making a logical, just, and rational judgment.

3. Decision-Making Skills - Decision-making involves selection of the best solution from various alternatives based on specific criteria and evidence to achieve a specific aim.

4. Problem Solving Skills – These skills involve finding solutions to challenges or unfamiliar situations or unanticipated difficulties in a systematic manner.

5. Literacy Skills

A strong emphasis must be placed on various types of literacy, from financial to technological, from media to mathematical, from content to cultural. Literacy may be defined as the ability of an individual to use information to function in society, to achieve goals and to develop her or his knowledge and potential. Teachers emphasize certain aspects of literacy over others, depending on the nature of the content and skills they want students to learn.

The following literacy skills are intended to be exemplary rather than definitive

- Listens, read, write, and speak with comprehension and clarity
- Define and apply discipline-based conceptual vocabulary
- Describe people, places, and events, and the connections between and among them
- Arrange events in chronological sequence
- Differentiate fact from opinion
- Determine an author's purpose
- Determine and analyse similarities and differences
- Analyse cause and effect relationships
- Explore complex patterns, interactions and relationships
- Differentiate between and among various options
- Develop an ability to use and apply abstract principals
- Explore and/or observe, identify, and analyse how individuals and/or societies relate to one another

6. High Level Thinking Skills - These skills include analysis, synthesis, and evaluation skills.

i. Analysis Skills – Analysis skills involve examining in detail and breaking information into parts by identifying motives or causes, underlying assumptions, hidden messages; making inferences and finding evidence to support generalisations, claims, and conclusions.

Key Words				
Analyse	Differences	Find	List	Similar to
Appraise	Discover	Focus	Motivate	Simplify
Arrange	Discriminate	Function	Omit	Take part in
Assumption	Discussion	Group	Order	Test for
Breakdown	Distinction	Highlight	Organize	Theme
Categorize	Distinguish	In-depth	Point out	
Cause & effect	Dissect	Inference	Research	
Choose	Divide	Inspect	See	
Classify	Establish	Isolate	Select	
Comparing	Examine	Investigate	Separate	

ii. Synthesis Skills – Synthesis skills involve changing or creating something new, compiling information together in a different way by combining elements in a new pattern proposing alternative solutions.

iii. Evaluation Skills – Evaluation skills involve justifying and presenting and defending opinions by making judgments about information, validity of ideas or quality of work based on set criteria.

Types of Values

Personal engagement and civic engagement strategies help young to acquire and apply skills and dispositions that will prepare them to become competent and responsible citizens.

1. Personal Values (importance, worth, usefulness, etc.)

Core values	Sustaining values
• Sanctity of life • Truth • Aesthetics • Honesty • Human • Dignity • Rationality • Creativity • Courage • Liberty • Affectivity • Individuality	• Self-esteem • Self-reflection • Self-discipline • Self-cultivation • Principal morality • Self-determination • Openness • Independence • Simplicity • Integrity • Enterprise • Sensitivity • Modesty • Perseverance

2. Social Values

Core Values	Sustaining Values
• Equality • Kindness • Benevolence • Love • Freedom • Common good • Mutuality • Justice • Trust • Interdependence • Sustainability • Betterment of human kind • Empowerment • Solidarity • Peace and harmony	• Plurality • Due process of law • Democracy • Freedom and liberty • Common will • Patriotism • Tolerance • Gender equity and social inclusion • Equal opportunities • Culture and civilisation • Heritage • Human rights and responsibilities • Rationality • Sense of belonging • Safe and peaceful communities

3. Types of Attitude

Attitudes - Ways of thinking and behaving, points of view	
• Optimistic • Participatory • Critical • Creative • Appreciative • Empathetic • Caring and concern • Positive • Confident • Cooperative	• Responsible • Adaptable to change • Open-minded • Diligent • With a desire to learn • With respect for self, life, equality and excellence, evidence, fair play, rule of law, different ways of life, beliefs and opinions, and the environment.

Teaching and Learning Strategies

Computer Technology Strand emphasises and embraces the use of cognitive, reasoning, decision-making, problem solving and higher level thinking skills to enhance students' understanding of inter-disciplinary concepts and issues in relation to environment, geography, history, politics and economics within PNG and globally. It aims to provide a meaningful pedagogical framework for teaching and learning essential and in demand knowledge, skills, values, and attitudes that are required for the preparation of students for careers, higher education and citizenship in the 21st century.

Students must be prepared to gather and understand information, analyse issues critically, learn independently or collaboratively, organize and communicate information, draw and justify conclusions, create new knowledge, and act ethically.

These teaching and learning strategies will help teachers to;

- familiarise themselves with different methods of teaching in the classroom
- develop an understanding of the role of a teacher for application of various methods in the classroom

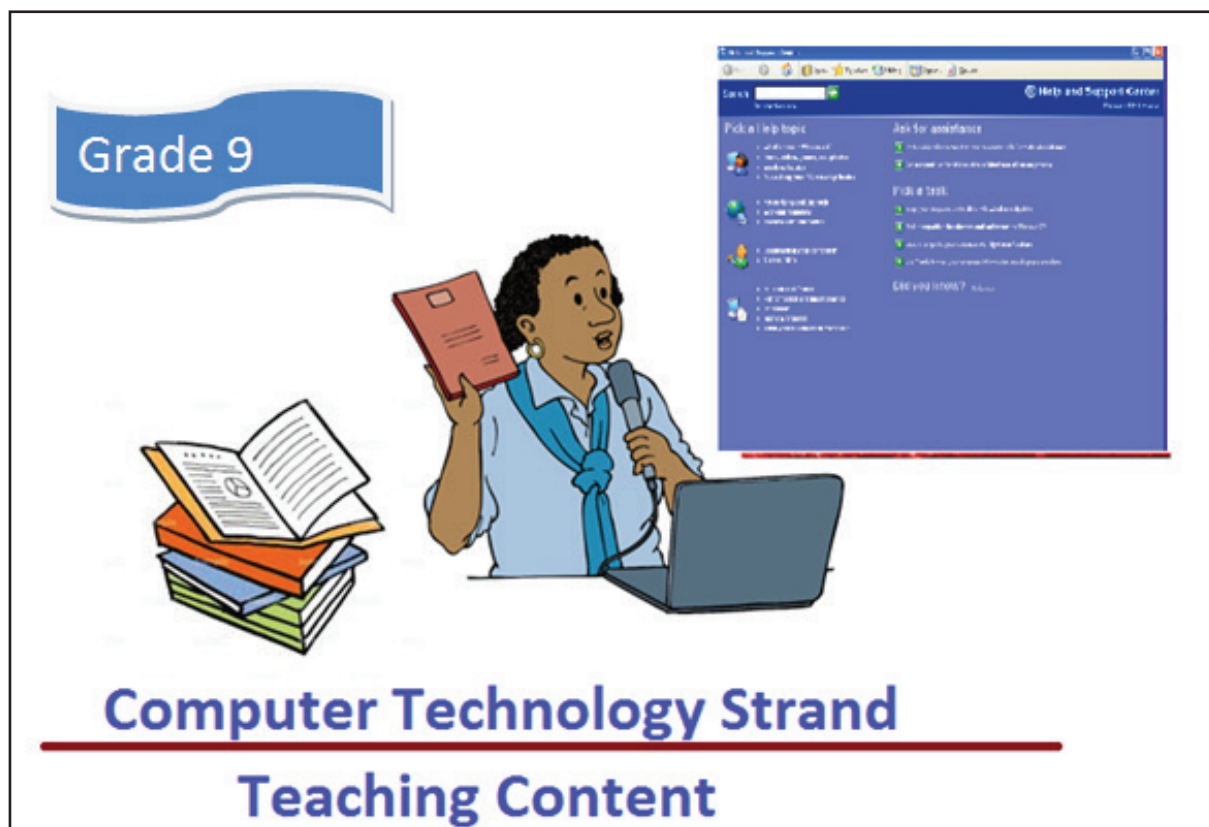
Successful teachers always keep in view that teaching must —be dynamic, challenging and in accordance with the learner's comprehension. He/she does not depend on any single method for making his/her teaching interesting, inspirational and effective.

Please find a list of the different teaching and learning strategies in the Appendix.

These strategies;

- make learning more engaging
- make learning more effective
- make learning fun
- encourage higher motivational level
- improve attention spans
- develop higher order thinking and reflective skills
- improve communication skills
- develop the spirit of teamwork/collaboration
- develop leadership skills and qualities
- encourage discovery learning

Therefore, teachers are encouraged to utilise the suggested strategies as well as others.



Grade 9 Strands, Units And Topics

Table of strand, units and topics

The table below outlines the contents of Grade 9 Computer Technology Strand in units, topics and with the suggested lesson titles to be taught in an academic year.

Teachers are provided with what will be taught under each of the two units in a year. This overview will guide the teachers on how to plan their teaching programs for a school year in each term.

Unit	Benchmarks	Topics	Lesson Titles
1. Computer Architecture	10.5.1.1 Construct and test simple interfaces and other electronic circuits	Simple Electronic Circuit	1. Building simple Electronics Circuitry 2. Advancing into electronic circuitries 3. Analog Components
	10.5.1.2 Apply fundamental programming concepts to develop a variety of simple programs. Including a program to control an external device.	Programming	1. Programming Concepts 2. Developing simple programs 3. Test and Troubleshoot 4. Learning online application for coding, eg. Scratch: Simple Computer Games
	10.5.1.3 Explore and investigate the electronics and robotics applications and structures	Robotics	1. Introduction to robotic electronics 2. Robotic electronic structures 3. Robotic electronics Applications
	10.5.1.4 Explore and investigate the electronic applications and structures in Artificial Intelligence (AI)	Artificial Intelligence	1. Introduction to Artificial Intelligence 2. Artificial Intelligence structure 3. Artificial Intelligence application
2. Computer Software	10.5.2.1 Install and configure the hardware and operating system and use file-management techniques effectively	Operating System	1. Installing the Operating Systems 2. Configuring Operating Systems 3. Advanced File Management Techniques
	10.5.2.2 Explore and investigate understand the various type of Machine and Programming Language	Machine Learning	1. Introduction to Machine Learning 2. Some types of Machine Language 3. Programming Language behind Machine Language
	10.5.2.3 Apply speed and accuracy in Typing.	Keyboard Typing	1. Apply typing skills with speed (30wpm) and accuracy (75-90 %) 2. Typing Test
	10.5.2.4 Apply programming concepts to develop a variety of simple programs, including a program to control an external device	Programming	1. Intermediate Programming Concepts 2. Developing Intermediate programs 3. Test and Troubleshoot 4. Case Study on connecting external devices through programming
	10.5.2.5 Apply file management and accessing information	File Management	1. Managing Documents, files and Folders 2. Creating Maintaining Folders 3. Importance of Backup

1| Computer Architecture

Topic 1: Simple Electronic Circuitry

Content Standard: Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.

Benchmark

10.5.1.1 Construct and test simple interfaces and other electronic circuits;

Learning Objective: By the end of the topic, students will be able to Construct and test the simple interfaces and electronic circuitries

Essential questions

1. How to build a simple electronic circuit?
2. What are the different advances in electronic circuitry?
3. What are digital analogue components in circuitry?

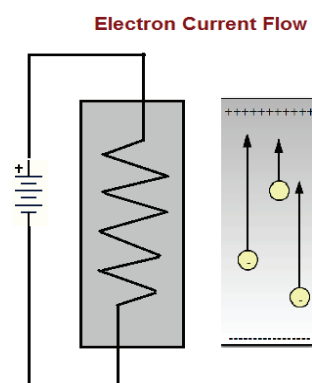
Key Concepts(SKAV)

Skills	Construct and test the simple interfaces and electronic circuitries
Knowledge	Simple Electronic Circuitry
Attitudes	Be creative in constructing simple interface and electronic circuit
Values	Creativity

Content Background

Building Simple Electronics Circuitry

Electrons and protons are a component of atoms, and their use—known as electronics—play an important role in many pieces of household equipment. Basic electronics comprises the minimal “electronics components” that make up a part of everyday electronics equipment. These electronic components include resistors, transistors, capacitors, diodes, inductors and transformers. Powered by a battery, they are designed to work under certain physics laws and principles. Basic electronics also concerns the measurement of voltage, current (electron flow) and resistance in the assembled working "circuit."



Advancing into electronic Circuitry

1. In electronics, a circuit is a path between two or more points along which an electrical current can be carried. (A circuit breaker is a device that interrupts the path when necessary to protect other devices attached to the circuit - for example, in case of a power surge.)
2. In telecommunications, a circuit is a discrete (specific) path between two or more points along which signals can be carried. Unless otherwise qualified, a circuit is a physical path, consisting of one or more wires (or wireless paths) and possibly intermediate switching points. A network is an arrangement of circuits. In a dial-up (switched) connection, a circuit is reserved for use by one user for the duration of the calling session. In a dedicated or leased line arrangement, a circuit is reserved in advance and can only be used by the owner or renter of the circuit.

PVC – is used on frame relay networks with wide area networks

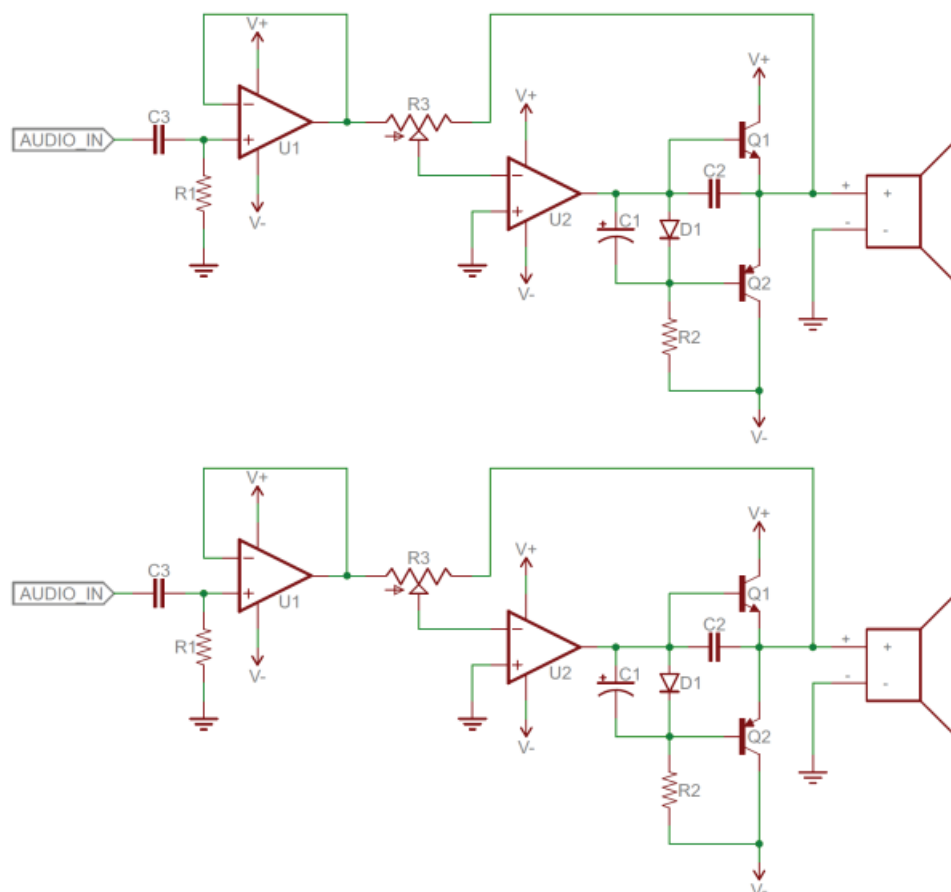
SVC – can be used on frame relay networks but must maintain a constant connection during the transfer

Analog components

Basic electronics is not complete without mention of the basic instruments used in electronics measurements. These include analog and digital meters that measure voltages, current, resistance and capacitance; power supplies, which provide stable regulated voltage and current; oscilloscopes, which measure circuit waveforms from circuits; and function generators, which provide standard desired waveforms.

Analog Electronics

Most of the fundamental electronic components -- resistors, capacitors, inductors, diodes, transistors, and operational amplifiers -- are all inherently analog. Circuits built with a combination of these components are usually analog.



Analog circuits are usually complex combinations of op amps, resistors, caps, and other foundational electronic components. This is an example of a class B analog audio amplifier.

Analog circuits can be very elegant designs with many components, or they can be very simple, like two resistors combining to make a voltage divider. In general, though, analog circuits are much **more difficult to design** than those which accomplish the same task digitally. It takes a special kind of analog circuit wizard to design an analog radio receiver, or an analog battery charger; digital components exist to make those designs *much* simpler.

Analog circuits are usually much more **susceptible to noise** (small, undesired variations in voltage). Small changes in the voltage level of an analog signal may produce significant errors when being processed.

Teaching and Learning Strategies

Teachers are encouraged to introduce students to simulations to better understand the concepts taught. Therefore, students will learn effectively and master the knowledge prescribed in each topic. Whilst introducing the topic, guided discovery and research will enable students to get a picture of Computer Architecture. The knowledge prescribed must be taught. It is not only about teaching what students should know but also to interpret that knowledge for students in a way that makes it relevant to them, and enables them to begin to acquire skills of analysis and problem solving, which will support teaching and learning. Students must be given opportunities to apply their knowledge, to be creative and to solve problems.

Lesson 1: Building Simple Electronics Circuitry

Teaching Strategies

- Use Spiral Teaching to connect Digital Analog Circuit when introducing the lesson.
- Ask students to make a model of a simple electronic circuit.
- Ask them to explain terms that are related to electronic circuit.

Learning Strategies

Activity 1: Demonstrate understanding on Digital Analog Circuit and Electronic Circuit.

Activity 2: Make a model of a simple electronic circuit.

Activity 3: Identify and explain terms that are related to electronic circuits.

RESOURCES:

<https://www.electronicshub.org/basic-electrical-circuits-componentstypes/>

Lesson 2: Advancing into Electronic Circuitries

Teaching Strategies

- Model different types of Electronic Circuitries
- Allow the students to work in groups to illustrate each circuit that they have identified and state clearly their usefulness.
- Allow students to work independently within their groups to develop a model of an electronic hub.

Learning Strategies

Activity 1: Differentiate different types of Electronic Circuitries

Activity 2: Work in groups to illustrate each circuit that they have identified and state clearly their usefulness.

Activity 3: As a group work develop a model of an electronic hub.

RESOURCES: <https://www.electronicshub.org/electronics-mini-project-circuits/>

Lesson 3: Analog Components

Teaching Strategies

- Review Digital Analog Circuit and its components
- Guide students to illustrate a computer analog circuit using the digital logic gate
- Ask students to produce a model of an electronic hub using the digital logic gate.

Learning Strategies

Activity 1: Review Digital Analog Circuit and its components

Activity 2: Work in groups to illustrate a computer analog circuit using the digital logic gate

Activity 3: Develop a model of an electronic hub using the digital logic gate.

Resources

<https://whatis.techtarget.com/definition/circuit>

DEFINITION Circuit -Posted by: Margaret Rouse WhatIs.com

<https://www.electronicshub.org/electronics-mini-project-circuits/>

1| Computer Architecture

Topic 2: Programming

Content Standard: Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.

Benchmark

10.5.1.2 Apply fundamental programming concepts to develop a variety of simple programs, including a program to control an external device.

Learning Objective: By the end of the topic, students will be able to

1. apply fundamental programming concepts
2. develop a variety of simple programs, including a program to control an external device.

Essential questions

1. What are the fundamental programming concepts?
2. How to develop a simple program?
3. How to test and troubleshoot a simple program?
4. How to use online learning applications for coding?

Key Concepts(SKAV)	
Skills	Apply and Develop simple programming
Knowledge	Simple programming
Attitudes	Be creative
Values	Creativity

Content Background

Basic Programming Concepts

Programming language is a language used to give instructions to computers.

During the 1960s and 1970s, a huge variety of programming languages were developed, most of which are no longer in wide use. Moreover, a substantial amount of programming is now done with special program development tools (e.g., Visual Basic), or in programming languages that pertain to specific pieces of software (e.g., Maple) rather than by simply writing instructions in a general-purpose language.

Developing simple programs

In computing, a program is a specific set of ordered operations for a computer to perform. In the modern computer that John von Neumann outlined in 1945, the program contains a one-at-a-time sequence of instructions that the computer follows. Typically, the program is put into a storage area accessible to the computer. The computer gets one instruction and performs it and then gets the next instruction. The storage area or memory can also contain the data that the instruction operates on. (Note that a program is also a special kind of "data" that tells how to operate on "application or user data.")

Programs can be characterized as interactive or batch in terms of what drives them and how continuously they run. An interactive program receives data from an interactive user (or possibly from another program that simulates an interactive user). A batch program runs and does its work, and then stops. Batch programs can be started by interactive users who request their interactive program to run the batch program. A command interpreter or a Web browser is an example of an interactive program. A program that computes and prints out a company payroll is an example of a batch program. Print jobs are also batch programs.

When you create a program, you write it using some kind of computer language. Your language statements are the source program. You then "compile" the source program (with a special program called a language compiler) and the result is called an object program (not to be confused with object-oriented programming). There are several synonyms for object program, including object module and compiled program. The object program contains the string of 0s and 1s called machine language that the logic processor works with.

The machine language of the computer is constructed by the language compiler with an understanding of the computer's logic architecture, including the set of possible computer instructions and the length (number of bits) in an instruction.

Test and Troubleshoot

Troubleshooting: A systematic approach to problem solving that is often used to find and resolve a problem, error, or fault within software or a computer system. Below are the 11 Troubleshooting Tips:

1. Free up RAM by closing other open program
2. Restart the software
3. Shut down and restart your computer
4. Use Internet to find help
5. Undo any recent hardware or software changes
6. Uninstall the software, then reinstall it
7. Look for software patches
8. Scan for virus and malware
9. Check for firewall conflict
10. Boot up in safe mode
11. Defragment your hard drive

RESOURCE

Google <http://www.edx.org>learn>scratch>

Teaching and Learning Strategies

Teachers are encouraged to introduce students to simulations to better understand the concepts taught. Therefore, students will learn effectively and master the knowledge prescribed in each topic. Whilst introducing the topic, guided discovery and research will enable students to get a picture of Computer Programming. The knowledge prescribed must be taught. It is not only about teaching what students should know but also to interpret that knowledge for students in a way that makes it relevant to them, and enables them to begin to acquire skills of analysis and problem solving, which will support teaching and learning. Students must be given opportunities to apply their knowledge, to be creative and to solve problems.

Lesson 1: Basic Programming Concepts

Teaching Strategies

- Review programming concepts with students.
- Guide students to write a simple algorithm process and sequence it.
- Provide a different programming language to the students.

Learning Strategies

Activity 1: Demonstrate understanding on programming concepts.

Activity 2: Write a simple algorithm process and sequence it.

Activity 3: Study the different programming languages and research on them.

Lesson 2: Developing simple programming concepts

Teaching Strategies

- Pose various programming languages with situations to students.
- Allow students to sequence and loop simple algorithms through solving each situation.
- Provide opportunities for students to read online about Scratch software and share their findings.

Learning Strategies

Activity 1: Discuss various programming languages and predict ways to apply them in various situations.

Activity 2: Work in pairs to sequence and loop simple algorithms to solve problems.

Activity 3: Conduct online research to learn about Scratch applications and share findings.

Resources

<https://searchsoftwarequality.techtarget.com/definition/program>

1| Computer Architecture

Topic 3: Robotics

Content Standard: Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.

Benchmark

10.5.1.3 Explore and investigate the electronics and robotics applications and structures

Learning Objective: By the end of the topic, students will be able to;

1. Explore and investigate the electronics applications of robotics
2. Explore and investigate the structures in robotics

Essential questions

1. What is Robotics?
2. What are the hardware and software structures of Robots?
3. What are the applications of robotics?

Key Concepts(SKAV)	
Skills	Explore and investigate electronics and robotic applications
Knowledge	electronics and robotic
Attitudes	Be appreciative and open-minded
Values	Rationality

Content Background

Introduction to robotic electronics

A recent innovation in technology that can be used for educational purposes is Educational robotics, by providing a learning environment in which people are involved in the design and construction of robot creations. It includes educational activities that upkeep and strengthen specific areas of knowledge and skills developed in students through the design, creation, assembly and operations of robots. The objective of teaching robotics is to familiarise students with current production processes, with the Automation Technology which is related to the use of mechanical, electronic and computer-based, in the operation and control of the production plays a very significant role. However, robotics system is well-thought-out beyond a working application. In robotics, robot hardware and software need to have a seamless connection as robotic movements are a link between the physical and logical.

REFERENCE

Educational Robotics in Teaching Learning Process

Igona Gorakhnath Research Scholar, Centre for Education, Central University of Punjab, Bathinda, India

Jubilee Padmanabhan

Assistant Professor, Centre for Education, Central University of Punjab, Bathinda, India

Robotic electronic structures

What are Robotics? Robotics is a science and technology of general purpose, programmable machine systems. Contrary to the popular fiction image of robots as ambulatory machines of human appearance capable of performing almost any task, most robotic systems are anchored to fixed positions in factories where they perform a flexible, but restricted, number of operations in computer-aided manufacturing.

Such a system minimally contains a computer to control operations and effectors, devices that perform the desired work. Additionally, it might have sensors and auxiliary equipment or tools under its control. Some robots are relatively simple mechanical machines that perform a dedicated task such as welding or spray painting. Other more complex, multitask systems use sensory systems to gather information needed to control its work. A robot's sensors might provide tactile feedback, so that it can pick up objects and place them properly, without damaging them. Another robot sensory system might include a form of machine vision that can detect flaws in manufactured goods. Some robots used to assemble electronic circuit boards can place odd-sized components in the proper location after visually locating positioning marks on the board. The simplest form of mobile robots, used to deliver mail in office buildings or to gather and deliver parts in manufacturing, follow the path of a buried cable or a painted line, stopping whenever their sensors detect an object or person in their path. More complex mobile robots are used in more unstructured environments such as mining.

Robots are machines that can substitute for humans and replicate human actions and are used to do jobs that are difficult, impossible, or just tedious for humans to do. Robots can be used in many situations and for lots of purposes, but today many are used in dangerous environments (including bomb detection and deactivation), manufacturing processes, or where humans cannot survive (e.g. in space, under water, in high heat, and for clean up and containment of hazardous materials and radiation). Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, or any other human activity. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

REFERENCE

From Wikipedia Roboticist"

Robotic electronics applications

Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots are built to do jobs that are hazardous to people, such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. Robotics is also used in STEM (science, technology, engineering, and mathematics) as a teaching aid. The advent of nanorobots, microscopic robots that can be injected into the human body, could revolutionise medicine and human health.

Robotics has historically been considered a branch of engineering that involves the conception, design, manufacture, and operation of robots. This field overlaps with electronics, computer science, artificial intelligence, mechatronics, nanotechnology and bioengineering.

Resources for teachers:

Teacher resources abound online to begin using LEGO Robotics in the classroom to teach all subject matter. Here are a few places to begin to explore:

<https://education.lego.com/en-us/elementary/explore/science>: Nice place to begin to gain a better understanding of the potential of robotics to address learning in a classroom.

Teaching and Learning Strategies

Teachers are encouraged to introduce students to simulations to better understand the concepts taught. Therefore, students will learn effectively and master the knowledge prescribed in each topic. Whilst introducing the topic, guided discovery and research will enable students to get a picture of Computer Architecture. The knowledge prescribed must be taught. It is not only about teaching what students should know but also to interpret that knowledge for students in a way that makes it relevant to them, and enables them to begin to acquire skills of analysis and problem solving, which will support teaching and learning. Students must be given opportunities to apply their knowledge, to be creative and to solve problems.

Lesson 1: Introduction to robotic electronics

Teaching Strategies

- Engage students to discuss the advancement of computer electronics and robotics.
- Integrate STEAM to guide students to design or create a robotic toy.
- Provide time allowance for students to work on the Project.

Learning Strategies

Activity 1: Discuss with the teacher the advancement of computer electronics and robotics.

Activity 2: In small groups work on a project to design or create a robotic toy.

Activity 3: Continue to work in pairs and record their process.

Lesson 2: Robotic electronic Structures

Teaching Strategies

- Model robotic structures.
- Through Guided discovery, ask students to identify and analyse robotic structure.
- Ask students to continue their project and record their process.

