Technology and Industrial Arts

Communication Technology

Junior High

Grade 11

Teacher Guide

Standards-Based

Papua New Guinea
Department of Education

Technology and Industrial Arts

Communication Technology

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Teacher Guide

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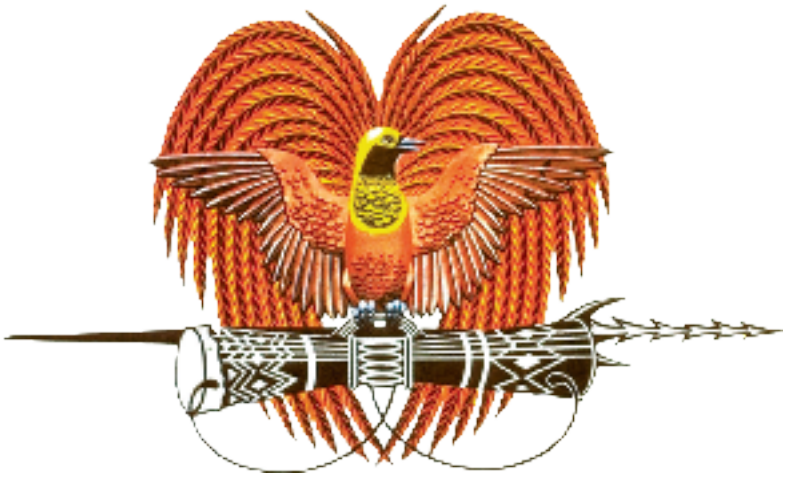

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Acronyms

AAL	Assessment as Learning
ARS	Audience Response System.
AFL	Assessment for Learning
AOL	Assessment of Learning
BoS	Board of Studies
CDD	Curriculum Development Division
CP	Curriculum Panel
CT	Computer Technology
DA	Diagnostic Assessment
IHD	Integral Human Development
GoPNG	Government of Papua New Guinea
KSVA	Knowledge Skills Values and Attitudes
MTDG	Medium Term Development Goals
NDoE	National Department of Education
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.

Standards-Based Curriculum (SBC) in PNG is closely aligned to and is key to achieving this aim and its related operational goals. The curriculum is underpinned by four key pillars:

- morals, values and attitudes
- cognitive, reasoning, decision-making, problem-solving, high level, and 21st century skills
- Science, Technology, Engineering, Arts and Mathematics (STEAM), and
- core curriculum

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 visualse 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.

In 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 Computer Technology Strand knowledge, skills, values and attitudes, and attain the national content standards.

I approve and commend this Computer Technology Strand Teacher Guide to be used by Grade 11 Teachers in all High Schools throughout Papua New Guinea.

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DR. UKE W KOMBRA, PhD

Secretary for Education

Introduction

Computer Technology Strand 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 computer 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 11 to 12 in a week.

Structure of the Teacher Guide

There are four main parts to this teacher guide. They provide essential information on what all teachers should know and do to effectively implement the Computer Technology Strand.

1. General Information of the Subject/Strand

   The general information section of the Teacher Guide informs teachers on the Computer Technology 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 Programming
   - 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 subject.

Purpose of the Teacher Guide

This teacher guide describes what all teachers should know and do to effectively plan, teach, and assess Grade 11 Computer Technology 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 teacher guide to plan, teach and assess different Computer Technology units and topics, and the KSVAs described in the grade-level benchmarks;

- understand the Computer Technology national content standards, grade-level benchmarks, and evidence outcomes;

- effectively make sense of the content (KSVAs) described in the Computer Technology 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 skills, processes, concepts, ideas, principles, practices, values and attitudes.

- confidently interpret, translate and use Computer Technology 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 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

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 11 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 subject, 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 Cre-

ative 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 on. 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 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.

Syllabus and Teacher Guide Alignment

The Grade 11 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 Outlines the ultimate aim and goals, and what to teach and why teach it	Teacher Guide 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 11 Communication 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 and Evidence Outcomes are linked to Learning Objectives, Lesson Objectives and Performance Standards in the Teacher Guide. (see table). 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 perfor-

mance 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.

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.

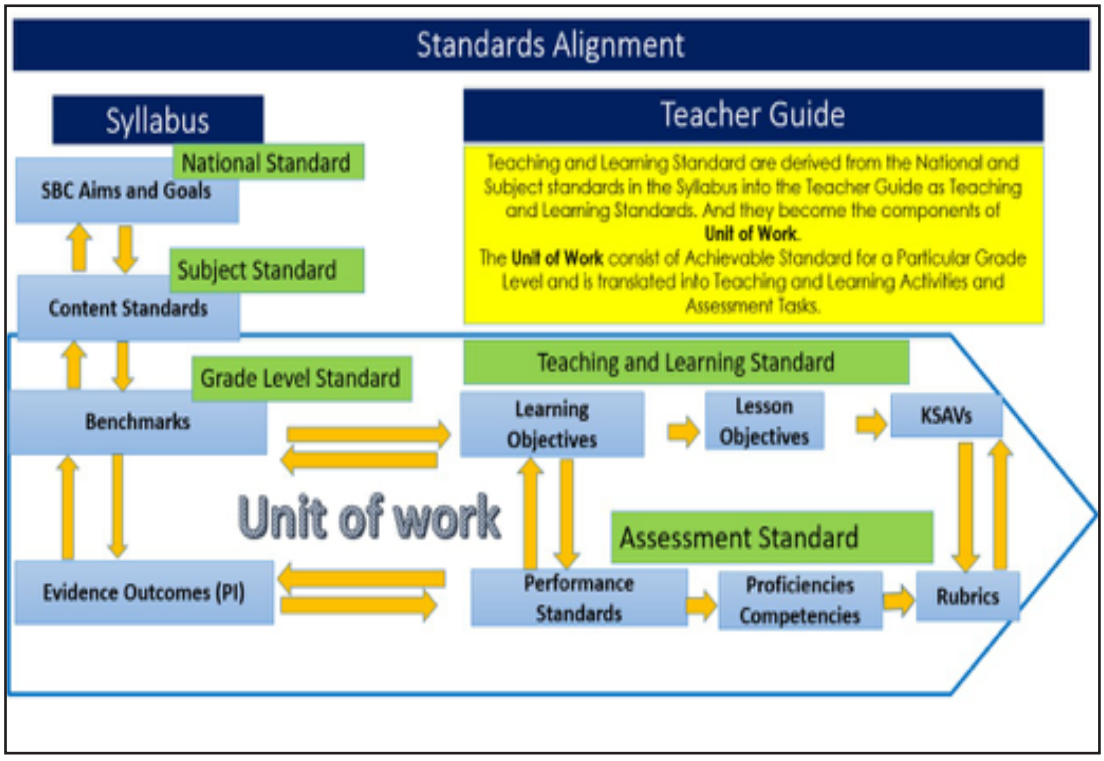


Figure 3 Standards Alignment that shows the alignment of standards in the syllabus and teacher guide

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 intended 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.

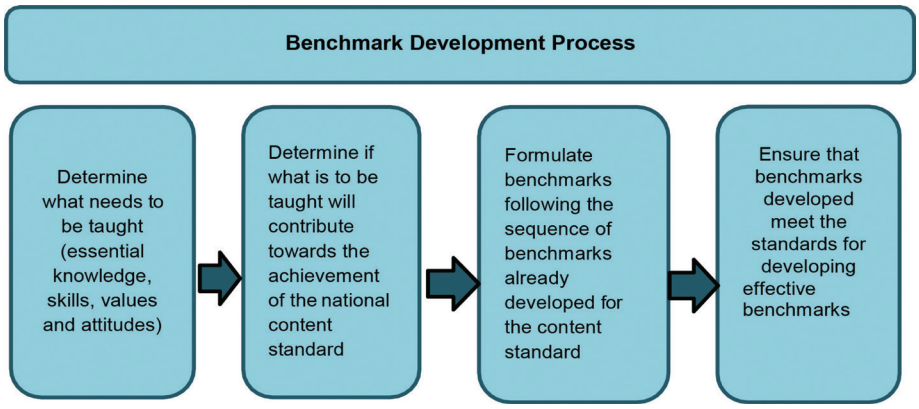
Approach for Setting National Content Standards and Grade-Level Benchmarks

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, reflect, 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



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 is 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 parts of a computer.

Performance Standards:

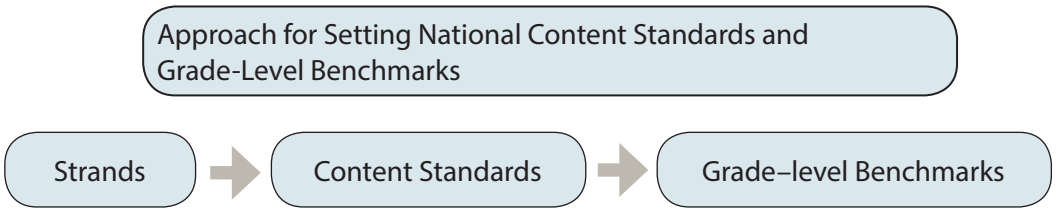
Performance Standards are concrete statements of how well students must learn what is set out in the content standards, often called the “be able to do” of “what students should know and be able to do.” Performance standards are the indicators of quality that specify how competent a students’ demonstration 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 of 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 learnings must be at the heart of all teaching and extracurricular programs and activities.

Science, Technology, Engineering, Arts and Mathematics (STEAM)

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:

- examine and use evidence to draw conclusions about how STEAM has and continues to change the social, political, economic, cultural and environmental contexts.
- Investigate and draw conclusions on the impact of STEAM solutions to problems on the social, political, economic, cultural and environmental contexts.
- Identify and solve problems using STEAM principles, skills, concepts, ideas and process.
- Identify, analyse and select the best solution to address a problem.
- build prototypes or models of solutions to problems.
- replicate a problem solution by building models and explaining how the problem was or could be solved.
- test and reflect on the best solution chosen to solve a problem.
- collaborate with others on a problem and provide a report on the process of problem solving used to solve the problem.
- use skills and processes learnt from lessons to work on and complete STEAM projects.
- demonstrate STEAM principles, skills, processes, concepts and ideas through simulation and modeling.
- 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 21s 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 advance 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 addressed a real problem and meets a human need.

The following are some of the STEAM problem solving processes.

1. 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.

2. 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.

3. 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 need to be tested. This process continues until the solution is found and the device is operating properly.

4. Troubleshooting

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

5. 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.

6. 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.

7. Extreme Cases

   Considering “extreme cases” – envisioning the problem in a greatly exaggerated or greatly simplified form, or testing using extreme condition – 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.

8. Trial and Error

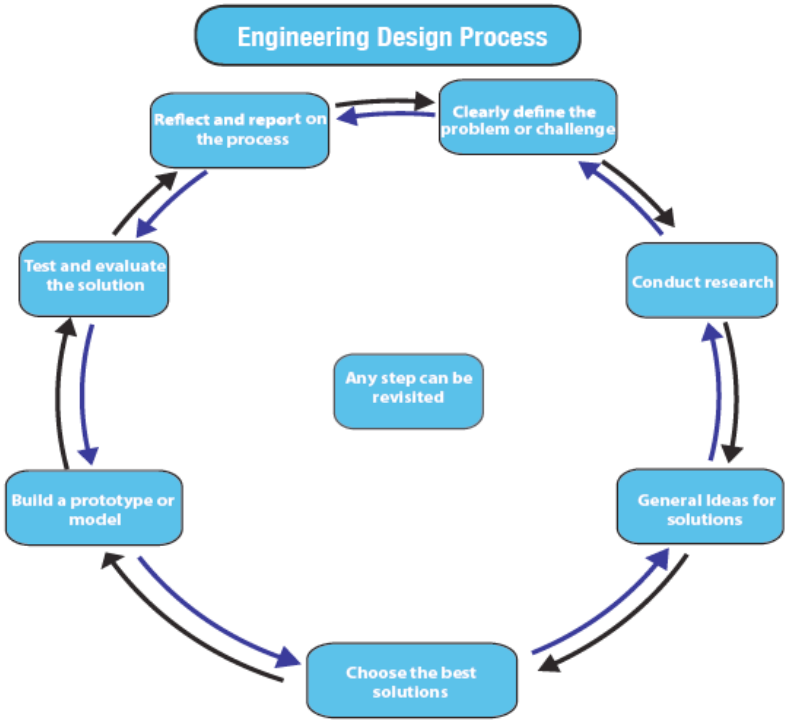
   The trial and error method involve trying different approaches until a solution is found. It is often used as a last resort when other methods have been exhausted.

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 sketch ing.
- 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.



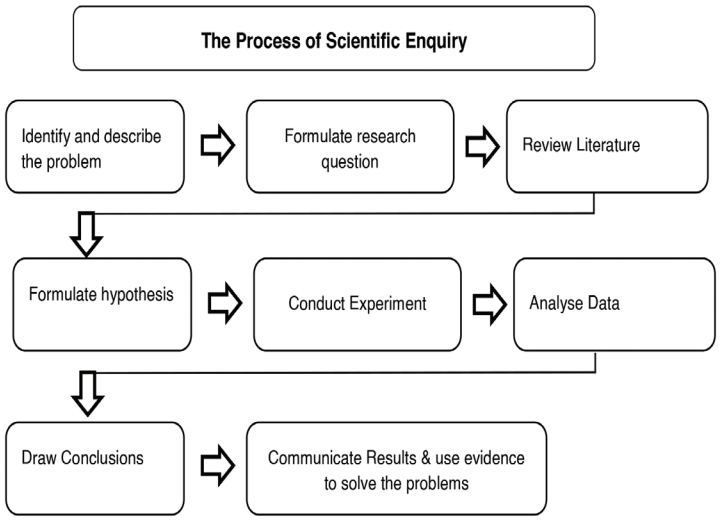
The Scientific Method and Approach to Problem-Solving

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:

- Observation
- Communication
- Classification
- Measurement
- Inference
- 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 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 comes 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 ask 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 experi-

ment/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. Scientist 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 experiment 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, scientist 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 main 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:

Define the problem

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

Conduct research

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

Brainstorming and conceptualization

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.

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.

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.

Product analysis

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

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 key to the achievement of expected STEAM 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 STEAM-based lesson plan is provided in appendix. 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.

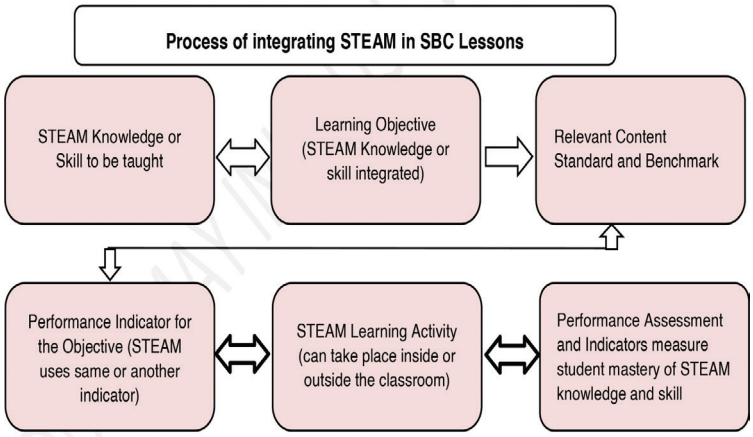
STEAM principles and problem-solving skills are integrated into the content standards and grade-level benchmarks. A list of these skills, including 21st century skills, is provided in the

grade 9 syllabus. Teachers should ensure that these skills are integrated in their standards-based lesson plans, taught and assessed to determine students' level of profi-

ciency on each skill or specific components of the skill. Teachers should use the following process as 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 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 KSVAs for each content standard and benchmark). This is could already be 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 the STEAM knowledge or skill specified by the learning objective and appropriate statement of the standards). Activity can take place inside or outside of the classroom, and during or after school hours.

Step 4: Develop and use performance descriptors (standards or indicators) to analyse students' STEAM related behaviours and 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 coming up with technological solutions.

Inquiry-Based Learning

Problem-Based Learning

Project-based learning

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 inquiry 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.

Participatory Learning

Group-Based Learning

Task Oriented Learning

Action Learning

Experiential Learning

Modeling

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 giving 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 students' level of competency or proficiency 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, assessments are designed for what students should know and be able to do. In STEAM learning students are assessed in a variety of ways including portfolios, project/problem-based assessments, backwards design, authentic assessments, or other student-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 Assessments (PBAs)
3. Portfolios
4. Student self-assessment
5. Peer-assessment
6. Student Response Systems(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 in use fit under one or more of the categories discussed. Furthermore, it is important to note that these strategies also connect in a variety of ways.

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 discrete 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 discussed in those sections as well.

Performance-Based Assessments

Performance-Based Assessments (PBA), also known as project-based or authentic assessments, 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.

Portfolio Assessment

Portfolios are a collection of student work gathered over time that is primarily used as a summative 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 standardised test), it highlights student effort, development, and achievement over a period of time; portfolios measure a student’s ability to apply knowledge rather than simply regurgitate. They are considered both student-centred and authentic assessments of learning.

Self-assessment

While the previous assessment tools and strategies listed in this report generally function as summative approaches, self-assessment is generally viewed as a formative strategy, rather than one used to determine a student’s final grade. 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 is negotiated between 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.

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 variety of products like papers, presentations, projects, or other skilled behaviours. Peer 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 assessee’s skills and knowledge.

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

Student Response System

Student response system (SRS), also known as classroom response (CRS), audience

response system (ARS) is a 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 teachers analysing information quickly and then devising real-time instructional solutions to maximize student 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)

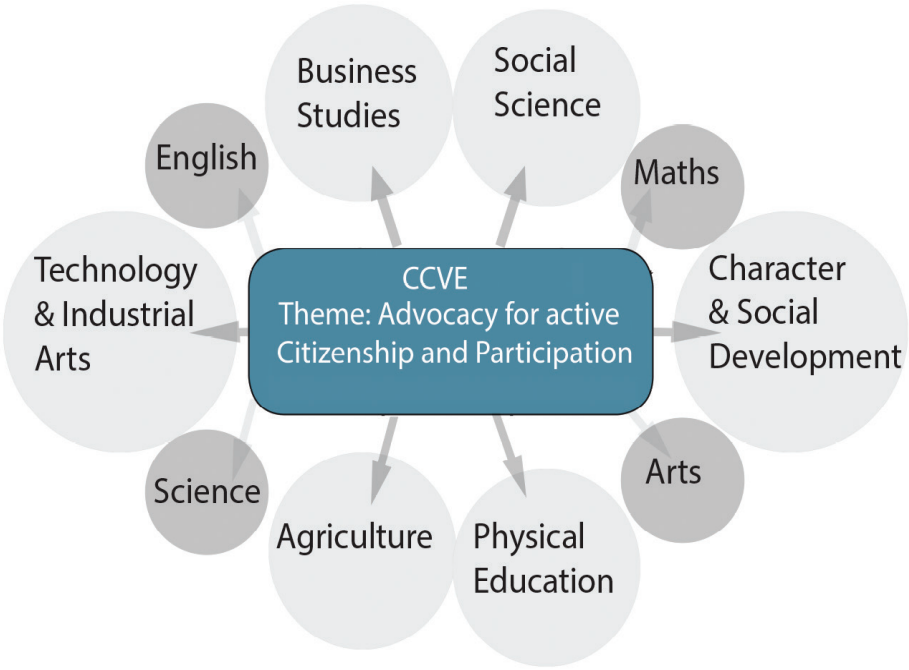
Teachers must develop intriguing curriculum by going beyond the traditional teaching of content based or fragmented teaching to one who is knowledge based and who should be perceived as a 21st century innovative educator. Curriculum integration is a holistic approach to learning thus curriculum integration in PNG SBC will 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 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.

(i) 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.

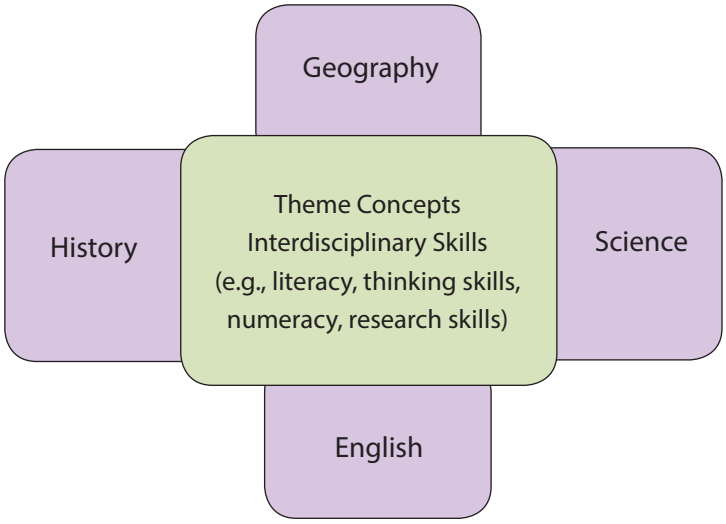


(ii) Interdisciplinary Approach

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.

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, children are well aware of the issues surrounding global warming and can address it confidently at each level of learning.



(iii) 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 effect these need. 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.

The three steps to planning project based curriculum (Chard 1998).

Teachers and students select a topic of study based on student interests, curriculum standards, and local resources

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.

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 have led to the following:

Students go far beyond the minimum effort

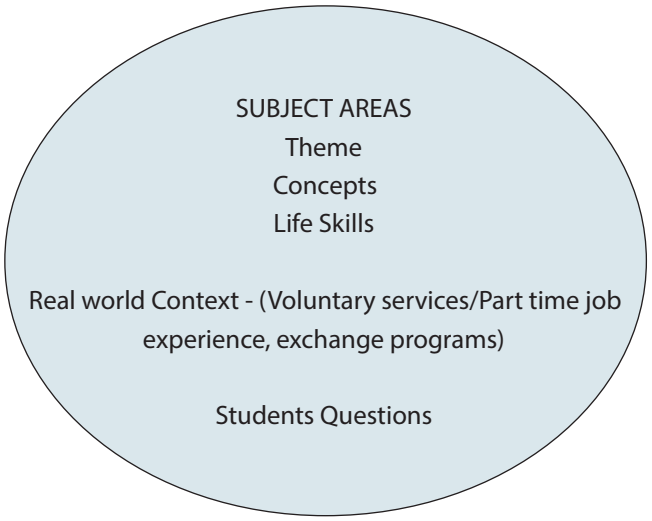
Make connections among different subject areas to answer open-ended questions

Retain what they have learnt

Apply learning to real-life problems

Have fewer discipline problems

Lower absenteeism (Curtis, 2002)



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 deepen 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

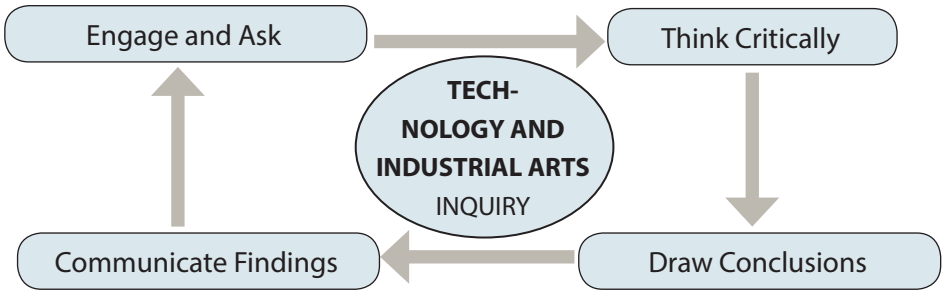
There are different types of knowledge. These include;	
• Public and private (privileged) knowledge • Specialized knowledge • Good and bad knowledge • Concepts, processes, ideas, skills, values, attitudes • Theory and practice • Fiction and non-fiction • Traditional, modern, and postmodern knowledge	• 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	

Technology 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.



Types of Skills:

There are different types of skills. These include:

i. Cognitive (Thinking) Skills

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

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;	
• Attributing • Comparing and contrasting • Grouping and classifying • Sequencing • Prioritising • Analysing	• Detecting bias • Evaluating • Metacognition (Thinking about thinking) • Making informed conclusions.

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;	
• Generating ideas • Deconstruction and reconstruction • Relating • Making inferences • Predicting • Making generalisations • Visualising	• Synthesising • Making hypothesis • Making analogies • Invention • Transformation • Modeling • Simulating

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

iii. 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.

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

v. 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	• 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 • 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

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

vii. 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	Organise	Theme
Categorise	Distinguish	In-depth	Point out	
Cause & effect	Dissect	Inference	Research	

Choose	Divide	Inspect	See	
Classify	Establish	Isolate	Select	
Comparing	Examine	Investigate	Separate	

viii. 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.

ix. 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 people to acquire and apply skills and dispositions that will prepare them to become competent and responsible citizens.

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

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

ii. Social Values

Core Values	Sustaining Values
• Equality	• Plurality
• Kindness	• Due process of law
• Benevolence	• Democracy
• Love	• Freedom and liberty

• Freedom • Common good • Mutuality Justice • Trust • Interdependence • Sustainability • Betterment of human kind • Empowerment	• Common will Patriotism • Tolerance Gender equity and social inclusion • Equal opportunities • Culture and civilisation • Heritage • Human rights and responsibilities • Rationality • Sense of belonging Solidarity • Peace and harmony • Safe and peaceful communities

Types of Attitudes:

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 teach to enhance students' understanding of inter-disciplinary concepts and issues in relation to environment, geography, history, politics and economic 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.

Strands, Units and Topics

This section of the teacher guide contains the Technology and Industrial Arts : Communication Technology content to be taught in grade 12. It consists of;

a brief explanation of how the topics, learning objectives and lesson topics are derived.

an overview of the content distributed according to the four terms in an academic year;

the unit of work per strand

Technology and Industrial Arts is organised around five main strands – Textiles, Food, Construction, Communication, and Computer of which Communication Technology is one strand. These strands embed the content that students are expected to learn and master at each grade and school level. National content standards are benchmarked at each grade level, which allows for essential KSAVs to be reinforced and expanded throughout the grades.

Benchmarks show grade level expectations of what students are able do to demonstrate that they are making progress towards attaining the content standard.

These grade-level benchmarks were then unpacked to identify the topics, learning objectives and the lesson topics. Below is a description of how topics were derived from the grade-level benchmarks.

Identifying topics from benchmarks

In order to identify the topic from the benchmark, we need to unpack the benchmark. When we unpack a benchmark, we are identifying what students will know and be able to do when they have mastered the benchmark.

- Write out the benchmark that you want to unpack.
- Write the verbs (skills/actions) – Higher order thinking skills
- Underline or highlight the big idea (content) in the benchmark. The big idea (content) is the topic derived from the benchmark.
- Write essential questions that would be engaging for students
- Develop sub-topics from the big idea (topic)
- Write learning objectives according to the sub-topics
- Write lesson topics from the learning objectives

The teaching and learning of Communication Technology as a strand in Grades 9 will follow the outline of content for the four terms in a year as a strand within the Technology and Industrial Arts.

This is only a sample to guide teachers as to how they are going to plan and teach the five strands in Technology and Industrial Arts in a school year.

TERM	STRAND	UNIT	CONTENT STANDARD
1	Textiles Technology	Fibres and Fabrics	**CS1.1** Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.
		Textiles 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
	Food Technology	Food and Nutrition	**CS2.1** Examine and analyse the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.
		Food Science	**CS2.2** 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 (eg, health, occasions, lifestyle, business)
2	Construction Technology	Building Technology	**CS3.1** 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.
		Electrical Technology	**CS3.2** 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.
		Plumbing Technology	**CS3.3** Investigate and analyse fundamental concepts of plumbing and theories, Occupational Health and Safety Regulations and standards ,trade drawing, demonstrations and applications of tools and materials specifications, installation of plumbing fittings and accessories in Drain, waste, vent system, and water (DWV) distribution system.
		Welding Technology	**CS3.4** 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.
		Engineering Technology	**CS3.5** 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.

3	Communication Technology	Data Communication and Network	CS4.1 Investigate and analyse communication technology utilising multi-media and the practices and systems in designing, installing, configuring and managing networks.
		Computer Security and Safety	CS4.2 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.
4	Computer Technology	Computer Architecture	CS5.1 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.
		Computer Software	CS5.2 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.

This strand consists of two (2) units ;

- Unit 1: Data Communication and Network and
- Unit 2: Computer Security and Safety

UNITS	TOPICS	LESSON TITLES
Unit 1: Data Communication and Network		
	1: Design Process	1. Introduction to design process 2. Implementation of a design process 3. Documentation of a design process
	2: Communication Design Principles	1. Case Studies (Published and Presented Project) Note: incorporate STEAM
	3: Internet (Advanced search strategies)	1. Introduction to Internet 2. Search browsers and Engines 3. Advanced Search Strategies 4. Internet strengths and limitations 5. The quality and appropriate use of Internet resources

	4: Technology Enhanced – Creative Works or Model	1. Appropriate Technology tools and resources for creative work 2. Technology tools and resource. (Incomplete) 3. Construction of technology enhanced models
	5: Multimedia Products	1. Elements of Multimedia 2. Enterprise multimedia products
	6: Communication Technology	1. Moral values (ethics) in communication technology 2. Responsible ways of using technology
	7: Impact of Computing	1. Impact of computer in: • Business • Manufacturing • the Society
Unit 2: Computer Security and Safety		
	1. Implication and Usage of Computer	• Impacts of computer usage on social and economic sector • Impacts of computer usage on business and society
	2. Data Security – File Maintenance	• Data Security • File Maintenance
	3. Ethical and Legal Technology	• ICT Standards • ICT Governing bodies • Ethical and Legal Technology • Solution and Strategies
	4. Data Encryption	• Introduction to data Encryption • Data Encryption Strategies and Schemes
	5. IT Copyright Law	• Introduction to Intellectual Property Theft • Copyright Law • Consequence of Bridging Copyright Law
	6. Network Security Threats	• Network Security • Types of Threats

UNIT 1: DATA COMMUNICATION AND NETWORK

Unit	Benchmarks	Topics	Lesson Titles
UNIT 1: DATA COMMUNICATION AND NETWORK			
	12.4.1.1	Design Process	• Introduction to design process • Implementation of a design process • Documentation of a design process
	12.4.1.2	Communication Design Principles	1. Case Studies (Published and Presented Project) Note: incorporate STEAM

	12.4.1.3	Internet (Advanced search strategies)	• 1.Introduction to Internet 2.Search browsers and Engines 3.Advanced Search Strategies • 4.Internet strengths and limitations 5.The quality and appropriate use of • Internet resources
	12.4.1.4	Technology Enhanced – Creative Works or Model	• Appropriate Technology tools and resources for creative work • Technology tools and resource. (Incomplete) • Construction of technology enhanced models
	12.4.1.5	Multimedia Products	• Elements of Multimedia • Enterprise multimedia products
	12.4.1.6	Communication Technology	• Moral values (ethics) in communication technology • Responsible ways of using technology
	12.4.1.7	Impact of Computing	• Impact of computer in: • Business • Manufacturing • the Society

UNIT 1. Data Communication and Network
Content Standard: 4.1 Investigate and analyse communication technology utilising multi- media and the practices and systems in designing, installing, configuring and managing networks.
Benchmark:. 12.4.1.1 Implement, document and present the design process as applied to a particular product, process or problem.
Topic 1: Design Process

Learning Objectives

By the end of this topic, the students will be able to;

Implement, document and present the design process of a Web Application page

Explore the design of Website Prototype from a wireframe

Essential Questions:

What is a Web Application process?

What steps are involved in the Web Application process?

What is the importance of Web Application process?

Essential knowledge, skills, values and attitudes

Knowledge	Skills	Values	Attitudes

• Implementation, Documentation and presentation of a Web Application • Design Process - • Web Application	• Implement documentation • Presentation	• Creativity, empowerment, participatory	• Creative, Critical, confident

Technology and Industrial Arts Application: Communication Technology

Content Background

What is Design Thinking?

Design thinking is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. Involving five phases—Empathize, Define, Ideate, Prototype and Test—it is most useful to tackle problems that are ill-defined or unknown.

Van den Hoven, J., Blaauw, M., Pieters, W., & Warnier, M. (2014). Privacy and information technology.