Learning Strategies

Activity 1: Demonstrate understanding on robotic structures.

Activity 2: Identify and analyse robotic structure.

Activity 3: Continue work on their project and record their process.

1| Computer Architecture

Topic 4: Artificial Intelligence

Content Standard: Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.

Benchmark

10.5.1.4 Explore and investigate the electronic applications and structures in Artificial Intelligence (AI)

Learning Objective: By the end of the topic, students will be able to:

1. Explore and investigate the electronic applications in Artificial Intelligence (AI)
2. Explore and investigate structures in Artificial Intelligence (AI)

Essential questions

1. What is Artificial Intelligence?
2. What are the hardware and software structures in Artificial Intelligence?
3. What are the applications of Artificial Intelligence?

Key Concepts(SKAV)	
Skills	Explore and Investigate electronics in Artificial Intelligence
Knowledge	Artificial Intelligence
Attitudes	Be appreciative and open-minded
Values	Rationality

Content Background

Introduction to Artificial Intelligence

Artificial intelligence

Artificial Intelligence allows machines to model, or even improve upon, the capabilities of the human mind and perform tasks commonly associated with human cognitive functions, such as interpreting speech and identifying patterns. They typically learn how to do so by processing massive amounts of data, looking for patterns to model their own decision making.

The creation of a machine with human-level intelligence that can be applied to any task is the goal for many AI researchers, this includes reasoning, knowledge representation, planning, learning, natural language processing, perception and the ability to move and manipulate objects. But the quest for artificial general intelligence has been brought with difficulty. And some believe strong AI research should be limited, due to the potential risks of creating a powerful AI without appropriate guardrails.

Artificial Intelligence structure

The field was founded on the assumption that human intelligence "can be so precisely described that a machine can be made to simulate it". This raises philosophical arguments about the nature of the mind and the ethics of creating artificial beings endowed with human-like intelligence. These issues have been explored by myth, fiction and philosophy since antiquity. Some people also consider AI to be a danger to humanity if it progresses unabated. Others believe that AI, unlike previous technological revolutions, will create a risk of mass unemployment. In the twenty-first century, AI techniques have experienced a resurgence following concurrent advances in computer power, large amounts of data, and theoretical understanding; and AI techniques have become an essential part of the technology industry, helping to solve many challenging problems in computer science, software engineering and operations research.

Teaching and Learning Strategies

Teachers are encouraged to conduct guided discovery learning to help students understand the concept in this topic. It would be the first time for most students to learn about Artificial Intelligence hence researching and paper presentation or case study will help students gain foundation knowledge on the topic.

Lesson 1: Introduction to Artificial Intelligence

Teaching Strategies

- Lead students to discover Artificial Intelligence (AI).
- Provide situations with impacts of AI.
- Provide inquiry questions for students' research online about AI

Learning Strategies

Activity 1: Express knowledge on Artificial Intelligence (AI).

Activity 2: Interpret situations with impacts of AI.

Activity 3: Use Inquiry questions to further read online about AI and record their findings

Lesson 2: Artificial Intelligence structure

Teaching Strategies

- Model Structure of AI.
- Ask students to present their findings from the previous lesson.
- Ask students to make predictions about AI.

Learning Strategies

Activity 1: Explain the Structure of Artificial Intelligence (AI).

Activity 2: Present their findings from the previous lesson.

Activity 3: Make predictions about future AI.

2| Computer Software

Topic 1: Operating System

Content Standard: Investigate and analyse computer system and application software, programming, algorithm, web design, and databases. And develop and apply the skills and knowledge in various software.

Benchmark

10.5.2.1 Install and configure the hardware and operating system and use file-management techniques effectively

Learning Objective: By the end of the topic, students will be able to:

1. Install and configure the hardware and operating system
2. use file-management techniques

Essential questions

1. What is an operating system?
2. How to install an operating system?
- 3.. How to configure an operating system?
4. How to apply advanced file management techniques or skills?

Key Concepts(SKAV)	
Skills	Install and configure hardware and operating system
Knowledge	Operating System
Attitudes	Be participatory
Values	Courage

Content Background

Introduction to Operating System

An Operating System (OS) is the program that after being initially loaded into the computer by a boot program, manages all of the other application programs in the computer. The application programs make use of the operating system by making requests for services through a defined application – a program interface (API)

For hardware functions such as input and output and memory allocation, the operating system acts as an intermediary between the programs and the computer hardware.

Installing the Operating Systems

1. Install an operating system:
2. Perform system updates: windows
3. Add features: windows 7: Review
4. Configure keyboard, mouse, display, sound, etc. windows: review Microsoft
5. Create user accounts: windows: review Microsoft
6. Research and compare license and support costs for windows, OSX, and Linux

Source: Google https://en.wikiversity.org/wiki/IT_Fundamentals/Installation_and_Configuration

Configuring the Operating System

- Installation (or setup) of a computer program (including device drivers and plugins), is the act of making the program ready for execution
- Installation typically involves code being copied/generated from the installation files to new files on the local computer for easier access by the operating system.
- Because code is generally copied/generated in multiple locations, uninstallation usually involves more than just erasing the program folder. For example, registry files and other system code may need to be modified or deleted for a complete uninstallation.
- Common operations performed during software installations include:
 - Making sure that necessary system requirements are met
 - Checking for existing versions of the software
 - Creating or updating program files and folders
 - Adding configuration data such as configuration files, Windows registry entries or environment variables
 - Making the software accessible to the user, for instance by creating links, shortcuts or bookmarks
 - Configuring components that run automatically, such as daemons or Windows services
 - Performing product activation
 - Updating the software versions
- Windows Update is a service offered by Microsoft that provides updates for Windows components.
- Microsoft Update is a service offered by Microsoft that provides updates for Windows components and other Microsoft software.
- A software license is a legal instrument (usually by way of contract law, with or without printed material) governing the use or redistribution of software.
- Software licenses are typically either proprietary licenses or free and open source licenses.
- With proprietary software licenses, the software publisher grants the use of one or more copies of software under the end-user license agreement (EULA), but ownership of those copies remains with the software publisher.
- Free and open-source licenses generally fall under two categories: Those with the aim to have minimal requirements about how the software can be redistributed (permissive licenses), and those that aim to preserve the freedoms that are given to the users by ensuring that all subsequent users receive those rights (copyleft Licenses)
- The Control Panel is a part of the Microsoft Windows graphical user interface which allows users to view and manipulate basic system settings and controls via applets
- System Preferences is an application included with the OS X operating system that allows users to modify various system settings which are divided into separate preference panes.

Source:

Google

https://en.wikiversity.org/wiki/IT_Fundamentals/Installation_and_Configuration

Advanced File Management Techniques

Managing Files and Folders

Although many Windows applications offer basic file management functions, Explorer is the tool you'll use most often to organise files. The basic techniques for creating folders, copying and moving files between folders, and deleting or renaming files have not changed appreciably in Windows Me, so this section is primarily an overview of essential techniques.

1. **Selecting Files and Folders**
2. **Moving and Copying Files and Folders**
3. **Renaming Files and Folders**
4. **Working with Shortcuts**
5. **Using Folder Shortcuts to Organize Files**
6. **Copying Disks**
7. **Undoing Changes**

Source: Google <https://www.informit.com/articles/article.aspx?p=131275&seqNum=4>

Teaching and Learning Strategies

Teachers are encouraged to guide students to solve authentic situations. Students will have learned about the foundation of troubleshooting, operating system and file management in Grade 9. Hence in this topic they are encouraged to apply learned knowledge to improve their skills and develop values that enhance their knowledge.

Lesson 1: Installing the Operating Systems

Teaching Strategies

- Review concepts learned in Grade 9
- Demonstrate steps to install operating systems to students.
- Guide students to install operating system

Learning Strategies

Activity 1: Review concepts of operating systems

Activity 2: Observe how to install an operating system

Activity 3: Install operating system through guided learning

Source: Google https://en.wikiversity.org/wiki/IT_Fundamentals/Installation_and_Configuration

Lesson 2: Configuring the Operating System

Teaching Strategies

- Model steps to configure operating systems
- Provide time allowance for students to Install an operating system
- Encourage the students to Record findings

Learning Strategies

Activity 1: Interpret steps to configure operating systems

Activity 2: Demonstrate understanding to configure operating system

Activity 3: Record findings

Source: Google https://en.wikiversity.org/wiki/IT_Fundamentals/Installation_and_Configuration

2| Computer Software

Topic 2: Machine Learning or Language

Content Standard: Investigate and analyse computer system and application software, programming, algorithm, web design, and databases. And develop and apply the skills and knowledge in various software.

Benchmark

10.5.2.2 Explore and investigate understand the various type of Machine and Programming Language

Learning Objective: By the end of the topic, students will be able to Explore and investigate the various type of Machine and Programming Language

Essential questions

1. What is Machine Learning?
2. What are some types of machine learning?
3. What are some types of programming languages used in machine learning?

Key Concepts(SKAV)	
Skills	Explore and Investigate Machine Learning
Knowledge	Machine Learning
Attitudes	Be appreciative and open minded
Values	Self Esteem

Content Background

Introduction to Machine Learning

Machine learning

From Wikipedia, the free encyclopaedia (Redirected from Machine Learning)

Machine learning (ML) is the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop a conventional algorithm for effectively performing the task.

Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a field of study within machine learning, and focuses on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics.

Some types of Machine Language

Sometimes referred to as **machine code** or **object code**, **machine language** is a collection of binary digits or bits that the computer reads and interprets. Machine language is the only language a computer is capable of understanding.

The exact machine language for a program or action can differ by operating system on the computer. The specific operating system will dictate how a compiler writes a program or action into machine language.

Computer programs are written in one or more programming languages, like C++, Java, or Visual Basic. A computer cannot directly understand the programming languages used to create computer programs, so the program code must be compiled. Once a program's code is compiled, the computer can understand it because the program's code is turned into machine language.

From Wikipedia, the free encyclopaedia

source: <https://www.javatpoint.com/what-is-machine-language#:~:text=Machine%20language%20is%a%low,is%20not%20understand%20by%20computers.>

:

Programming Language behind Machine Language

Programming language is a set of instructions that tells a computer what to do in order to come up with a solution to a particular problem. Programs are written using a programming language. A **programming language** is a formal language designed to communicate instructions to a computer. There are two major types of programming languages: low-level languages and high-level languages.

Low-level language consists of machine language and assembly language whilst high level language includes:

- 1) Algebraic Formula-Type Processing
2. Business Data Processing
3. String and List Processing
4. Object-Oriented Programming Language
5. Visual Programming Language

Teaching and Learning Strategies

Machine Language is a new concept that many students will be challenged to learn about though they are exposed to utilising it directly or indirectly.

The teacher is encouraged to support learning by teaching the prescribed knowledge in this topic. Providing opportunities to students to acquire the foundational knowledge is crucial, thus guided discovery and inquiry based learning approaches should be conducted inside and outside learning environment.

Lesson 1: Introduction to Machine Language

Teaching Strategies

- Engage and ask students about Machine Language.
- Guide students to discover Machine language and its function.
- Provide Inquiry questions and ask students to conduct a search on Machine Language

Learning Strategies

Activity 1: Engage and discuss Machine Language.

Activity 2: Express knowledge on Machine language through discovery learning.

Activity 3: Use inquiry questions to search and record findings on Machine Language.

Resources

<https://study.com/academy/lesson/machine-code-and-high-level-languages-using-interpreters-and-compilers.html>

Lesson 2: Some Type of Machine Learning

Teaching Strategies

- Discuss students' findings on Machine Language in class.
- Model various types of Machine Learning.
- Allow students to analyse various types of Machine Language.

Learning Strategies

Activity 1: Discuss findings on Machine Language with the teacher.

Activity 2: Express understanding on types of Machine Learning.

Activity 3: Analyse various types of Machine Learning.

Resources Google Wikipedia, the free encyclopaedia

<https://study.com/academy/lesson/machine-code-and-high-level-languages-using-interpreters-and-compilers.html>

2| Computer Software

Topic 3: Keyboard Typing

Content Standard: Investigate and analyse computer system and application software, programming, algorithm, web design, and databases. And develop and apply the skills and knowledge in various software.

Benchmark

10.5.2.3 Apply speed and accuracy in Typing.

Learning Objective: By the end of the topic, students will be able to;

- apply speed and accuracy in typing.

Essential questions

1. How to apply advanced keyboard technique skills?
2. How to test advanced typing and accuracy?

Key Concepts(SKAV)	
Skills	Keyboarding
Knowledge	Keyboarding
Attitudes	Be confident
Values	Self- Determination

Content Background

Top tips for teaching keyboarding at school and home

Insert here: [Diagram of a computer keyboard](#)

What to watch out for

1. *Looking down at the keyboard.*
What to do? Throw a dish towel over their hands or attach a sheet of typing paper to the back of the keyboard with a bit of masking tape to prevent the student from looking. Some students, however, don't like the feel of something over their hands. An alternative would be to cut the front out of a shoebox and place it over the keyboard.
2. *Struggling to find a key.*
What to do? It's a fact that many people have never noticed the little bumps on the F and J keys. They are there so you can find the correct starting position for your fingers without looking down. It may help beginning learners to practice lining up their fingers a few times before they start to type. Some students, for example, those with fine motor difficulties, may have a problem with the reach for a particular letter or letters. Put some Blue Tack on the key to differentiate it from the others and make it easier to feel without looking. Once that particular reach has been mastered, you can remove it. Move the Blue Tack around the keyboard as appropriate.
3. *Typing two keys at once.*
What to do? Ensure the hand guides are visible on the screen and revisit the modules that introduced the problematic keys. Practice makes perfect. Touch-type Read and Spell encourages students to correct their mistakes as they go along.
4. *Not returning hands to the home-row position.*
What to do? Develop an acronym and practice having them locate the home-row keys with their eyes closed.

5. *Sacrificing accuracy in pursuit of speed.*

What to do? Adjust the settings so no feedback on speed is shown at the end of lessons and they only receive accuracy scores. With Touch-type Read and Spell, it's recommended that the speed scores are not turned on for early modules.

6. *Typing a key more than once.*

What to do? Explain that very little pressure needs to be applied to type the key. If your computer has a 'Sticky keys' setting, turn it off.

Teaching and Learning Strategies

With good posture and typing skills the students are now challenged to develop high typing speed and accuracy. The lessons in this topic increase in complexity, after the student masters the basics of letter locations on the keyboard, learning about the Home Row with a few exercises to strengthen this knowledge.

Lesson 1: Apply typing skills with speed (30 wpm) and accuracy (75-90 %)

Teaching Strategies

- Pose typing challenge and observe students using finger to letter keystrokes, reinforcing the association of each letter to finger motion.
- Provide keyboard tips to the students as they practice Home Row Keys with simple exercise to practice finger placement.
- Allow students to practice typing 40 words per minute.

Learning Strategies

Activity 1: Students practice using finger to letter keystrokes, reinforcing the association of each letter to finger motion.

Activity 2: Master Tips as they practice Home Row Keys with simple exercise.

Activity 3: Practice typing 30 words per minute.

Lesson 2: Typing Test with speed (30 wpm) and accuracy (75-90 %)

Teaching Strategies

- Challenge your students' typing speed with entire paragraphs of text, and allow ongoing practice to improve their speed and accuracy.

Learning Strategies

Activity 1: Take the challenge.

Resources

<https://www.mapcon.com/us-en/improve-or-maintain-computer-keyboarding-skills>

2| Computer Software

Topic 4: Advance Programming

Content Standard: Investigate and analyse computer system and application software, programming, algorithm, web design, and databases. And develop and apply the skills and knowledge in various software.

Benchmark

10.5.2.4 Apply programming concepts to develop a variety of simple programs, including a program to control an external device

Learning Objective: By the end of the topic, students will be able to:

- apply programming concepts to develop a variety of simple programs, including a program to control an external device

Essential questions

1. What are intermediate programming concepts?
2. How to develop an intermediate program?
3. How to test and troubleshoot an intermediate program?
4. What are examples of connecting external devices using programming?

Key Concepts(SKAV)	
Skills	Apply and develop simple programs
Knowledge	Programming
Attitudes	Be creative
Values	Creativity

Content Background

Intermediate Programming Concepts

An **intermediate language** is an abstract programming language used by a compiler as an in-between step when translating a computer program into machine code. Before compiling the program into code for an actual, physical machine, the compiler first translates it into intermediate code suitable for a theoretical, abstract machine. This code is analyzed by the compiler, and if any opportunities for optimization are identified the compiler can perform the optimizations when making the translation into assembly language.

SOURCED: <https://www.computerhope.com/jargon/p/programming-language.htm>

Develop intermediate programs

Programming language A language used to write a program that the computer can execute. Almost 200 programming languages exist. An example is the popular C language, which is well suited to a variety of computing tasks. With C, programmers can write anything from a device driver, to an application, to an operating system.

Certain kinds of tasks, particularly those involving artificial intelligence (LISP or Prolog), process control (Forth), or highly mathematical applications (FORTRAN and APL) can benefit from a more specific language.

Programming languages are also divided into low-level languages, such as assembly language, and high-level languages, such as C, C++, and Java.

See *also* assembly language; compiler; interpreter; machine language.

Sources: Dictionary of networking (pdf copy)

How a Program Works

A computer's CPU can only understand instructions that are written in machine language. Because people find it very difficult to write entire programs in machine language, other programming languages have been invented. We can understand the function of a computer by understanding how the CPU is designed to perform operations such as the following:

- ❖ Reading a piece of data from main memory
- ❖ Adding two numbers
- ❖ Subtracting one number from another number
- ❖ Multiplying two numbers
- ❖ Dividing one number by another number
- ❖ Moving a piece of data from one memory location to another
- ❖ Determining whether one value is equal to another value

The CPU performs simple operations on pieces of data. The CPU does nothing on its own, however. It has to be told what to do, and that's the purpose of a program. A program is nothing more than a list of instructions that cause the CPU to perform operations.

Through the study of Binary and programming, the students would have understood the function of Binary and programming languages.

To execute a program you use the mouse to double-click the program's icon. This causes the program to be copied from the disk into main memory. Then, the computer's CPU executes the copy of the program that is in main memory. This process is illustrated in Figure 1.

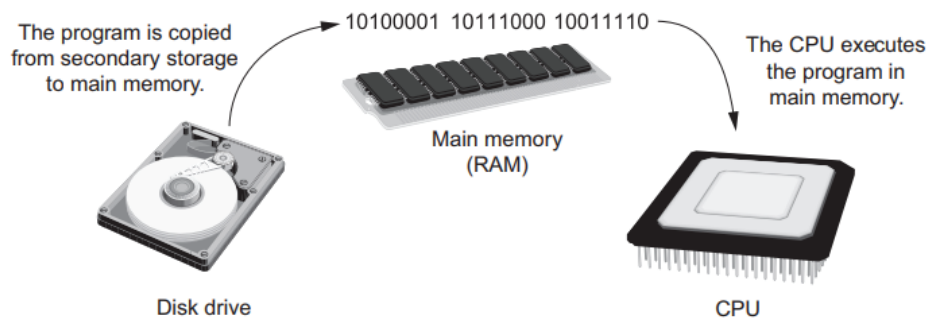


Figure 1: A program is copied into main memory and then executed.

When a CPU executes the instructions in a program, it is engaged in a process that is known as the fetch-decode-execute cycle. This cycle, which consists of three steps, is repeated for each instruction in the program.

The steps are:

- 1) **Fetch** A program is a long sequence of machine language instructions. The first step of the cycle is to fetch, or read, the next instruction from memory into the CPU.
- 2) **Decode** A machine language instruction is a binary number that represents a command that tells the CPU to perform an operation. In this step the CPU decodes the instruction that was just fetched from memory, to determine which operation it should perform.
- 3) **Execute** The last step in the cycle is to execute, or perform, the operation.

Figure 2: illustrates these steps. Main memory (RAM) Disk drive CPU The program is copied from secondary storage to main memory. The CPU executes the program in main memory.

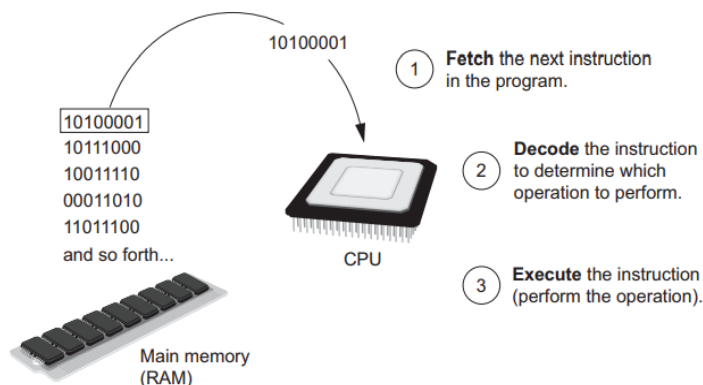


Figure 2: The fetch-decode-execute cycle

From Machine Language to Assembly Language

Computers can only execute programs that are written in machine language. As previously mentioned, a program can have thousands or even millions of binary instructions, and writing such a program would be very tedious and time consuming. Programming in machine language would also be very difficult because putting a 0 or a 1 in the wrong place will cause an error.

Assembly language programs cannot be executed by the CPU, however. The CPU only understands machine language, so a special program known as an assembler is used to translate an assembly language program to a machine language program.

This process is shown in Figure 3: An assembler translates an assembly language program to a machine language program.

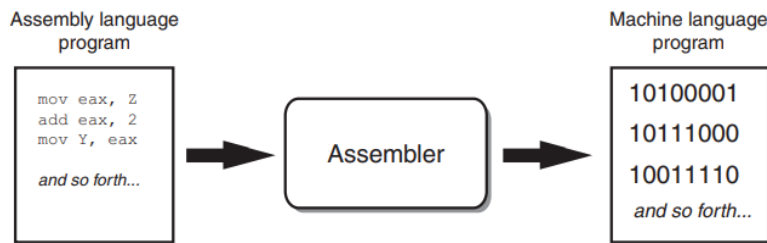


Figure 3: An assembler translate an assembly language program to a machine language program

The machine language program that is created by the assembler can then be executed by the CPU. Although a computer's CPU only understands machine language, it is impractical for people to write programs in machine language. For this reason, assembly language was created in the early days of computing as an alternative to machine language. Instead of using binary numbers for instructions, assembly language uses short words that are known as mnemonics. For example, in assembly language, the mnemonic `add` typically means to add numbers, `mul` typically means to multiply numbers, and `mov` typically means to move a value to a location in memory. When a programmer uses assembly language to write a program, he or she can write short mnemonics instead of binary numbers.

An assembler translates an assembly language program to a machine language program NOTE: There are many different versions of assembly language. It was mentioned earlier that each brand of CPU has its own machine language instruction set. Each brand of CPU typically has its own assembly language as well. High-Level Languages Although assembly language makes it unnecessary to write binary machine language instructions, it is not without difficulties. Assembly language is primarily a direct substitute for machine language, and like machine language, it requires that you know a lot about the CPU. Assembly language also requires that you write a large number of instructions for even the simplest program. Because assembly language is so close in nature to machine language, it is referred to as a low-level language. In the 1950s, a new generation of programming languages known as high-level languages began to appear. A high-level language allows you to create powerful and complex programs without knowing how the CPU works, and without writing large numbers of low-level instructions. In addition, most high-level languages use words that are easy to understand.

Teaching and Learning Strategies

Teachers are required to abreast their knowledge and skills on programming in order to facilitate active learning. Spiral learning and guided discovery is encouraged through formal and informal learning. Conducting STEAM projects or case study enables students to demonstrate their understanding, skills and values/attitude on the topic. An authentic situation is necessary for new knowledge and skills to be developed.

Lesson 1: Intermediate Programming Concepts

Teaching Strategies

- Review Programming Language.
- Pose situations for students to predict how they can solve using programming language.
- Use learned knowledge to express ways to solve problems using programming language.

Learning Strategies

Activity 1: Review programming language.

Activity 2: Predict how problems can be solved using programming language.

Activity 3: Express ways to solve problems using programming language

Lesson 2: Develop intermediate programs

Teaching Strategies

- Ask students to analyse low-level and high-level language and state how the program works.
- Ask students to write and illustrate how programs can be created.
- Introducing programming projects to students.

Learning Strategies

Activity 1: Analyse low-level and high-level language and state how the program works.

Activity 2: Write and illustrate how programs can be created.

Activity 3: Interpret programming project.

Lesson 3: Test and Troubleshoot

Teaching Strategies

- Provide time allowance for students to create, test and troubleshoot a program.
- Ask students to record and report their findings.

Learning Strategies

Activity 1: Create, test and troubleshoot a program.

Activity 2: Record and report their findings.

Resources

https://en.wikipedia.org/wiki/Intermediate_representation

2| Computer Software

Topic 5: File Management

Content Standard: Investigate and analyse computer system and application software, programming, algorithm, web design, and databases. And develop and apply the skills and knowledge in various software.

Benchmark

10.5.2.5 Apply file management and accessing information

Learning Objective: By the end of the topic, students will be able to:

- apply file management and accessing information

Essential questions

1. What are the steps in file management and information accessibility?
2. How to maintain folders and files?
3. What is the importance of Backup?

Key Concepts(SKAV)	
Skills	Apply File Management to access information
Knowledge	File Management
Attitudes	Be Cooperative
Values	Self – Discipline

Content Background

File Management

File management refers to the process of organising and storing information in a easily retrievable manner. It involves creating an organised structure for file storage and using computer storage devices, such as drives to hold information.

Effective File Management

1. Avoid saving unnecessary documents
2. Follow consistent method for naming your file and folders
3. Store related documents together whatever their type
4. Separate ongoing work from completed work
5. Avoid overfilling folders
6. Organise documents by date
7. Make backup copies of documents

Reference: <http://theecmconsultatn.com/what-is-file-management/>

Managing Files and Folders

Although many Windows applications offer basic file management functions, Explorer is the tool you'll use most often to organize files. The basic techniques for creating folders, copying and moving files between folders, and deleting or renaming files have not changed appreciably in Windows Me, so this section is primarily an overview of essential techniques.

Selecting Files and Folders

Here's a lightning-fast way to select all but a few icons within a folder. This technique comes in handy when you want to archive or delete most of the files in a folder yet keep a small number of items. Select the objects you plan to keep and then choose Edit, Invert Selection. You can now use any of the standard Windows techniques to move, copy, or delete the selected objects. Another option is to press Ctrl+A to highlight them all and then hold down Ctrl while you deselect the ones you want to keep.

Moving and Copying Files and Folders

The best way to predict what Explorer will do when you drag and drop icons is to examine the mouse pointer before you release the mouse button. If you see a plus sign just to the right of the pointer, you can expect a copy; a small arrow next to the pointer means you'll get a shortcut; and a plain pointer means you're about to move the selected objects. If the pointer you see doesn't match the result you intended, press Esc before releasing the mouse button to abort the procedure.

Renaming Files and Folders

Working with Shortcuts

Some shortcuts (notably those on the Programs menu and the Quick Launch bar) have no arrow. You can use Microsoft's Tweak UI utility to change the shortcut arrow to a lighter version or remove it completely, so that all shortcuts look just like their corresponding target files. In that case, you'll need to use the Details view in an Explorer window, or right-click and inspect the icon's properties, to see whether it's a shortcut.

Creating a new shortcut is a two-step process with this wizard.

- Click the Browse button and select the document or program file from the Browse list. To create a shortcut to a drive or folder, you must type its name directly in the Command Line text box. Include the full path if necessary. Then click Next.
- Give the shortcut a descriptive name and click Finish. Test the shortcut to ensure it works correctly.

The easiest way to create a shortcut is by dragging and dropping the target file's icon. Select the icon in an Explorer window, hold down the right mouse button, and drag the icon to the desktop or another folder. Choose Create Shortcut(s) Here from the pop-up menu.

You can define a keyboard combination that automatically launches any shortcut stored on the desktop or the Start menu. This is an especially effective way to make your favourite accessories or Web pages available. To create a keyboard shortcut, right-click the shortcut icon and choose Properties. On the Shortcut tab, click in the Shortcut key box and then press the specific key combination you want to use

CAUTION

Shortcut keys you create take precedence over other access keys in Windows. Be careful that you don't inadvertently redefine a systemwide key combination or one that you use in other Windows applications.