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 data communication and network. 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 design process – Web Application Development Process

Teaching Strategies

Engage students in the discussion in group on Web Application Development Process

Engage the students in the present of their discussion on the steps of Web Application Development Process.

Learning Strategies

Activity 1 Define and understand what is a Web Application Development Process

Activity 2 Discuss the function of a Web Application and process

Activity 3 Demonstrate on computer the application used to create Web page

Resources: https://existek.com/blog/web-application-development-process-flow/

Lesson 2: Implementation of a design process

Teaching Strategies

Apply the design process in the creation of a web page.

Learning Strategies

Activity 1 Identify the web page development problem to be solved using the design process.

Activity 2 Conduct research in exploring ways of solving the problem.

Activity 3 Using a computer application, create a web page prototype.

UNIT 1. Data Communication and Network
Content Standard: 4.1 Investigate and analyse communication technology utilising multi-media and the practices and systems in designing, installing, configuring and managing networks.
Benchmark:. 12.4.1.2 Apply appropriate communication design principles in published and presented projects to communicate with others, incorporating emerging technologies
Topic 2: Communication Design Principles

Learning Objectives

By the end of this topic, the students will be able to;

Apply appropriate communication design principles in:

published projects to communicate with others, incorporating emerging technologies

presented projects to communicate with others, incorporating emerging technologies

Essential Questions:

What is communication design principles?

What steps are involved in the communication design principles?

What are emerging technologies?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
Communication Design Principles	Apply	Rationality, creativity, empowerment	Creative, critical

Content Background

Data Communication Concepts

Description of Data Communication:

Communication can be defined as the exchange of information between two or more bodies. In engineering, exchange of information is not only between people, information exchange also takes place between machines or systems. Communication has increased significantly in importance in recent years. Voice services have seen unprecedented increase in use throughout the world with the introduction of mobile phones, with embedded data services such as SMS, and web browsing.

Data is referred to as a piece of information formatted in a special way. Data can exist in a variety of forms, such as numbers or text on pieces of paper, as bits and bytes stored in electronic memory, or as facts stored in a person's mind. Strictly speaking, data is the plural of datum, a single piece of information. In practice, however, people use data as both the singular and plural form of the word. In electronics terms data is a digital bit or digitized analog signal. Signals are physical quantity that changes with time.

Signal can be a voltage that is proportional to the amplitude of message. It could also be a sequence of pulses in fiber optics cable or electromagnetic wave irradiated by an antenna. When these signals are transfer between two or more points, we say data is transmitted. Transmission of data from source to destination usually takes place via some transmission media and this depends on two main factors; quality of signal being transmitted and characteristics of transmission medium. Data transmission always uses the form of electromagnetic waves and they are classified into guided electromagnetic waves and unguided electromagnetic waves. Examples of guided waves are twisted pair, coaxial cable and optical fiber. Unguided waves mean transmitting electromagnetic waves but they are not guided as example propagation through air, vacuum and seawater.

1.1 Analog and Digital Signal

The entire world is full of signals, both natural and artificial. Signals can be analog or digital. Figure 1 illustrates an analog signal. The term analog signal refers to signal that is continuous and takes continuous value. Most phenomenon's in the world today are analog. There are an infinite number of colours to paint an object (even if the difference is indiscernible to the eye), it is possible for us to hear different sounds and also smell different odours. The common theme among all of these analog signals is their infinite possibilities.

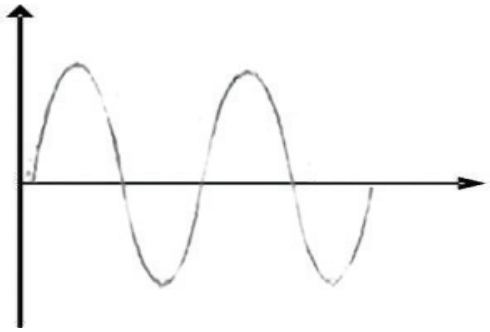


Figure 1: Typical Analog signal

As seen time is plotted on horizontal (x-axis), and voltage on the vertical (y-axis).

While this signal may be limited to a range of maximum and minimum values. There are still an infinite number of possible values within that range. For example, the analog voltage that light the bulbs is clamped between -220V and +220V, but as you increase the resolution more and more, you discover an infinite number of values that the signal can be. For example, pure audio signals are analog. The signal that comes out of a microphone is full of analog frequencies and harmonics, which combine to beautiful music.

A digital signal is a physical signal that is a representation of a sequence of discrete values. The signal must have a finite set of possible values, the number of sets which can be anywhere between two and very large number that is not infinity. Digital signal is one of two voltage value (0V or 5V) timing graphs of these signals look like square waves as shown in figure 2.

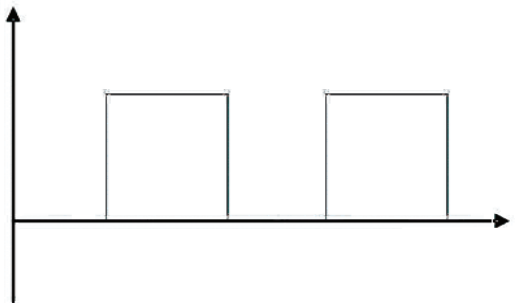


Figure 2: Typical Digital Signal

1.2 Why Data Communication?

Data communication refers to the movement of encoded information from one point to another by means of electronic transmission system. It can also be defined as the exchange of data between two devices via some form of transmission medium which can be wired or wireless. Another definition for data communications simply mean the transferring of digital information (usually in binary form) between two or more points (terminals). At both the source and destination, data are in digital form; however, during transmission, they can be in digital or analog form Information is carried by signal, which is a physical quantity that changes with time. The signal can be a voltage proportional to the amplitude of the voice like in simple telephone, a sequence of pulses of light in an optical fiber, or a radio-electric wave radiated by an antenna.

The fundamental purpose of data communication is to exchange information which is done by following certain rules and regulations called protocols and standards. Communications between devices are justified for the following reasons:

i. Reduces time and effort required to perform business task

ii. Captures business data at its source

iii. Centralizes control over business data

iv. Effect rapid dissemination of information

v. Reduces current and future cost of doing business

vi. Supports expansion of business capacity at reasonably incremental cost as the organization Supports organization‘s objective in centralizing computer system

vii. Supports improved management control of an organization

Components of Data Communication:

Basic Components of data communication are: Source: It is the transmitter of data. Examples are: Terminal, Computer, Mainframe etc. Medium: The communications stream through which the data is being transmitted. Examples are: Cabling, Microwave, Fiber optics, Radio Frequencies (RF), Infrared Wireless etc. Receiver: The receiver of the data transmitted.

Examples are: Printer, Terminal, Mainframe, and Computer.

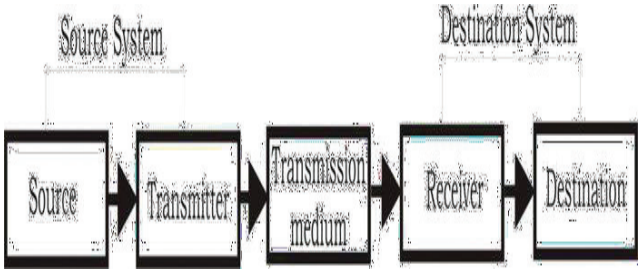


Figure 3: Data Communication System

It shows the basic block diagram of a typical data communication system. This can further be broken down to three; the source system, transmission system and destination system

i. Source

The source generates the information or data that will be transmitted to the destination. Popular forms of information include text, numbers, pictures, audio, video or a combination of any of these. Information are put together in analog or digital form and broken into group or segment of data called packets. Each packet consists of the following:

- the actual data being sent
- header
- information about the type of data
- where the data came from
- where it is going, and
- How it should be reassembled so the message is clear and in order when it arrives at the destination

ii. Transmitter

The transmitter a device used to convert the data as per the destination requirement. For example, a modem, converts the analog (telephonic) signal to digital (computer) signals and alternatively digital to analog

iii. Transmission medium

The transmission medium is the physical path by which data travels from transmitter to receiver. Example of such channels is copper wires, optical fibers and wireless communication channels etc.

iv. Receiver

This receives the signals from the transmission medium and converts it into a form that is suitable to the destination device. For example, a modem accepts analog signal from a transmission channel and transforms it into digital bit stream which is acceptable by computer system.

v. Destination

It is simply a device for which source device sends the data.

Data Communication Criteria

The effectiveness of data communications system depends on four fundamental characteristics:

Delivery. The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.

Accuracy. The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable

Timeliness. The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called real-time transmission and this occurs in a real-time system

Jitter. Jitter refers to the variation in the packet arrival time. It is the uneven delay of delivery of audio or video packets. For example, let us assume that video packets are sent every 20ms. If some of the packets arrive with 20ms delay and others with 30ms delay, an uneven quality in the video is the result.

Data Communication and Terminal Equipment Communication

Facilities have an ancient history, but we tend to think of the advent of the telegraph and later the telephone as the beginning of modern communications. Extensive telegraph and telephone networks were established all over the world, decades before the emergence of computers. Data communication equipment (DCE) is the hardware devices that can be used to establish, maintain and terminate communication between a data source and its destination. Data communications equipment is most used to perform signal exchange, coding and line clocking tasks as part of intermediate equipment or DTE. A typical example of data communication equipment is the modem.

Data terminal equipment (DTE) refers to the interface equipment which is source or destination in communication. The terminal equipment is capable of converting infor-

mation to signals and also reconverting received signals. Data terminal equipment does communicate directly with each other. Communication between them is done by data communication equipment. Popular examples of data terminal equipment are computers, printers, routers, servers etc.

Data communication equipment and data terminal equipment are often confused with each other. In fact, the confusion is more pronounce when data communication equipment is embedded in some data terminal equipment. The truth is that when the two are separated they are interlinked. Also, data terminal equipment and data communication connectors are wired differently if a single straight cable is employed. Data communication equipment generates internal clock signals, while data terminal equipment works with externally provided signals. Figure 4 shows a typical arrangement of data communication and terminal equipment

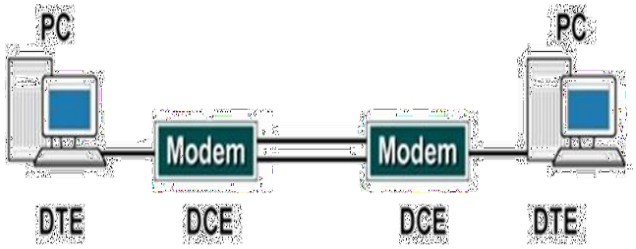


Figure 4: Data communication

vi. Data Representation

Data representation is defined as the methods used to represent information in computers. Different types of data can be stored in the computer system. This includes numeric data, text, executable files, images, audio, video, etc. all these will look different to us as human. However, all types of information or data stored in the computer are represented as a sequence of 0s and 1s.

vii. Decimal Numbers

As human we are used to writing numbers using digits 0 to 9. This is called base 10. This number system has been widely adopted, in large part because we have 10 fingers. However, other number systems still persist in modern society.

viii. Binary Numbers

Any positive integer (whole number) can be represented by a sequence of 0s and 1s. Numbers in this form are said to be in base two, and are called binary numbers. Computers are based on the binary (base 2) number system because electrical wire can only be of two states (on or off).

Hexadecimal Numbers

Writing numbers in binary is tedious since this representation uses between 3 to 4 times as many digits as the decimal representation. The hexadecimal (base 16) number system is often used as shorthand for binary. Base 16 is useful because 16 is a power of 2, and numbers have roughly as many digits as in the corresponding decimal representation. Another name for hexadecimal numbers is alpha decimal because the numbers are written from 0 to 9 and A to F. where A is 10, B is 11 up to F that is 15.

Text

American Standard Code for Information Interchange (ASCII code) defines 128 different symbols. The symbols are all the characters found on a standard keyboard, plus a few extra. Unique numeric code (0 to 127) is assigned to each character. In ASCII, -A‖ is 65, -B‖ is 66, -a‖ is 97, -b‖ is 98, and so forth.

When a file is saved as -plain text‖, it is stored using ASCII. ASCII format uses 1 byte per character 1 byte gives only 256 (128 standard and 128 non-standard) possible characters. The code value for any character can be converter to base 2, so any written message made up of ASCII characters can be converted to a string of 0s and 1s.

ix. Graphics

Graphics on computer screen are consists of pixels. The pixels are tiny dots of color that collectively paint a graphic image on a computer screen. It is physical point in a raster image, or the smallest addressable element in an all points addressable display device. Hence it is the smallest controllable element of a picture represented on the screen. The address of a pixel corresponds to its physical coordinates. LCD pixels are manufactured in two-dimensional grid, and are often represented using dots or squares, but CRT pixels correspond to their timing mechanism and sweep rates. The pixels are organized into many rows and columns on the screen.

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 data communication and network. 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: Case Studies (Published and Presented Project) Note: incorporate STEAM

Teaching Strategies

Research the communication design principles using case studies.

Learning Strategies

- Activity 1: Research case studies that use the communication design principles
- Activity 2 : Discover their benefits and implications in communication.
- Activity 3: Discover how STEAM can be the driving factor of communication.

Content Standard: 4.1 Investigate and analyse communication technology utilising multi- media and the practices and systems in designing, installing, configuring and managing networks.
Benchmark:.12.4.1.3. Formulate advanced search strategies, demonstrating an understanding of the strengths and limitations of the Internet, and evaluate the quality and appropriate use of Internet resources
Topic 3: Internet (Advanced search strategies)

Learning Objectives

By the end of this topic, the students will be able to;

Formulate and demonstrate advanced search internet strategies

Evaluate the quality and appropriate use of Internet resources

Essential Questions:

What is internet ?

What makes up the internet?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
Internet	Formulate, Demonstrate, Evaluate	Creativity, Simplicity, Empowerment	Creative, Appreciative, Responsible

Technology and Industrial Arts Application: Communication Technology

Content Background

Internet:

The Internet alternatively referred to as the net or web is the world's largest network because it's a collection of worldwide system of computers and networks linked together. These computers and networks, which are scattered across the globe, vary in shape and size. They cooperate with each other in order to exchange data through a wide variety of network technologies. Words, images, sound and software can all be transmitted through via the telephone system, copper wires, cables, optical fibers or radio waves. The Internet contains billions of web pages created by people and companies from around the world, making it a limitless place to locate information and entertainment. The Internet also has thousands of services that help make life more convenient.

Internet basics:

- The Internet and the WWW are not the same.
- The Internet is explored using a browser and the act of browsing the Internet is commonly referred to as surfing.
- Users browse websites and web pages by following hyperlinks that point to an address more commonly referred to as a URL.

- Finding information on the Internet is achieved by using a search engine.
- Files, pictures, songs, and video can be shared by downloading (receiving) and uploading (sending).
- The Internet utilizes the TCP/IP protocol and is accessed using a computer modem, broadband, 3G, 4G, or network that is connected through an ISP (Internet Service Provider).
- With broadband, many computers and devices use Wi-Fi to connect to a router and share an Internet connection.
- The computer you're using to view this web page is considered a host and it's connected to our server to view this page.

Why the Internet is considered a network?

The Internet is the world's largest network because it's a collection of computers and servers that are connected to each other globally using routers and switches. The Internet works the same way a network would in a home or office but has millions of more computers, routers, and switches.

Search Engine and Web Browser Search Engine

Most information is found on the Internet by utilizing search engines.

A search engine is a web service that uses web robots to query millions of pages on the Internet. Internet users can then use these services to find information on the Internet.

A search engine is software, usually accessed on the Internet that searches a database of information according to the user's query. The engine provides a list of results that best match what the user is trying to find. Clicking a search result opens the linked web page (content) in the web browser.

Popular search engines include: Google, Yahoo and Bing, Web Browser People access search engines from a web browser.

A web browser is an application/program on your computer or your device that allows you to

i. view/browse websites on the internet.

ii. Popular web browsers include: Chrome, Internet Explorer, and Firefox.

Advance Search Strategies/ Techniques

Finding What You Want on the Web Easily, Quickly and Effortlessly

The internet is vast and often confusing, and in order to find what you want, you need to take some basic steps to make your search as focused and rewarding as possible. Strategies for pinpointing the best, most relevant content include the following:

- Vary your search engine/ Try Alternative Search Engine: in fact, get used to using several, as they have different strengths.
- Use specific keywords: be as specific as you can in your wording.
- Simplify your search terms: strip out unnecessary stop words and avoid suffixes.
- Use quotation marks: this narrows searches down to particular words and phrases.
- Remove unhelpful words: remove confusing or misdirecting terms from your searches with the - (minus) operator.
- Refine your search using operators: use operators to search specific sites, related sites, and particular combinations of terms.
- Avoid search pitfalls: the internet is a selling tool as well as a fantastic resource. Be sure that you only view advertisements if you want to

Strengths and Limitation of Internet Strength

- Wealth of Information Resources: - The internet provides a wide range of information resources in almost all fields of knowledge.
- Multimedia Capabilities for Connectivity, Communication and Sharing: Store, Process and Disseminate information in a variety of formats, make it highly convenient for education and training.

Ease of Use: The simplicity and ease to access and use

- Fast and Up to Date: It provides fast and reliable communication infrastructure that provides up-to-date and real-time information
- Number of people reached: Internet has millions of host computers which indicates the wide reach of the internet to a large number of people.
- Affordability: As the technology matures, the cost also goes down.
- Technology Support: A worldwide community of experts is working on this technology round the clock. Many are also working in an individual capacity.

Limitation of Internet

- Availability to rural people: The internet is still an urban phenomenon.
- Costly for an institution or an individual
- Security: As messages travel across several backbone infrastructure, there is the possibility of hacking and leakage of sensitive information over the network.
- Junk e-mail: Consume a lot of subscriber‘s time as Internet are flooded with useless and unwanted e-mails
- Computer Virus: Computers to be installed with antivirus because internet e-mail and download files contain viruses.
- Not Effective or Slow

Quality and Appropriate Use of Internet:

All of the potentially positive uses of the Internet come potential abuses, as well.

From different survey and observation, internet users browser the Web sites that were unrelated to their work. E.g., spending more time on Social Media Texting and

Surfing.

Basic rules and guidelines:

○ Set Up Rules – Clearly state out acceptable practices and restrictions

Example: Internet Policy for a School/ Private Organization

- An internet usage policy provides employees with rules and guidelines about the appropriate use of School/company's equipment, network and Internet access.
- Company employees are expected to use the Internet responsibly and productively. Internet access is limited to job-related activities only and personal use is not permitted
- Job-related activities include research and educational tasks that may be found via the Internet that would help in an employee's role
- All sites and downloads may be monitored and/or blocked by if they are deemed to be harmful and/or not productive to business

Use Filters -

Consider using filtering or monitoring software for your computer. Look into safeguarding programs or options your online service provider might offer. These can include monitoring or filtering capabilities.

Check out privacy policies: Always read a Web site's privacy policy before you or your children provide any personal information.

Discipline and Focus – Be discipline to avoid distraction

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 data communication and network. 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 Internet

Teaching Strategies:

Discover the internet, how it is formulated and how to use it ethically and with responsibility.

Learning Strategies:

- **Activity 1** Students define internet and internet basics **Activity 2** Students identify search engine and web Browser

- **Activity 3** Students identify strengths and limitation of internet Resources

Lesson 2: Search browsers and Engines

Teaching Strategies
Discover search browsers and or engines
Learning Strategies

Activity 1: Discuss the relation of the internet and the search browsers and or engines.

Activity 1: Discuss advanced search engines.
Activity 2: Discover ways of utilizing advanced search engines. Activity 3.
Activity 3.
Resources

Lesson 4: Internet strengths and limitations Teaching Strategies

Discover internet strengths and limitations.

Learning Strategies
Activity 1: Discuss internet strengths and limitations.
Activity 2: Discuss ways of utilizing internet resources.
Activity 3

Resources

Lesson 5: The quality and appropriate use of Internet resources

Teaching Strategies

- Demonstrate responsible and ethical use of the internet resources.

Learning Strategies
Activity 1: Define internet resources and how to access them.
Activity 2: Discover the responsible attitudes in using internet resources.

UNIT 1. Data Communication and Network
Content Standard: 4.1 Investigate and analyse communication technology utilising multi- media and the practices and systems in designing, installing, configuring and managing networks.
Benchmark:. 12.4.1.4 Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology enhanced models.

Topic 4: Technology Enhanced – Creative Works or Model

Learning Objectives

By the end of this topic, the students will be able **to;**

1. identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology enhanced models

Essential Questions:

What are technology tools and resources?

How are they used in the production of creative works?

How are they used to create technology enhanced models?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
• Technology and Resources	• Identify, Apply	• Creativity	• Creative

Content Background

Indeed, technology may be considered an important layer in most instructional systems, similar to how architectural buildings comprise various layers from the framing to the electrical to (nowadays) the technological. Gibbons (2014) articulated this layered approach to instructional design, arguing that just as multiple layers work together to support the purpose of the building, various design layers must similarly work together within instructional products. As we attend to different elements within instructional design layers, we should consider the content, purposes, and instructional strategies as well as how the instruction is represented and controlled through available technology tools. This enables us to design more effective and purposeful instructional solutions and promote powerful learning experiences.

Reference

McDonald, J. K., & Gibbons, A. S. (2009). Technology I, II, and III: Criteria for understanding and improving the practice of instructional technology. *Educational Technology Research and Development*, *57*, 377-392.

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 data communication and network. 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.

UNIT 1. Data Communication and Network
Content Standard: 4.1 Investigate and analyse communication technology utilising multi- media and the practices and systems in designing, installing, configuring and managing networks.
Benchmark:. 12.4.1.5 Integrate multimedia elements into a cohesive multimedia product in a given context
Topic 5: Multimedia Products

Learning Objectives

By the end of this topic, the students will be able to;

1. integrate multimedia elements into a multimedia product in a given context

Essential Questions:

What are multimedia elements?

What are multimedia products?

How are multimedia elements integrated into multimedia products?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
Multimedia Products	Integrate	Creative	Creative, Optimistic

Content Background

What is Multimedia?

Multimedia means that computer information can be represented through audio, video, and animation in addition to traditional media (i.e., text, graphics/drawings, images).

It is the field concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally. It is also a media that uses multiple form of information content and information processing.

History of Multimedia

Multimedia is a media that uses multiple form of information content and information processing.

Basic Element of Multimedia:

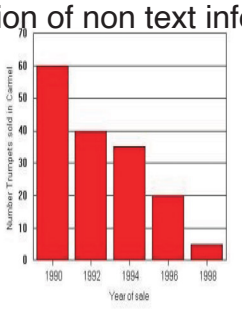
- Graphics-text information, such as a drawing, chart, or photograph.
- Text

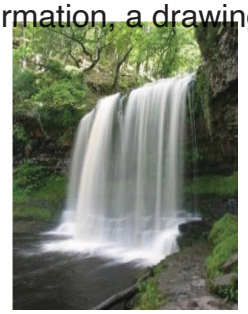
- Characters that are used to create, words, sentences and even paragraphs

Titles	Multimedia is a rich medium that accommodates numerous instructional strategies. Multimedia addresses many of the challenges of instruction in both the academic and corporate environments. It is accessible over distance and time and provides a vehicle for consistent delivery. Multimedia can provide the best medium with which to communicate a concept.	•Monitor •Keyboard •Mouse •Speaker

Graphics

A digital representation of non text information, a drawing, chart or photograph





Animation

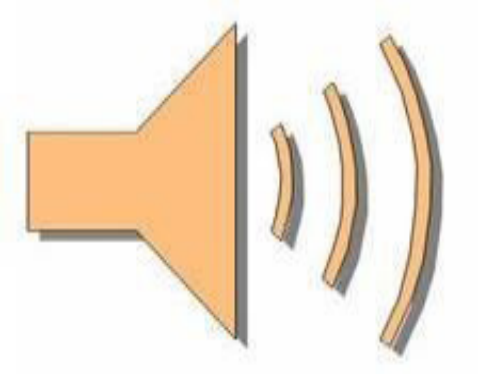
Flipping through a series of still images. It is a series of graphics that creates an illusion of motion.

Video

Photographic images that are played at speeds of 15 to 30 frames a second and provides the appearance of full motion.

Audio

Music, speech or any other sound



Two types of Multi- media presentation:

- Linear

active content progresses often without any navigational control for the viewer such as a cinema presentation.

- **Non-linear** uses interactivity to control progress as with a video game or self-paced computer-based training. Hypermedia is an example of non-linear content.

Usage:

Multimedia finds its application in various areas including, but not limited to:

i. Advertisements Art
ii. Education
iii. Entertainment
iv. Engineering
v. Medicine
vi. Mathematics
vii. Business
viii. Scientific research

In education, multimedia can be used as a source of information. Students can search encyclopaedias such as Encarta, which provide facts on a variety of different topics using multimedia presentations.

Teachers can use multimedia presentations to make lessons more interesting by using animations to highlight or demonstrate key points.

A multimedia presentation can also make it easier for pupils to read text rather than trying to read a teacher‘s writing on the board. Programs which show pictures and text whilst children are reading a story can help them learn to read; these too are a form of multimedia presentation.

Multimedia is used for advertising and selling products on the Internet.Some businesses use multimedia for training where CD-ROMs or on-line tutorials allow staff to

learn at their own speed, and at a suitable time to the staff and the company.

People use the Internet for a wide range of reasons, including shopping and finding out about their hobbies. The Internet has many multimedia elements embedded in web pages and web browsers support a variety of multimedia formats.

Many computer games use sound tracks, 3D graphics and video clips.

Figure 1 Computer Based Training

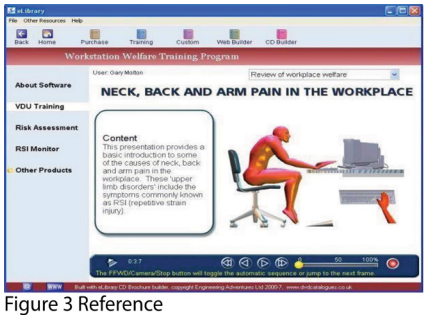


Figure 3 Reference

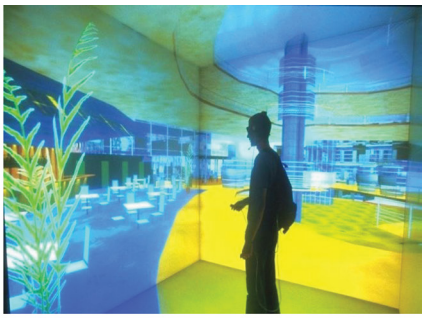


Figure 6 Simulation

Advantages

- It is very user friendly. It doesn't take much energy out of the user, in the sense that you can sit and watch the presentation, you can read the text and hear the audio.
- It is multi sensorial. It uses a lot of the user's senses while making use of multimedia, for example, hearing, seeing and talking.
- It is integrated and interactive. All the different mediums are integrated through the digitisation process interactivity is heightened by the possibility of easy feedback.
- It is flexible. Being digital, this media can easily be changed to fit different situations and audience.
- It can be used for a wide variety of audiences.

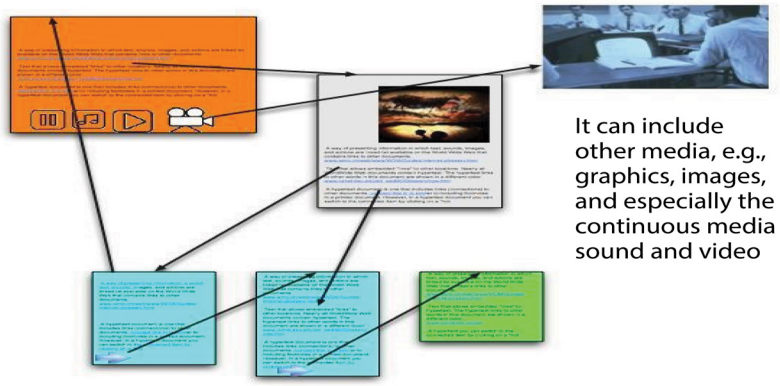
Disadvantages

- Information overload. Because it is so easy to use, it can contain too much information at once.
- It takes time to compile. Even though it is flexible, it takes time to put the original draft together
- It can be expensive. Multimedia makes use of a wide range of resources, which can cost you a large amount of money.
- Too much makes it unpractical. Large files like video and audio has an effect of the time it takes for your presentation to load. Adding too much can mean that you have to use a larger computer to store the files.

Hypertext and Hypermedia:

Hypertext is a text which contains links to other texts. The term was invented by Ted Nelson around 1965. Information is linked and cross-referenced in many different ways and is widely available to end users.

Hypertext means a database in which information (text) has been organized nonlinearly. The database consists of pages and links between pages.



Important questions in designing the hypermedia are:

- Converting linear text to hypertext
- Text format conversions
- Are nodes in a database or are they separate files on file system
- Client-server or standalone

Characteristics of Hypermedia

- It must be possible to use hypermedia both writing and reading information.
- The information comprises non-sequential structures, and may thus be followe along alternative paths.
- The information must follow natural associations from one information unit to
- The information may be hierarchically structured.
- Each information unit is presented in a separate on-screen window.
- It must be possible to share the information or parts of it among several
-

- It must be possible to have several people working against the database at the same time.
- The information resides in a database.

Delivering Multimedia

- Multimedia can be delivered using
  - « Optical disk (CD-based)
  - « Over a distributed network (Web-based) Optical Disks

- The most cost-effective method of delivery for multimedia materials.

- These devices are used to store large amounts of some combination of text, graphics, sound, and moving video Optical Disks

Media	Storage
Compact Disc (CD)	650MB
Digital Versatile Disc (DVD)	4.7GB
Bluray Disc (BD)	27GB

Web-based	**CD-based**
Limited in picture size and low video resolution	Can store high end Multimedia elements
Can be changes, damaged or deleted by irresponsible individuals	Can be permanently stored and not changeable
Information can be updated easily and cheaper	Information can be quickly outdated

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 data communication and network. 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: Elements of Multimedia Teaching Strategies

Define multimedia and its elements in multimedia products.

Learning Strategies

Use multimedia products to define and explain multimedia elements and how they are incorporated.

Activity 1: Discuss multimedia and its elements.

Activity 2: Demonstrate how multimedia elements are used in multimedia products.
Resources

Lesson 2: Enterprise multimedia products Teaching Strategies

Conduct research on enterprise multimedia products.

Learning Strategies

Formulate research questions to understand enterprise multimedia products.

Activity 1: Research enterprise multimedia products.

UNIT 1. Data Communication and Network
Content Standard: 4.1 Investigate and analyse communication technology utilising multi- media and the practices and systems in designing, installing, configuring and managing networks.
Benchmark:. 12.4.1.6 Responsibly, competently, confidently and creatively use communication technology.
Topic 6: Communication Technology

Learning Objectives

By the end of this topic, the students will be able to;

1. responsibly, competently, confidently and creatively use communication technology.

Essential Questions:

What are ethics in electronic technology?

How can communication technology be competently done without abuse and misuse?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
• Communication Technology	• Apply	• Betterment of human kind	• Empathetic, Caring and concern

Technology and Industrial Arts Application: Communication Technology

Content Background

ETHICS AND INFORMATION AND COMMUNICATION TECHNOLOGY

Abstract:

New areas of communication and technology use are constantly developed. The human relation to technology then gets important to consider from both an ethical and an affective perspective. According to this work information technology needs to be extended and explicitly include a communicative perspective. Ethical issues related to implementation and use of ICT (Information and Communication Technology) is important since these issues constitutes the conditions for human attitudes and values specifying human actions and behavior, and implying conditions for usefulness and maintenance of such systems. In this work the intrinsic relation between ethics and technology is established and a synthesis of what could be considered an ethical framework for ICT implementation and use is presented through two examples.