Using Folder Shortcuts to Organise Files**CAUTION**

Folder shortcuts are an undocumented feature of Windows Me. As such, you run the risk that Microsoft will remove this feature at any time through an update to Internet Explorer or Windows. Use this feature at your own risk, and be sure to keep thorough backups!

Copying Disks**CAUTION**

Windows automatically erases any data on a destination disk without prompting you. That can be disastrous if the destination disk contains important data. If you store important files on floppy disks, always use the write-protect tab to prevent accidental erasure.

Undoing Changes

The Undo shortcuts also work if you make a mistake on the Windows desktop. If you accidentally move or delete a desktop file, press Ctrl+Z immediately to recover it.

CAUTION

It's not always easy to tell exactly what Undo will accomplish, and no Redo option is available to restore your original action, either. In fact, if you press Ctrl+Z while the focus is on the Windows desktop, Windows might undo an action you took in an Explorer window hours ago. You get no feedback; although the effect might be to restore the original name of a file you renamed, or to move a file back to a folder where you don't want it stored

Source: Google <https://www.informit.com/articles/article.aspx?p=131275&seqNum=4>

Teaching and Learning Strategies

Teachers are encouraged to guide students to solve authentic situations. Students will have learned about file management in the previous topic. Hence in this topic they are encouraged to apply learned knowledge to improve their skills and develop values that enhance their knowledge.

Lesson 1: Managing Documents, Files and Folders**Teaching Strategies**

- Engage and ask students to model steps to manage files.
- Provide an authentic situation for students to create tips to manage documents, files and folders.
- Ask students to communicate their ideas.

Learning Strategies

Activity 1: Model steps to manage files.

Activity 2: Create tips to manage documents, files and folders.

Activity 3: Communicate their ideas with others in class

Lesson 2: Creating, Maintaining Folders**Teaching Strategies**

- Pose situations where folders pathways were difficult to find and ask students to solve.
- Ask students to create and maintain folders
- Allow students to communicate their ideas

Learning Strategies

Activity 1: Identify ways to solve given situations.

Activity 2: Create and maintain folders.

Activity 3: Communicate their findings.

Programming And Planning

The 8 steps in Planning and Programming Process

1. Identify the number of Strands and Units in the subject Syllabus
2. Identify the total number of Content Standards, Benchmarks and Number of Topics (Syllabus and Teacher Guide)
3. Consider the Facts and Considerations in the Planning and Programming Process (subject related)
4. Distribute the Content evenly across the 4 school terms in a Matrix (Proposed Template)
5. Expand and plot the distributed content into the complete Yearly Content Overview for the subject for the grade (Proposed Template)
6. Develop the Termly Programs (Proposed Template)
7. Develop the Weekly Teaching Program (Proposed Template) Daily Lesson Plan (SBC Template)
8. Review, Evaluate and Re-plan the yearly, termly, weekly Programs

Planning and Programming Process

The Planning and Programming Process used by the Business and Technology Subjects is a 8 step process. This process begins from Unpacking the Content Standards and Benchmarks and ends with planning a daily lesson plan.

- | | |
|---------|---|
| Step 1: | Identify the number of Strands and Units in the subject Syllabus |
| Step 2: | Identify the total number of Content Standards, Benchmarks and Number of Topics (Syllabus and Teacher Guide) |
| Step 3: | Consider the Facts and Considerations in the Planning and Programming Process (subject related) |
| Step 4: | Distribute the Content evenly across the 4 school terms in a Matrix (Proposed Template) |
| Step 5: | Expand and plot the distributed content into the complete Yearly Content Overview for the subject for the grade (Proposed Template) |
| Step 6: | Develop the Termly Programs (Proposed Template – 3 part programme) |
| Step 7: | Develop the Weekly Teaching Program (Proposed Template) Daily Lesson Plan (SBC Template) |
| Step 8: | Review, Evaluate and Re-plan the yearly, termly, weekly Programs |

Technology And Industrial Arts Planning And Programming Process

Planning and Programming Process involves 8 steps. The steps are outlined and described with samples provided to assist and guide you.

Step 1: Identify the number of Strands and Units in the subject Syllabus (Grade 9 & 10 TIA Syllabus Page 31)

It is important to first identify the strand and unit names for familiarisation and also the number of strands and units in the Grade 9 Technology and Industrial Arts subject.

Technology and Industrial Arts has 5 strands and 13 Units

Table of Strands and Units

The table below outlines the strands and units for grade 9 Technology and Industrial Arts subject. This helps teachers understand how to deal with units per strand when they are expanded into evidence outcomes and benchmarks at each grade.

The strands and units of content standards explain the progression from Grade 9 to Grade 10, linking to senior high school Technology and Industrial Arts content. The order and linkage of units signifies what the students will achieve from one grade to the next.

Technology and Industrial Arts is organised around five strands – Textile Technology, Food Technology, Construction Technology, Communication Technology and Computer Technology. These strands are comparable with the strands used internationally. The Content Standard of each Strand is based on units. The Strands, Units and Content Standards are outlined in the table below:

Step 1: Identify the number of Strands and Units in the subject Syllabus
(Grade 9 & 10 TIA Syllabus Page 31)

STRANDS	UNITS
Textiles Technology	Fibres and Fabrics
	Textiles and Clothing
Food Technology	Food and Nutrition
	Food Science
Construction Technology	Building Technology
	Electrical Technology
	Plumbing Technology
	Welding Technology
	Engineering Technology
Communication Technology	Data Communication and Network
	Computer Security and Safety
Computer Technology	Computer Architecture
	Computer Software

Step 2: Identify the total number of Content Standards, Benchmarks and Number of Topics (Syllabus and Teacher Guide)

- Use the Syllabus to derive the total number of Content Standards and total number of Benchmarks
- Use the unpacking tool to derive your topics and the total number of topics
- Place or slot them in a matrix as in the sample shown below so you are knowledgeable and made aware of the total number of content standards, benchmarks and topics that you will be working with in the planning and programming of teaching and learning for the subject in a school year for that grade.

Grade 9 Technology and Industrial Arts Content Matrix

Consult the Grade 9 Technology and Industrial Arts Content Matrix showing the total number of strands, units, content standards, Benchmarks and topics to be covered in Grade 9. Note that this would be in the teacher Guide but because the teacher guides are not available, we have provided this matrix for you to use to program.

Total Number Of Strands	Total Number Of Units	Total Number of Content Standards	Total Number Of Benchmarks	Total Number Of Topics
1	2	2	11	11
2	2	2	13	13
3	5	5	29	29
4	2	2	12	12
5	2	2	11	11
Totals	13	13	77	77

Step 3: Consider the Facts and Considerations in the Planning and Programming Process (subject related)

It is important to consider and analyse facts that are worth considering if these facts will help or if these facts will pose a challenge to the planning and programming process.

Facts and Considerations about the Grade 9 Technology and Industrial Arts

1. As per the Matrix, there are a total of 77 Benchmarks and Topics which must be programmed and taught in a school year.
2. TIA is now a subject which requires all students to take all 5 strands in the subject unlike the OBC practice.
3. There are no specialist teachers who are trained to teach all the specialist content in the TIA subject.
4. Current practice has one teacher who can teach Food and Textile (Currently Home Economics), one teacher who can teach Construction Technology (currently Practical Skills) and one teacher who can teach Communication and computer Technology (currently Computer Studies and ICT).

5. With consideration #4, there are 3 personnel who will be required to teach TIA together to deliver the subject. *Thus, this fact is considered to propose the Planning and Programming Process for TIA subject into a 3-part Teaching and Learning Planning and Programming Process.* Which means TIA Subject Program is made up of 3 sub-programs
6. Time Allocation for Grade 9 Technology and Industrial Arts is 240 minutes per week which means it has 6 periods/6 lessons a week: 1 block of 80 minutes (2periods) periods and 1 x 160 minutes (4 periods blocked).
7. There is a total of 40 teaching weeks in a school year (4 Terms x 10 Weeks each)
8. In a term, there are about 8 weeks of actual teaching weeks which gives us 48 periods/48 lessons of actual teaching in a term (6 periods a week x 8 actual teaching weeks in a term).
9. Using these facts and considerations, we can Plan and Program the TIA according to this understanding

Understanding 1:

There are 3 x Teachers who are required to teach the TIA subjects in 40 weeks. Therefore teaching and learning must be programmed using the 3 parts ($40/3 = 13.3$ weeks per part).

Understanding 2:

There are 77 Benchmarks for TIA that must be planned and programed for 40 weeks but distributed equally according to the 3-parts: Textile & Food =34 BMs; Construction = 33 BMs; Communication & Computer = 33. (use the strand with the highest BMS to determine the number of BMS per week = $34 / 16 = 2.1$ BMS week)

Understanding 3:

The 3-factor plan and program for TIA becomes the Yearly plan and Program (meaning to say, the plan and program will be utilised by the teacher for 3 lots of students taking TIA in a rotation approach for a year. The TIA Content distribution will be determined by the 3 parts (3 available personnel) and therefore the content will be distributed.

Understanding 4:

In the instance where the school decides to deliver the Food Technology, Textile Technology, Communication Technology and Computer Technology from term 1-3, then the Construction Technology gets to be taught in Term 4. This allows for the school to acquired or make available the necessary requirements for the construction technology strand. Otherwise, it becomes school-based and students are awarded an attainment certificate - for the strands they have learnt and NOT TIA. TIA is externally examined and certified.

Step 4: Distribute the Content evenly across the 3-Parts (Proposed Template)

The teaching content outweighs the teaching weeks and therefore considerations must be made on teaching and learning approaches for example; integration, project-based learning, etc. we have provided some information to help you distribute the Technology and Industrial Arts subject content to be programmed fairly across the 3-parts. The tables include:

Grade 9 Technology and Industrial Arts Content distribution for the Teaching Year

The Grade 9 TIA has been distributed according to the 3-parts in a 13 week rotation program. The content standards and Benchmarks according to the Distribution are also written and provided for you in a table (4a).

Week	Textile Technology and Food Technology	Construction Technology	Communication and Computer Technology
1	Textile Technology: Fibres and Fabrics: CS: 9.11 BMs: 9.1.1.1 and 9.1.1.2	Building Technology CS: 9.3.1 BMs: 9.3.1.1, 9.3.1.2, 9.3.1.3,	Communication Technology Data Communication and Network CS: 9.4.2 BMs: 9.4.1.1, 9.4.1.2, ,
2	Textile Technology: Fibres and Fabrics: CS: 9.11 BMs: 9.1.1.3, .1.1.4,	Building Technology CS: 9.3.1 BMs: 9.3.1.4, 9.3.1.5, 9.3.1.6,	Communication Technology Data Communication and Network CS: 9.4.1 BMs: 9.1.4.3, 9.1.4.4, 9.1.4 .5
3	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs:9.1.2.1, 9.1.2.2,	Electrical Technology CS: 9.3.1 BMs: 9.3.2.1, 9.3.2.2, 9.3.2.3,	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.1, 9.4.2.2,
	Assessment	Assessment	Assessment
4	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.3, 9.1.2.4,	Electrical Technology CS: 9.3.2 BMs: 9.3.2.4, 9.3.2.5,	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.3, 9.4.2.4
5	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.5, 9.1.2.6,	Electrical Technology CS: 9.3.2 BMs: 9.3.2.6, 9.3.2.7	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.5, 9.4.2.6,
6	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.1, 9.2.1.2	Plumbing Technology CS: 9.3.3 BMs: 9.3.3.1, 9.3.3.2	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.5.1.1, 9.5.1.2
	Assessment	Assessment	Assessment
7	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.3, 9.2.1.4	Plumbing Technology CS: 9.3.3 BMs: 9.3.3.3, 9.3.3.4,	

8	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.5, 9.2.1.6,	Welding Technology CS: 9.3.4 BMs: 9.3.4.1, 9.3.4.2,	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.1.5.3, 9.1.5.4
9	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.7	Welding Technology CS: 9.3.4 BMs: 9.3.4.3, 9.3.4.4, 9.3.4.	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.1.5.5
	Assessment	Assessment	Assessment
10	Food Technology: Food Science: CS: 9.2.1 BMs: 9.2.2.1, 9.2.2.2	Engineering Technology CS: 9.3.5 BMs: 9.3.5.1, 9.3.5.2,	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.1, 9.5.2.2
11	Food Technology: Food Science: CS: 9.2.1 BMs: 9.2.2.3, 9.2.2.4,	Engineering Technology CS: 9.3.5 BMs: 9.3.5.3, 9.3.5.4,	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.3, 9.5.2.4
12	Food Technology: Food Science: CS: 9.2.1 BMs: 9.2.2.5	Engineering Technology CS: 9.3.5 BMs: 9.3.5.5, 9.3.5.6, 9.3.5.7	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.5,
13	Summative Assessment		

Grade 9 Technology and Industrial Arts Content Standards and Benchmarks Overview as per Strands and Units

The five strands – Textile Technology, Food Technology, Construction Technology, Communication Technology and Computer Technology are unpacked into units to Benchmarks as outlined in the table below:

STRAND 1: TEXTILE TECHNOLOGY	
UNIT 1: FIBRES AND FABRICS	
Content Standard	Benchmarks
CS1.1 Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.	9.1.1.1 – 9.1.1.6
	9.1.1.1 Compare and contrast social, economic, cultural and technological changes to textiles, fashion and clothing
	9.1.1.2 Distinguish the properties and characteristics of fibres and fabrics
	9.1.1.3 Explore the elements of design and the design and construction of fashion ideas
	9.1.1.4 Describe the functions of tools and equipment and their safe usage
	9.1.1.5 Explore the range of textile construction techniques
	9.1.1.6 Apply appropriate safety practices in fashion design and construction
STRAND 1: TEXTILE TECHNOLOGY	
UNIT 2: TEXTILE AND CLOTHING	
CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for a variety of needs and occasions	9.1.2.1 – 9.1.2.6
	9.1.2.1 Describe historical influences, technological progression and emerging trends as inspirational sources of design
	9.1.2.2 Demonstrate an awareness of the fundamentals of the design process through various artistic versions
	9.1.2.3 Apply a broad range of contemporary and appropriate tools and techniques with competence and in the development of design projects
	9.1.2.4 Describe how the properties of textile fibres affect textile wear and care
	9.1.2.5 Apply the design process to respond to needs and opportunities in textile design projects
	9.1.2.6 Select and use appropriate technology to creatively document, communicate and present design and project work
STRAND 2: FOOD TECHNOLOGY	
UNIT 1: FOOD AND NUTRITION	
CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.1 – 9.2.1.7
	9.2.1.1 Compare and contrast the nature and properties of food
	9.2.1.2 Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development
	9.2.1.3 Examine the nutritional components of food and food development and the impact of food consumption on nutrition.
	9.2.1.4 Explore nutrition as integral to making food choices
	9.2.1.5 Discuss economic, social and technological influences of food, food product and food sciences
	9.2.1.6 Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues
	9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment

STRAND 2: FOOD TECHNOLOGY	
UNIT 2: FOOD SCIENCE	
CS 2.2 Students will be	9.2.2.1 – 9.2.2.6
able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions, lifestyle, business)	9.2.2.1 Identify and describe the cultural, physical, biological and nutritional characteristics of food that influence food development
	9.2.2.2 Describe the nutritional and sensory characteristics of food to meet the needs, health and occasions.
	9.2.2.3 Apply management strategies in food selection, meal preparation, product development, storage and preservation
	9.2.2.4 Explore safety and hygiene practices relating to food, and changes that occur in the functional properties of food.
	9.2.2.5 Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the distribution of food from the point of production to consumption
	9.2.2.6 Apply the design process to create food solutions.
STRAND 3: CONSTRUCTION TECHNOLOGY	
UNIT 1: BUILDING TECHNOLOGY	
CS 3.1 Investigate the history and theory of buildings and analyse the components and systems of buildings, occupational health and safety procedures, the properties of building materials and the processes in which those materials and equipment are used according to industry standards.	9.3.1.1 – 9.3.1.6
	9.3.1.1 Investigate the history and theory of buildings
	9.3.1.2 Identify and describe a variety of construction materials, components, and processes
	9.3.1.3 Describe the elements of drawings, and their application in technical drawings.
	9.3.1.4 Identify and describe the elements of safety
	9.3.1.5 Describe the scope and purpose of building codes, and identify other regulations and standards that apply to construction projects
	9.3.1.6 Apply mathematical skills and scientific concepts in the planning and building of a variety of construction projects
STRAND 3: CONSTRUCTION TECHNOLOGY	
UNIT 2: ELECTRICAL TECHNOLOGY	
CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship, sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	9.3.2.1 – 9.3.2.7
	9.3.2.1 Describe the historical development of electricity
	9.3.2.2 Investigate and communicate OHS legislation and regulation and assess and employ emergency procedures whilst observing safety
	9.3.2.3 Identify, design, develop and evaluate processes and products related to electrical technology and communicate the findings through the use of appropriate electrical and electronic terminology.
	9.3.2.4 Define electricity and conductivity and differentiate insulators from conductors
	9.3.2.5 Identify symbols used and explain the functions of components and devices in electrical circuit diagrams
	9.3.2.6 Identify the different types of circuits and explain the parts and operation of a simple practical circuit.
	9.3.2.7 Investigate the concepts, principles and practices related to electrical

STRAND 3: CONSTRUCTION TECHNOLOGY**UNIT 3: PLUMBING TECHNOLOGY**

CS 3.3 Investigate and analyse fundamental concepts of plumbing and theories, OHS, Occupational Health and safety Regulations and standards, trade drawing, demonstrations and applications of tools and materials

9.3.3.1 – 9.3.3.4

9.3.3.1 Describe and explain the fundamentals, concepts, and their relevance in the plumbing trade

9.3.3.2 Analyse and describe OHS Regulations and standards in the plumbing trade and work places.

specifications, installation of plumbing fittings and accessories in (DWV) Drain, waste, vent system, and water distribution system.

9.3.3.3 Demonstrate and apply basic plumbing tools and equipment and their specifications and practice in trade math.

9.3.3.4 Explore and apply basic concepts of trade drawings in plumbing.

STRAND 3: CONSTRUCTION TECHNOLOGY**UNIT 4: WELDING TECHNOLOGY**

CS 3.4 Investigate and analyse safety procedures, print reading, measurement and layout, identify properties of metals, the welding techniques, cutting processes according to welding codes, inspections, testing principles and apply fundamentals of fabrication.

9.3.4.1 – 9.3.4.5

9.3.4.1 Investigate safe workshop setup and safety procedures in welding

9.3.4.2 Explore and interpret welding principles, codes and standards

9.3.4.3 Demonstrate knowledge in fundamental print reading, measurement and layout or fit-up techniques

9.3.4.4 Investigate and analyse the properties of metals

9.3.4.5 Investigate the various welding techniques and cutting processes

STRAND 3: CONSTRUCTION TECHNOLOGY**UNIT 5: ENGINEERING TECHNOLOGY**

CS 3.5 Investigate and analyse the historical and societal influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.

9.3.5.1 – 9.3.5.7

9.3.5.1 Describe how history and society has influenced the engineering field and critically analyse innovations.

9.3.5.2 Investigate the scope of engineering, roles and responsibilities of an engineer and recognise current innovations

9.3.5.3 Explore and distinguish the different types of the Engineering fields.

9.3.5.4 Explore and discuss engineering principles and practices and the appropriate materials in engineering.

9.3.5.5 Explore and analyse the general safety practices in engineering.

9.3.5.6 Outline management and problem solving skills using the engineering design process.

9.3.5.7. Explore and utilise communication practices appropriate to engineering.

STRAND 4: COMMUNICATION TECHNOLOGY**UNIT 1: DATA COMMUNICATION AND NETWORK**

CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.

9.4.1.1 – 9.4.1.7

9.4.1.1 Define the elements of data communication system.

9.4.1.2 Describe the functions of the different components of a computer network.

9.4.1.3 Define the OSI (Open Systems Interconnect) model and how it functions.

9.4.1.4 Explore the use of technical terminology, basic scientific concepts, and mathematical concepts used in communications technology and apply them to the creation of media products.

9.4.1.5 Explore and articulate the core concepts, techniques, and skills required to produce a range of communications media products or services.

9.4.1.6 Research and apply the design brief to design, configure and manage simple network.

9.4.1.7 Explore the Authoring Software or Multimedia associate software

STRAND 4: COMMUNICATION TECHNOLOGY**UNIT 2: COMPUTER SECURITY AND SAFETY**

CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.

9.4.2.1 – 9.4.2.5

9.4.2.1 Investigate and demonstrate appropriate posture in using computer equipment

9.4.2.2 Identify health hazards associated with the use of ICT and propose good ergonomic practices

9.4.2.3 Identify effects of the widespread use of computers and associated technologies on society

9.4.2.4 Evaluate the impact of past, current and emerging technologies on the Individual, society and environments.

9.4.2.5 Demonstrate an understanding of and apply safe work practices in communications technology activities

STRAND 5: COMPUTER TECHNOLOGY**UNIT 1: COMPUTER ARCHITECTURE**

CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.

9.5.1.1 – 9.5.1.6

9.5.1.1 Comprehend and explain the Computer System and types of computer.

9.5.1.2 Explore generations of computer

9.5.1.3 Investigate and describe the design brief of solving problems.

9.5.1.4 Identify and describe the functions of, as well as important advances related to, electronic and computer components;

9.5.1.5 Demonstrate a basic understanding of binary numbers and digital logic

9.5.1.6 Explore and describe hardware and software troubleshooting principles

STRAND 5: COMPUTER TECHNOLOGY**UNIT 2: COMPUTER SOFTWARE**

CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.

9.5.2.1 – 9.5.2.5

9.5.2.1 Explore programming software and applications

9.5.2.2 Demonstrate the understanding of Operating Systems/ Software and File Management

9.5.2.3 Apply typing skills with speed (20wpm) and accuracy (80%)

9.5.2.4 Create documents using Microsoft Office

9.5.2.5 Explore the Authoring Software or Multimedia associate software

Grade 9 Technology and Industrial Arts Content Standards, Benchmarks and Topics Overview as per the Strands and Units

STRAND 1: FOOD TECHNOLOGY		
UNIT 1: FIBRES AND FABRICS		
Content Standard	Benchmark	Topic
CS1.1 Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction,	9.1.1.1 Compare and contrast social, economic, cultural and technological changes to textiles, fashion and clothing	Impact of changes on textiles, fashion and clothing
	9.1.1.2 Distinguish the properties and characteristics of fibres and fabrics	Introduction to fibres and fabrics
	9.1.1.3 Explore the elements of design and the design and construction of fashion ideas	Designing and Construction
production, representation, regulation and marketing.	9.1.1.4 Describe the functions of tools and equipment and their safe usage	Functions and safe usage of tools and equipment
	9.1.1.5 Explore the range of textile construction techniques	Techniques in textile construction
	9.1.1.6 Apply appropriate safety practices in fashion design and construction	Safety practices in fashion designing and construction
STRAND 1: TEXTILE TECHNOLOGY		
UNIT 2: TEXTILE AND CLOTHING		
Content Standard	Benchmark	Topic
CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for a variety of needs and occasions	9.1.2.1 Describe historical influences, technological progression and emerging trends as inspirational sources of design	Sources of Design
	9.1.2.2 Demonstrate an awareness of the fundamentals of the design process through various artistic versions	Fundamentals of design process
	9.1.2.3 Apply a broad range of contemporary and appropriate tools and techniques with competence and in the development of design projects	Tools and techniques in project designs
	9.1.2.4 Describe how the properties of textile fibres affect textile wear and care	Textiles wear and care
	9.1.2.5 Apply the design process to respond to needs and opportunities in textile design projects	Designing a textile project
	9.1.2.6 Select and use appropriate technology to creatively document, communicate and present design and project work	Documenting a project portfolio

STRAND 2: FOOD TECHNOLOGY
UNIT 1: FOOD AND NUTRITION

Content Standard	Benchmark	Topic
CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.1 Compare and contrast the nature and properties of food	Nature and properties of food
	9.2.1.2 Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development	Safety and hygienic practices in food product development
	9.2.1.3 Examine the nutritional components of food and food development and the impact of food consumption on nutrition.	Food and nutrients
	9.2.1.4 Explore nutrition as integral to making food choices	Food metabolism
	9.2.1.5 Discuss economic, social and technological influences of food, food product and food sciences	Influences on food product development
	9.2.1.6 Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues	Food composition and energy metabolism
	9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment	Food product development

STRAND 2: FOOD TECHNOLOGY
UNIT 2: FOOD SCIENCE

Content Standard	Benchmark	Topic
CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions, lifestyle, business)	9.2.2.1 – 9.2.2.6	
	9.2.2.1 Identify and describe the cultural, physical, biological and nutritional characteristics of food that influence food development	Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils
	9.2.2.2 Describe the nutritional and sensory characteristics of food to meet the needs, health and occasions.	Sensory characteristics of food
	9.2.2.3 Apply management strategies in food selection, meal preparation, product development, storage and preservation	Food management
	9.2.2.4 Explore safety and hygiene practices relating to food, and changes that occur in the functional properties of food.	Food safety and hygienic practices
	9.2.2.5 Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the distribution of food from the point of production to consumption	Factors influencing food processing and packaging
	9.2.2.6 Apply the design process to create food solutions	The technology design

STRAND 3: CONSTRUCTION TECHNOLOGY
UNIT 1: BUILDING TECHNOLOGY

Content Standard	Benchmark	Topic
CS 3.1 Investigate the history and theory of buildings and analyse the components and systems of buildings, occupational health and safety procedures, the properties of building materials and the processes in which those materials and equipment are used according to industry standards.	9.3.1.1 Investigate the history and theory of buildings	The history and theory of buildings
	9.3.1.2 Identify and describe a variety of construction materials, components, and processes	Building construction materials
	9.3.1.3 Describe the elements of drawings, and their application in technical drawings.	Trade drawing
	9.3.1.4 Identify and describe the elements of safety	The Elements Occupational Health and Safety
	9.3.1.5 Describe the scope and purpose of building codes, and identify other regulations and standards that apply to construction projects	Building Codes, Standards and regulations
	9.3.1.6 Apply mathematical skills and scientific concepts in the planning and building of a variety of construction projects	Trade Maths

STRAND 3: CONSTRUCTION TECHNOLOGY
UNIT 2: ELECTRICAL TECHNOLOGY

Content Standard	Benchmark	Topic
CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship, sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	9.3.2.1 – 9.3.2.7	
	9.3.2.1 Describe the historical development of electricity	History of Electricity
	9.3.2.2 Investigate and communicate OHS legislation and regulation and assess and employ emergency procedures whilst observing safety	Workplace and Electrical safety
	9.3.2.3 Identify, design, develop and evaluate processes and products related to electrical technology and communicate the findings through the use of appropriate electrical and electronic terminology.	Electrical or Electronic processes and products
	9.3.2.4 Define electricity and conductivity and differentiate insulators from conductors	Fundamentals of electricity
	9.3.2.5 Identify symbols used and explain the functions of components and devices in electrical circuit diagrams	Components and devices used on circuit diagrams
	9.3.2.6 Identify the different types of circuits and explain the parts and operation of a simple practical circuit.	Circuits
	9.3.2.7 Investigate the concepts, principles and practices related to electrical	Electrical Fundamentals

STRAND 3: CONSTRUCTION TECHNOLOGY
UNIT 3: PLUMBING TECHNOLOGY

Content Standard	Benchmark	Topic
CS 3.3 Investigate and analyse fundamental concepts of plumbing and theories, OHS, Occupational Health and safety Regulations and standards ,trade drawing, demonstrations and applications of tools and materials specifications, installation of plumbing fittings and accessories in (DWV) Drain, waste, vent system, and water distribution system.	9.3.3.1 – 9.3.3.4	
	9.3.3.1 Describe and explain the fundamentals, concepts, and their relevance in the plumbing trade	Fundamental concept and relevance of plumbing trade
	9.3.3.2 Analyse and describe OHS Regulations and standards in the plumbing trade and work places.	Topic 2: Occupational Health and Safety regulations and standard
	9.3.3.3 Demonstrate and apply basic plumbing tools and equipment and their specifications and practice in trade math.	Plumbing tool and equipment
	9.3.3.4 Explore and apply basic concepts of trade drawings in plumbing.	Trade Drawing

STRAND 3: CONSTRUCTION TECHNOLOGY
UNIT 4: WELDING TECHNOLOGY

Content Standard	Benchmark	Topic
CS 3.4 Investigate and analyse safety procedures, print reading, measurement and layout, identify	9.3.4.1 – 9.3.4.5	
	9.3.4.1 Investigate safe workshop setup and safety procedures in welding	Workshop Organisation
	9.3.4.2 Explore and interpret welding principles, codes and standards	Welding Standards
properties of metals, the welding techniques, cutting processes according to welding codes, inspections, testing principles and apply fundamentals of fabrication.	9.3.4.3 Demonstrate knowledge in fundamental print reading, measurement and layout or fit-up techniques	Measurement Techniques
	9.3.4.4 Investigate and analyse the properties of metals	Metals
	9.3.4.5 Investigate the various welding techniques and cutting processes	Cutting and Welding

STRAND 3: CONSTRUCTION TECHNOLOGY
UNIT 5: ENGINEERING TECHNOLOGY

Content Standard	Benchmark	Topic
CS 3.5 Investigate and analyse the historical and societal influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.	9.3.5.1 – 9.3.5.7	
	9.3.5.1 Describe how history and society has influenced the engineering field and critically analyse innovations.	Historical aspects of Engineering Design Process
	9.3.5.2 Investigate the scope of engineering, roles and responsibilities of an engineer and recognise current innovations	Introduction to Engineering
	9.3.5.3 Explore and distinguish the different types of the Engineering fields.	Engineering Fields
	9.3.5.4 Explore and discuss engineering principles and practices and the appropriate materials in engineering.	Engineering Principles and practices
	9.3.5.5 Explore and analyse the general safety practices in engineering.	Occupational Health & safety
	9.3.5.6 Outline management and problem solving skills using the engineering design process.	Engineering Design Process
	9.3.5.7. Explore and utilise communication practices appropriate to engineering.	Engineering Communication

STRAND 4: COMMUNICATION TECHNOLOGY
UNIT 1: DATA COMMUNICATION AND NETWORK

Content Standard	Benchmark	Topic
CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.	9.4.1.1 Define the elements of data communication system.	Data Communication Systems
	9.4.1.2 Describe the functions of the different components of a computer network.	Computer Networks
	9.4.1.3 Define the OSI (Open Systems Interconnect) model and how it functions.	OSI Model
	9.4.1.4 Explore the use of technical terminology, basic scientific concepts, and mathematical concepts used in communications technology and apply them to the creation of media products.	Communication Technology Terminologies Basic Scientific and Mathematical Concepts in creating media products
	9.4.1.5 Explore and articulate the core concepts, techniques, and skills required to produce a range of communications media products or services.	Media Communication
	9.4.1.6 Research and apply the design brief to design, configure and manage simple network.	Design Brief-Simple Network
	9.4.1.7 Explore the Authoring Software or Multimedia associate software	Authoring Software Multimedia

STRAND 4: COMMUNICATION TECHNOLOGY
UNIT 2: COMPUTER SECURITY AND SAFETY

Content Standard	Benchmark	Topic
CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.	9.4.2.1 – 9.4.2.6	9.4.2.1 – 9.4.2.6
	9.4.2.1 Investigate and demonstrate appropriate posture in using computer equipment	Postures in Computer Equipment Usage
	9.4.2.2 Identify health hazards associated with the use of ICT and propose good ergonomic practices	Health and Safety in ICT
	9.4.2.3 Identify effects of the widespread use of computers and associated technologies on society	Effects of Computer Usage
	9.4.2.4 Evaluate the impact of past, current and emerging technologies on the Individual, society and environments.	Emerging Technological Impact
	9.4.2.5 Demonstrate an understanding of and apply safe work practices in communications technology activities	Safe Working Practices/Habits

STRAND 5: COMPUTER TECHNOLOGY
UNIT 1: COMPUTER ARCHITECTURE

Content Standard	Benchmark	Topic
CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.	9.5.1.1 Comprehend and explain the Computer System and types of computer.	Computer System
	9.5.1.2 Explore generations of computer	History of Computers
	9.5.1.3 Investigate and describe the design brief of solving problems.	Design Brief
	9.5.1.4 Identify and describe the functions of, as well as important advances related to, electronic and computer components;	Computer Electronics
	9.5.1.5 Demonstrate a basic understanding of binary numbers and digital logic	Binary
	9.5.1.6 Explore and describe hardware and software troubleshooting principles	Troubleshooting

STRAND 5: COMPUTER TECHNOLOGY
UNIT 2: COMPUTER SOFTWARE

Content Standard	Benchmark	Topic
CS 5.2 Investigate and analyse computer system and application software, programming,	9.5.2.1 Explore programming software and applications	Software Programming
	9.5.2.2 Demonstrate the understanding of Operating Systems/ Software and File Management	Operating System
algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.	9.5.2.3 Apply typing skills with speed (20wpm) and accuracy (80%)	Keyboarding
	9.5.2.4 Create documents using Microsoft Office	Microsoft Office
	9.5.2.5 Explore the Authoring Software or Multimedia associate software	Authoring Software/ Multimedia

Grade 9 Technology and Industrial Arts Topics and Lesson Titles as per Strands and Units

The strand, Units and Benchmarks are further unpacked into Topics and Lesson Titles in the Teacher Guides. These are outlined in the table below:

STRAND 1: TEXTILE TECHNOLOGY	
UNIT 1: FIBRES AND FABRICS	
Topics	Lesson Titles
Benchmarks	9.1.1.1 – 9.1.1.6
Topic 1: Impact of changes on textiles, fashion and clothing	Lesson 1: Exploring Textiles? Lesson 2: Origins of textiles, fashion and clothing Lesson 3: Factors affecting changes in textile, fashions and clothing
Topic 2: Introduction to fibres and fabrics	Lesson 1: What are fibres and fabrics? Lesson 2: Characteristics and properties of fibres and fabrics Lesson 3: From fibres to fabrics.
Topic 3: Designing and Construction	Lesson 1: Elements of design and design types. Lesson 2: Sources of fashion ideas. Lesson 3: Basic construction processes.
Topic 4: Functions and safe usage of tools and equipment	Lesson 1: Textile Construction methods tools and their functions. Lesson 2: Safety when using textile tools and equipment. Lesson 3: Care and maintenance of textile products.
Topic 5: Techniques in textile construction	Lesson 1: Textile construction methods Lesson 2: Colouring and decorating methods Lesson 3: Fabric finishes
Topic 6: Safety practices in fashion designing and construction	Lesson 1: Differentiating between textile designing and construction processes Lesson 2: Safety practices in textile.
STRAND 1: TEXTILE TECHNOLOGY	
UNIT 2: TEXTILE AND CLOTHING	
Benchmarks	9.1.2.1 – 9.1.2.6
Topic 1: Sources of Design	Lesson 1: Sources of design Lesson 2: Technological progression Lesson 3: Emerging trends
Topic 2: Fundamentals of design process	Lesson 1: Importance of design process Lesson 2: Skills in the design process Lesson 3: Various artistic version
Topic 3: Tools and techniques in project designs	Lesson 1: Fashion and types of garments Lesson 2: Transferring patterns from garment to garment Lesson 3: Patterning techniques
Topic 4: Textiles wear and care	Lesson 1: Types of tools for textile projects Lesson 2: Safe uses of special tools Lesson 3: Care for tools
Topic 5: Designing a textile project	Lesson 1: What is design process Lesson 2: Phases in Textile Project development Lesson 3: Textile Projects
Topic 6: Documenting a project portfolio	Lesson 1: People and textile industry Lesson 2: Textile technology equipment Lesson 3: Textile Project exhibit

STRAND 2: FOOD TECHNOLOGY	
UNIT 1: FOOD AND NUTRITION	
Benchmarks	9.2.1.1 – 9.2.1.7
Topic 1: Nature and properties of food	Lesson 1: Introduction to food –(Nature and sources of food) Lesson 2: Food groups and dietary guidelines Lesson 3: Properties of starch, carbohydrates, fats and oil Lesson 4: Introduction to food product development
Topic 2: Safety and hygienic practices in food product development	Lesson 1: Personal hygiene and safety practices Lesson 2: Kitchen hygiene Lesson 3: Hygiene practices and safety in food development (preparation etc.)
Topic 3: Food and nutrients	Lesson 1: Functions of nutrients and food sources Lesson 2: Eating practices Lesson 3: Meal planning
Topic 4: Food metabolism	Lesson 1: Digestion and absorption of food Lesson 2: Functions of food and nutrients in human body Lesson 3: Over nutrition and malnutrition (anorexia, bulimia, obesity, hypertension etc.)
Topic 5: Influences on food product development	Lesson 1: Food ingredients Lesson 2: Principles of cooking methods Lesson 3: Food management Lesson 4: Economic, Social and technological influences on food product development
Topic 6: Food composition and energy metabolism	Lesson 1: Food composition Lesson 2: Food labelling Lesson 3: Energy metabolism Lesson 4: Meals for special needs
Topic 7: Food product development	Lesson 1: Introduction to food product development Lesson 2: Design process Lesson 3: Design Brief Lesson 4: Sensory analysis
STRAND 2: FOOD TECHNOLOGY	
UNIT 2: FOOD SCIENCE	
Benchmarks	9.2.2.1 – 9.2.2.6
Topic 1: Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils	Lesson 1 Cooking methods in food product development Lesson 2 Physical and biological properties of cereals, vegetables and fruits Lesson 3 Physical and biological properties of fruits, legumes, fats and oils
Topic 2: Sensory characteristics of food	Lesson 1 Sensory analyses of food Lesson 2 Nutritional functions of food Lesson 3 Functional foods
Topic 3: Food management	Lesson 1 Food management Lesson 2 Trends, fashion and food Lesson 3 Seasons and food
Topic 4: Food safety and hygienic practices	Lesson 1 Food borne diseases Lesson 2 Contamination Lesson 3 First Aid
Topic 5: Factors influencing food processing and packaging	Lesson 1 Factors that influence food processing Lesson 2 The role of food packaging Lesson 3 Developments in packaging and distribution Lesson 4 Techniques to evaluate products and processes
Topic 6: The technology design	Lesson 1 Design brief and the technological process Lesson 3 Evaluate the new product Lesson 2 Using a design product to create a new product

STRAND 3: CONSTRUCTION TECHNOLOGY**UNIT 1: BUILDING TECHNOLOGY****Benchmarks****9.3.1.1 – 9.3.1.6**

Topic 1: The history and theory of buildings	Lesson 1: Introduction to Building Lesson 2: Definition of Building Lesson 3: Different Types of Building Lesson 4: Types of material used Lesson 5: Importance of building and career paths.
Topic 2: Building construction materials	Lesson 1: Define Building materials Lesson 2: Timber Building Materials Lesson 3: Bricks and Concrete materials Lesson 4: Metal and steel materials
Topic 3: Trade drawing	Lesson 1: Define trade drawing Lesson 2: Types of trade drawing Lesson 3: Isometric drawing Lesson 4: Pictorial drawing Lesson 5: Orthographic drawing Lesson 6: Types of lines use
Topic 4: The Elements Occupational Health and Safety	Lesson 1: Define occupational Health and safety Lesson 2: The regulations of OHS Lesson 3: The standards of OHS
Topic 5: Building Codes, Standards and regulations	Lesson 1: Define Building legislations and regulations Lesson 2: Types of building codes Lesson 3: Types of building regulations
Topic 6: Trade Maths	Lesson 1: Define Applied maths Lesson 2: Formulae to calculate substructure Lesson 3: Define sub-structure member (footings, post, bearers) Lesson 4: Define super-structure members (Floor joist, studs, roofing frame) Lesson 5: Types of building defect

STRAND 3: CONSTRUCTION TECHNOLOGY**UNIT 2: ELECTRICAL TECHNOLOGY****Benchmarks****9.3.2.1 – 9.3.2.7**

Topic 1: History of Electricity	Lesson 1: Electrical Energy Production & Supply Lesson 2: Modern Power Generation methods Lesson 3: Renewable and sustainable energy practices.
Topic 2: Workplace and Electrical safety	Lesson 1: Electrical Energy Production & Supply Lesson 2: Renewable and sustainable energy practices. Lesson 3: Career Pathway in Electrical Technology
Topic 3: Electrical or Electronic processes and products	Lesson 1: OHS legislation & Regulation Lesson 2: Personal Safety Lesson 3: Emergency procedures.
Topic 4: Fundamentals of electricity	Lesson 1: Electrical or Electronic processes Lesson 2: Electrical or Electronic products
Topic 5: Components and devices used on circuit diagrams	Lesson 1: Electricity Lesson 2: Conductivity Lesson 3: Conductors and Insulators
Topic 6: Circuits	Lesson 1: Electrical components & devices Lesson 2: Electrical symbols used in circuit diagrams
Topic 7: Electrical Fundamentals	Lesson 1: OHMs LAW Lesson 2: Kirchhoff's Law Lesson 3: Circuit Calculations

STRAND 3: CONSTRUCTION TECHNOLOGY**UNIT 3: PLUMBING TECHNOLOGY****Benchmarks****9.3.3.1 – 9.3.3.4****Topic 1:** Fundamental concept and relevance of plumbing trade

Lesson 1: Introduction to plumbing trade.
Lesson 2: Importance of plumbing trade.
Lesson 3: Career pathways of plumbing trade.

Topic 2: Occupational Health and Safety regulations and standard

Lesson 1: Define Occupational Health Safety regulations and standards.
Lesson 2: Types of regulations and standards.

Topic 3: Plumbing tool and equipment

Lesson 1: Define plumbing tools and equipment.
Lesson 2: Types of manual tools and equipment.
Lesson 3: Types of plumbing materials and specifications.

Topic 4: Trade Drawing

Lesson 1: Define trade drawing.
Lesson 2: Methods of Isometric drawing.
Lesson 3: Methods of Pictorial drawing.
Lesson 4: Types of lines used.

STRAND 3: CONSTRUCTION TECHNOLOGY**UNIT 4: WELDING TECHNOLOGY****Benchmarks****9.3.4.1 – 9.3.4.5****Topic 1:** Workshop Organisation

Lesson 1: Workshop Set-up
Lesson 2: Workshop safety procedures

Topic 2: Welding Standards

Lesson 1: Welding Principles
Lesson 2: Welding Codes
Lesson 3: Welding Standards

Topic 3: Measurement Techniques

Lesson 1: Measurement
Lesson 2: Print reading
Lesson 3: Layout/ fit-up Techniques

Topic 4: Metals

Lesson 1: Types of metals
Lesson 2: Metal Properties

Topic 5: Cutting and Welding

Lesson 1: Types of Welding
Lesson 2: Thermal cutting, heating and gouging
Lesson 3: Brazing
Lesson 4: Welding processes

STRAND 3: CONSTRUCTION TECHNOLOGY**UNIT 5: ENGINEERING TECHNOLOGY****Benchmarks****9.3.5.1 – 9.3.5.7****Topic 1:** Historical aspects of Engineering Design Process

Lesson 1: Engineering, past, present & Future
Lesson 2: Engineering Innovations
Lesson 3: Influence of Engineering in the society.

Topic 2: Introduction to Engineering

Lesson 1: Introduction to Engineering
Lesson 2: Scope of Engineering
Lesson 3: Roles and responsibilities of Engineers

Topic 3: Engineering Fields

Lesson 1: Types of engineering fields
Lesson 2: Specific terminologies for the different types of engineering.
Lesson 3: Processes of manufacturing materials in various engineering discipline

Topic 4: Engineering Principles and practices

Lesson 1: Engineering principles
Lesson 2: Engineering practices
Lesson 3: Engineering materials

Topic 5: Occupational Health & safety

Lesson 1: OHS legislations and regulations for Engineers
Lesson 2: Hazards & Risk Control Measures
Lesson 3: Risk Assessment & Management
Lesson 4: Basic First –Aid and CPR

Topic 6: Engineering Design Process

Lesson 1: Steps of Engineering Design
Lesson 2: Management skills
Lesson 3: Problem-solving skills

Topic 7: Engineering Communication	Lesson 1: Effective communication Lesson 2: Interpersonal and intrapersonal communication skills Lesson 3: Telephones, emails, directories Lesson 4: Report writing, Lesson 5: Memorandums Lesson 6: Incident reports
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STRAND 4: COMMUNICATION TECHNOLOGY

UNIT 1: DATA COMMUNICATION AND NETWORK

Benchmarks	9.4.1.1 – 9.4.1.7
Topic 1: Data Communication Systems	Lesson 1: Introduction to Data Communication Systems Lesson 2: Elements of Data Communication systems
Topic 2: Computer Networks	Lesson 1: Introduction to Computer Networks Lesson 2: Functions of Computer Network Components
Topic 3: OSI Model	Lesson 1: Introduction OSI Model Lesson 2: Functions of the OSI Model
Topic 4: Communication Technology Terminologies Basic Scientific and Mathematical Concepts in creating media products	Lesson 1: Communication Technology Terminologies Lesson 2: Application of Terminologies Lesson 3: Media Products.
Topic 5: Media Communication	Lesson 1: Introduction to Media Communication Lesson 2: Techniques and Skills for application purposes
Topic 6: Design Brief-Simple Network	Lesson 1: Introduction to Design Brief Lesson 2: Research and apply Design Lesson 3: Brief in simple Networking
Topic 7: Authoring Software Multimedia	Lesson 1: Introduction to Multimedia, Authoring Software Lesson 2: Categories of Authoring Software Lesson 3: Features of Multimedia, Authoring Software

STRAND 4: COMMUNICATION TECHNOLOGY

UNIT 2: COMPUTER SECURITY AND SAFETY

Benchmarks	9.4.2.1 – 9.4.2.6
Topic 1: Postures in Computer Equipment Usage	Lesson 1: Introduction to Ergonomics Lesson 2: Correct Posture or Positions Lesson 3: Case Study - Posture
Topic 2: Health and Safety in ICT	Lesson 1: Types Health Hazards associated with use of ICT Lesson 2: Good ergonomics practices to minimise Health hazards associated in ICT usage
Topic 3: Effects of Computer Usage	Lesson 1: Introduction to computer technology Lesson 2: Effects of Computer Technology Usage on society
Topic 4: Emerging Technological Impact	Lesson 1: The evolution of emerging technologies Lesson 2: Impact of emerging technologies on society and environment Lesson 3: Case-Study (Music)
Topic 5: Safe Working Practices/ Habits	Lesson 1: Introduction to Work Place Safety Lesson 2: Safe Work Practices

STRAND 5: COMPUTER TECHNOLOGY	
UNIT 1: COMPUTER ARCHITECTURE	
Benchmarks	9.5.1.1 – 9.5.1.5
Topic 1: Computer System	Lesson 1: Information-Processing- Cycle Lesson 2: Computer Hardware and Software Lesson 3: Types of Computer
Topic 2: History of Computers	Lesson 1: History of Computers Lesson 2: Generation of Computers Lesson 3: Classification of Computers
Topic 3: Design Brief	Lesson 1: Introduction to Design Brief Lesson 2: Stage Design Brief Lesson 3: Case Study of Design Brief
Topic 4: Computer Electronics	Lesson 1: Fundamentals of Computer Electronics Lesson 2: Functions of computer electronic components
Topic 5: Binary	Lesson 1: Introduction to Binary Numbers
	Lesson 2: Binary Numbers Lesson 3: Digital Logic Circuitry
Topic 6: Troubleshooting	Lesson 1: Introduction to Computer Troubleshooting Lesson Lesson 2: Troubleshooting Lesson 3: Case Study of Troubleshooting
STRAND 5: COMPUTER TECHNOLOGY	
UNIT 2: COMPUTER SOFTWARE	
Benchmarks	9.5.2.1 – 9.5.2.5
Topic 1: Software Programming	Lesson 1: Introduction to Programming. Lesson 2: Types of Programming software and applications Lesson 3: Example of Software Programs and associated programming languages
Topic 2: Operating System	Lesson 1: Introduction to Operating System Lesson 2: Categories of Operating Systems Software Lesson 3: File Management
Topic 3: Keyboarding	Lesson 1: Introduction to Keyboard Lesson 2: Keyboard Techniques Lesson 3: Hands on Typing
Topic 4: Microsoft Office	Lesson 1: Introduction to Microsoft Word Lesson 2: Introduction to Microsoft Excel Lesson 3: Introduction to Microsoft PowerPoint/Publisher
Topic 5: Authoring Software/ Multimedia	See Strand 4 , Benchmark 9.4.1.7

Step 5: Expand and plot the distributed content into the complete 16 Week 3-Part Yearly Content Overview for the grade

The strand, Units and Benchmarks are further unpacked into Topics and Lesson Titles in the Teacher Guides. Because the Teacher Guide is not available now, the Grade 9 content overview has been adopted and expanded in this facilitators and in-service guide in the absence of the Grade 9 teacher guides to help you plan a Grade 9 Technology and Industrial Art Teaching Program

- The Yearly Content Overview for the Technology and Industrial Arts is a 16 week 3-part Content Overview which is Yearly Content Overview for the Technology and Industrial Arts Subject. .
- It outlines the Strands, Units, Content Standards, Benchmarks, Topics and Lessons to be taught in 16 weeks for each part. Teachers

have the option of outlining the their Yearly Content Overview in a template that can be easily read and understood by all who will be using the Yearly Overview to derive their Termly teaching programs. (a sample template is provided below)

- In the sample below, the Strands, Units, Content Standards, Benchmarks, Topics and Lesson Titles are distributed evenly across the 16 weeks for each part that must be programmed
- A sample is given below for your convenience to help you plan for your termly program.

Grade 9 Textile And Food Technology Yearly Content Overview

Week	Textile Technology and Food Technology	Content Standard	Benchmark	Topic	Lesson Title
1	Textile Technology: Fibres and Fabrics: CS: 9.11 BMs: 9.1.1.1 and 9.1.1.2, 9.1.1.3,	CS1.1 Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.	9.1.1.1 Compare and contrast social, economic, cultural and technological changes to textiles, fashion and clothing	Impact of changes on textiles, fashion and clothing	Lesson 1: Exploring Textiles? Lesson 2: Origins of textiles, fashion and clothing Lesson 3: Factors affecting changes in textile, fashions and clothing
			9.1.1.2 Distinguish the properties and characteristics of fibres and fabrics	Introduction to fibres and fabrics	Lesson 1: What are fibres and fabrics? Lesson 2: Characteristics and properties of fibres and fabrics Lesson 3: From fibres to fabrics.
			9.1.1.3 Explore the elements of design and the design and construction of fashion ideas	Designing and Construction	Lesson 1: Elements of design and design types. Lesson 2: Sources of fashion ideas. Lesson 3: Basic construction processes
2	Textile Technology: Fibres and Fabrics: CS: 9.11 BMs: 9.1.1.4, 9.1.1.5, 9.1.1.6	CS1.1 Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.	9.1.1.4 Describe the functions of tools and equipment and their safe usage	Functions and safe usage of tools and equipment	Lesson 1: Textile Construction methods tools and their functions. Lesson 2: Safety when using textile tools and equipment. Lesson 3: Care and maintenance of textile products.
			9.1.1.5 Explore the range of textile construction techniques	Techniques in textile construction	Lesson 1: Textile construction methods Lesson 2: Colouring and decorating methods Lesson 3: Fabric finishes
			9.1.1.6 Apply appropriate safety practices in fashion design and construction	Safety practices in fashion designing and construction	Lesson 1: Differentiating between textile designing and construction processes Lesson 2: Safety practices in textile.
3	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.1, 9.1.2.2,	CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction	9.1.2.1 Describe historical influences, technological progression and emerging trends as inspirational sources of design	Sources of Design	Lesson 1: Sources of design Lesson 2: Technological progression Lesson 3: Emerging trends
			9.1.2.2. Demonstrate an awareness of the fundamentals of the	Fundamentals of design process	Lesson 1: Importance of design process Lesson 2: Skills in the design process
		for a variety of needs and occasions	design process through various artistic versions		Lesson 3: Various artistic version

4	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.3, 9.1.2.4,	CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for a variety of needs and occasions	9.1.2.3 Apply a broad range of contemporary and appropriate tools and techniques with competence and in the development of design projects	Tools and techniques in project designs	Lesson 1: Fashion and types of garments Lesson 2: Transferring patterns from garment to garment Lesson 3: Patterning techniques
			9.1.2.4 Describe how the properties of textile fibres affect textile wear and care	Textiles wear and care	Lesson Types of tools for textile projects Lesson Safe uses of special tools Lesson Care for tools
5	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.5, 9.1.2.6,	CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for a variety of needs and occasions	9.1.2.5 Apply the design process to respond to needs and opportunities in textile design projects	Designing a textile project	Lesson What is design process Lesson Phases in Textile Project development Lesson Textile Projects
			9.1.2.6 Select and use appropriate technology to creatively document, communicate and present design and project work	Documenting a project portfolio	Lesson People and textile industry Lesson Textile technology equipment Lesson Textile Project exhibit
6	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.1. 9.2.1.2	CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.1 Compare and contrast the nature and properties of food	Nature and properties of food	Lesson 1: Introduction to food –(Nature and sources of food) Lesson 2: Food groups and dietary guidelines Lesson 3: Properties of starch, carbohydrates, fats and oil Lesson 4: Introduction to food product development
			9.2.1.2 Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development	Safety and hygienic practices in food product development	Lesson 1: Personal hygiene and safety practices Lesson 2: Kitchen hygiene Lesson 3: Hygiene practices and safety in food development (preparation etc.)
7	Food Technology:	CS 2.1 Students will	9.2.1.3 Examine the nutritional	Food and nutrients	Lesson 1: Functions of nutrients and food sources

	Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.3, 9.2.1.4	be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	components of food and food development and the impact of food consumption on nutrition.		Lesson 2: Eating practices Lesson 3: Meal planning
			9.2.1.4 Explore nutrition as integral to making food choices	Food metabolism	Lesson 1: Digestion and absorption of food Lesson 2: Functions of food and nutrients in human body Lesson 3: Over nutrition and malnutrition (anorexia, bulimia, obesity, hypertension etc.)
8	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.5, 9.2.1.6,	CS 2.1 Students will be able to examine and analyse the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.5 Discuss economic, social and technological influences of food, food product and food sciences	Influences on food product development	Lesson 1: Food ingredients Lesson 2: Principles of cooking methods Lesson 3: Food management Lesson 4: Economic, Social and technological influences on food product development
			9.2.1.6 Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues	Food composition and energy metabolism	Lesson 1: Food composition Lesson 2: Food labelling Lesson 3: Energy metabolism Lesson 4: Meals for special needs
9	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.7	CS 2.1 Students will be able to examine and analyse the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment	Food product development	Lesson 1: Introduction to food product development Lesson 2: Design process Lesson 3: Design Brief Lesson 4: Sensory analysis

10	Food Technology: Food Science: CS: 9.2.2 BMs: 9.2.2.1, 9.2.2.2	CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions,	9.2.2.1 Identify and describe the cultural, physical, biological and nutritional characteristics of food that influence food development	Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils	Lesson 1 Cooking methods in food product development Lesson 2 Physical and biological properties of cereals, vegetables and fruits Lesson 3 Physical and biological properties of fruits, legumes, fats and oils
			9.2.2.2 Describe the nutritional and sensory characteristics of food to meet the needs, health and occasions.	Sensory characteristics of food	Lesson 1 Sensory analyses of food Lesson 2 Nutritional functions of food Lesson 3 Functional foods
11	Food Technology: Food Science: CS: 9.2.2 BMs: 9.2.2.3, 9.2.2.4,	CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions,	9.2.2.3 Apply management strategies in food selection, meal preparation, product development, storage and preservation	Food management	Lesson 1 Food management Lesson 2 Trends, fashion and food Lesson 3 Seasons and food
			9.2.2.4 Explore safety and hygiene practices relating to food, and changes that occur in the functional properties of food	Food safety and hygienic practices	Lesson 1 Food borne diseases Lesson 2 Contamination Lesson 3 First Aid
12	Food Technology: Food Science: CS: 9.2.1 BMs: 9.2.2.5 9.2.2.6	CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional,	9.2.2.5 Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the	Factors influencing food processing and packaging	Lesson 1 Factors that influence food processing Lesson 2 The role of food packaging Lesson 3 Developments in packaging and distribution Lesson 4 Techniques to evaluate products and processes

		biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions,	distribution of food from the point of production to consumption		
			9.2.2.6 Apply the design process to create food solutions.	The technology design	Lesson 1 Design brief and the technological process Lesson 3 Evaluate the new product Lesson 2 Using a design product to create a new product
13	Textile and Food Summative Assessment				

Grade 9 Construction Technology Yearly Content Overview

Week	Construction Technology	Content Standard	Benchmark	Topic	Lesson Title
1	Building Technology CS: 9.3.1 BMS: 9.3.1.1, 9.3.1.2, 9.3.1.3,	CS 3.1 Investigate the history and theory of buildings and analyse the components and systems of buildings, occupational health and safety procedures, the properties of building materials and the processes in which those materials and equipment are used according to industry standards.	9.3.1.1 Investigate the history and theory of buildings	The history and theory of buildings	Lesson 1: Introduction to Building Lesson 2: Definition of Building Lesson 3: Different Types of Building Lesson 4: Types of material used Lesson 5: Importance of building and career paths.
			9.3.1.2 Identify and describe a variety of construction materials, components, and processes	Building construction materials	Lesson 1: Define Building materials Lesson 2: Timber Building Materials Lesson 3: Bricks and Concrete materials Lesson 4: Metal and steel materials
			9.3.1.3 Describe the elements of drawings, and their application in technical drawings.	Trade drawing	Lesson 1: Define trade drawing Lesson 2: Types of trade drawing Lesson 3: Isometric drawing Lesson 4: Pictorial drawing Lesson 5: Orthographic drawing Lesson 6: Types of lines use
2	Building Technology CS: 9.3.1 BMs: 9.3.1.4, 9.3.1.5, 9.3.1.6,	CS 3.1 Investigate the history and theory of buildings and analyse the components and systems of buildings, occupational health and safety procedures, the properties of building materials and the processes in which those materials and equipment are used according to industry standards.	9.3.1.4 Identify and describe the elements of safety	The Elements Occupational Health and Safety	Lesson 1: Define occupational Health and safety Lesson 2: The regulations of OHS Lesson 3: The standards of OHS
			9.3.1.5 Describe the scope and purpose of building codes, and identify other regulations and standards that apply to construction projects	Building Codes, Standards and regulations	Lesson 1: Define Building legislations and regulations Lesson 2: Types of building codes Lesson 3: Types of building regulations
			9.3.1.6 Apply mathematical skills and scientific concepts in the	Trade Maths	Lesson 1: Define Applied maths Lesson 2: Formulae to calculate substructure

			planning and building of a variety of construction projects		Lesson 3: Define sub-structure member (footings, post, bearers) Lesson 4: Define super -structure members (Floor joist, studs, roofing frame) Lesson 5: Types of building defect
3	Electrical Technology CS: 9.3.2 BMs: 9.3.2.1, 9.3.2.2, 9.3.2.3,	CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship, sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	9.3.2.1 Describe the historical development of electricity	History of Electricity	Lesson 1: Electrical Energy Production & Supply Lesson 2: Modern Power Generation methods Lesson 3: Renewable and sustainable energy practices.
			9.3.2.2 Investigate and communicate OHS legislation and regulation and assess and employ emergency procedures whilst observing safety	Workplace and Electrical safety	Lesson 1: Electrical Energy Production & Supply Lesson 2: Renewable and sustainable energy practices. Lesson 3: Career Pathway in Electrical Technology
			9.3.2.3 Identify, design, develop and evaluate processes and products related to electrical technology and communicate the findings through the use of appropriate electrical and electronic terminology.	Electrical or Electronic processes and products	Lesson 1: OHS legislation & Regulation Lesson 2: Personal Safety Lesson 3: Emergency procedures.
4	Electrical Technology CS: 9.3.2 BMs: 9.3.2.4, 9.3.2.5,	CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship, sustainability and	9.3.2.4 Define electricity and conductivity and differentiate insulators from conductors	Fundamentals of electricity	Lesson 1: Electrical or Electronic processes Lesson 2: Electrical or Electronic products
			9.3.2.5 Identify symbols used and explain the functions of components and devices in electrical circuit diagrams	Components and devices used on circuit diagrams	Lesson 1: Electricity Lesson 2: Conductivity Lesson 3: Conductors and Insulators
		as a tool for change, improving the quality of life responsive to individual, community and industrial needs.			