4. ETHICS AND INFORMATION AND COMMUNICATION TECHNOLOGY

The relation to humans and human values characterizes the components of the ICT system. Information, communication, and technology are parts of “Human Activity Systems” (Banathy, 2002), organized groups of people and resources with purposes, objectives and social roles, characterized by pluralism and different ontological perspectives. Interpretations make communication produce something in a state between the extremes of consensus and conflict. People in groups or larger systems are also affected by participation as such, meaning that the relations in a system affect the system as a whole (Malmsjo & Karlsson, 2002). These synergic effects cannot be understood or predicted when studying the system as an aggregation of parts, and this means that awareness and maintenance of the relationships in human systems has a fundamental impact on the outcome of systems (Flood & Carson, 1993). When technology based environments is considered, and the complexity that emerges in the cross between humans, between humans and technology, and between information, communication and technology, a cultural focus emerges where human attitudes, values and behavior sets the conditions for communication and interaction. Ethics and ethical considerations are important factors for where to end up in the span between conflict and consensus and according to Peter Singer (1979), ethical considerations characterizes human attitudes and behavior towards the environment. Also according to Singer (1979), all ethical questions may be considered relevant if thinking persons are occupied with them. This supports an exposure of the ethical backbone in information, communication, and technology.

1 Information and Ethics

According to Floridi (2002), “We are our information”. The author considers information ethics to be a development from the concept of computer ethics. Within the ethical sphere of information the problem of appropriate or correct behavior related to information, creation of information, and transfer of information is considered at first hand. Judgments are based on what is happening within the information area, the infosphere (Floridi, 2002), in which humans are included as information creators and carriers. It is not actions as such that is of interest, but their consequences for the infosphere. An important aspect is then that information is considered an object rather than a condition for the moral value of human actions. This means that without information there are no moral actions and that the lowest common denom-

inator in the ethical questions at issue are the information states of the concerned entities (Floridi, 2002) and that every process and action may be considered as an information process. Ethics is inevitably entwined with the concept of information and according to Floridi (2002), an adequate normative information ethic is then to consider what favours information and the infosphere, or what it means to live as a responsible and respectful entity within the infosphere

2. Communication and Ethics

When human relations communication between people are studied, then the moral or applied ethics may be seen as a glue attaching separate components of the human society - something that creates an abstract synthesis to hold on to in order to keep homeostasis in life (Collste, 1996). In a changing technological infrastructure ethical consideration have an impact on the outcome of human communication. Common norms and rules must be respected to enable humans to live and act together - inside or outside of society. Rules or norms can be both explicit and implicit.

Technology and Ethics

Technology characterizes the modem western society. Conditions for life has changed and hopefully improved. The flipside of ICT and other automation technology is that few persons master the technology, a technology that society depends on. This dependence brings to the fore ethical considerations of its design, use, and implementation. ICT-ethics has been defined by Moor (in Taylor & Moynihan, 2002) as "The analysis of the nature and social impact of it and the corresponding foundation and justification of policies for the ethical use of such technology" (Sid 56). According to Adam (2002), there are two main perspectives on ICT and ethics identified. One characterized by technological determinism, technology as an unavoidable force following its own rules and laws, and an opposing constructivist view - saying that technology is a product of conscious and political choices. Either way, this creates an ethical and problematic sphere in technology, since all consequences emerging in technology development are impossible to predict. The use and benefit of technology is inclined to take its own route independent of the mind in which it is created (Havas, 1999).

Summary

In the cutting edge between ethics and information the concept of information is found as a prerequisite for moral actions, implying a normative ethical approach to what is happening in the infosphere. Ethics and communication together reflect an applied and normative ethics as a prerequisite for societal interplay. Ethics and technology is united by the changing conditions rising from new possibilities of communication and difficulty to comprehend the consequences of technical development. From this synthesis, an abstracted system (Karlsson & Malmsj6, 2003) of the following interrelated components can be identified:

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 data communication and network. 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: Moral values (ethics) in communication technology

Teaching Strategies

Research the global moral values on communication technology.

Create personal and enterprises moral and ethical values for the communication industry.

Learning Strategies

Activity 1: Develop research questions on the global moral values or ethics of communication technology

Activity 2: Devise personal and enterprises moral and ethical values for the communication technology industry.

Activity 3: Advocate moral and ethical values for the communication technology industry using technology tools and resources.

Resources

Lesson 2: Responsible ways of using technology Teaching Strategies

Research, and create tools to promote responsible ways of using technology.

Learning Strategies

Activity 1: Conduct research on using technology responsibly, efficiently and competently.

Activity 2: Create technology models that promotes responsible, efficient and competent use of technology by utilizing technology tools and resources.

Activity 3: Presentation of technology models.

Resources

STEAM Activity

Create technology models by utilising technology tools and resources.

UNIT 1. Data Communication and Network
Content Standard: 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.
Benchmark:12.4.1.7 Explain the impact of computing on business, manufacturing, commerce, and society
Topic 7: Impact of Computing

Learning Objectives

By the end of this topic, the students will be able to;

1. able to explain the impact of computing on business, manufacturing, commerce, and society

Essential Questions:

How does computing affect and impact business, manufacturing, and commerce?

What are the implications of computing on society?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
Impacts of computing on business, manufacturing, commerce andsociety	explain	enterprise	empowerment

Technology and Industrial Arts Application: Communication Technology

Content Background

Impact of Computers on Small Business:

The growth of the personal computer and computer networks continues to impact businesses both large and small. The abundance and accessibility of information available online means that virtually anyone can start and operate a small business with just a computer and Internet connection. Computers also have an impact on how small enterprises conduct businesses.

Getting Started

Computers make it easier to start a small business. You can start businesses like writing a blog or buying and selling merchandise in your own home with just a computer and Internet connection. You can also perform administrative tasks like paying your business's bills, keeping tax records and even managing a payroll on your computer, as well as marketing your business online.

Mobility

Computers provide increased opportunities for where you can operate your business. If you own a laptop computer with wireless Internet capability, you can conduct business in airport lounges, hotel rooms, public libraries or Wi-Fi cafes. This type of mobility also means that business operations are not limited to the typical business hours, allowing for greater flexibility.

Productivity

Computers can have a positive and negative impact on small-business productivity. The 24/7 access to the Internet means that you can increase your number of work hours, and tools like email and instant messaging allow for easy communication. However, the Internet can also be a distraction for you or your employees, as it offers the temptation of browsing instead of working.

Need for Training

Proper training in computer system applications and usage is critical to the success of using computers in small businesses, states Questia Media America. As a result, business owners or employees who have difficulty learning a new computer system or are resistant to its implementation may need additional training or coaching. This learning curve can temporarily reduce the business's productivity and service level.

Employee Flexibility

The Yale-New Haven Teachers Institute reports that the development of computer technology has resulted in an increase in the number of work functions that can be conducted from home. For the small- business owner who is in direct competition with larger corporations for talented workers, offering the option of telecommuting can provide a competitive advantage in the recruiting and retention of workers.

Computers in manufacturing:

Computers have made a massive impact on the speed and accuracy in which products can be made. It is now possible to manufacture high-quality outcomes in a short period of time when previously people would have taken a number of days to make the same products with no guarantee that they would all be of the same standard.

Computer Aided Design (CAD)

CAD is a system that allows designers to create solutions to problems within a computer program through the use of illustrations. Designs can be modelled in 3D and manipulated time and again from all angles. There are many CAD packages available; your school may have a version.

With an increase in the need for quality manufacturing along with the factors such as short lead time and short product lives and increasing consumer awareness as regards the quality of the product, it is becoming increasingly important for the manufacturers to initiate steps to achieve all these. The developments in microelectronics in the recent past have made higher computational ability available at a low cost. Therefore, it becomes imperative that manufacturing takes advantage of the availability of low cost and also using yet more powerful computers. Computers have been in use in manufacturing industries since 1960. Initially they were in use only in supportive functions such as inventory control purchase accounting, etc. In today's time, computer applications have progressed considerably in all areas of design and manufacturing involving CAD and CAM. This however needs to be emphasized that all the benefits of CAD and CAM can be achieved only if these two important functions are effectively interfaced. This interfacing is known as CAD/CAM. It involves the flow of information in both the directions. With the result the parts and assemblies are designed keeping in view the limitations and capabilities of the processes and materials. Consequently, newer and superior products can be produced more quickly and at lower costs.

Computer Aided Manufacture (CAM)

CAM is a term used to describe any activity where a machine is programmed with several instructions to produce a component from a raw material. CAD packages are commonly used through an interface software to drive the special machine codes that in turn tell the machine what to do and where to cut and shape the material.

A car has many thousands of components that all need to behave in specific ways. Cars have become increasingly complicated, yet each small piece of the engine or controls is relatively simple to make. This is because machines assemble and shape the raw materials or assist people in assembling them.

It is easy to imagine how a craftsman, equipped with hand tools, can manipulate hardwood into a well- made table or use metals to create some fine jewellery. In these cases, human touch and sensitivity toward the aesthetics of the pieces is easy to appreciate. However, computers are needed when manufacturing to consistently satisfy high demand and reproducible quality.

Sophisticated computer systems can be integrated together to monitor every aspect of a manufacturing process. Designs can be modified time and again without the need to repeat all the drawings and computers can hold vast amounts of technical data with great accuracy. This information can be fed into a manufacturing cell where several robots or machines can carry out the precise tasks time and again precisely and with accuracy.

Computer Aided Industrial Design

In CAID, computer designs are more commonly modelled in 3D and rendered to make the designs look as real as possible. The software is very sophisticated and more advanced than that found in schools.

Computer Aided Market Analysis (CAMA)

When companies wish to monitor consumer behaviour, they may use CAMA data to

analyse their sales. For example, the use of bonus and reward cards in supermarkets provides information about what products people are buying and when they are buying them. This helps designers target new products.

Computer Numerical Control (CNC)

This is the control of machines using numbers or digital information. This can be provided manually or through a computer. Generally, this is used for milling and drilling procedures. You may have machine at school with a CNC interface attached.

Flexible Manufacturing Systems (FMS)

A flexible manufacturing system involves the use of pre-programmed machines and computers to carry out a series of tasks and operations. They can be programmed so that a different set of operations can be carried out as the designs change.

Computer Aided Administration (CAA)

Here data can be collected and accessed in a quick and effective way to assist manufacturing or information management. For example, your school may have an electronic registration system, or a company may use clocking-in identification to monitor the whereabouts of its employees.

Automatic Guided Vehicle (AGV)

This is an unmanned vehicle that follows a pre-programmed route around a factory floor or warehouse.

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 data communication and network. 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: Impact of computer in:- Business- Manufacturing- the Society

Teaching Strategies

Conduct research on the impacts of computers on Business, Manufacturing and the Society at large.

Learning Strategies

Activity 1 Discover the impacts of computers

Activity 2 Discover on Business, manufacturing and society

Resources https://www.pearsonschoolsandfecolleges.co.uk/Secondary/DesignAndTechnology/LearningSupport/Cre ateProductDesign/Samples/SampleMaterial/Create-

ProdDesD.pdf

Lesson 2: Impact of computer in:- Business- Manufacturing- the Society

Teaching Strategies

Conduct research on the impacts of computers on Business, Manufacturing and the Society at large.

Learning Strategies

Activity 1 Discover the impacts of computers

Activity 2 Discover on Business, manufacturing and society

UNIT 2: COMPUTER SECURITY AND SAFETY

Unit	Benchmark	Topic	Lesson Titles

Unit 2: Computer Safety and Security	**12.4.2.1**	Implication and Usage of Computer	1. Impacts of computer usage on social and economic sector 2. Impacts of computer usage on businesses and society
	12.4.2.2	Data Security – File Maintenance	1. Data Security 2. File Maintenance 3. File Management
	12.4.2.3	Ethical and Legal Technology	1. ICT Standards 2. ICT Governing bodies 3. Ethical and Legal Technology 4. Solution and Strategies
	12.4.2.4	Data Encryption	1. Introduction to data Encryption 2. Data Encryption Strategies and Schemes
	12.4.2.5	IT Copyright Law	1. Introduction to Intellectual Property Theft 2. Copyright Law 3. Consequence of Bridging Copyright Law
	12.4.2.6	Network Security Threats	1. Network Security 2. Types of Threats

UNIT 2. Computer Security and Safety
Content Standard: 4.2 Investigate and analyses the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.
Benchmark: 12.4.2.1 Analyse the social and economic implications and the use of computers.
Topic 1: Implication and Usage of Computer

Learning Objectives

By the end of this topic, the students will be able to;

1. to analyse the social and economic implications and the use of computers

Essential Questions:

What are the social implications and the use of computers?

What are the economic implications and the use of computers?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
• Implication and usage of computers	• Analyse	• Rationality	• Responsible

Technology and Industrial Arts Application: Communication Technology

Content Background

Computers are commonly used items in many areas. Computers impacted many items in today's society. Technology has allowed people to have higher levels of convenience and proficiency. In addition, society has become accustomed to on-demand answers or solutions to requests or services and the Internet is the platform which fulfills the need. Computers have made the dissemination of knowledge easier. Computers connected to networks have made access to knowledge via applications such as web browsers and search engines as easy as clicking a mouse button. Never before in history has so much knowledge been available to people. The Internet has enabled knowledge in the form of databases, webpages and blogs to be connected online and then accessed by anyone who has a connection to the Internet.

Why computers have the impact they do on society? What are the characteristics that are the root of this impact? The characteristics described below are factors in the social impact of computer technology. These will also provide the roles of computers in our society.

1. Ubiquity - It is perhaps stating the obvious that computers appear to be everywhere today. Even when we do not encounter them directly in their various forms of modern convenience devices, such as digital watches, microwave ovens, VCRs, and the like. We generate transactions that are processed via computers without actively doing anything.

ii. Magnification - Computers tend toward magnification in several different ways. First, the explosion of the availability of information is due in large part to the computer's ability to generate, collect, and store an ever-increasing amount of raw data. Since the ability to create and collect data is growing exponentially, so too is the generation of information that can be synthesized from this data. Second, the types of negative impacts a single error can have has grown enormously with computer technology. Finally, the number of people directly affected by a system error has also grown enormously, to where a single software system literally can affect millions directly.

iii. Accessibility - Access to information continues to increase at hard to believe speeds. To begin with, the vast quantities of information available on-line (through, for instance, the Internet) appear to be growing exponentially. In addition, we now have unprecedented accessibility to information and communications from nearly anywhere we happen to be. Next, information is available to an unprecedented number of people. Finally, the promises of the "information superhighway" to open up

new lanes of access, including text, voice, graphics, and video increases the types of information to which we have access to include all media.

iv. Reproducibility and Distributability - The major concern of the recording industry regarding the introduction of digital audio tape (DAT) systems was the ability to make exact duplicates of digital material, indistinguishable from the original. The concern, of course, has been that DAT technology would cause unprecedented reproducing of recordings, to the obvious disadvantage of the recording industry, composers, and performers. Clearly, any digital file can just as easily be duplicated. Many information resources are available only in digital form, via, for instance, the Internet. As more information is converted to digital form (e.g. voice and video), the ability to duplicate and distribute such information increases enormously. (Oz, 1994)

v. Lack of Accountability - It has become a popular complaint that it is getting more and more difficult to locate a human being who is willing to accept responsibility for an error made by a computerised system. While it is tempting to blame such problems on incompetent employees but really the problem may be a poor user interface, lack of training, or an error in the software, none of which can be solved by those providing the front-line service. Another difficulty is finding someone who will, indeed, fix an error in an account. It is often the case that service representatives are reluctant to accept the responsibility for making a necessary change. In addition, it can often be difficult to even find a human being to deal with a problem. Getting lost in a voice-mail system has become a modern urban legend. (Nissenbaum, 1994).

vi. Temporality - Computers have several effects on time and the timeliness of information. It seems that computer technology is to be blamed for the “speed up” of modern society - everything has to get done faster, be there sooner, and be available immediately. Another form of temporality in computer systems is that information can be retained over long periods of time, even when they appear to have been destroyed. Another temporal shift for which computers have been responsible is that people who work together do not necessarily have to do so at the same time. Finally, services and information are more frequently available on a 24-hour basis. This allows people to request a service or seek information when it fits their schedule, rather than when it fits the service provider’s schedule.

vii. Spatiality - Computers have done more to shorten distances than any previous technology, even the supersonic jet. It is possible to send large amounts of data, messages, video, and others virtually anywhere in the world via networks such as Internet. Long distance learning, using information databases or video feeds of courses via satellite, is a reality for a growing portion of our modern society. We can now even be on the move when we talk with someone on the phone, or receive a fax.

viii. Surveillability - In addition to the usual surveillance equipment such as cameras and microphones, transactional data is increasingly being collected for virtually all types of transactions, even cash purchases and the acquisition of services.

ix. Shifting of Relationships/Changes in Intercommunication Protocols - One of the more difficult characteristics to track is how computer technology has changed communication between people and groups of people. In particular, the use of email has been shown to eliminate a lot of the usual visual and verbal cues we often use in com-

municating with one another. In addition to removing such cues, computer-mediated communications mask attributes such as race, gender, age, or physical disability, in addition, perhaps, to the person's social or management status within an organisation. (Grudin, 1994; Perrole, 1987).

x. Illusion of Precision - It is not difficult to make many people who are not in the computer field believed that any numeric result generated by a computer is correct. Those not well versed in the hardware of computers have little understanding of the fact that numbers must be converted back and forth between decimal and binary forms, or that there is a limitation on the accuracy of numbers due to memory constraints. As a result, they willingly accept values generated by a computer as infinitely accurate. (Liffick, 1985).