5	Electrical Technology CS: 9.3.2 BMs: 9.3.2.6, 9.3.2.7	CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship, sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	9.3.2.6 Identify the different types of circuits and explain the parts and operation of a simple practical circuit.	Circuits	Lesson 1: Electrical components & devices Lesson 2: Electrical symbols used in circuit diagrams
			9.3.2.7 Investigate the concepts, principles and practices related to electrical	Electrical Fundamentals	Lesson 1: OHMs LAW Lesson 2: Kirchhoff's Law Lesson 3: Circuit Calculations
6	Plumbing Technology CS: 9.3.3 BMs: 9.3.3.1, 9.3.3.2	CS 3.3 Investigate and analyse fundamental concepts of plumbing and theories, OHS, Occupational Health and safety Regulations and standards ,trade drawing, demonstrations and applications of tools and materials specifications, installation of plumbing fittings and accessories in (DWV) Drain, waste, vent system, and water distribution system.	9.3.3.1 Describe and explain the fundamentals, concepts, and their relevance in the plumbing trade	Fundamental concept and relevance of plumbing trade	Lesson 1: Introduction to plumbing trade. Lesson 2: Importance of plumbing trade. Lesson 3: Career pathways of plumbing trade.
			9.3.3.2 Analyse and describe OHS Regulations and standards in the plumbing trade and work places.	Topic 2: Occupational Health and Safety regulations and standard	Lesson 1: Define Occupational Health Safety regulations and standards. Lesson 2: Types of regulations and standards.

7	Plumbing Technology CS: 9.3.3 BMs: 9.3.3.3, 9.3.3.4,	CS 3.3 Investigate and analyse fundamental concepts of plumbing and theories, OHS, Occupational Health and safety Regulations and standards ,trade drawing, demonstrations and applications of tools and materials specifications, installation of plumbing fittings and accessories in (DWV) Drain, waste, vent system, and water distribution system.	9.3.3.3 Demonstrate and apply basic plumbing tools and equipment and their specifications and practice in trade math.	Plumbing tool and equipment	Lesson 1: Define plumbing tools and equipment. Lesson 2: Types of manual tools and equipment. Lesson 3: Types of plumbing materials and specifications.
			9.3.3.4 Explore and apply basic concepts of trade drawings in plumbing.	Trade Drawing	Lesson 1: Define trade drawing. Lesson 2: Methods of Isometric drawing. Lesson 3: Methods of Pictorial drawing. Lesson4: Types of lines used.
8	Welding Technology CS: 9.3.4 BMs: 9.3.4.1, 9.3.4.2,	CS 3.4 Investigate and analyse safety procedures, print reading, measurement and layout, identify properties of metals, the welding techniques, cutting processes according to welding codes, inspections, testing principles and apply fundamentals of fabrication.	9.3.4.1 Investigate safe workshop setup and safety procedures in welding	Workshop Organisation	Lesson 1: Workshop Set-up Lesson 2: Workshop safety procedures
			9.3.4.2 Explore and interpret welding principles, codes and standards	Welding Standards	Lesson 1: Welding Principles Lesson 2: Welding Codes Lesson 3: Welding Standards
9	Welding Technology CS: 9.3.4 BMs: 9.3.4.3, 9.3.4.4, 9.3.4.5	CS 3.4 Investigate and analyse safety procedures, print reading, measurement and layout, identify properties	9.3.4.3 Demonstrate knowledge in fundamental print reading, measurement and layout or fit-up techniques	Measurement Techniques	Lesson 1: Measurement Lesson 2: Print reading Lesson 3: Layout/ fit-up Techniques

		of metals, the welding techniques, cutting processes according to welding codes, inspections, testing principles and apply fundamentals of fabrication.	9.3.4.4 Investigate and analyse the properties of metals 9.3.4.5 Investigate the various welding techniques and cutting processes	Metals Cutting and Welding	Lesson 1: Types of metals Lesson 2: Metal Properties Lesson 1: Types of Welding Lesson 2: Thermal cutting, heating and gouging Lesson 3: Brazing Lesson 4: Welding processes
10	Engineering Technology CS: 9.3.5 BMs: 9.3.5.1, 9.3.5.2,	CS 3.5 Investigate and analyse the historical and societal influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.	9.3.5.1 Describe how history and society has influenced the engineering field and critically analyse innovations.	Historical aspects of Engineering Design Process	Lesson 1: Engineering, past, present & Future Lesson 2: Engineering Innovations Lesson 3: Influence of Engineering in the society.
			9.3.5.2 Investigate the scope of engineering, roles and responsibilities of an engineer and recognise current innovations	Introduction to Engineering	Lesson 1: Introduction to Engineering Lesson 2: Scope of Engineering Lesson 3: Roles and responsibilities of Engineers
11	Engineering Technology CS: 9.3.5 BMs: 9.3.5.3, 9.3.5.4,	CS 3.5 Investigate and analyse the historical and societal influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.	9.3.5.3 Explore and distinguish the different types of the Engineering fields.	Engineering Fields	Lesson 1: Types of engineering fields Lesson 2: Specific terminologies for the different types of engineering. Lesson 3: Processes of manufacturing materials in various engineering discipline
			9.3.5.4 Explore and discuss engineering principles and practices and the appropriate materials in engineering.	Engineering Principles and practices	Lesson 1: Engineering principles Lesson 2: Engineering practices Lesson 3: Engineering materials
12	Engineering Technology CS: 9.3.5 BMs: 9.3.5.5,	CS 3.5 Investigate and analyse the historical and societal	9.3.5.5 Explore and analyse the general safety practices in engineering.	Occupational Health & safety	Lesson 1: OHS legislations and regulations for Engineers Lesson 2: Hazards &

	9.3.5.6, 9.3.5.7	influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.			Risk Control Measures Lesson 3: Risk Assessment & Management Lesson 4: Basic First –Aid and CPR
			9.3.5.6 Outline management and problem solving skills using the engineering design process.	Engineering Design Process	Lesson 1: Steps of Engineering Design Lesson 2: Management skills Lesson 3: Problem-solving skills
			9.3.5.7. Explore and utilise communication practices appropriate to engineering.	Engineering Communication	Lesson 1: Effective communication Lesson 2: Interpersonal and intrapersonal communication skills Lesson 3: Telephones, emails, directories Lesson 4: Report writing, Lesson 5: Memorandums Lesson 6: Incident reports
13	SUMMATIVE ASSESSMENT				

Grade 9 Communication And Computer Technology Yearly Content Overview

Week	Communication and Computer Technology	Content Standard	Benchmark	Topic	Lesson Title
1	Communication Technology Data Communication and Network CS: 9.4.2 BMs: 9.4.1.1, 9.4.1.2, ,	CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.	9.4.1.1 Define the elements of data communication system.	Data Communication Systems	Lesson 1: Introduction to Data Communication Systems Lesson 2: Elements of Data Communication systems
			9.4.1.2 Describe the functions of the different components of a computer network.	Computer Networks	Lesson 1: Introduction to Computer Networks Lesson 2: Functions of Computer Network Components
2	Communication Technology Data Communication and Network CS: 9.4.1 BMs: 9.4.1.3, 9.4.1.4,	CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.	9.4.1.3 Define the OSI (Open Systems Interconnect) model and how it functions.	OSI Model	Lesson 1: Introduction OSI Model Lesson 2: Functions of the OSI Model
			9.4.1.4 Explore the use of technical terminology, basic scientific concepts, and mathematical concepts used in communications technology and apply them to the creation of media products.	Communication Technology Terminologies Basic Scientific and Mathematical Concepts in creating media products	Lesson 1: Communication Technology Terminologies Lesson 2: Application of Terminologies Lesson 3: Media Products.
3	Communication Technology Data Communication and Network CS: 9.4.1 BMs: 9.1.4 .5, 9.1.4 .6, 9.1.4 .7	CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and	9.4.1.5 Explore and articulate the core concepts, techniques, and skills required to produce a	Media Communication	Lesson 1: Introduction to Media Communication Lesson 2: Techniques and Skills for application purposes

		systems in designing, installing, configuring and managing networks.	range of communications media products or services.		
			9.4.1.6 Research and apply the design brief to design, configure and manage simple network.	Design Brief-Simple Network	Lesson 1: Introduction to Design Brief Lesson 2: Research and apply Design Lesson 3: Brief in simple Networking
			9.4.1.7 Explore the Authoring Software or Multimedia associate software	Authoring Software Multimedia	Lesson 1: Introduction to Multimedia, Authoring Software Lesson 2: Categories of Authoring Software Lesson 3: Features of Multimedia, Authoring Software
4	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.1, 9.4.2.2,	CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.	9.4.2.1 Investigate and demonstrate appropriate posture in using computer equipment	Postures in Computer Equipment Usage	Lesson 1: Introduction to Ergonomics Lesson 2: Correct Posture or Positions Lesson 3: Case Study - Posture
			9.4.2.2 Identify health hazards associated with the use of ICT and propose good ergonomic practices	Health and Safety in ICT	Lesson 1: Types Health Hazards associated with use of ICT Lesson 2: Good ergonomics practices to minimise Health hazards associated in ICT usage
5	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.3, 9.4.2.4,	CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society	9.4.2.3 Identify effects of the widespread use of computers and associated technologies on society	Effects of Computer Usage	Lesson 1: Introduction to computer technology Lesson 2: Effects of Computer Technology Usage on society
			9.4.2.4 Evaluate the impact of past, current and emerging technologies on the Individual, society and environments.	Emerging Technological Impact	Lesson 1: The evolution of emerging technologies Lesson 2: Impact of emerging technologies on society and environment Lesson 3: Case-Study (Music)

6	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.5,	CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society	9.4.2.5 Demonstrate an understanding of and apply safe work practices in communication s technology activities	Safe Working Practices/Hab its	Lesson 1: Introduction to Work Place Safety Lesson 2: Safe Work Practices
7	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.5.1.1, 9.5.1.2	CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.	9.5.1.1 Comprehend and explain the Computer System and types of computer.	Computer System	Lesson 1: Information-Processing- Cycle Lesson 2: Computer Hardware and Software Lesson 3: Types of Computer
			9.5.1.2 Explore generations of computer	History of Computers	Lesson 1: History of Computers Lesson 2: Generation of Computers Lesson 3: Classification of Computers
8	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.5.1.3, 9.5.1.4	CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be	9.5.1.3 Investigate and describe the design brief of solving problems.	Design Brief	Lesson 1: Introduction to Design Brief Lesson 2: Stage Design Brief Lesson 3: Case Study of Design Brief
			9.5.1.4 Identify and describe the functions of, as well as important advances related to, electronic and computer components;	Computer Electronics	Lesson 1: Fundamentals of Computer Electronics Lesson 2: Functions of computer electronic components
		aware of related environmental and societal issues.			

9	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.5.1.5, 9.5.1.6	CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.	9.5.1.5 Demonstrate a basic understanding of binary numbers and digital logic	Binary	Lesson 1: Introduction to Binary Numbers Lesson 2: Binary Numbers Lesson 3: Digital Logic Circuitry
			9.5.1.6 Explore and describe hardware and software troubleshooting principles	Troubleshooting	Lesson 1: Introduction to Computer Troubleshooting Lesson Lesson 2: Troubleshooting Lesson 3: Case Study of Troubleshooting
10	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.1, 9.5.2.2	CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.	9.5.2.1 Explore programming software and applications	Software Programming	Lesson 1: Introduction to Programming. Lesson 2: Types of Programming software and applications Lesson 3: Example of Software Programs and associated programming languages
			9.5.2.2 Demonstrate the understanding of Operating Systems/ Software and File Management	Operating System	Lesson 1: Introduction to Operating System Lesson 2: Categories of Operating Systems Software Lesson 3: File Management
11	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.3, 9.5.2.4	CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.	9.5.2.3 Apply typing skills with speed (20wpm) and accuracy (80%)	Keyboarding	
			9.5.2.4 Create documents using Microsoft Office	Microsoft Office	Lesson 1: Introduction to Keyboard Lesson 2: Keyboard Techniques Lesson 3: Hands on Typing

12	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.5,	CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.	9.5.2.5 Explore the Authoring Software or Multimedia associate software	Authoring Software/ Multimedia	Lesson 1: Introduction to Microsoft Word Lesson 2: Introduction to Microsoft Excel Lesson 3: Introduction to Microsoft PowerPoint/Publisher
13	SUMMATIVE ASSESSMENT				

Step 6: Develop the Termly Programs

- Extract the terms content from the Yearly Overview to expand the content into the termly teaching program.
- Note that the TIA program is developed in 3-parts and 1 of the 3 parts is the program to be used all year around for the different lots of students rotating to take all 5 strands of TIA. Below is a proposed Template to develop a Teaching Program for a Term.(13 weeks)

Subject: _____ **Grade** _____ **Term:** _____ **Year:** _____

Week	Content Standards	Benchmark	Unit	Topic	Learning Objective	Knowledge	Skill	Attitude/ Values	Performance Standard
Write the week number	Write the Coding only	Write the Coding only	Write the Unit number and Name	Write the Topic number and Name	By the end of this Topic, Students will be able to: Write the learning Objectives for the Topic	Write the essential knowledge to be learnt in this topic	Write the essential skill to be learnt in this topic	Write the essential attitude and values to be learnt in this topic	By the end of this Topic, students will be able to; Write the Performance Standard (if the Benchmark carries one)

Note: A Performance Standard will only be included if the Benchmark has been nominated to carry a Performance Standard (Assessment). Otherwise, it is not very necessary for all Benchmarks to have a Performance Standard.

Step 7: Develop the Weekly Teaching Program (Proposed Template) and Daily Lesson Plan (SBC Template)

Template 1: Using Topics to develop Weekly Teaching Program

- You can use the Topics to develop the weekly teaching program
- Below is a proposed Template to develop a Teaching Program for a week

Subject: _____ Grade _____ Term: _____ Week: _____ Date: _____ Year: _____

Week	Content Standards	Benchmark	Unit	Topic	Learning Objective	Knowledge	Skill	Attitude/Values	Performance Standard
Write the week number	Write the Coding only	Write the Coding only	Write the Unit number and Name	Write the Topic number and Name	By the end of this Topic, Students will be able to: Write the learning Objectives for the Topic	Write the essential knowledge to be learnt in this topic	Write the essential skill to be learnt in this topic	Write the essential attitude and values to be learnt in this topic	By the end of this Topic, students will be able to; Write the Performance Standard (if the Benchmark carries one)

Template 2: Using Lesson Titles to develop Weekly Teaching Program

- Use the unpacking process to derive lesson titles and lesson objectives to be able to expand your weekly teaching program.
- Below is a proposed Template to develop a Teaching Program for a week

Subject: _____ Grade _____ Term: _____ Week: _____ Date: _____ Year: _____

Week	Content Standards	Benchmark	Unit	Topic	Learning Objective	Knowledge	Skill	Attitude/Values	Lesson Number and Titles	Lesson Objectives	Suggested Learning Activities
Write the week number	Write the Coding only	Write the Coding only	Write the Unit number and Name	Write the Topic number and Name	By the end of this Topic, Students will be able to: Write the learning Objectives for the Topic	Write the essential knowledge to be learnt in this topic	Write the essential skill to be learnt in this topic	Write the essential attitude and values to be learnt in this topic	Lesson 1:	L1 Objectives	
									Lesson 2:	L2 Objectives	
									Lesson 3: Etc.	L3 Objectives	

Timetabling of Technology and Industrial Arts

The teaching and learning of TIA can be organised in the manner of class rotational basis. There are three teachers who will be teaching the subject TIA.

- 1: The Home Economics Teacher,
- 2: The Practical Skills Teacher, and
- 3: The Maths/Science/Computing Teacher.

These three teachers will be timetabled to teach TIA during the term. Then the planning and programming will be organized in this same manner only each strand teacher will extract the strand program for teaching as these are subject specific content. This is to ensure that teachers are on contact throughout the terms and to maintain their teaching loads.

Sample 1st Rotational Program for the First 13 Weeks (Term1 Week 1-10 and Term 2 Week 1-2)

Class	Strand	Content Teacher	These classes can be rotated so they all cover all the strands of TIA
Class 1 and 2	Food and Textile Technology	Home Economics Teacher	
Class 3 and 4	Construction Technology	Practical Skills Teacher	
Class 5 and 6	Communication and Computer Technology	Computing ICT Teacher	

Sample 2nd Rotational Program for the Next 13 Weeks (Term 2 Week 4 – Term 3 Week 6)

Class	Strand	Content Teacher	These classes can be rotated so they all cover all the strands of TIA
Class 1 and 2	Construction Technology	Practical Skills	
Class 3 and 4	Communication and Computer Technology	Computing ICT Teacher	
Class 5 and 6	Food and Textile Technology	Home Economics Teacher	

Sample 3rd Rotational Program for the Next 13 Weeks (Term 3 Week 7 – Term 4 Week 9)

Class	Strand	Content Teacher	These classes can be rotated so they all cover all the strands of TIA
Class 1 and 2	Communication and Computer Technology Food and Textile Technology	Home Economics	
Class 3 and 4	Food and Textile Technology	Home Economics Teacher	
Class 5 and 6	Construction Technology	Practical Skills	

Step 8: Review, Evaluate and Re-plan the yearly, termly, weekly Programs.

This Process MUST BE DONE COLLABORATIVELY BY ALL WHO TEACH THE SUBJECT.

IT MUST BE DONE PROGRESSIVELY

Recording, Monitoring and Evaluation

Recording and Reporting

Recording and reporting are integral to assessment for students from grades 9 to 12. Therefore, it is commended that reporting and recording of students' achievements for Business and Technology Subjects must be done by grade levels in school based assessment or also referred to as internal school assessment.

The marks awarded to students in their internal assessment will be a combination of the internal assessment mark and the examination mark. Internal assessment provides a measure of student's achievements based on a wider range of syllabus content and benchmarks than maybe covered by the external examination. Business and Technology subjects provide a summation of each student's achievement in Grades 9-12. The internal assessment mark must comply with the types of tasks and assessment rubrics specified in the holistic or analytic rubrics. The external examination provides a measure of student achievement of those aspects of the content standards that can be reliably measured in an examination setting.

Recording

It is required that schools maintain and submit student assessment records according to the school based assessment policy. Teachers can record the evidence of students' demonstrations' of achieving the content standards and benchmarks using assessment instruments that are manageable. Here are some recommended recording methods;

- Individual or class checklists or class grid to record observations
- Comments on students work indicating what they have done well and where they need to improve
- Work samples being added to a portfolio
- Test marks
- Students assessments of their own performances using rubrics or assessment criteria and
- Students assessment of their peers using the assessment criteria

Students are given constructive feedback by the teacher on what they can do well and what they need to improve on. Likewise, teachers are focused on the content they are assessing and are able to apply fair, precise and consistent judgment.

Reporting

Teachers are obliged to report on what students have done or how well they have performed and how they improve further. Formal reporting through written reports and interviews are done to inform parents and guardians of the students learning progress and other related areas such as behavior. Teachers must ensure that the student has demonstrated and achieved the standards independently on a number of occasions.

These can be done formally or informally. The achievements are reported to respected stakeholders in relation to;

- Weaknesses in the learner
- Strengths in the learner
- Parent and guardian support and
- Evaluation

Certification

Certifying of students must be done through an awarding system which will determine the level of achievement. This will be in a form of achievement statements suggested below;

Levels of achievement

1. Very high achievement
2. High achievement
3. Satisfactory achievement
4. Low achievement
5. Below requirement level

All teachers responsible for grades 9-12 must consider school based assessment levels of achievements to be affected across all Business and technology Subjects.

Monitoring and Evaluation

Standards based reporting is and about student understanding and mastering a learning standard and less about grades. A standards based report card can list the most important skills students should learn in each subject at a particular grade level. Instead of letter grades, students receive marks or a code that show how well they have mastered the skills. The marks or codes that schools use to represent student progress are;

- A - Advanced
- B - Proficient
- C - Progressing
- D - Novice

The learning standards are basically the learning standards and expectations for each grade level. SBC requires a new way of recording and reporting to measure progress. Reporting progress is based on the teaching and learning strategies for performance based learning which are accurately assessing the performance towards mastery. The teaching model is changing therefore the performance measurements of Standards-Based Reporting will be more reflective of learning in the classroom. Hence, SBA lets students know against which criteria they will judge their work, and the standards attached to each of the criteria. It tells students what is required and allows teachers to gain a sense of how students are doing overall based on their achievement of the standards and promotes mastery learning.

Students Are Provided with Appropriate Feedback that Will Improve their Skills

In a standards-based learning approach, teachers are expected to provide their students with quality feedback that will improve student learning. As opposed to the traditional grading system that only provides students with a single numerical or letter grade, the standards-based grading system requires teachers to provide their students with meaningful and appropriate feedback that will accelerate mastery of learning standards. It is believed that standards-based grading allowed students to identify their areas of growth and to improve on their own competencies.

Teachers need to communicate with their students what each proficiency score means and should be explained to the students' parents what each score means and how they can help their children demonstrate mastery of learning standards expected of them for the subject.

Students Can Track their Progress

In a standards-based grading approach, students understand the meaning of each score that they receive. Because there are rubrics that explain the meaning of each proficiency score, students can easily monitor which standards need to be improved further and which learning standards have already been met. As such, students begin to monitor their progress and become accountable for their learning goals.

Interventions and Monitoring

Underachievement is poorer than expected performance. Students who consistently display performance demonstrative of underachievement are identified and interventions for regress are planned to promote learning. Such interventions should be planned not as a general aspect but should address individual students' limitations in learning and should encourage learning.

Monitoring of Students Learning

Monitoring of students learning is done through strategies that teacher devise to track their teaching and students achievement. This is through the assessment program, classroom teaching, and performance in performance-based learning and students self-assessment in achieving the learning standards.

Re-planning

Re-planning of teaching programs and lesson planning are addressed apart from the planning and programming for all other students. This is specifically addressing underachievers. Re-planning includes teaching and learning strategies, resources, remedial activities which can be planned into the normal teaching times instead of creating extra times after classes.

Standards-Based Lesson Planning

What are Standards-Based Lessons?

In a Standards-Based Lesson, the most important or key distinction is that, a student is expected to meet a defined standard for proficiency. When planning a lesson, the teacher ensures that the content and the methods of teaching the content enable students to learn both the skills and the concepts defined in the standard for that grade level and to demonstrate evidence of their learning.

Planning lessons that are built on standards and creating aligned assessments that measure student progress towards standards is the first step teacher must take to help their students reach success. A lesson plan is a step-by-step guide that provides a structure for an essential learning.

When planning a standards-based lesson, teacher instructions are very crucial for your lessons. How teachers instruct the students is what really points out an innovative teacher to an ordinary teacher. Teacher must engage and prepare motivating instructional activities that will provide the students with opportunities to demonstrate the benchmarks. For instance, teacher should at least identify 3-5 teaching strategies in a lesson; teacher lectures, ask questions, put students into groups for discussion and role play what was discussed.

Why is Standards-Based Lesson Planning Important?

There are many important benefits of having a clear and organised set of lesson plans. Good planning allows for more effective teaching and learning. The lesson plan is a guide and map for organising the materials and the teacher for the purpose of helping the students achieve the standards. Lesson plans also provide a record that allows good, reflective teachers to go back, analyze their own teaching (what went well, what didn't), and then improve on it in the future.

Standards-based lesson planning is vital because the content standards and benchmarks must be comparable, rigorous, and measurable and of course evidence based and be applicable in real life that we expect students to achieve. Therefore, teachers must plan effective lessons to teach students to meet these standards. As schools implement new standards, there will be much more evidence that teachers will use to support student learning to help them reach the highest levels of cognitive complexity. That is, students will be developing high-level cognitive skills.

Components of a Standards-Based Lesson Plan

An effective lesson plan has three basic components;

- aims and objectives of the course;
- teaching and learning activities;
- assessments to check student understanding of the topic.

Effective teaching demonstrates deep subject knowledge, including key concepts, current and relevant research, methodologies, tools and techniques, and meaningful applications.

Planning for under-achievers

Who are underachieving students?