From the above presentation, let us then study the pictures below on how computers impacted the different areas of our lives in the society.

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 data communication and network. 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.

Learning Objectives

By the end of this topic, the students will be able to;

1. Evaluate and apply appropriate file maintenance practices to organize and safeguard data

Essential Questions:

What is data security?

What is file maintenance?

How can file maintenance ensure data security?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
• Data security	• Evaluate • Apply	• Honesty, sensitivity	• Positive

Technology Application: Communication Technology

Content Background

What is file security?

File security is all about safeguarding your business-critical information from prying eyes by implementing stringent access control measures and flawless permission hygiene. Apart from enabling and monitoring security access controls, decluttering data storage also plays an important role in securing files. Regularly optimize file storage by purging old, stale, and other junk files to focus on business-critical files. Tackle data security threats and storage inefficiencies with periodic reviews and enhancements to your file security strategy.

How is file security different from data security?

Files are the most basic securable units of a repository. Often data is stored and shared as files and folders. Therefore, file security is a subset of data security that focuses on the secure use of files.

Data security protects data in use, in transit, and at rest. Infrastructural and software controls are used to implement stringent data security strategies. File security, on the other hand, protects sensitive files like personal information of customers and other business files.

Why is file security important?

- To protect sensitive data

Personally identifiable information (PII), electronic personal health information (ePHI), confidential contracts, and other business-critical data must be stored safely. Careless transmission or use of such files could lead to data privacy violations, resulting in heavy fines for the organization.

- To secure file sharing

Files transferred through unsecured channels can be misused by insiders or hackers for malicious activities. Comprehensive data leak prevention software can help prevent unauthorized movement of business-critical data out of the organization.

- To avoid data breaches

In 2019, personal details of 10.6 million MGM resort guests were breached. The impact of such a breach can be fatal to any organization. It is not just the fines and legal consequences, but also the loss of trust that can destroy a business.

File security best practices

Eliminate permission hygiene issues

The principle of least privileges (POLP) ensures that only the bare minimum privileges required to complete a task is granted. It is advisable to define access control lists (ACL) for files and folders based on user roles and requirements. Resolve permission hygiene propagation issues like undue privileges, and open access to files with a security permission analyzer.

Secure file sharing channels

All file transfers should be authorized and secure. Audit all the possible ways files can be transferred, and block private devices like personal USB drives. Use USB data theft protection software to stop unofficial data transfers.

Implement file server auditing

Be wary of multiple failed accesses, bulk file renames, or modifications. Mass, unofficial file modifications such as delete events may indicate a ransomware attack. Be prepared by automating your incident response against file threats with robust file server auditing software.

Enforce authentication and authorization protocols

Enforce multi-factor authentication (MFA) for all users in your organizations. MFA makes it difficult for hackers to penetrate the network. Authorize only valid and official data access requests. Grant open access to all employees and partners only when necessary.

Conduct file storage analysis

Analyze and manage your file repositories periodically. Know where your critical files are stored in the organization. Continuous review of stale files and unused files helps eliminate permission misuse incidents. Revoke permissions on files owned by former employees. Compute the cost of storing stale files with the help of our infographic.

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 data communication and network. 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.

UNIT 2. Computer Security and Safety
Content Standard: 4.2 Investigate and analyses the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.
Benchmark 12.4.2.3 Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.
Topic 3: Ethical and Legal Technology

Learning Objectives

By the end of this topic, the students will be able to;

1. Analyse ethical and legal technology issues and formulate solutions and strategies

that foster responsible technology usage.

Essential Questions:

What is ethical and legal technology?

What does ethical and legal technology have control of?

How will ethical and legal technology impact responsible technology use?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
• Ethical and Legal Technology	• Analyse, Formulate	• integrity	• honesty

Technology and Industrial Arts Application: Communication Technology

Content Background

Communications technology, also known as information **technology**, refers to all equipment and programs that are used to process and **communicate** information. Professionals in the **communication technology** field specialize in the development, installation, and service of these hardware and software systems.

Computer Ethics are a set of moral standards that govern the use of computers, and it is a part of practical philosophy concerned with how computing professionals should make decisions regarding professional and social conduct. Margaret Anne Pierce, a professor in the Department of Mathematics and Computers at Georgia Southern University has categorized the ethical decisions related to computer technology and usage into three primary influences:

History of Computer ethics –

Computer Ethics is the branch of philosophy that analysis the nature and social impact of computer technology as well as the standards of conduct that pertain to the proper use of computers. It involves social issues, such as access rights, working place monitoring, censorship, and junk mail; professional issues such as professional responsibility and code of conduct; legal issues such as legal obligations, data protection, computer misuse, and software piracy.

Within a relatively short period of time, computer technology has created huge new possibilities and also the ethical and social implications on both business and individual's life. However, ethical framework and laws lag behind all the new innovations, to fill the vacuum, it needs timely effort to make laws, to corporate with company policy, personal policy, and social conventions. Computer ethics is at its relatively young stages.

The concept of computer ethics originated in the 1940s with MIT professor Norbert Wiener, the American mathematician, and philosopher. While working on anti-air-

craft artillery during World War II, Wiener and his fellow engineers developed a system of communication between the part of a cannon that tracked a warplane, the part that performed calculations to estimate a trajectory, and the part responsible for the firing. Wiener termed the science of such information feedback systems, -cybernetics,‖ and he discussed this new field with its related ethical concerns in his 1948 book, Cybernetics. In 1950, Wiener‘s second book, -The Human Use of Human Beings‖, delved deeper into the ethical issues surrounding information technology and laid out the basic foundations of computer ethics.

A bit later during the same year, the world‘s first computer crime was committed. A programmer was able to use a bit of computer code to stop his banking account from being flagged as overdrawn. However, there were no laws in place at that time to stop him, and as a result, he was not charged. To make sure another person did not follow suit, an ethics code for computers was needed.

Privacy concerns, intellectual property rights, and effects on society are some of the common issues of computer ethics.

Privacy Concerns –

Hacking – is an unlawful intrusion into a computer or a network. A hacker can intrude through the security levels of a computer system or network and can acquire unauthorized access to other computers.

Malware – means malicious software that is created to impair a computer system. Common malware are viruses, spyware, worms, and trojan horses. A virus can delete files from a hard drive while spyware can collect data from a computer.

Data Protection – also known as information privacy or data privacy is the process of safeguarding data that intends to influence a balance between individual privacy rights while still authorizing data to be used for business purposes.

Anonymity – is a way of keeping a user‘s identity masked through various applications.

Intellectual Property Rights –

Copyright – is a form of intellectual property that gives proprietary publication, distribution, and usage rights for the author. This means that whatever idea the author created cannot be employed or disseminated by anyone else without the permission of the author.

Plagiarism – is an act of copying and publishing another person‘s work without proper citation. It‘s like stealing someone else‘s work and releasing it as your own work.

Cracking – is a way of breaking into a system by getting past the security features of the system. It‘s a way of skipping the registration and authentication steps when installing software.

Software License – allows the use of digital material by following the license agreement. Ownership remains with the original copyright owner, users are just granted licenses to use the material based on the agreement.

Effects on Society –

Jobs – Some jobs have been abolished while some jobs have become simpler as computers have taken over companies and businesses. Things can now be done in just one click whereas before it takes multiple steps to perform a task. This change may be considered unethical as it limits the skills of the employees.

There are also ethical concerns on the health and safety of employees getting sick from constant sitting, staring at computer screens and typing on the keyboard, or clicking on the mouse.

Environmental Impact – The environment has been affected by computers and the internet since so much time spent using computers increases energy usage which in turn increases the emission of greenhouse gases.

There are ways where we can save energy like limiting computer time and turning off the computer or putting on sleep mode when not in use. Buying energy-efficient computers with Energy Star labels can also help save the environment.

Social Impact – Computers and the internet help people stay in touch with family and friends. Social media has been very popular nowadays.

Computer gaming influenced society both positively and negatively. Positive effects are improved hand-eye coordination, stress relief, and improved strategic thinking. Negative effects are an addiction of gamers, isolation from the real world, and exposure to violence.

Christensson, P. (2021, January 22). *Computer Ethics Definition*. Retrieved 2021, Jul 13, from https://techterms.com

Teaching and Learning Strategies

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UNIT 2. Computer Security and Safety
Content Standard: 4.2 Investigate and analyses the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.
Benchmark: 12.4.2.4. Explain and implement various encryption schemes that are used to secure data and communication over networks.
Topic 4: Data Encryption

Learning Objectives

By the end of this topic, the students will be able to;

1. Explain and implement various encryption schemes that are used to secure data and communication over networks

Essential Questions:

What is data encryption?

Why is it essential in information technology?

How does it function?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
• •Data Encryption	• • Explain, Implement	• Self-Discipline	• Due process of law, sensitivity

Technology and industrial Arts Application: Communication Technology

Content Background

Data Encryption:

Encryption is the process of converting data to an unrecognizable or "encrypted" form. It is commonly used to protect sensitive information so that only authorized parties can view it. This includes files and storage devices, as well as data transferred over wireless networks and the Internet.

You can encrypt a file, folder, or an entire volume using a file encryption utility such as GnuPG or AxCrypt. Some file compression programs like Stuffit Deluxe and 7-Zip can also encrypt files. Even common programs like Adobe Acrobat and Intuit TurboTax allow you to save password- protected files, which are saved in an encrypted format.

An encrypted file will appear scrambled to anyone who tries to view it. It must be decrypted in order to be recognized. Some encrypted files require a password to open, while others require a private key, which can be used to unlock files associated with the key.

Encryption is also used to secure data sent over wireless networks and the Internet. For example, many Wi-Fi networks are secured using WEP or the much stronger WPA encryption. You must enter a password (and sometimes a username) connect to a secure Wi-Fi network, but once you are connected, all the data sent between your device and the wireless router will be encrypted.

Many websites and other online services encrypt data transmissions using SSL. Any website that begins with "https://," for example, uses the HTTPS protocol, which encrypts all data sent between the web server and your browser. SFTP, which is a

secure version of FTP, encrypts all data transfers.

There are many different types of encryption algorithms, but some of the most common ones include AES (Advanced Encryption Standard), DES (Data Encryption Standard), Blowfish, RSA, and DSA (Digital Signature Algorithm). While most encryption methods are sufficient for securing your personal data, if security is extremely important, it is best to use a modern algorithm like AES with 256-bit encryption

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 data communication and network. 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.

UNIT 2. Computer Security and Safety
Content Standard: 4.2 Investigate and analyses the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.
Benchmark: 12.4.2.5 Examine and evaluate the competing forces of privacy policies and their legal, social, ethical, and economic consequences
Topic 5: IT Copyright Law

Learning Objectives

By the end of this topic, the students will be able to;

1. Examine and evaluate the competing forces of privacy policies and their legal, social, ethical, and

economic consequences

Essential Questions:

What are IT copyright laws?

Why are IT copyright laws written and enacted and what are the main functions?

What are the legal, social, ethical and economic consequences faced when IT copyright laws are not

present?

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes

IT copyright Law	• Examine, and Evaluate	Justice	Caring and concern

Technology and Industrial Arts Application: Communication Technology

Content Background

IT Copyright Law:

Copyright and intellectual property

With so much of our lives shared online, it's important to understand the basics of copyright law and know about data protection and the Creative Commons license.

Copyright overview:

An original piece of work is covered by copyright. It could be a piece of music, a play, a novel, photos or a piece of software. Copyright can be enforced by law. It is against the law to copy and distribute copyrighted material without the copyright owner's permission.

Copyright facts

- Copyright is automatic and there is no need to register for it.
- The symbol © indicates copyright but a piece of work is still covered without it.
- Copyright does not last forever and will expire after a certain period of time.
- It is illegal to share copyrighted material on the internet without the copyright owner's permission.
- If you create a piece of work for your employer, the copyright usually belongs to them.

Software copyright

Software is covered by copyright. It prevents:

- copies being made and given to friends and family for free, or being sold for profit
- using software on a network, where multiple users can access it (unless the licence permits it)
- lending the software to friends or family

There are exceptions. Some copyright owners allow their work to be copied and distributed for educational use or for non-profitable use. The copyright owner will make this clear.

Search engine images

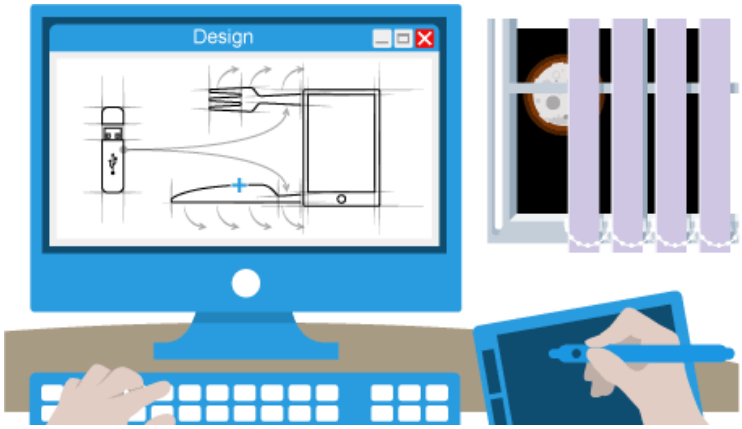
Images returned by search engines do not belong to the search engine and are not

free to use. The search engine has included them from a number of websites. All of the major search engines provide a link to the website that the original image is from. If you want to use an image you have found using a search engine, always check who it belongs to.

Intellectual property

There are other ways to stop your work from being copied and distributed without your permission:

- Trademark – a sign or logo that identifies a brand or company
- Patent – a patent protects a new idea or invention
- Design – a product's visual appearance



All companies register their name and address with Companies House.

https://www.bbc.co.uk/bitesize/guides/zchcwmn/revision/2

Legal and Ethical Issues in ICT:

Intellectual property theft involves robbing people or companies of their ideas, inventions, and creative expressions—known as -intellectual property‖—which can include everything from trade secrets and proprietary products and parts to movies, music, and software.

It is a growing threat—especially with the rise of digital technologies and Internet file sharing networks. And much of the theft takes place overseas, where laws are often lax and enforcement is more difficult. All told, intellectual property theft costs U.S. businesses billions of dollars a year and robs the nation of jobs and tax revenues. Preventing intellectual property theft is a priority of the FBI's criminal investigative program. It specifically focuses on the theft of trade secrets and infringements on products that can impact consumers' health and safety, such as counterfeit aircraft, car, and electronic parts. Key to the program's success is linking the considerable resources and efforts of the private sector with law enforcement partners on local, state, federal, and international levels. https://www.fbi.gov/investigate/white-collar-crime/piracy-ip-theft

Intellectual Property rights (IPRs) are generally known as "negative rights" because the owner enforces them by stopping third parties from exploiting the rights' sub-

jects. An IPR is typically infringed when a third party performs an act that is legally restricted to either the owner of the IPR or a person who has the owner's permission to exploit the right (a licensee). It is essential for general counsels, business owners or shareholders to understand IP infringement's precise nature in various circumstances and how it can be combated.