Under achievers are students who fail or do not perform as expected. Underachievement may be caused by emotions (low self-esteem) and the environment (cultural influences, unsupportive family)

How can we help underachievement?

Underachievement varies between students. Not all students are in the same category of underachievement.

Given below is a suggested strategies teachers may adopt to assist underachievers in the classroom.

- Examine the Problem Individually
It is important that underachieving students are addressed individually by focusing on the student's strengths.
- Create a Teacher-Parent Collaboration
Teachers and parents need to work together and pool their information and experience regarding the child. Teachers and parents begin by asking questions such as;
 - In what areas has the child shown exceptional ability?
 - What is the child's preferred learning styles?
 - What insights do parents and teachers have about the child's strengths and problem areas?
- Help student to plan every activity in the classroom
- Help students set realistic expectations
- Encourage and promote the student's interests and passions.
- Help children set short and long-term academic goals
- Talk with them about possible goals.
- Ensure that all students are challenged (but not frustrated) by classroom activities
- Always reinforce students

Standards-Based Lesson Planning

To help teachers plan effective lessons, there are sample lessons from the five strands provided. Teachers are encouraged to study the layout of the different components of these lessons and follow this design in their preparation and teaching of each lesson. Planning a good lesson helps the teacher in maintaining a standard teaching pattern and does not let the class deviate from the topic.

Sample of Standards-Based Lesson Planning

The following sample lesson can help teachers to plan effective lessons. Teachers are encouraged to study the layout of the different components of these lessons and follow this design in their preparation and teaching of each lesson. Planning a good lesson helps the teacher in maintaining a standard teaching pattern which should not deviate students' learning of the concept from the topic.

Sample Lesson Plan

UNIT 1. Data Communication and Network

Topic 1: Computer System

Content Standard: Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.

Benchmark 10.5.1.1: Construct and test simple interfaces and other electronic circuits;

Lesson 1: Building Simple Electronics Circuitry

Lesson Objective: By the end of the lesson, students will be able to;

- Explain the components of a circuit and the purpose of each component.
- Use the different components of a circuit to make a circuit.

Teaching Strategies

1. Use Spiral Teaching to connect Digital Analog Circuit when introducing the lesson.
2. Ask students to make a model of a simple electronic circuit.
3. Ask them to explain terms that are related to electronic circuit.

Learning Strategies

Activity 1: Demonstrate understanding on Digital Analog Circuit and Electronic Circuit.

Activity 2: Make a model of a simple electronic circuit.

Activity 3: Identify and explain terms that are related to electronic circuits.

Resources:

<https://www.electronicshub.org/basic-electrical-circuits-componentstypes/>

Lesson Procedures:

Teacher (Outline of teaching Strategies)	Students (Outline of learning strategies)
Lesson Introduction	
1. Engaged and ask students the following: ✓ What is the difference between Analogue Circuit and Digital Circuit?	1. Write down their answers to the questions. 2. Share their answer with their friends
Lesson Body	
1. Model ✓ Teacher gives brief history on the invention of computers.	1. Model • Listen and note the difference and similarities of Analogue and Digital circuits.
2. Guided Practice ✓ Teacher divide students into small groups for discussions ✓ Teacher provide notes or website for students to read about the electric circuits. ✓ Teacher ask students to draw a electric circuit.	2. Guided Practice • In small groups gathered and summaries given/ researched notes • Identify and list components of electric circuits. • Draw an electric circuit
3. Independent Practice ✓ Ask students to collect materials in groups ✓ Allow them at their own time to assemble a basic circuit with one battery, two wires and a bulb (optional: switch). ✓ Ask students to make prediction and write their prediction. ✓ Allow students to present their work in the next class.	3. Independent Practice • Students to collect materials in groups • At their own time assemble a basic circuit with one battery, two wires and a bulb (optional: switch). • Write their prediction. • Prepare to present their work in the next class.
Lesson Conclusion	
Pose Reflection questions: ✓ What are the components of an electric circuit? ✓ Explain with diagram	• Name the components of an electric circuit and Show in diagram how the components are connected.
Formative Assessment	
Area of Assessment	Tick off ✓ or put ✕
• List components of electric circuit	
• Draw an electric circuit	
• Explain the function of each components	

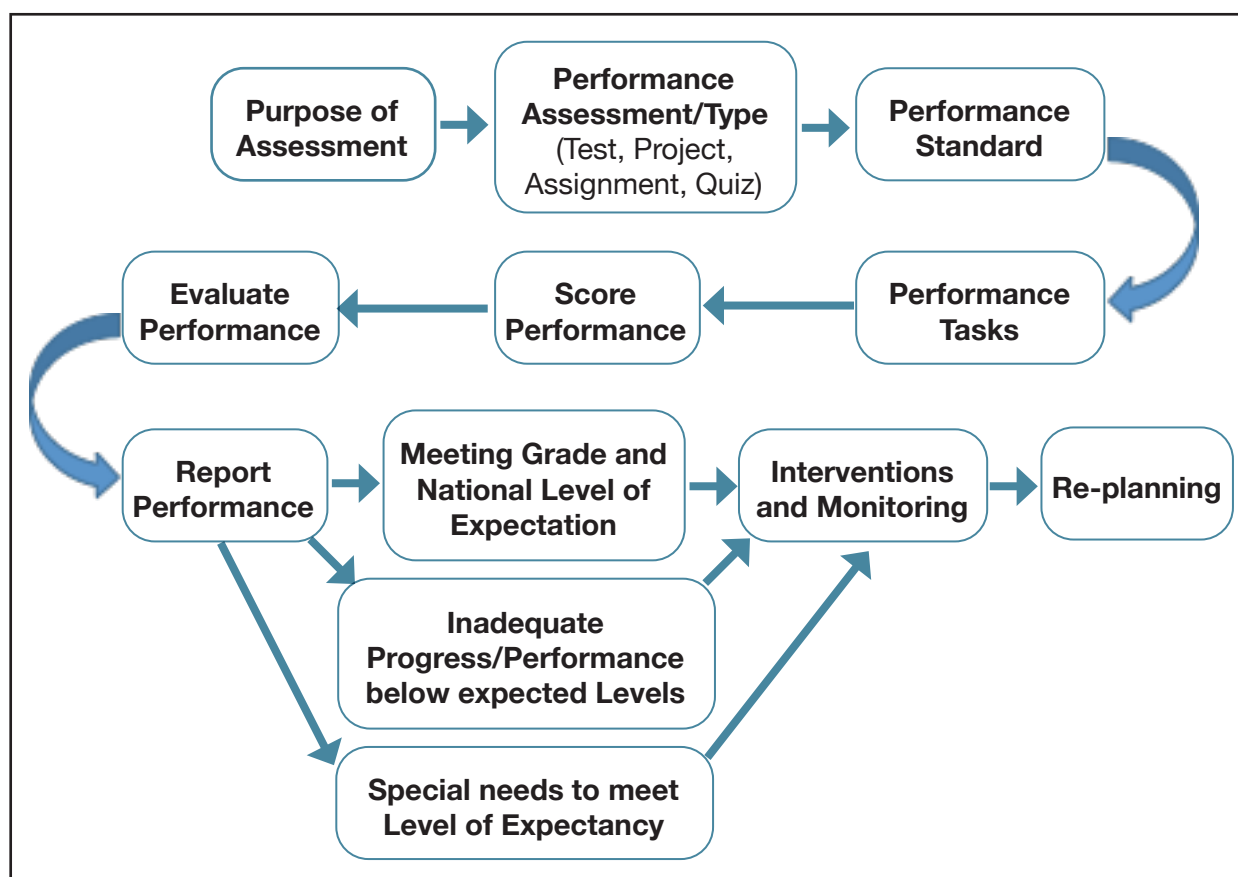
Assessment, Monitoring And Reporting

What is Standards-Based Assessment (SBA)?

Standards-Based Assessment is an on-going and a systematic process of assessing, evaluating, reporting and monitoring students' performance and progression towards meeting grade and national level expectations. It is the measurement of students' proficiency on a learning objective of a content standard and progression towards the attainment of that content standard and benchmark.

Standards-Based Assessment Cycle

The Standards-Based Assessment Cycle begins with the purpose to assess learning. Teachers must always clearly define the purpose and expectations of the assessment tasks or activities before starting the assessment. The cycle consist the delivery of the assessment, scoring of performance, monitoring or learning, evaluating learning and performance, reporting of achievement and underachievement, developing interventions for underachievers and advance learners and replanning assessment as demonstrated below;



Purpose of Standards-Based Assessment

Standards-Based Assessment (SBA) serves different purposes. These include instruction and learning purposes. The primary purpose of SBA is to improve student learning so that all students can attain the expected level of proficiency or quality of learning.

Enabling purposes of SBA is to:

- measure students' proficiency on well-defined content standards, benchmarks and learning objectives
- ascertain students' attainment or progress towards the attainment of specific component of a content standard
- ascertain what each student knows and can do and what each student needs to learn to reach the expected level of proficiency
- enable teachers to make informed decisions and plans about how and what they would do to assist weak students to make adequate progress towards meeting the expected level of proficiency
- enable students to know what they can do and help them to develop and implement strategies to improve their learning and proficiency level
- communicate to parents, guardians, and relevant stakeholders the performance and progress towards the attainment of content standards or its components
- compare students' performances and the performances of other students

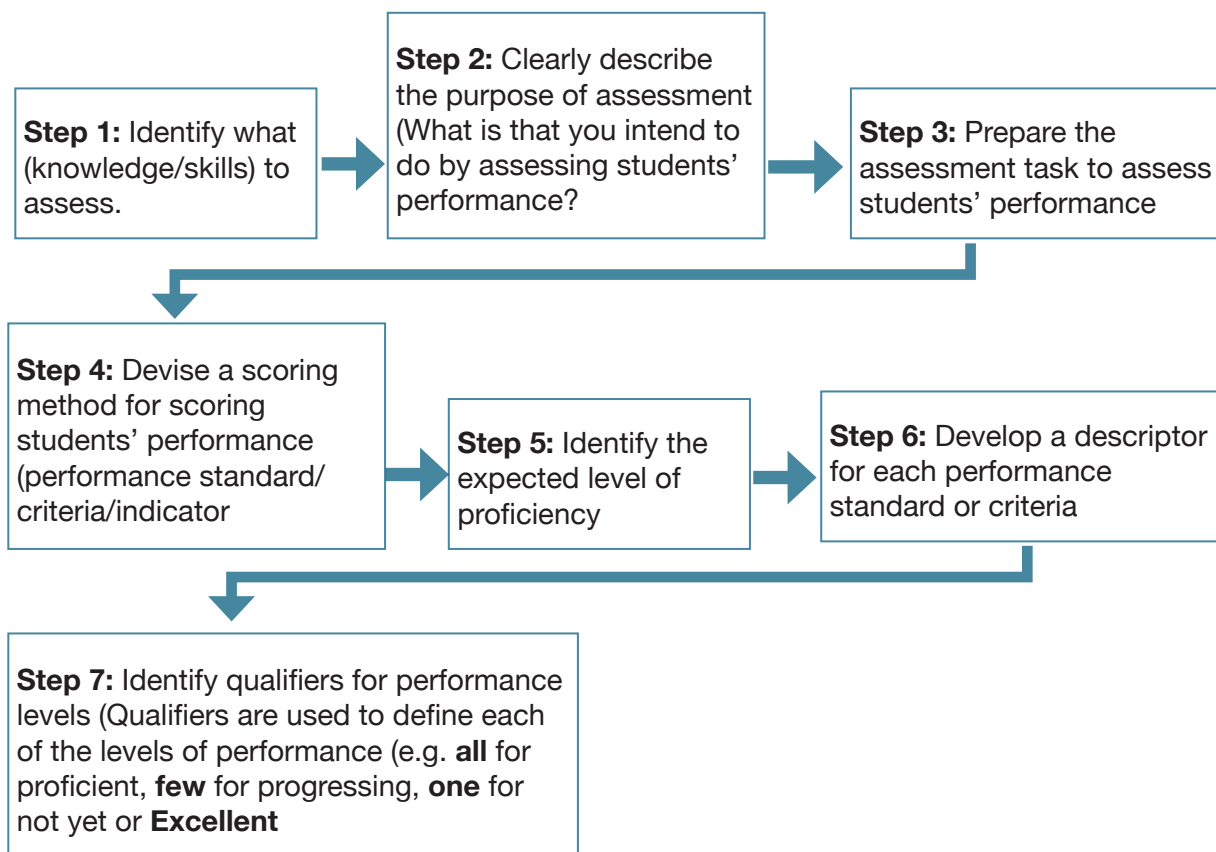
Principles of Standards-Based Assessment

The principle of SBA is for assessment to be;

- emphasizing on tasks that should encourage deeper learning
- be an integral component of a course, unit or topic and not something to add on afterwards
- a good assessment requires clarity of purpose, goals, standards and criteria
- of practices that should use a range of measures allowing students to demonstrate what they know and can do
- based on an understanding of how students learn
- of practices that promote deeper understanding of learning processes by developing students' capacity for self-assessment
- improving performance that involves feedback and reflection
- on-going rather than episodic
- given the required attention to outcomes and processes
- be closely aligned and linked to learning objectives, benchmarks and content standards

Standards-Based Assessment Process

Teachers are required to use the steps outlined below when planning assessment. These steps will guide you to develop effective assessments to improve student's learning as well as evaluating their progress towards meeting national and grade –level expectations.



Authentic Assessment

Authentic Assessments in Standards-based (SBA) Assessment directly measure student's performance through "real life tasks" or "situations" that resemble "real life situations." Authentic assessment;

- Is performed in a real life context that approximates as much as possible, the use of a skill or concept in the real world.
- Is based on the development of a meaningful product, performance or process
- Students develop and demonstrate the application of their knowledge, skills, values and attitudes in real life situations which promote and support the development of deeper levels of understanding.
- Is mostly associated with assessment as or while learning and assessment for learning but occasionally or contextually in summative learning.
- includes assessment activities such as demonstrations, debates, field work, simulations, problem solving, project-based learning, Poster Presentations, Research, Laboratory work, Reflections, Problem-based activities, Role Play, Report/Essay, Field experience, Field report, Recounts etc.

Advantages of Authentic Activities

- Empower students to take ownership in their learning
- Appreciates Learning experience
- enables and encourages the Learning experiences to be used as a basis of learning
- Meaningful, relevant, practical
- Assess the actual learning experience which means; you do not need to “teach” and then assess, rather you assess actual learning experience while it is actually happening

Authentic Assessment Criteria

In SBA, teachers are encouraged to step out of their traditional assessment and explore authentic assessment. The criteria in authentic assessment;

- Looks at students actively engaged in completing a task that represents the achievement of a learning objective or standard
- Takes place in real life situations
- Asks students to apply their knowledge, skills, values and attitudes in real life situations
- Students are given the criteria against which they are being assessed

A Comparison of Authentic and Traditional Assessment

Authentic Assessments	Traditional Assessments
• Portfolios, demonstrations, field work, case studies, assignments, lab reports • Students take an active role in process • Qualitative • Interpretive • Focuses on performance, process and product • High level thinking • Use of rubric • Use of criterion levels evaluation • Part of teaching and learning Process • Shows mastery and learning performance • Generally extends over time•	• Multiple choice tests, true-false, fill in the blanks, sentence completion, matching, diagram completions • External – (teacher driven – assessing performance of teacher rather than the student) • Teacher-centered (what is appropriate and convenient for the teacher and what teacher thinks is good for students and decides what should be and should not be learnt) • Quantitative (driven to collect marks) • Objective • End product (only looking for the end product and not concerned about the performance and process) • Standardized or norm referenced • Isolated facts • Low level content • Generally occurs in “one setting

Standards-Based Assessment Types

In SBA, there are three broad assessments types.

1. Formative Assessment

Formative assessment includes ‘assessment for and as’ and is conducted during the teaching and learning of activities of a topic.

Purposes of assessment for Learning

- On-going assessment that allows teachers to monitor students on a day-to-day basis.

- Provide continuous feedback and evidence to the teachers that should enable them to identify gaps and issues with their teaching, and improve their classroom teaching practice.
- Helps students to continuously evaluate, reflect on, and improve their learning

Purposes of assessment as Learning

- Occurs when students reflect on and monitor their progress to inform their future learning goals
- Helps students to continuously evaluate, reflect, and improve their own learning
- Helps students to understand the purpose of their learning and clarify learning goals

2. Summative Assessment

Summative assessment focuses on ‘assessment of learning’ and is conducted after or at the conclusion of teaching and learning of activities or a topic.

Purposes of assessment of Learning

- Help teachers to determine what each student has achieved and how much progress he/she has made towards meeting national and grade-level expectations
- Help teachers to determine what each student has achieved at the end of a learning sequence or a unit.
- Enable teachers to ascertain each student’s development against the unit or topic objectives and to set future directions for learning.
- Help students to evaluate, reflect on, and prepare for next stage of learning

3. Performance Assessment

Performance assessment is a form of testing that requires students to perform a task rather than select an answer from a ready-made list. For example, a student may be asked to explain historical events, generate scientific hypotheses, solve math problems, converse in a foreign language, or conduct research on an assigned topic. Teachers, then judge the quality of the student's work based on an agreed-upon set of criteria. It is an assessment which requires students to demonstrate that they have mastered specific skills and competencies by performing or producing something.

Types of performance assessment;

i. Products-Oriented

This refers to concrete tangible items that students create through either the visual, written or auditory media such as;

- Creating a health/physical activity poster
- Video a class game or performance and write a broadcast commentary
- Write a speech to be given at a school council meeting advocating for increased time for health and physical education in the curriculum

- Write the skill cues for a series of skill photo's
- Create a brochure to be handed out to parents during education week
- Develop an interview for a favourite sportsperson
- Write a review of a dance performance
- Essays
- Projects

ii. Performances-Oriented

It deals with observable affective or psycho-motor behaviours put into action such as;

- Skills check during game play
- Role plays
- Officiating a game
- Debates
- Performing dance/gymnastics routines
- Teaching a skill/game/dance to peers

Performance Standards

Performance standards are measurement standards that are observed through evidence outcomes and performance indicators. Evidence outcomes and Performance Indicators are used to measure students' performances, proficiency, competency, progression and achievement of the desired grade or level of expectation.

Performance Standards are concrete statements of how well students must learn what is set out in the content standards and benchmarks, often called the "be able to do" or "what students should know and be able to do." Performance standards indicate the quality that specifies how competent a students' demonstration or performance must be. They include explanations of how well students must demonstrate the content, explaining "how good is good enough."

Performance standards:

- measure students' performance and proficiency (using performance indicators) in the use of a specific knowledge, skill, value, or attitude in real life or related situations
- provide the basis (performance indicators) for evaluating, reporting and monitoring students' level of proficiency in use of a specific knowledge, skills, value, or attitude
- are used to plan for individual instruction to help students not yet meeting expectations (desired level of mastery and proficiency) to make adequate progress towards the full attainment of benchmarks and content standards
- are used as the basis for measuring students' progress towards meeting grade-level benchmarks and content standards
- A stem statement for Performance Standards will begin with...
"Students will be able to....."
- A stem statement for Performance Indicator will begin with
"Students can be able to....."

Assessment Strategies is important for teachers to know that, assessment is administered in different ways. Assessment does not mean a test only. There are many different ways to find out about student's strengths and weaknesses. Relying on only one method of assessing will not reflect student's achievement.

Provided in the appendices is a list of suggested strategies you can use to assess student's performances. These strategies are applicable in all the standards-based assessment types.

Action Verbs to Assessment Strategies		
Cognitive Learning	Action Verbs	Assessment Strategies
Knowledge - to recall or remember facts without necessarily understanding them	Arrange, define, duplicate, label, memorise, name, order, recognise, relate, recall, reproduce, list, tell, describe, identify, show, label, collect, examine, tabulate, quote	• Prior knowledge inventory, misconception/preconception check • Focused listing, empty outlines • Pre-post test, quiz, quick poll
Comprehension – to understand and interpret learned information	Classify, describe, discuss, explain, express, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend, translate, review, restate, locate, recognise, report	• Minute paper, muddiest (or clearest) point • Observe and evaluate a student artifact or performance task using a rubric • Directed paraphrasing • Pre-post test, quiz • Interviews
Application – to put ideas and concepts to work in solving problems	Apply, choose, demonstrate, dramatise, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, calculate, complete, show, examine, modify, relate, change, experiment, discover	• Observe and evaluate a student artifact, performance, or task using a rubric • Directed paraphrasing, real-world application (apply learning in a new context) • Test, quiz • Job/internship evaluation, skill ratings
Analysis – to break information into its components to see interrelationships and ideas	Analyse, appraise, calculate, categorise, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test, separate, order, connect, classify, arrange, divide, infer	• Pro and con grid, categorising grid, compare and contrast, concept maps • Observe and evaluate a student artifact, performance, or task using a rubric • Journaling • Job/internship evaluation, skill ratings
Evaluation – to judge the value of information based on established criteria	Appraise, argue, assess, attach, defend, judge, predict, rate, support, evaluate, recommend, convince, judge, conclude, compare, summarise	• Reflection component of a portfolio or experience • Journaling • Peer evaluation
Affective Learning	appreciate, accept, attempt, challenge, defend, dispute, join, judge, praise, question, share, support	• Reflection component of a portfolio or experience • Journaling • Observe and evaluate group work • Surveys, interviews, focus groups

Assessment Strategies

Strategy	Description
Analogies	Students create an analogy between something they are familiar with and the new information they have learned. When asking students to explain the analogy, it will show the depth of their understanding of a topic.
Classroom Presentations	A classroom presentation is an assessment strategy that requires students to verbalize their knowledge, select and present samples of finished work, and organize their thoughts about a topic in order to present a summary of their learning. It may provide the basis for assessment upon completion of a student's project or essay.
Conferences	A conference is a formal or informal meeting between the teacher and a student for the purpose of exchanging information or sharing ideas. A conference might be held to explore the student's thinking and suggest next steps; assess the student's level of understanding of a particular concept or procedure; and review, clarify, and extend what the student has already completed
Discussions	Having a class discussion on a unit of study provides teachers with valuable information about what the students know about the subject. Focus the discussions on higher level thinking skills and allow students to reflect their learning before the discussion commences.
Essays	An essay is a writing sample in which a student constructs a response to a question, topic, or brief statement, and supplies supporting details or arguments. The essay allows the teacher to assess the student's understanding and/or ability to analyse and synthesize information.
Exhibitions/ Demonstrations	An exhibition/demonstration is a performance in a public setting, during which a student explains and applies a process, procedure, etc., in concrete ways to show individual achievement of specific skills and knowledge.
Interviews	An interview is a face-to-face conversation in which teacher and student use inquiry to share their knowledge and understanding of a topic or problem, and can be used by the teacher to explore the student's thinking; assess the student's level of understanding of a concept or procedure and gather information, obtain clarification, determine positions, and probe for motivations.
Learning Logs	A learning log is an ongoing, visible record kept by a student and recording what he or she is doing or thinking while working on a particular task or assignment. It can be used to assess student progress and growth over time.
Observation	Observation is a process of systematically viewing and recording students while they work, for the purpose of making programming and instruction decisions. Observation can take place at any time and in any setting. It provides information on students' strengths and weaknesses, learning styles, interests, and attitudes.
Peer Assessment	Assessment by peers is a powerful way to gather information about students and their understanding. Students can use set criteria to assess the work of their classmates.
Performance Tasks	During a performance task, students create, produce, perform, or present works on "real world" issues. The performance task may be used to assess a skill or proficiency, and provides useful information on the process as well as the product.
Portfolios	A portfolio is a collection of samples of a student's work, and is focused, selective, reflective, and collaborative. It offers a visual demonstration of a student's achievement, capabilities, strengths, weaknesses, knowledge, and specific skills, over time and in a variety of contexts.
Questions And Answers (Oral)	In the question-and-answer strategy, the teacher poses a question and the student answers verbally, rather than in writing. This strategy helps the teacher to determine whether students understand what is being, or has been, presented, and helps students to extend their thinking, generate ideas, or solve problems.
Quizzes, Tests, Examinations	A quiz, test, or examination requires students to respond to prompts in order to demonstrate their knowledge (orally or in writing) or their skills (e.g., through performance). Quizzes are usually short; examinations are usually longer. Quizzes, tests, or examinations can be adapted for exceptional students and for re-teaching and retesting.

Questionnaires	Questionnaires can be used for a variety of purposes. When used as a formative assessment strategy, they provide teachers with information on student learning that they can use to plan further instruction.
Response Journals	A response journal is a student's personal record containing written, reflective responses to material he or she is reading, viewing, listening to, or discussing. The response journal can be used as an assessment tool in all subject areas.
Selected Responses	Strictly speaking a part of quizzes, tests, and examinations, selected responses require students to identify the one correct answer. The strategy can take the form of multiple-choice or true/false formats. Selected response is a commonly used formal procedure for gathering objective evidence about student learning, specifically in memory, recall, and comprehension.
Student Self-Assessments	Self-assessment is a process by which the student gathers information about, and reflects on, his or her own learning. It is the student's own assessment of personal progress in terms of knowledge, skills, processes, or attitudes. Self-assessment leads students to a greater awareness and understanding of themselves as learners.

Scoring Methods for Performance Assessment

Assessment can be scored during or after the students have completed the assessment task. However, it is best done during a lesson - using a checklist, rating scales & rubrics.

A rubric is a coherent set of criteria for students' work that includes descriptions of levels of performance quality on the criteria. Rubrics have two major aspects: coherent sets of criteria and descriptions of levels of performance. Rubrics include;

- (1) Descriptions of the of task
- (2) The scales to be used
- (3) The dimensions of the task
- (4) The description of each dimension on the scale

A Rubric

- Is a scoring guide that helps teachers evaluate student performance, based on a range of criteria.
- A rubric lists the criteria, or characteristics, that student work should exhibit and describes specific quality levels for those criteria.
- Rubrics are a great way to improve communication, learning, and grading fairness.
- Knowing how to create and use rubrics gives you a better understanding of assessment and another option for assessing student performance.
- Are descriptive and not evaluative.
- Of course, rubrics can be used to evaluate, but the operating principle is to match the performance to the description rather than "judge" it.
- Thus rubrics are as good or bad as the criteria selected and the descriptions of the levels of performance under each.
- Effective rubrics have appropriate criteria and well-written descriptions of performance

Purpose of Rubrics

Like any other evaluation tool, rubrics are useful for certain purposes and not for others. *The main purpose of rubrics is to assess performances.* For some performances, you observe the student in the process of doing something, like using an electric drill or discussing an issue. For other performances, you observe the product that is the result of the student's work, like a finished bookshelf or a written report.

1. Support authentic assessment

While traditional tests measure how well students recall content, rubrics measure how well students can apply knowledge to authentic contexts or real-world tasks.

2. Clearly communicate expectations

Because rubrics define student "quality" in terms of objective criteria and standards, they clearly communicate how instructors will evaluate student performance.

3. Improve performance

Rubrics lead to better student performance. When students understand assignments and expectations before they begin, they are more likely to fulfil them. They know what specific criteria and standards of excellence will be used to rate their performance.

4. To inspire fairness

Because rubrics have detailed assessment information, students don't feel that grades are assigned subjectively or arbitrarily. Also, when you have more than one grader, a rubric allows all graders to apply the same criteria in the same way.

Although rubrics have many benefits--and make grading faster and easier--a good rubric takes time, effort and patience to construct.

You'll probably need to change (change, not add to) your grading and assessment methods, based on what you believe about learning assessment. Rubrics are best for critical assessments, major projects, and other assignments that require a multi-dimensional performance evaluation. The trick is to know what type of rubric to create for your situation.