In general terms, patents protect inventions, entitling owners to bar the unauthorized exploitation of them. Trademarks protect distinctive signs and names, and copyrights protect original works of art and literature. In all cases, holders of these rights are likewise entitled to prevent unauthorized use of the protected invention, confusingly similar marks or stop the reproduction or adaptation of one or more protected artworks, as the case may be. The exact nature of an IPR is such that an owner of an IPR has the power and monopoly to prevent others from exploiting the subject of the right without the owner's permission.

What is 'IP theft', and is this the proper term?

Before we go any further, we need to establish an essential aspect: IP cannot be the subject of theft in any literal or legal sense. The term *"theft"* concerning IP is often incorrectly used by the general public and media. Since IP is a negative right that grants monopoly control over original creations, it is incorporeal and cannot be seen or touched.

At the same time, IP infringement can, in some instances, be accompanied by the theft of actual physical property or in conjunction with other civil wrongdoings and crimes. This simultaneous overlapping of several distinct types of unlawful conduct can engender incorrect assumptions among many that IP can be *"stolen."* For example, suppose research and development papers are physically stolen. In that case, we are talking about an act of theft (or robbery, if taken by force) that affects an iteration of the victim's IP, but not the IP itself. Similarly, when digital files containing product blueprints or technical drawings are accessed without authorization to *"steal"* the subject matter, various cybercrime laws and other types of civil wrongdoing such as unlawful competition can occur in conjunction with IP infringement.

Even so, "IP theft" has recently emerged in popular parlance due to factors including the issue's politicization vis-a-vis the U.S.-China trade war, with President Donald Trump and his administration being proponents of the term. Nevertheless, "infringement" is the most accurate term for IP rights violations and should not be confused with "theft," no matter how prevalent it might be.

Numerous misconceptions may result from the use of *"IP theft"* in the wrong context. Early in my career, I recall a matter in South Africa where an order for costs was obtained to *"attach"* a portfolio of patents and trademarks to found jurisdiction and as security for costs. A local Sheriff of the Court tried to execute the order by visiting the defendant and expecting to collect the IP in question from the premises. Imagine someone knocking on the door and saying they are arriving to collect patents, trademarks and copyrights? Of course, this is not possible. IP rights can be attached by entering a caveat against the register of patents or trademarks, preventing their transfer to a third party until a specific condition has been met.

Trade secrets are typically covered by non-disclosure agreements (NDAs), and unlaw-

ful conduct, when considering trade secret violation, is the disclosure of the confidential information.

In the same way that an IP right cannot be loaded onto the back of a truck to execute a Court order to attach the IP, it is impossible to *"steal"* IP, which should be made more evident to business owners. After all, without a general understanding of IP, it will be nearly impossible to develop any strategy, even a basic one, to identify, protect and enforce the IP. Below, we have made a few comments as guidelines.

How is IP 'stolen?'

If someone says *"IP theft,"* it is essential to understand that they probably mean infringement of a trademark, patent, copyright or other IP rights. This occurs in a variety of iterations:

- Patent infringement: In general, patent infringement ensues when a patent that has been approved by a government agency like the U.S. Patent and Trademark Office (USPTO) or European Patent Office (EPO) is used or applied in the industry by another person without the permission of the patent owner.

- Trademark infringement: Trademark infringement occurs when a third party makes unauthorized use, in the course of trade, usually concerning similar or competing goods, of a mark that is identical to the registered trademark (or so similar to the registered trademark that consumers are likely to be confused or deceived as to the origin of the goods).

- Copyright infringement: Generally, copyright infringement happens when a novel, film or musical work (but also potentially something like a technical manual) is reproduced (in whole or in part) relating to the original work or has numerous major elements copied in a derivative work.

- Trade secret violation: Although not often protected directly by legislation, trade secrets are typically covered by non-disclosure agreements (NDAs) when shared between two parties. Therefore, if one party that has seen another party's trade secrets decides to publicize them contrary to an agreement or apply the secrets commercially without the information holder's permission, they have violated their NDA. The essence of an NDA is the definition of *"confidential information."* Unlawful conduct, when considering trade secret violation, is the disclosure of the confidential information.

- Counterfeit: In some jurisdictions, such as in the EU, there is no distinction between *"infringement of goods"* and *"counterfeit goods,"* while other regions have a precise legal delineation between the two. Where such a difference exists, the definition of *"counterfeit goods"* is narrower than the requirements for trademark infringement since *"counterfeit goods"* must constitute an infringement of an IP right while also being *"colorable imitations"* of the genuine goods. In other words, to the consumer, the actual counterfeit product must look like a fake. For those who are interested, we dealt with this topic extensively in another blog post from 2018.

As previously noted, literal theft does sometimes occur in conjunction with IP in-

fringement. A hacker stealing the copyrighted source code of a software development firm's flagship program would be a fitting example of multiple overlapping unlawful acts, as would an individual's physical theft of blueprints for a roughly sketched device or a prototype with pending patents.

How is IP infringement proven?

The first step in proving that an IP right has been infringed is to confirm that the IP owner is, in fact, the owner of the IP right in question. Having documentary evidence available represents a significant part of the battle. Where an IP right is registered, this step often is straightforward.

Proving that an IP right has been validly registered is the beginning of setting out the evidence. Where IP is not registered, as is usually the case of copyrighted works, the evidence needs to be meticulously set out. The plaintiff needs to prove all the requirements of copyright subsistence and ownership. Usually, this involves producing documentary evidence proving who the author of the work was and that the protected work was "original" when it was created. It also needs to show that the plaintiff is the copyright owner despite not being the author if the copyright has been sold or transferred.

Actual theft does sometimes occur in conjunction with IP infringement. A hacker stealing the copyrighted source code of a software is an excellent example of multiple overlapping unlawful acts.

The second step is for the plaintiff to prove that each requirement for the infringement of a specific IP right, as set out in the applicable legislation, has been met. There must be concrete proof of infringing conduct. For example, in the case of trademark infringement, it must generally be proven that the defendant has made unauthorized use of a trademark that is identical or similar to the registered mark and done so with several caveats:

- In the course of trade for commercial purposes
- The infringer has traded in goods or services that are identical or similar enough to those goods covered by the registered trademark that members of the public are likely (as in more than 50% chance) to be confused or deceived by using the infringing trademark.

An IP lawyer with considerable local experience must advise in these circumstances. The specific laws of each jurisdiction vary considerably.

Many of the same criteria for proving IP infringement translate to counterfeit goods. In some jurisdictions, there are separate civil or criminal remedies, making the burden of proof. In criminal proceedings, the burden often is *"beyond a reasonable doubt"* versus the civil burden of a balance of probabilities. In this aspect, the law of evidence relating to IP rights is no different from the general distinction.

If we are to compare IP infringement to *"theft,"* we must add that *"theft"* is almost always a crime, whereas IP infringement may be of either a civil or criminal nature

(although most IP infringement types are defined as civil wrongdoings only).

What are the legal consequences of 'IP theft'?

Financial penalties (and an award for damages) for civil infringement of IP rights are determined based on local laws' factors. In many common law jurisdictions and the EU, punitive damages are generally not awarded, with few notable exceptions: Typically, a plaintiff must prove the actual or likely financial loss due to the infringement to be considered eligible for punitive or exemplary damages. As substantial financial loss can be challenging to prove, in many jurisdictions, a reasonable royalty (that would have been payable by a hypothetical licensee) instead of damages may be awarded by a judge after an inquiry into the applicable royalty rate. There may also be statutory judgments with lump-sum fines imposed on defendants, as is the case in Chinese IP law.

References

Shafinah, K., & Ikram, M. M. (2011). File Security based on Pretty Good Privacy (PGP) Concept. *Computer and*

Information Science, *4*(4), 10.

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 data communication and network. 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.

Learning Objectives

By the end of this topic, the students will be able to;

1. Evaluate the network security threats and formulate effective measures to improve security on both LAN and WAN

Essential Questions:

What are network security threats?

What effective measures can be formulated to improve security on LAN and WAN.

Essential Knowledge, Skills, Values and Attitudes

Knowledge	Skills	Values	Attitudes
• Network Security	• Evaluate, formulate	Honesty, truth, integrity	Responsible, caring and concern

Technology and Industrial Arts Application: Communication Technology

Content Background

Human beings value their privacy and the protection of their personal sphere of life. They value some control over who knows what about them. They certainly do not want their personal information to be accessible to just anyone at any time. But recent advances in information technology threaten privacy and have reduced the amount of control over personal data and open up the possibility of a range of negative consequences as a result of access to personal data. In the second half of the 20th century data protection regimes have been put in place as a response to increasing levels of processing of personal data. The 21st century has become the century of big data and advanced information technology (e.g. forms of deep learning), the rise of big tech companies and the platform economy, which comes with the storage and processing of exabytes of data.

Van den Hoven, J., Blaauw, M., Pieters, W., & Warnier, M. (2014). Privacy and information technology.

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 data communication and network. 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.

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 (Sample):

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.

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
Textile 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 pause a challenge to the planning and programming pro-

cess.

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 OBE 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 utilized 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	
Content Standard:	**Benchmark:**
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 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
	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 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
	9.3.3.2 Analyse and describe OHS Regulations and standards in the plumbing trade and work places.
	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 fi t-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

UNIT 1: FIBRES AND FABRICS		
STRAND 1: FOOD TECHNOLOGY		
Content Standard	**Benchmark**	**Topic**
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
	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	Introduction to fibres and fabrics
		Designing and Construction
	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		
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
UNIT 1: FOOD AND NUTRITION		
STRAND 2: FOOD TECHNOLOGY		
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	**9.2.1.1** 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
UNIT 2: FOOD SCIENCE		
STRAND 2: FOOD TECHNOLOGY		
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
UNIT 1: BUILDING TECHNOLOGY		
STRAND 3: CONSTRUCTION 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** 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
UNIT 2: ELECTRICAL TECHNOLOGY		
STRAND 3: CONSTRUCTION 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	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
UNIT 3: PLUMBING TECHNOLOGY		
STRAND 3: CONSTRUCTION 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 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 relevancein 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
UNIT 4: WELDING TECHNOLOGY		
STRAND 3: CONSTRUCTION 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	Workshop Organisation
	9.3.4.2 Explore and interpret welding principles, codes and standards	Welding Standards
	9.3.4.3 Demonstrate knowledge in fundamental print reading, measurement and layout or fi t-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		
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
UNIT 1: DATA COMMUNICATION AND NETWORK		
STRAND 4: COMMUNICATION TECHNOLOGY		
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

UNIT 2: COMPUTER SECURITY AND SAFETY		
STRAND 4: COMMUNICATION TECHNOLOGY		
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** 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
UNIT 1: COMPUTER ARCHITECTURE		
STRAND 5: COMPUTER TECHNOLOGY		
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
UNIT 2: COMPUTER SOFTWARE		
STRAND 5 COMPUTER TECHNOLOGY		
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
	9.5.2.2 Demonstrate the understanding of Operating Systems/ Software and File Management	Operating System

	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

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 **Lesson3:** Factors affecting changes in textile, fashions and clothing
Topic2: 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** Types of tools for textile projects **Lesson** Safe uses of special tools **Lesson** Care for tools
Topic 5: Designing a textile project	**Lesson** What is design process **Lesson** Phases in Textile Project development **Lesson** Textile Projects
Topic Documenting a project portfolio	**Lesson** People and textile industry **Lesson** Textile technology equipment **Lesson** 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 SCEINECE**	
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. **Lesson4:** 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
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

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.

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:

<table>
<tr><th>Week</th><th>Textile Technology and Food Technology</th><th>Content Standard</th><th>Benchmark</th><th>Topic</th></tr>
<tr><td rowspan="8">1</td><td rowspan="8">Textile Technology:

Fibres and Fabrics:

CS: 9.11

BMs: 9.1.1.1 and 9.1.1.2, 9.1.1.3,</td><td rowspan="8">CS1.1 Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.</td><td>9.1.1.1 Compare and contrast social, economic, cultural and technological changes to textiles, fashion and clothing</td><td>Impact of changes on textiles, fashion and clothing</td></tr>
<tr><td colspan="2">Lesson 1: Exploring Textiles?

Lesson 2: Origins of textiles, fashion and clothing

Lesson3: Factors affecting changes in textile, fashions and clothing</td></tr>
<tr><td>9.1.1.2 Distinguish the properties and characteristics of fibres and fabrics</td><td>Introduction to fibres and fabrics</td></tr>
<tr><td colspan="2">Lesson 1: What are fibres and fabrics?

Lesson 2: Characteristics and properties of fibres and fabrics

Lesson 3: From fibres to fabrics.</td></tr>
<tr><td>9.1.1.3 Explore the elements of design and the design and construction of fashion ideas</td><td>Designing and Construction</td></tr>
<tr><td colspan="2">Lesson 1: Elements of design and design types.

Lesson 2: Sources of fashion ideas.

Lesson 3: Basic construction processes</td></tr>
</table>

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 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
			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 design process through various artistic versions	Fundamentals of design process
			Lesson 1: Importance of design process **Lesson 2:** Skills in the design process **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 1: Types of tools for textile projects **Lesson 2:** Safe uses of special tools **Lesson 3:** 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 1: What is design process **Lesson 2:** Phases in Textile Project development **Lesson 3:** 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 1 People and textile industry **Lesson 2:** Textile technology equipment **Lesson 3:** 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 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	**9.2.1.1** 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: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.3, 9.2.1.4	**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	**9.2.1.3** Examine the nutritional components of food and food development and the impact of food consumption on nutrition.	Food and nutrients
			Lesson 1: Functions of nutrients and food sources **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, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions,	**9.2.2.5** 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
			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	
			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
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 planning and building of a variety of construction projects	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	
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 as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	**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	
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 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 fi t-up techniques	Measurement Techniques
			Lesson 1: Measurement **Lesson 2:** Print reading **Lesson 3:** Layout/ fit-up Techniques	
			9.3.4.4 Investigate and analyse the properties of metals	Metals
			Lesson 1: Types of metals **Lesson 2:** Metal Properties	
			9.3.4.5 Investigate the various welding techniques and cutting processes	Cutting and Welding
			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, 9.3.5.6, 9.3.5.7	**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.	**9.3.5.5** 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
13	**SUMMATIVE ASSESSMENT**			

Grade 9 Communication and Computer Technology Yearly Content Overview

Week	Communication and Computer Technology	Content Standard	Benchmark	Topic

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 systems in designing, installing, configuring and managing networks.	**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
			Lesson 1: Introduction to Media Communication **Lesson 2:** Techniques and Skills for application purposes	
			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 communications technology activities	Safe Working Practices/ Habits
			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	

<table>
<tr><td rowspan="6">8</td><td rowspan="6">Computer Technology

Computer Architecture

CS: 9.5.1

BMs: 9.5.1.3, 9.5.1.4</td><td rowspan="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.</td><td>9.5.1.3 Investigate and describe the design brief of solving problems.</td><td>Design Brief</td></tr>
<tr><td colspan="2">Lesson 1: Introduction to Design Brief
Lesson 2: Stage Design Brief
Lesson 3: Case Study of Design Brief</td></tr>
<tr><td>9.5.1.4 Identify and describe the functions of, as well as important advances related to, electronic and computer components;</td><td>Computer Electronics</td></tr>
<tr><td colspan="2">Lesson 1: Fundamentals of Computer Electronics
Lesson 2: Functions of computer electronic components</td></tr>
<tr><td rowspan="6">9</td><td rowspan="6">Computer Technology

Computer Architecture

CS: 9.5.1

BMs: 9.5.1.5, 9.5.1.6</td><td rowspan="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.</td><td>9.5.1.5 Demonstrate a basic understanding of binary numbers and digital logic</td><td>Binary</td></tr>
<tr><td colspan="2">Lesson 1: Introduction to Binary Numbers
Lesson 2: Binary Numbers
Lesson 3: Digital Logic Circuitry</td></tr>
<tr><td>9.5.1.6 Explore and describe hardware and software troubleshooting principles</td><td>Troubleshooting</td></tr>
<tr><td colspan="2">Lesson 1: Introduction to Computer Troubleshooting Lesson
Lesson 2: Troubleshooting
Lesson 3: Case Study of Troubleshooting</td></tr>
<tr><td rowspan="6">10</td><td rowspan="6">Computer Technology

Computer Software

CS: 9.5.2

BMs: 9.5.2.1, 9.5.2.2</td><td rowspan="6">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.</td><td>9.5.2.1 Explore programming software and applications</td><td>Software Programming</td></tr>
<tr><td colspan="2">Lesson 1: Introduction to Programming.
Lesson 2: Types of Programming software and applications
Lesson 3: Example of Software Programs and associated programming languages</td></tr>
<tr><td>9.5.2.2 Demonstrate the understanding of Operating Systems/ Software and FileManagement</td><td>Operating System</td></tr>
<tr><td colspan="2">Lesson 1: Introduction to Operating System
Lesson 2: Categories of Operating Systems Software
Lesson 3: File Management</td></tr>
<tr><td rowspan="6">11</td><td rowspan="6">Computer Technology

Computer Software

CS: 9.5.2

BMs: 9.5.2.3, 9.5.2.4</td><td rowspan="6">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.</td><td>9.5.2.3 Apply typing skills with speed (20wpm) and accuracy (80%)</td><td>Keyboarding</td></tr>
<tr><td>9.5.2.4 Create documents using Microsoft Office</td><td>Microsoft Office</td></tr>
<tr><td colspan="2">Lesson 1: Introduction to Keyboard
Lesson 2: Keyboard Techniques
Lesson 3: Hands on Typing</td></tr>
</table>

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 strand s of TIA.