Reasons for Creating Rubrics/Marking schemes

Rubrics or marking schemes are created for;

1. Categories to assess-different components or elements that will assess
 - Factual information
 - Application
 - Analysis
 - Writing Skills
2. Criterion for assessment
 - Accuracy
 - Completeness
 - Length or number of examples
 - Supported with research
 - Range of answer
 - Description and support

3. Levels or points 3-5 levels

- Exemplary. Proficient, acceptable, not acceptable
- Excellent, good, fair, poor
- 10 points, 5 points, 1 point

Parts of a Rubric

- A rubric is a matrix of criteria and their descriptors.
- The left side of a rubric matrix lists the criteria (performance standards) for the expected product or performance.
- Across the top of the rubric matrix is the rating scale that provides a set of values for rating the quality of performance for each criterion.
- Descriptors under the rating scale provide examples or concrete indicators for each level of performance.
- The dimensions of the task that qualifies the achievement

Criteria	Performance Standards (Descriptors)
BEYOND	Beyond Standard(s) - Advanced in Performance and Understanding
	Consistently demonstrates advanced conceptual mathematical understandings Consistently generates tasks that make connections between and among mathematical ideas Consistently applies strategies to unique situations Consistently demonstrated confidence to approach tasks beyond the proficiency level for grade Consistently initiates mathematical investigations
CONSISTENT	Meet Standard(s) - Proficient in Performance and Understanding
	Consistently demonstrates understanding of mathematical standards and cluster at the grade level Consistently demonstrated conceptual understanding Consistently applies multiple strategies flexibly in various situations Understands and fluently applies procedures with understanding Consistently demonstrates perseverance and precision Constructs logical mathematical arguments of thinking and reasoning Uses mathematical language correctly and appropriately
INCONSISTENT	Progressing - Not Yet Proficient in Performance and Understanding
	Inconsistently uses tools appropriately and strategically Demonstrates inconsistent understanding of key mathematical ideas at grade level Demonstrates inconsistent conceptual understanding of key mathematical ideas at grade level Inconsistent in understanding and application of grade level appropriate strategies Depends upon assistance of teacher and/or peers to understand and complete tasks Needs additional time to complete tasks Applies models of mathematical ideas inconsistently
SELDOM	Not Yet - Limited Performance and Understanding
	Exhibits minimal understanding of key mathematic ideas at grade level Rarely demonstrates conceptual understanding Seldom provides precise response Seldom use appropriate strategies Consistently requires assistance and alternative instruction Use tools inappropriately to model mathematics

Types of Rubrics

1. Analytical Rubric

Analytic rubrics describe work on each criterion separately. For most classroom purposes, analytic rubrics are best. Focusing on the criteria one at a time is better for instruction and better for formative assessment because students can see what aspects of their work need what kind of attention. Focusing on the criteria one at a time is good for any summative assessment (grading) that will also be used to make decisions about the future—for example, decisions about how to follow up on a unit or decisions about how to teach something next year.

Template for Analytic Rubrics

Criteria	Beginning	Developing	Accomplished	Exemplary	Score
Criteria 1	Description reflecting beginning	Description reflecting movement toward mastery level of performance	Description reflecting achievement of mastery level of performance	Description reflecting of highest level of performance	
Criteria 2	Description reflecting beginning level performance	Description reflecting movement toward mastery level of performance	Description reflecting achievement of mastery level of performance	Description reflecting of highest level of performance	
Criteria 3	Description reflecting beginning level performance	Description reflecting movement toward mastery level of performance	Description reflecting achievement of mastery level of performance	Description reflecting of highest level of performance	
Criteria 4	Description reflecting beginning level performance	Description reflecting movement toward mastery level of performance	Description reflecting achievement of mastery level of performance	Description reflecting of highest level of performance	

Sample Analytic Rubric

Performance Standard/Criteria	Qualifier Descriptor			
	Advanced	Proficient	Progressing	Not Yet
Identify reasons for developing caring relationships	Identify and explain <u>all</u> the reasons for developing caring relationships	Identify <u>all</u> the reasons for developing caring relationships	Identify only a <u>few</u> of the reasons for developing caring relationships	Identify only <u>one</u> reason for developing caring relationships
Explain the reasons for developing caring relationships	Explain all the reasons for developing caring relationships and provide an in-depth justification for some of the reasons	Explain all the reasons for developing caring relationships	Explain only a few of the reasons for developing caring relationships	Explain only one reason for developing caring relationships

Holistic Rubrics

Holistic rubrics describe the work by applying all the criteria at the same time and enabling an overall judgment about the quality of the work. Holistic rubrics are based on criteria for good work and on observation of how the work meets those criteria.

One classroom purpose for which holistic rubrics are better than analytic rubrics is the situation in which students will not see the results of a final summative assessment and you will not really use the information for anything except a grade. Some high school final examinations fall into this category. Grading with rubrics is faster when there is only one decision to make, rather than a separate decision for each criterion.

Decide on type of rubric to be used (Holistic or Analytic)

1. When to use Holistic Rubric

- There is no single correct answer/response to a task
- The focus has no the overall quality, proficiency, or understanding of a specific content or skills.
- You are assessing large numbers (eg. 150 portfolios)

Holistic Rubric						
Score	5	4	3	2	1	0
Description	Demonstrate <u>complete</u> understanding of the problem. All requirements of task are <u>included in response.</u>	Demonstrate <u>considerate</u> understanding of the problem. All requirements of task are <u>included.</u>	Demonstrate <u>partial</u> understanding of the problem. Most requirements of task are <u>included.</u>	Demonstrate <u>little</u> understanding of the problem. Many requirements of task are <u>missing.</u>	Demonstrate <u>no</u> understanding of the problem.	No response/ not attempted task

2. When to use Analytic Rubric

- Several subjects are assessing the student work.
- Description promote consistent scoring.
- Stakeholders will be examining the rubric scores.
- Substantial feedback to students or the subjects is desired.
- Outlines of specific strengths/weaknesses are anticipated.

Analytic Rubric				
Criteria	4	3	2	1
Criteria 1	Description reflecting <u>highest</u> level of performance.	Description reflecting <u>mastery</u> level of performance.	Description reflecting <u>movement towards</u> mastery level of performance.	Description reflecting <u>beginning</u> level of performance.
Criteria 2	Description reflecting <u>highest</u> level of performance.	Description reflecting <u>mastery</u> level of performance.	Description reflecting <u>movement towards</u> mastery level of performance.	Description reflecting <u>beginning</u> level of performance.
Criteria 3	Description reflecting <u>highest</u> level of performance.	Description reflecting <u>mastery</u> level of performance.	Description reflecting <u>movement towards</u> mastery level of performance.	Description reflecting <u>beginning</u> level of performance.
Criteria 4	Description reflecting <u>highest</u> level of performance.	Description reflecting <u>mastery</u> level of performance.	Description reflecting <u>movement towards</u> mastery level of performance.	Description reflecting <u>beginning</u> level of performance.

Scoring of Performance for Formative Assessment

(Assessment as/while learning and Assessment for learning)

1. Scoring Assessment using Rating Scale

Rating Scales are a type of checklists that judge the degree to which a criteria is met. They generally have a scale of between 1-6 options.

Types of Rating Scales

A. Frequency Rating Scales

A frequency rating scale scores how often a task is done to meet criteria.

Sample Rating Scale Descriptive Words

1. Words that describe the skill of ***selecting 'the right' information*** at varying levels of quality

Excellent	Proficient	Adequate	Limited
Pertinent	relevant	suitable	trivial
Insightful	meaningful	appropriate	superficial
Significant	relevant	predictable	vague
Perceptive	thoughtful	basic	questionable
Precise	logical	partially correct	confusing
Purposeful	focused	appropriate	irrelevant

2. Words that describe the skill of ***selecting 'enough' information*** at varying levels of quality.

Excellent	Proficient	Adequate	Limited
comprehensive	thorough	cursory	superficial
in-depth	sufficient	partial	incomplete
rich & detailed	specific	simplistic	undeveloped
Extensive	substantial	partial	sketchy

3. Words that describe the skill of ***evaluating product or connecting insights to personal experience*** at varying levels of quality

Excellent	Proficient	Adequate	Limited
insightful	thoughtful	predictable	trivial
astute	relevant	appropriate	unfocused
perceptive	thoughtful	routine	trivial
intuitive	logical	rudimentary	unsubstantiated
innovative	credible	predictable	trite
compelling	meaningful	obvious	tenuous

4. Words that describe the skill of ***designing or constructing*** at varying levels of quality

Excellent	Proficient	Adequate	Limited
efficient	practical	viable	unworkable
innovative	effective	workable	ineffective

5. Words that describe the skill of **organizing or formatting information** at varying levels of quality

Excellent	Proficient	Adequate	Limited
skillful	systematic	simplistic	haphazard
purposeful	logical	methodical	disorganized

6. Words that describe the skill of **analyzing information or data** at varying levels of quality

Excellent	Proficient	Adequate	Limited
comprehensive	thorough	cursory	superficial
in-depth	sufficient	partial	incomplete
rich & detailed	specific	simplistic	undeveloped
Extensive	substantial	partial	sketchy

7. Words that describe the skill of **presenting or communicating information or selecting appropriate visuals** at varying levels of quality

Excellent	Proficient	Adequate	Limited
vivid	interesting	simplistic	lacks appeal
compelling	effective	predictable	does little to
sustain interest	thoughtful	routine	trivial
enhances	supports	partially supports	interferes with
engaging	interesting	straightforward	ineffective
skillful	effective	appropriate	inappropriate
intriguing	interesting	predictable	ineffective

Sample Scoring using Rating Scale to assess “Collaboration”

Criteria	Frequency			
	Always = 4	Sometimes = 3	Rarely = 2	Never = 1
1. Embraces everyone's' abilities and encourages participation	Always Embraces everyone's' abilities and encourages participation	Sometimes Embraces everyone's' abilities and encourages participation	Rarely Embraces everyone's' abilities and encourages participation	Never Embraces everyone's' abilities and encourages participation
2. Ensures everyone is tasked to and activity	Always Ensures everyone is tasked to and activity	Sometimes Ensures everyone is tasked to and activity	Rarely Ensures everyone is tasked to and activity	Never Ensures everyone is tasked to and activity
3. Encourages everyone to achieve together	Always Encourages everyone to achieve together	Sometimes Encourages everyone to achieve together	Rarely Encourages everyone to achieve together	Never Encourages everyone to achieve together

2. Scoring assessment using a Checklist

Check lists are one of the easiest methods of scoring assessment tasks. The criteria i.e. skills, cues or tasks are considered separately according to whether they have been accomplished.

Types of Checklists include

- Yes/No
- Tick/Cross
- Circling
- Narrow scale, e.g. Sometimes, rarely, never
- Colouring
- Symbols (signifiers), e.g. pictures, facials, artifacts, signs, drawings, concept maps)

Sample Scoring using Yes/No Checklist Scale to assess “Collaboration”

No.	Criteria	Write Yes (score 2) or No (score 1)
1	Embraces everyone’s abilities and encourages participation	
2	Ensures everyone is tasked to an activity	
3	Encourages everyone to achieve together	

Sample Scoring using Tick/Cross Checklist Scale to assess “Collaboration”

No.	Criteria	Place a tick (score 2) or and X (score 1)
1	Embraces everyone’s abilities and encourages participation	
2	Ensures everyone is tasked to an activity	
3	Encourages everyone to achieve together	

Scoring of Performance for Summative Assessment

Grade rating scales are better scoring tools for summative assessment of students’ performance. They indicate students’ level of performance using such as; A, B, C, D etc

A Grade is given after the accumulated total for a number of assessments has been completed either at the end of an assessment period, a topic, a term, a grade or year.

The subject assessment components, tasks and weightings should be able to guide the grading of achievements as demonstrated in a rubric designed for this purpose.

SAMPLE SUBJECT ASSESSMENT STRUCTURE

The internal assessment for the Technology and Industrial Arts/Business Studies subject is based on the Grade 9 & 10 and Grade 11 and 12 Technology and Industrial Arts/Business Studies Syllabus. The final assessment should be based on a range and balance of assessment strategies and instruments. Assessment must be both normative and criterion.

Component	Weighting	Tasks	Assessment Referencing
Practical Work in response to design brief (Moderation and Projects included here?)	60 % (of mandatory total)	Development and application of design ideas, safe and skillful use of materials, tools and equipment to make a product and the identified processes	Criterion Referencing Rubrics?
Design folio with outcomes of research, investigations and planning	20 % (of mandatory total)	Folio showing results of investigation in response to design brief, rough notes or sketches of design ideas, timelines, final drawings or plans, processes used to make the product and evaluation reports	Referencing Rubrics?
Tests	20 % (of mandatory total)	Theory and also applications in theory	Normative
Marks	100 %	A combination of design folios, practical applications, moderations and tests.	

Sample Assessment

SBC embraces standards and as such, standards must also drive the administration of assessments to students. It is important that every student must be given the outline of the Assessment that has been planned for the term. Each Term will include 6 pieces (can have any number from 4-6) of assessment. Assessment is weighted accordingly.

Assessment Type	Component	Weighting
Topic Tests x 2	Students will be given two topic tests based on the content learnt in the term. 1 will be given mid-term and 1 at end-term. The test will be comprised of 10 multiple choice questions and 5 short written answers.	1 = 15 marks 1 = 10 marks
Portfolio	Individual Students will be assessed.....	10 marks
Moderation	In groups of four - five, students work to critically engage with one another in the required design process. Students will address criteria provided in class and prepare and deliver a 5-10 minute presentation addressing the criteria.	30 marks
Project (Application)	In groups of three to four, students work to critically engage with one another in the assigned project. Students will address criteria provided in class and prepare and deliver a 5-10 minute presentation addressing the criteria.	20 marks
Participation	2 marks will be allocated each day for attendance. Another 3 marks will be awarded for active participation.	5 marks

STEAM Assessment

Steps in Developing a STEAM Activity

1. Identify the Real/Authentic Situations that can be solved through the STEAM Activity
2. Select a well-defined a Benchmark in your subject area that will carry the STEAM Activity
3. Identify related subject areas with their concepts to be used solve the Authentic Situation
4. Note down the Main parts of the Unit Of Work for the STEAM Activity

5. Write a Description of the Authentic Situation for the STEAM Activity based on the identified Authentic situation.
6. Write down the Task Descriptions for the STEAM Activity in order to approach the Authentic situation.
7. Develop the Rubric to Assess the STEAM Activity

1. Authentic Situation identified for this STEAM Activity

- Students spending too much time using their smart mobile phones on Facebook, WhatsApp and surfing the internet rather than their school work.
- Students still bringing their smart mobile phones to school despite the school rules telling them not to.
- Most schools need to fully utilise their School Rules, Mottos, Missions and Visions which determines the way they want to shape our students' Knowledge, Attitudes and Values, during and after, they leave the school at end of G10 and G12.
- Our schools in our country have been labelled as 'a very good school to a very bad school' due school student fightings and vandalism of school properties.
- Stakeholders of the schools are blaming the school management for the school students behaviour problems and parents are transferring their students out of schools to others school in the country.

2. Select a well-defined Benchmark in your subject area that will carry/drive the STEAM Activity and its associated Big Idea (product, project etc.)

- Sample:
 - i. SUBJECT: BUSINESS STUDIES
 - ii. BENCHMARK 9.2.5.1. Analyse the impact of information technology on society.
 - iii. BIG IDEA/PRODUCT: Video Clip



3. Identify other related subject areas with the appropriate concepts to solve the Authentic Situation(s)

- Identify related subject areas with their concepts/Knowledge, Skills, Attitudes and Values to be used to solve the Steam Authentic Situation

SUBJECTS	BENCHMARKS	BIG IDEA/ PRODUCT	KNOWLEDGE	SKILLS	ATTITUDES	VALUES
1. Arts (Theatre Arts)	9.2.2.2		Video script	Script Writing		
2. Christian Civic Value Education (CCVE)	9.3.1.3		School Rules, Motto, Vision, Mission	Examine Civic values	Responsibility	Ownership, Love
3. Character Social Development (CSD)	9.1.5.1, 9.1.5.2, 9.1.5.3, 9.1.5.4, 9.1.5.5		School Rules, Motto, Vision, Mission	Asses experiences and mistakes	Caring, Positivity	Respect
4. English	9.2.2.1		Descriptive Writing	Descriptive Writing	Neatness	
5. Social Science (History)	9.2.2.3, 9.2.2.4		School history	Discuss school culture		Ownership
6. Social Science (Political Science)	9.3.3.1, 9.3.3.2		National development aspirations/demands of citizens	Anticipative skills		
7. Technology Industrial Arts (TIA)	9.4.1.4, 9.4.1.5, 9.4.1.6		Range of communications media products	Creative media communication	Alertness	
8. Business Studies	9.2.5.6	Video clip	Media rich projects	Shooting with mobile	Creativity	Innovative

There must be an anchor subject benchmark for any STEAM assessment.

4. *Descriptions of the Steam Authentic Situation*

- Paragraph 1 describes the problem/situation
- Paragraph 2 describes the solution to the problem/situation and who will be responsible to take up the task
- Paragraph 3 would mention any rewards/awards for an adequate solution to the problem/situation as a booster to create a competitive competition and a promoter of critical thinking amongst the students so that they can come out with the best products.

5. *Write down the Task Descriptions for the STEAM Activity*

- Plan and write a short write-up for your video-clip.
- Use the notes to Make a 2-minute video clip to advertise and market your school to the public.
- The short video clip must embrace the school rules, motto, and mission and vision statements.
- It must also contain messages of new and competent management.
- This video clip has to have the potential to positively change the image of the school
- This 2-minute video clip must be captivating and totally convincing to attract students to want to enroll at your school.
- This clip must not be more than 2 minutes (maximum time limit)
- Present your video clip to be assessed
- Submit both your write-up (on a chart) together with your video clip

6. *Developing Rubrics to Assess the Steam Video Clips*

- 1.) Decide on type of rubric to be used (Holistic or Analytic)
- 2.) Decide what point scale rubric to use (always use 3, 4 or 5 point-scale) and rating scales to use (descriptive words or numerals)
- 3.) Plan the layout to develop the rubric
- 4.) Decide what to assess from the Category of Tasks Description
- 5.) Identify and List down the Category of Tasks Description for the Criteria

- 6.) Reword the Tasks Descriptions to create Criteria
 - Plan and write a short write-up for your video-clip. **(The write up of the video)**
 - Use the notes to make a 2-minute video clip to advertise and market your school to the public. **(The development of the video)**
 - The short video clip must embrace the school rules, motto, and mission and vision statements. **(The content of the video)**
 - It must also contain messages of new and competent management. **(The content of the video)**
 - This clip must not be more than 2 minutes (maximum time limit) **(The presentation of the video)**
 - Submit both your write-up (on a chart) together with your video clip. **(The product)**
- 7.) List down the criteria against the Task Descriptions in a table
- 8.) Unpack the Task Descriptions and Identify the essential KSAV that can be assessed
- 9.) Reword the Task Descriptions with the inclusion of KSAVs into a Descriptor statement for each criteria and distribute into each Competency Level/Level of Achievement
- 10.) Determine appropriate variance of Qualifiers for each Descriptors of each Achievement Level
- 11.) Determine the appropriate Descriptive Words or Number for Point Scales of the intended rubric.
- 12.) Completed rubric sample: Video clip Assessment Rubric
- 13.) Consider the Applications of the Steam Rubric

Sample 4

Strand 2: Business Management

Unit 5: Information Technology

Content Standard 2.5: Students will be able to explain the information technology concepts and examine the systems and tools needed to gather, access, analyse, synthesise, evaluate, manage, and disseminate information.

Benchmark: 9.2.5.1: Analyse the impact of information technology on society.

Topic: Impact of information technology on society.

Learning Objective: By the end of this Topic, students will be able to demonstrate a positive impact of information technology on society

Purpose of Assessing the Topic (Benchmark):

To assess whether students can be able to use mobile technology to positively Impact their society and analyse this impacts

How the Performance Task will be done: Group Project Presentation

Performance Standard: By the end of the project, students will be able to use mobile technology to positively impact their community/society.

Situation (Authentic)

A school has been faced with the challenge of behavioral issues for some time now and the public has lost its confidence in the school to be a good or genuine school. Most parents fear sending their children to his school and always opt to transfer their children in very first instances. The Board of Governors of the school has decided to raise the Behavior Standards or Benchmarks to a certain degree to improve its image and standards of learning.

To meet the expectations of the BOG, the principal and teachers intend to market the school to the public of NCD to lure students to have the interest to enroll at the school. With such a PAST bad reputation, the school will really need to convince the public that they have raised their standards and that their school is worth enrolling in it. The Principal and the teachers now have a task on hand to convince the public to enroll their children there and they have to try every means to do so.

To achieve this, the school is now requesting the Business and Technology Department to design an assessment Task for a certain Grade to assist with the situation. The Business & Technology Department has opted to design the task for Grade 9 students as one of their projects towards their assessments. The school principal also announces that the best video assessed by the B&T Department will be rewarded as it is also a competition.

Task Descriptions:

- Plan and write a short write-up for your video-clip.
- Use the notes to make a 2-minute video clip to advertise and market your school to the public.
- The short video clip must embrace the school rules, motto, and mission and vision statements.
- It must also contain messages of new and competent management.
- This video clip has to have the potential to positively change the image of the school
- This 2-minute video clip must be captivating and totally convincing to attract students to want to enroll at your school.
- This clip must not be more than 2 minutes (maximum time limit)
- Submit both your write-up (on a chart) together with your video clip
- Teacher will present your video clips for the whole class to observe and use the rubric below to assess the video clip.

Materials: Smartphone, butcher papers, markers

1. Developing Rubrics to Assess Video Clips

- i. Decide on type of rubrics to be used (Holistic or Analytic)
- ii. After you decide, plan the rubrics
- iii. Planning to develop the rubric
- iv. Categorise the Tasks Description into Criteria's

Sample of Categorising tasks for the rubric

- Plan and write a short write-up for your video-clip. **(The write up of the video)**
- Use the notes to Make a 2-minute video clip to advertise and market your school to the public. **(The development of the video)**
- The short video clip must embrace the school rules, motto, and mission and vision statements. **(The content of the video)**
- It must also contain messages of new and competent management. **(The content of the video)**
- This video clip has to have the potential to positively change the image of the school **(The content of the video)**
- This 2-minute video clip must be captivating and totally convincing to attract students to want to enroll at your school. **(The content of the video)**
- This clip must not be more than 2 minutes (maximum time limit) **(The presentation of the video)**
- Present your video clip to be assessed **(The presentation of the video)**
- Submit both your write-up (on a chart) together with your video clip. **(The product)**

2. Identify and list down categories of tasks

Category	Task Description
The write up of the video	Plan and write a short write-up for your video-clip.
The development of the video	Use the notes to Make a 2-minute video clip to advertise and market your school to the public.
The content of the video	• The short video clip must embrace the school rules, motto, and mission and vision statements. • It must also contain messages of new and competent management. • This video clip has to have the potential to positively change the image of the school • This 2-minute video clip must be captivating and totally convincing to attract students to want to enroll at your school.
The Presentation of the video	• This clip must not be more than 2 minutes (maximum time limit) • Present your video clip to be assessed
The product	Submit both your write-up (on a chart) together with your video clip.

3. Unpack the Task Descriptions and Identify the essential KSAV that can be assessed

Category	Task Description	Essential KSAVs
The write up of the video script	Plan and write a short write-up for your video-clip.	Skill: Procedural Writing
The development of the video	Use the notes to Make a 2-minute video clip to advertise and market your school to the public.	Values and attitudes: • Teamwork and cooperation • Creativity Knowledge: Know about the school

The Presentation of the video	- The short video clip must embrace the school rules, motto, and mission and vision statements. - It must also contain messages of new and competent management. - This video clip has to have the potential to positively change the image of the school - This 2-minute video clip must be captivating and totally convincing to attract students to want to enroll at your school.	Knowledge: Adequate content about the school Skill: convincing and persuasive Values and attitude: Encouraging and luring
The Presentation of the video	- This clip must not be more than 2 minutes (maximum time limit) - Present your video clip to be assessed	Skill: - Time management - delivery skills (posture, language) and - communication skills - social skills (relativity and connectivity) Values and attitude: confidence
The product	Submit both your write-up (on a chart) together with your video clip.	EKSAVs in the Write up and Presentation

4. Reword the Task Descriptions with the inclusion of KSAVs into a Descriptor statement for each criteria and distribute into each Competency Level/Level of Achievement

5. Determine the appropriate Descriptive Words or Number for Point Scales of the intended rubric.

Criteria	Advanced	Progressing	Novice	Mark
The write up of the video script	Skill: Procedural Writing Organised paper of video script writing procedures	Organised paper of video script writing procedures	Organised paper of video script writing procedures	/3
The development of the video	Values and attitudes: - Teamwork and cooperation - Creativity Knowledge: Know about the school The video corresponds to the 2-minutes script and illustrates teamwork	The video corresponds to the 2-minutes script and illustrates teamwork	The video corresponds to the 2-minutes script and illustrates teamwork	/3
Content of the video	Knowledge: Adequate content about the school Skill: Convincing and persuasive Values and attitude: Encouraging and luring The short video clip embraces the core ideas of school rules, motto, and mission and vision statements.	The short video clip embraces the core ideas of school rules, motto, and mission and vision statements.	The short video clip embraces the core ideas of school rules, motto, and mission and vision statements.	/3

Presentation of the video	Skill: - Time management - delivery skills (posture, language) and - communication skills - social skills (relativity and connectivity) Values and attitude: Confidence The video clip captures essence of vital messages of the new and competent management with potentials to positively change the image of the school and captivating and convincing to attract students to want to enroll at the school.	The video clip captures essence of vital messages of the new and competent management with potentials to positively change the image of the school and captivating and convincing to attract students to want to enroll at the school.	The video clip captures essence of vital messages of the new and competent management with potentials to positively change the image of the school and captivating and convincing to attract students to want to enroll at the school.	/3
The product	EKSAVs in the Write up and Presentation: Video clip submitted at the assessment deadline for presentations	Video clip submitted at the assessment deadline for presentations	Video clip submitted at the assessment deadline for presentations	/3

6. Completed rubric sample: Video clip Assessment Rubric

Criteria	Achieved	Progressing	Novice	Mark
Video Script Write up	Innovative and well organised paper with clarity of video <u>script</u> writing procedures	Well organised paper with clarity of video <u>script</u> writing procedures	Organised paper with some clarity of video <u>script</u> writing procedures	/3
Video Development	Appropriately considered details for the video are well corresponded to the 2-minutes script and illustrates a well-coordinated teamwork	Considered details for the video are mostly corresponded to the 2-minutes script and illustrates a coordinated teamwork	Some details considered for the video are partially corresponded to the 2-minutes script and illustrates a less coordinated teamwork	/3
Video Clip Content	The short video clip fully embraces the core ideas of school rules, motto, and mission and vision statements.	The short video clip mostly embraces the core ideas of school rules, motto, and mission and vision statements.	The short video clip somewhat embraces the core ideas of school rules, motto, and mission and vision statements.	/3
Video Presentation	The video clip fully captures essence of vital messages of the new and competent management with necessary potentials to positively change the image of the school and really captivating and totally convincing to attract students to want to enroll at the school.	The video clip mostly captures the essence of vital messages of the new and competent management with most potentials to positively change the image of the school and mostly captivating and partially convincing to attract students to want to enroll at the school.	The video clip somewhat captures the essence of vital messages of the new and competent management with some potentials to positively change the image of the school and almost captivating and less convincing to attract students to want to enroll at the school.	/3
Video Clip Submission Time	Video clip submitted well before the assessment deadline for presentations	Video clip submitted just before the assessment deadline for presentations	Video clip submitted within the assessment time for presentations	/3

1. How to Score using the rubric

Scoring Rubrics

Criteria	Achieved	Progressing	Novice	Mark
Video Script Write up	Innovative and well organised paper with clarity of video <u>script</u> writing procedures	Well organised paper with clarity of video <u>script</u> writing procedures	Organised paper with some clarity of video <u>script</u> writing procedures	2/3
Video Development	Appropriately considered details for the video are well corresponded to the 2-minutes script and illustrates a well-coordinated teamwork	Considered details for the video are mostly corresponded to the 2-minutes script and illustrates a coordinated teamwork	Some details considered for the video are partially corresponded to the 2-minutes script and illustrates a less coordinated teamwork	1/3
Video Clip Content	The short video clip fully embraces the core ideas of school rules, motto, and mission and vision statements.	The short video clip mostly embraces the core ideas of school rules, motto, and mission and vision statements.	The short video clip somewhat embraces the core ideas of school rules, motto, and mission and vision statements.	3/3
Video Presentation	The video clip fully captures essence of vital messages of the new and competent management with necessary potentials to positively change the image of the school and really captivating and totally convincing to attract students to want to enroll at the school.	The video clip mostly captures the essence of vital messages of the new and competent management with most potentials to positively change the image of the school and mostly captivating and partially convincing to attract students to want to enroll at the school.	The video clip somewhat captures the essence of vital messages of the new and competent management with some potentials to positively change the image of the school and almost captivating and less convincing to attract students to want to enroll at the school.	3/3
Video Clip Submission Time	Video clip submitted well before the assessment deadline for presentations	Video clip submitted just before the assessment deadline for presentations	Video clip submitted within the assessment time for presentations	2/3
				11/15

2. How to Grade using the rubric

Grading Rubrics

Score Range	Grade	Qualifier (Proficiency)	Descriptor	Percentage
13 – 15	A	Advanced	Description reflecting highest level of performance.	76 - 100%
9 - 12	B	Achieved	Description reflecting mastery level of performance.	46 - 75%
5 – 8	C	Progressing	Description reflecting movement towards mastery level of performance.	26 - 45%
0 - 4	D	Novice	Description reflecting beginning level of performance.	0 - 25%

3. How to Report using the rubric

A. Reporting an individual student's performance on the task

Assessment Task Report				
Assessment Task: Video Development Project				
Name:		Grade:	Class:	Score and Grade: /15
Criteria	Achieved A	Progressing B	Novice C	
Video Script Write up	Innovative and well organised paper with clarity of video <u>script</u> writing procedures	Well organised paper with clarity of video <u>script</u> writing procedures	Organised paper with some clarity of video <u>script</u> writing procedures	
Video Development	Appropriately considered details for the video are well corresponded to the 2-minutes script and illustrates a well-coordinated teamwork	Considered details for the video are mostly corresponded to the 2-minutes script and illustrates a coordinated teamwork	Some details considered for the video are partially corresponded to the 2-minutes script and illustrates a less coordinated teamwork	
Video Clip Content	The short video clip fully embraces the core ideas of school rules, motto, and mission and vision statements.	The short video clip mostly embraces the core ideas of school rules, motto, and mission and vision statements.	The short video clip somewhat embraces the core ideas of school rules, motto, and mission and vision statements.	
Video Presentation	The video clip fully captures essence of vital messages of the new and competent management with necessary potentials to positively change the image of the school and really captivating and totally convincing to attract students to want to enroll at the school.	The video clip mostly captures the essence of vital messages of the new and competent management with most potentials to positively change the image of the school and mostly captivating and partially convincing to attract students to want to enroll at the school.	The video clip somewhat captures the essence of vital messages of the new and competent management with some potentials to positively change the image of the school and almost captivating and less convincing to attract students to want to enroll at the school.	
Video Clip Submission Time	Video clip submitted well before the assessment deadline for presentations	Video clip submitted just before the assessment deadline for presentations	Video clip submitted within the assessment time for presentations	

Note: The shaded is the student's proficiency score for each task.

Related links to this Business Studies Benchmark in Business Studies with other subject areas:

Subjects	Reference Benchmark Codes
1. Arts (Theatre Arts)	9.2.2.2
2. Christian Civic Value Education (CCVE)	9.3.1.3
3. Character Social Development (CSD)	9.1.5.1, 9.1.5.2, 9.1.5.3, 9.1.5.4, 9.1.5.5
4. English	9.2.2.1
5. Social Science (History)	9.2.2.3, 9.2.2.4
6. Social Science (Political Science)	9.3.3.1, 9.3.3.2
7. Technology Industrial Arts (TIA)	9.4.1.4, 9.4.1.5, 9.4.1.6

The anchor subject in this sample STEAM assessment is Communication Technology.

Glossary

Terms	Definitions
Assessment	Activities teachers use to help students learn and to measure and monitor their progress towards the attainment of expected levels of proficiency.
Assessment As Learning	Assessment is used to help students understand and reflect on what they have learnt or are having difficulties with, identify areas of strengths and weaknesses, and set clear, measurable, and attainable personal goals to improve their own learning.
Assessment For Learning	A common form of assessment. It is an ongoing assessment process that arises out of the interaction between teaching and learning. Also referred to as formative assessment.
Assessment Of Learning	Provides a summary of students learning over a given period of time and is generally carried out at the end of a course of study. Also referred to as summative assessment.
Assessment Strategies	Different ways or approaches of assessing students work.
Authentic	Based on real life context.
Benchmarks	Benchmarks are more detailed descriptions of a specific level of performance expected of students at particular ages, grades, school levels or levels of development. They are the specific components of the knowledge, process, skill, concept, principle, or idea identified by a content standard.
Content Standards	Content Standards are broadly stated expectations of what (content) students should know. They describe the knowledge, skills, values, and attitudes that students should attain.
Control	The means by which a device or process is activated or regulated.
Environmental sustainability	The creation of products or services and use of resources in a way that allows present needs to be met without compromising the ability of future generations to meet their needs. An important related concept is that of environmental stewardship – the acceptance of responsibility for the sustainable use and treatment of land and other natural resources.
Ergonomics	The design of a product, process, or service in a way that takes the user's well-being with respect to its use or delivery into account – that is, in a way that minimises discomfort, risk of injury, and expenditure of energy.
Evidence Outcomes	Evidence outcomes are indicators that indicate students' mastery of essential knowledge, skills, values and attitudes at the end of each grade or school level.
Function	The use for which a product, process, or service is developed.
Performance Assessment	A form of assessment that is focused on measuring students' mastery of knowledge, skills, values and attitudes taught and learnt in each lesson.
Standard	A standard is a level of quality or achievement, especially a level that is thought to be acceptable. It is something used to measure or estimate the quality or degree of something, for example, how good a piece of work is.
Standards-Based Curriculum	Describes what all students should know and be able to do at the end of a grade or school level. The main idea behind standards-based curriculum is standards.

Standards-Based Education	An academic program in which clearly defined academic content and benchmarks are aligned. It spells out what schools and communities need to do to ensure achievement of expectations. The main idea behind standards-based education is standards.
Standards-Based Assessment	A systematic and ongoing process of collecting and interpreting information about students' achievements.

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Appendices

Appendix 1: Bloom's Taxonomy

LEVEL OF UNDERSTANDING	KEY VERBS
CREATING Can the student create a new product or point of view?	Construct, design, and develop, generate, hypothesize, invent, plan, produce, compose, create, make, perform, plan, produce, assemble, formulate,
EVALUATING Can the student justify a stand or decision?	Appraise, argue, assess, choose, conclude, critique, decide, defend, evaluate, judge, justify, predict, prioritize, provoke, rank, rate, select, support, monitor,
ANALYZING Can the student distinguish between the different parts?	Analyzing, characterize, classify, compare, contrast, debate, criticise, deconstruct, deduce, differentiate, discriminate, distinguish, examine, organize, outline, relate, research, separate, experiment, question, test,
APPLYING Can the student use the information in a new way	Apply, change, choose, compute, dramatize, implement, interview, prepare, produce, role play, select, show, transfer, use, demonstrate, illustrate, interpret, operate, sketch, solve, write,
UNDERSTANDING Can the student comprehend ideas or concepts?	Classify, compare, exemplify, conclude, demonstrate, discuss, explain, identify, illustrate, interpret, paraphrase, predict, report, translate, describe, classify,
REMEMBERING Can the student recall or remember the information?	Define, describe, draw, find, identify, label, list, match, name, quote, recall, recite, tell, write, duplicate, memorise, recall, repeat, reproduce, state,

Appendix 2: 21st Century Skills

WAYS OF THINKING	Creativity and innovation • Think creatively • Work creatively with others • Implement innovations Critical thinking, problem solving and decision making • Reason effectively and evaluate evidence • Solve problems • Articulate findings Learning to learn and meta-cognition • Self-motivation • Positive appreciation of learning • Adaptability and flexibility
WAYS OF WORKING	Communication • Competency in written and oral language • Open minded and preparedness to listen • Sensitivity to cultural differences Collaboration and teamwork • Interact effectively with others • Work effectively in diverse teams • Prioritise, plan and manage projects
TOOLS FOR WORKING	Information literacy • Access and evaluate information • Use and manage information • Apply technology effectively ICT literacy • Open to new ideas, information, tools and ways of thinking • Use ICT accurately, creatively, ethically and legally • Be aware of cultural and social differences • Apply technology appropriately and effectively
LIVING IN THE WORLD	Citizenship – global and local • Awareness and understanding of rights and responsibilities as a global citizen • Preparedness to participate in community activities • Respect the values and privacy of others Personal and social responsibility • Communicate constructively in different social situations • Understand different viewpoints and perspectives Life and career • Adapt to change • Manage goals and time • Be a self-directed learner • Interact effectively with others

Appendix 3: Teaching And Learning Strategies

Strategy	Teacher	Students
CASE STUDY Used to extend students understanding of real life issues.	Provide students with case studies related to the topic of the lesson and allow them to analyse and evaluate.	Study the case study and identify the problem addressed. They analyse the problem and suggest solutions supported by conceptual justifications and make presentations. This enriches the students' existing knowledge of the topic.
DEBATE A method used to increase students' interest, involvement and participation.	Provide the topic or question of debate on current issues affecting a bigger population, clearly outlining the expectations of the debate. Explain the steps involved in debating and set a criteria/standard to be achieved.	Conduct researches to gather supporting evidence about the selected topic and summarizing the points. They are engaged in collaborative learning by delegating and sharing tasks to group members. When debating, they improve their communication skills.
DISCUSSION The purpose of discussion is to educate students about the process of group thinking and collective decision.	The teacher opens a discussion on certain topic by asking essential questions. During the discussion, the teacher reinforces and emphasises on important points from students responses. Teacher guide the direction to motivate students to explore the topic in greater depth and the topic in more detail. Use how and why followup questions to guide the discussion toward the objective of helping students understand the subject and summarise main ideas.	Students ponder over the question and answer by providing ideas, experiences and examples. Students participate in the discussion by exchanging ideas with others.
GAMES AND SIMULATIONS Encourages motivation and creates a spirit of competition and challenge to enhance learning.	Being creative and select appropriate games for the topic of the lesson. Give clear instructions and guidelines.	The game selected must be fun and build a competitive spirit to score more than their peers to win small prizes. Go into groups and organize. Follow the instructions and play to win.

Strategy	Teacher	Students
OBSERVATION Method used to allow students to work independently to discover why and how things happen as the way they are. It builds curiosity.	Give instructions and monitor every activity students do. Students Observe and ask essential questions	Students possess instinct of curiosity and are curious to see the things for themselves and particularly those things which exist around them. A thing observed and a fact discovered by the child for himself becomes a part of mental life of the child. It is certainly more valuable to him than the same fact or facts learnt from the teacher or a book.
PEER TEACHING & LEARNING Record Interpret (power point presentations, pair learning) each other using different ways to learn from each other.	It encourages; team work, develops confidence, feel free to ask questions, improves communication skills and most importantly develop the spirit of inquiry.	Distribute topics to groups to research and teach others in the classroom. Go through the basics of how to present their peer teaching. Go into their established working groups. Develop a plan for the topic. Each group member is allocated a task to work on. Research and collect information about the topic allocated to the group. Outline the important points from the research and present their findings in class.
PERFORMANCE RELATED TASKS (dramatization, song/lyrics, wall magazines) Encourages creativity and take on the overarching ideas of the topic and are able to recall them at a later date.	Students are given the opportunity to perform the using the main ideas of a topic. Provide the guidelines, expectations and the set criteria.	Go into their established working groups. Being creative and create dramas, songs/lyrics or wall magazines in line with the topic.
PROJECT (individual/group) Helps students complete tasks individually or collectively.	Teacher outline the steps and procedures of how to do and the criteria.	Students are involved in investigations and finding solutions to problems to real life experiences. They carry out researches to analyse the causes and effects of problems to provide achievable solutions. Students carefully utilise the problem-solving approach to complete projects.
USE MEDIA & TECHNOLOGY to teach and generate engagement depending on the age of the students.	Show a full movie, an animated one, a few episodes form documentaries, you tube movies and others depending on the lesson. Provide questions for students to answer before viewing.	Viewing can provoke questions, debates, critical thinking, emotion and reaction. After viewing, students engage in Critical thinking and debate.

Appendix 4: Lesson Plan Template

Strand:

Unit:

Content Standard:

Benchmark:

Topic:.....

Lesson Topic:

Lesson Objective (s): By the end of the lesson, students will be able to;

-
-
-

Essential Questions:

1.
2.
3.

Knowledge:

-
-

Skill(s):

-
-

Values:

-
-

Attitudes:

-
-

Appendix 5: Assessment Strategies

Strategy	Description
Analogies	Students create an analogy between something they are familiar with and the new information they have learned. When asking students to explain the analogy, it will show the depth of their understanding of a topic.
Classroom Presentations	A classroom presentation is an assessment strategy that requires students to verbalise their knowledge, select and present samples of finished work, and organize their thoughts about a topic in order to present a summary of their learning. It may provide the basis for assessment upon completion of a student's project or essay.
Conferences	A conference is a formal or informal meeting between the teacher and a student for the purpose of exchanging information or sharing ideas. A conference might be held to explore the student's thinking and suggest next steps; assess the student's level of understanding of a particular concept or procedure; and review, clarify, and extend what the student has already completed
Discussions	Having a class discussion on a unit of study provides teachers with valuable information about what the students know about the subject. Focus the discussions on higher level thinking skills and allow students to reflect their learning before the discussion commences.
Essays	An essay is a writing sample in which a student constructs a response to a question, topic, or brief statement, and supplies supporting details or arguments. The essay allows the teacher to assess the student's understanding and/or ability to analyse and synthesize information.
Exhibitions/ Demonstrations	An exhibition/demonstration is a performance in a public setting, during which a student explains and applies a process, procedure, etc., in concrete ways to show individual achievement of specific skills and knowledge.
Interviews	An interview is a face-to-face conversation in which teacher and student use inquiry to share their knowledge and understanding of a topic or problem, and can be used by the teacher to explore the student's thinking; assess the student's level of understanding of a concept or procedure and gather information, obtain clarification, determine positions, and probe for motivations.
Learning Logs	A learning log is an ongoing, visible record kept by a student and recording what he or she is doing or thinking while working on a particular task or assignment. It can be used to assess student progress and growth over time.
Observation	Observation is a process of systematically viewing and recording students while they work, for the purpose of making programming and instruction decisions. Observation can take place at any time and in any setting. It provides information on students' strengths and weaknesses, learning styles, interests, and attitudes.
Peer Assessment	Assessment by peers is a powerful way to gather information about students and their understanding. Students can use set criteria to assess the work of their classmates.
Performance Tasks	During a performance task, students create, produce, perform, or present works on "real world" issues. The performance task may be used to assess a skill or proficiency, and provides useful information on the process as well as the product.

Strategy	Description
Portfolios	A portfolio is a collection of samples of a student's work, and is focused, selective, reflective, and collaborative. It offers a visual demonstration of a student's achievement, capabilities, strengths, weaknesses, knowledge, and specific skills, over time and in a variety of contexts.
Questions And Answers (Oral)	In the question-and-answer strategy, the teacher poses a question and the student answers verbally, rather than in writing. This strategy helps the teacher to determine whether students understand what is being, or has been, presented, and helps students to extend their thinking, generate ideas, or solve problems.
Quizzes, Tests, Examinations	A quiz, test, or examination requires students to respond to prompts in order to demonstrate their knowledge (orally or in writing) or their skills (e.g., through performance). Quizzes are usually short; examinations are usually longer. Quizzes, tests, or examinations can be adapted for exceptional students and for re-teaching and retesting.
Questionnaires	Questionnaires can be used for a variety of purposes. When used as a formative assessment strategy, they provide teachers with information on student learning that they can use to plan further instruction.
Response Journals	A response journal is a student's personal record containing written, reflective responses to material he or she is reading, viewing, listening to, or discussing. The response journal can be used as an assessment tool in all subject areas.
Selected Responses	Strictly speaking a part of quizzes, tests, and examinations, selected responses require students to identify the one correct answer. The strategy can take the form of multiple-choice or true/false formats. Selected response is a commonly used formal procedure for gathering objective evidence about student learning, specifically in memory, recall, and comprehension.
Student Self-Assessments	Self-assessment is a process by which the student gathers information about, and reflects on, his or her own learning. It is the student's own assessment of personal progress in terms of knowledge, skills, processes, or attitudes. Self-assessment leads students to a greater awareness and understanding of themselves as learners.

Appendix 6: Sample Lesson Plan And Assessment

Sample Lesson Plan _Grade 9 Unit 1 _ Topic 1: Computer System

UNIT 1. Computer Security and Safety

Topic 1: Computer System

Content Standard: Explore and analyses computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.

Benchmark: 10.5.1.1 Construct and test simple interfaces and other electronic circuits

Lesson 1: Building Simple Electronics Circuitry

Lesson Objective: By the end of the lesson, students will be able to;

- Explain the components of a circuit and the purpose of each component.
- Use the different components of a circuit to make a circuit.

Teaching Strategies

1. Use Spiral Teaching to connect Digital Analog Circuit when introducing the lesson.
2. Ask students to make a model of a simple electronic circuit.
3. Ask them to explain terms that are related to electronic circuit.

Learning Strategies

Activity 1: Demonstrate understanding on Digital Analog Circuit and Electronic Circuit.

Activity 2: Make a model of a simple electronic circuit.

Activity 3: Identify and explain terms that are related to electronic circuits.

Resources:

<https://www.electronicshub.org/basic-electrical-circuits-componentstypes/>

Lesson Procedures:

Teacher (Outline of teaching Strategies)	Students (Outline of learning strategies)
Lesson Introduction	
1. Engaged and ask students the following: ✓ What is the difference between Analogue Circuit and Digital Circuit?	1. Write down their answers to the questions. 2. Share their answer with their friends
Lesson Body	
1. Model ✓ Teacher gives brief history on the invention of computers.	1. Model • Listen and note the difference and similarities of Analogue and Digital circuits.
2. Guided Practice ✓ Teacher divide students into small groups for discussions ✓ Teacher provide notes or website for students to read about the electric circuits. ✓ Teacher ask students to draw a electric circuit.	2. Guided Practice • In small groups gathered and summaries given/ researched notes • Identify and list components of electric circuits. • Draw an electric circuit
3. Independent Practice ✓ Ask students to collect materials in groups ✓ Allow them at their own time to assemble a basic circuit with one battery, two wires and a bulb (optional: switch). ✓ Ask students to make prediction and write their prediction. ✓ Allow students to present their work in the next class.	3. Independent Practice • Students to collect materials in groups • At their own time assemble a basic circuit with one battery, two wires and a bulb (optional: switch). • Write their prediction. • Prepare to present their work in the next class.
Lesson Conclusion	
Pose Reflection questions: ✓ What are the components of an electric circuit? ✓ Explain with diagram	• Name the components of an electric circuit and Show in diagram how the components are connected.
Formative Assessment	
Area of Assessment	Tick off ✓ or put ✕
• List components of electric circuit	
• Draw an electric circuit	
• Explain the function of each components	

Sample Assessment Tasks

Formative Sample 1 - Unit 1_Topic 1: Computer System

Benchmark 10.5.1.1: Construct and test simple interfaces and other electronic circuits.

Lesson 1: Building Simple Electronics Circuitry

Lesson Objective: By the end of the lesson, students will be able to;

- Explain the components of a circuit and the purpose of each component.
- Use the different components of a circuit to make a circuit.

What is to be assessed? - (KSAVs)

Confidently draw a Timeline highlighting the important people, dates and events in the history of computers.

Purpose of the assessment

To measure students' proficiency on the achievement of the benchmark and lesson objectives

Expected level of proficiency

Draw Timeline and display information in order to appreciate important inventors and their inventions.

Performance Task

Draw Timeline and explain the significance of each invention highlighted.

Assessment Strategy

This assessment can be conducted in one lesson as an assessed lesson exercise.

Assessment Scoring

Rubrics must be developed to articulate the real proficiency of the child. This is an analytical rubrics used to assess the child's learning through the assessment tool and a lesson exercise.

Performance standards/ Criteria	A	B	C	D	Score
	Advance 5	Proficient 4	Progressing 3	Not Yet 2	___/15 Marks
List components of electric circuit	Accurately list all the components and their functions	Logically list all the components of an electric circuits	List partially accurate components of an electric circuit	List some components of electricity with Flawed	
Draw an electric circuit	Draw an electric circuit showing ALL of the components.	Draw an electric circuit showing SOME of the components.	Draw an electric circuit showing FEW of the components.	Draw an incomplete electric circuit showing FEW the components.	
Explain the function of each components	Explain ALL the function of each components with precise information	Explain SOME function of each components with interesting information	Explain FEW of the function of each components with simple explanations	Lacks information to explain the function of each components	
TOTAL SCORE					___/15 Marks

Resource

Bayrak, B., Kanli, U., & Ingec, S. K. (2007). To Compare the Effects of Computer Based Learning and the Laboratory Based Learning on Students' Achievement Regarding Electric Circuits. *Online Submission*, 6(1).

Summative Sample 2 - Unit 1_Topic: Simple Electronic Circuit Circuitry

Content Standard: Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.

Benchmark 10.5.1.1: Construct and test simple interfaces and other electronic circuits.

Lesson Objective: By the end of the lesson, students will be able to;

- Construct and test the simple interfaces and electronic circuitries

Key Concepts(SKAV)	
Essential Skills	Construct and test the simple interfaces and electronic circuitries
Knowledge	Simple Electronic Circuitry
Attitudes	Be creative in constructing simple interface and electronic circuit
Values	Creativity

Purpose of the assessment

To measure students' proficiency on the achievement of the benchmark and learning objectives

Expected level of proficiency

Construct a timeline and state the impacts of computer on each dates.

Performance Task

Be able to Construct a timeline and state the impacts of computer on each dates.

Assessment Strategy

This assessment can be conducted in several lessons as an assessed lesson practical.

Assessment Scoring

Rubrics must be developed to articulate the real proficiency of the child.

This is an analytical rubrics used to assess the child's learning through the assessment tool and a lesson exercise.

Categories	80 – 100% A	70 - 79% B	60 - 69% C	50 - 59% D
Reasoning, Decision-Making, and Problem-Solving – The use of reasoning, decision-making, and problem-solving skills				
	The Student:			
1. Identify the important events and people in the history of computer	List different events and state with high effectiveness the uniqueness of their development	List different events and state with considerable uniqueness of their development	List different events and state some of the uniqueness of their development	List different events and state with few uniqueness of their development
2. Draw a Timeline showing the history of computer	uses reasoning skills with high degree of effectiveness when drawing a timeline with vivid dates	uses reasoning skills with considerable effectiveness when drawing a timeline with interesting dates	uses reasoning skills with some effectiveness when drawing a timeline with dates	uses reasoning skills with limited effectiveness when drawing a timeline with few dates
3. State the impacts of computer in their daily life	uses problem-solving skills with high degree of effectiveness	uses problem-solving skills with considerable effectiveness	uses problem-solving skills with some effectiveness	Uses problem-solving skills with limited effectiveness

Authentic Assessment

Sample 3

Sample STEAM Assessment

Benchmark 10.5.1.1: Construct and test simple interfaces and other electronic circuits.

Lesson Title: Constructing Simple Electronic Circuitry

Learning Objective: By the end of the topic students will be able to;

- construct a simple electronic circuit that conducts electricity from an energy source.

Conductors, insulators, Circuit Board, Lead Light, clippers, energy source
(Students are encouraged to use available or less cost materials in this assessment)

Key Concepts(SKAV)

Skills	Construct and test the simple interfaces and electronic circuitries
Knowledge	Simple Electronic Circuitry
Attitudes	Be creative in constructing simple interface and electronic circuit
Values	Creativity

Purpose of the assessment

To measure students' proficiency on the achievement of the benchmarks and learning objectives for integrated subjects in the project. (STEAM Project)

Expected level of proficiency

All students are expected to construct a simple electronic circuit from available low cost materials

Performance Task

Students will do a Real World Application Project out of 20 marks. You can use other assessment tools (assignment, projects, etc.) to assess a student's proficiency on these benchmarks.

Task: Students will be given three weeks to complete this task. They are to;

- Investigate materials and principles of electricity.
- Research and develop a predictive model, illustrate and present it to the class using technology.
- Use simple electronic circuit to measure authentic problems

Note: Students may evaluate and synthesise simple electronic circuits to conduct electricity to solve everyday problems. Some of these applications include:

- Light
- Phone charge
- Toys
- Fan
- Sensor

Assessment Strategy

This assessment can be conducted in several lessons as an assessed lesson practical.

Assessment Scoring

Rubrics must be developed to articulate the real proficiency of the child. This is an analytical rubrics used to assess the child's learning through the assessment tool and a lesson exercise.

Criteria	Model/Exemplar	Model/Exemplar	Developing	Beginning
	4	3	2	1
Conduct research on materials and principles of electricity relevant to construct a simple electronic circuit	Correctly explain Most materials and principles that are important to construct simple electronic circuit	Explain some materials and principles that are important to construct simple electronic circuit	Explain briefly few materials and principles that are important to construct a simple electronic circuit	Explain with irrelevant material and principles to construct a simple electronic circuit
Research and illustrate the predictive model	Illustrate clearly and explain All the steps to construct electronic circuit using predictive model	Illustrate and explain Some the steps to construct electronic circuit using predictive model	Illustrate and explain Few the steps to construct electronic circuit using predictive model	Explain few steps to construct electronic circuit using predictive model
Construct an electronic circuit using defined material	Construct a simple electronic circuit that conducts electricity using improvised materials	Construct a simple electronic circuit that conducts electricity using defined materials	Construct a simple electronic circuit with defined material	Not able to Construct a simple electronic circuit
Uses high level skills (evaluate, analyse and synthesis) to solve everyday problems using simple electronic circuit	Uses high degree of skills with high degree of effectiveness	Uses high level of skills with considerable degree of effectiveness	Uses high of skills with some degree of effectiveness	Uses critical skills with limited effectiveness

Sample STEAM Assessment

Strand: Integrate Strand from other Subjects (Mathematics, Science, Agriculture, Social Science, Food, Textile, Construction and Business Studies)

Benchmark 10.5.1.2: Apply fundamental programming concepts to develop a variety of simple programs. Including a program to control an external device.

Topic: Tourism Hotspot in Papua New Guinea

Learning Objective: By the end of the topic students will be able to;

- Showcase 5 interactive maps that promote the environment, historical sites or natural resources.

Key Concepts(SKAV)	
Essential Skills	Apply and Develop simple programming
Knowledge	Simple programming
Attitudes	Be creative
Values	Creativity

What is to be assessed? - (KSAVs)

Students are expected to create an informative map and highlight reasons for tourists to visit an area.

Purpose of the assessment

To measure students' proficiency on the achievement of the benchmarks and learning objectives for integrated subjects in the project. (STEAM Project)

Expected level of proficiency

All students are expected to;

- Create an interactive map with symbols or icons and facts about a place in Papua New Guinea to attract Tourism Hotspots.
- Use icons or symbols to represent information and when clicked, pictures and information will appear.
- Integrate MS PowerPoint and Communication Skills with environment awareness, historical awareness, natural resources awareness, tourism attraction, local or national features and more.

Performance Task

This is a project based-assignment that can be done in a Term by teachers from concerned subjects in other subjects. Each teacher can give 10 minutes of their lesson time for STEAM project which will lead to an informative extracurricular week/day. The teacher can plan for the following activity for each week:

1. Investigate any real-world phenomenon– allow students to examine an area of their choice and contemplate how they connect geography to human activity.
2. Brainstorm a Topic for the Map – Specify a question for investigation using inquiry- based approach. Allow students to investigate the research questions such as:
 - What makes you feel national pride?
 - What historical event influenced the chosen area?
 - How do natural resources support the economy?
 - Why are heritage sites important?
 - How are the people in the area involved in global affairs?
 - Where are the current events happening?
3. Organise Research Finding – the students will investigate a topic based on their inquiry.
4. Create Map and Information Slide – The students will design a map slide with a title, suitable map of the area and produce information slides that contain interesting facts about a location.
5. Connect Slides in Interactive Map – All information on the slide should be connected with a symbol.
6. Do a checklist – Students will assess the navigation, content, and design of the interactive map. Solve any issues.

Share the Interactive Map – Share information with others. This activity can be done during extracurricular activity time where students interact and teachers of respective subjects can be able to carry out assessment.

'FREE ISSUE - NOT FOR SALE'