Below is a proposed Template to develop a Teaching Program for a Term.(13 weeks)

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

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

CS	• Write the Coding only
BM	• Write the Coding only
Unit	• Write the Unit number and Name
Topic	• Write the Topic number and Name
Learning Objective	By the end of this Topic, Students will be able to: • Write the learning Objectives for the Topic
Knowledge	• Write the essential knowledge to be learnt in this topic
Skill	• Write the essential skill to be learnt in this topic
Attitude/ Values	• Write the essential attitude and values to be learnt in this topic
Suggested Learning Activities	• List down the learning activities that will be done in this topic
Performance Standard	By the end of this Topic, students will be able to; • Write the Performance Standard (only if the Bench-mark carries a performance standard)

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: _____

CS	• Write the Coding only
BM	• Write the Coding only
Unit	• Write the Unit number and Name
Topic	• Write the Topic number and Name
Learning Objective	By the end of this Topic, Students will be able to: • Write the learning Objectives for the Topic
Knowledge	• Write the essential knowledge to be learnt in this topic
Skill	• Write the essential skill to be learnt in this topic
Attitude/ Values	• Write the essential attitude and values to be learnt in this topic

Performance Standard	By the end of this Topic, students will be able to; • Write the Performance Standard (if the Benchmark carries one)
Lesson Number and Titles	• Lesson 1:
	• Lesson 2:
	• Lesson 3
Lesson Objectives	• Lesson 1 Objective
	• Lesson 2 Objective
	• Lesson 3 Objective
Suggested Learning Activities	

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

Performance Assessment 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. A- Advanced

b. B- Proficient

c. C- Progressing

d. 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 under-achievers. 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 panning 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 organized set of lesson plans. Good planning allows for more effective teaching and learning. The lesson plan is a guide and map for organizing 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, analyse 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 are suggested strategies teachers may adopt to assist underachievers in the classroom.

1. Examine the Problem Individually

   It is important that underachieving students are addressed individually by focusing on the student's strengths.

2. 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?

3. Help student to plan every activity in the classroom

4. Help students set realistic expectations

5. Encourage and promote the student's interests and passions.

6. Help children set short and long-term academic goals

7. Talk with them about possible goals.
8. Ensure that all students are challenged (but not frustrated) by classroom activities

9. 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- Topic 1: Simulation Models

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 12.5.1.1: Identify different types of models used for simulations

Learning Objective:

By the end of the topic, students will be able to identify different types of simulation models

Essential questions:

- What are simulation models?
- Explain the purpose of simulation models
- What are the different types of simulation models?

Skills, Knowledge, Attitudes and Values:

Key Concepts(SKAV)	
Skills	Identify different types of simulation models
Knowledge	Simulation Models
Attitudes	Creativity in designing different types of simulation modeling
Values	Rationality

Lesson 1: Simulation Modeling

Lesson Objective:

By the end of the lesson the student will recognise that a model is made up of multiple variables that work together.

Lesson Procedure:

Teacher will …..	Student will ….
Introduction (time in minutes)	
Ask students to brainstorm what they think a "model" is in science and examples of models they know of. Explain that a model is a representation of something in the real world that can't be experienced directly, such as climate change.	• Note their ideas in their exercise books. • Recognise that the models can represent an idea, an object, a process, or a system.
Body (time in minutes)	
Modeling	
Give examples of Simulation models - Computer Model - Play Grow a Tree - Illustrate how the gravitational force controls the motion of the planets	Discuss their ideas on different simulation models using the examples given.
Guided Practice	
Guide students to Illustrate how the gravitational force controls the motion of the planets.	Using the program, they are familiar with, they draw, code and simulate the gravitational force that controls the motion of the planets.
Independent Practice	
Allow students to explore the different motions that a group of planetary bodies can have.	Using the online program explore the different motions that a group of planetary bodies can have.
Conclusion (time in minutes)	
What are computer models good for?	To computer models are good for illustrating ideas, process or system that represent real world.
Assessment	

Confirm students understanding on models with the following; • Why are models useful? • How can computer models be used to learn about the real world? • What can be different about a model vs. the world?	Affirm understanding on models by; 1. Justify the usefulness of models 2. Model a real world 3. State the difference about a model and the world.

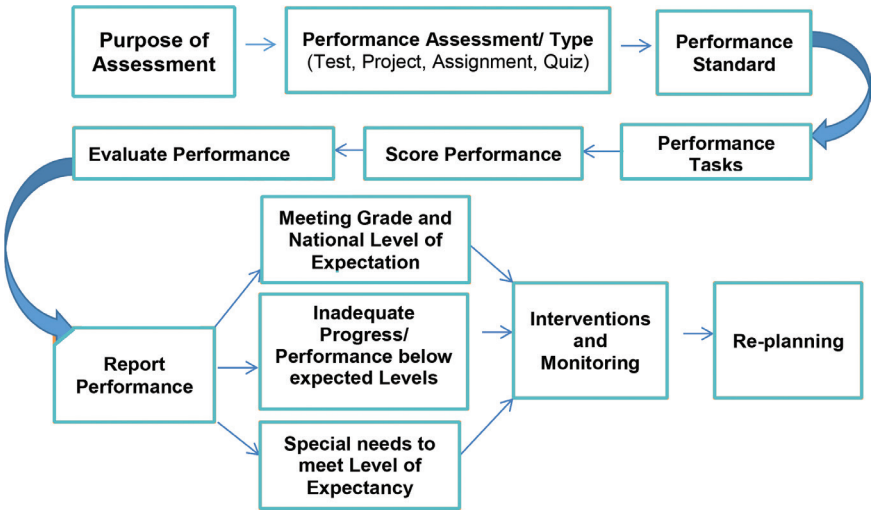
Assessment, Monitoring And Reporting

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

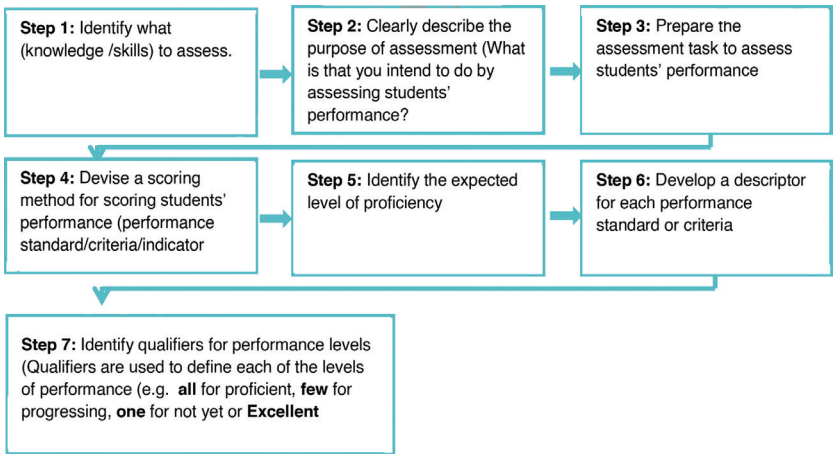
Principles of Standards-Based Assessment:

The principle of SBA is for assessment to be;

- emphasing 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	• 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
• Use of criterion levels evaluation • Part of teaching and learning Process • Shows mastery and learning performance • Generally extends over time	• 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 cconducted 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" of "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. (move all assessment strategies in the appendices to this section and include strategies suggested by JP, page # 74 and 57)

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,criticise, 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, summarize	• 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 synthesise 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;

a. Descriptions of the of task

b. The scales to be used

c. The dimensions of the task

d. The description of each dimension on the scale

A Rubric:

- 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

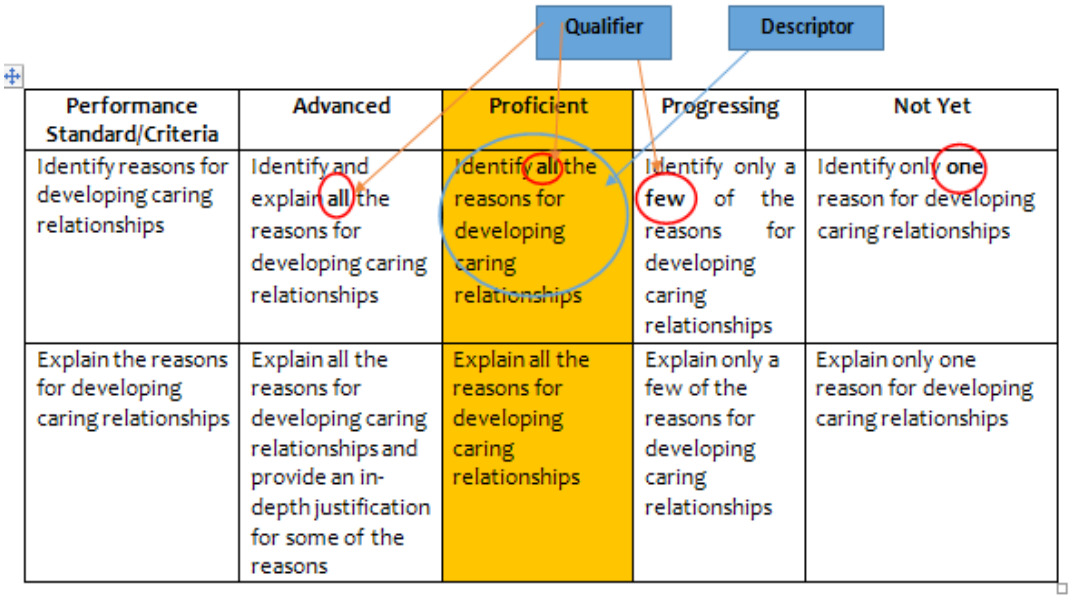
Analytical Rubric:

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 ofperformance	
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 ofperformance	
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	Advanced	Proficient	Progressing	Not Yet
Identify reasons for developing caring relationships	Identify and explain all the reasons for developing caring relationships	Identify all the reasons for developing caring relationships	Identify only a few of the reasons for developing caring relationships	Identify only one 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 fi-

nal 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 **complete** understanding of the problem. **All** requirements of task are **included in response**.	Demonstrate **considerate** understanding of the problem. **All** requirements of task are **included**.	Demonstrate **partial** understanding of the problem. **Most** requirements of task are **included**.	Demonstrate **little** understanding of the problem. **Many** requirements of task are **missing**.	Demonstrate **no** 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 **highest** level of performance.	Description reflecting **mastery** level of performance.	Description reflecting **movement towards** mastery level of performance.	Description reflecting **beginning** level of performance.
Criteria # 2	Description reflecting **highest** level of performance.	Description reflecting **mastery** level of performance.	Description reflecting **movement towards** mastery level of performance.	Description reflecting **beginning** level of performance.

Criteria # 3	Description reflecting **highest** level of performance.	Description reflecting **mastery** level of performance.	Description reflecting **movement towards** mastery level of performance.	Description reflecting **beginning** level of performance.
Criteria # 4	Description reflecting **highest** level of performance.	Description reflecting **mastery** level of performance.	Description reflecting **movement towards** mastery level of performance.	Description reflecting **beginning** 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

• Frequency Rating Scales: A frequency rating scale scores how often a task is done to meet criteria.

Sample Rating Scale Descriptive Words:

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

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

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

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

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

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

Excellent	Proficient	Adequate	Limited
accurate	logical	partially accurate	flawed
insightful	logical	simplistic	unsupported
astute	credible	plausible	inaccurate
precise	relevant	basic	irrelevant

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
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. Encourag-es everyone to achieve together	Always Encour-ages everyone to achieve together	Sometimes Encour-ages everyone to achieve together	Rarely Encour-ages everyone to achieve together	Never Encourag-es 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 and 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	Criterion 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	Description	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

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.

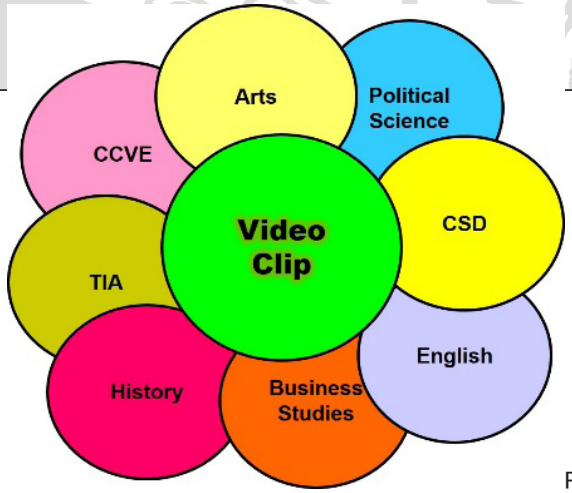
Students still bringing their smart mobile phones to school despite the school rules telling them not to.

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.

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



Product Idea/ Model

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

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.

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 respon-

sible 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.

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-miunte 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

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 con-

tent 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 intend ed rubric.

12. Completed rubric sample: Video clip Assessment Rubric

13. Consider the Applications of the Steam Rubric

Sample 4

Unit 5: Information Technology

Strand 2: Business Management

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 im-

pacts

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 behavioural 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 Behaviour 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

i. Plan and write a short write-up for your video-clip.

ii. Use the notes to make a 2-minute video clip to advertise and market your school to the public.

iii. The short video clip must embrace the school rules, motto, and mission and vision statements.

iv. It must also contain messages of new and competent management.

v. This video clip has to have the potential to positively change the image of the school

vi. This 2-miunte video clip must be captivating and totally convincing to attract students to want to enrol at your school.

vii. This clip must not be more than 2 minutes (maximum time limit)

viii. Submit both your write-up (on a chart) together with your video clip

ix. 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:

- Decide on type of rubrics to be used (Holistic or Analytic)
- After you decide, plan the rubrics
- Planning to develop the rubric
- 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-miunte video clip must be captivating and totally convincing to attract students to want to enrol 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 enrol 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 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 enrol 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	Marks
Video Script Write up	**Innovative** and **well** organised paper with **clarity** of video script writing procedures	**Well** organised paper with **clarity** of video script writing procedures	Organised paper with some **clarity** of video script 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 enrol 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 enrol 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 enrol 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

How to Score using the rubric

Scoring Rubrics:

Criteria	Achieved ~~3~~	Progressing ~~2~~	Novice ~~1~~	Scoring
Video Script Write up -	**Innovative** and **well** organised paper with **clarity** of video script writing procedures	**Well** organised paper with **clarity** of video script writing procedures	Organised paper with some **clarity** of video script 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 enrol 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 enrol 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				

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%**

How to Report using the rubric

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 script writing procedures	**Well** organised paper with **clarity** of video script writing procedures	Organised paper with some **clarity** of video script 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 enrol 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 enrol 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
Arts (Theatre Arts)	9.2.2.2
Christian Civic Value Education (CCVE)	9.3.1.3
Character Social Development (CSD)	9.1.5.1, 9.1.5.2, 9.1.5.3, 9.1.5.4, 9.1.5.5
English	9.2.2.1
Social Science (History)	9.2.2.3, 9.2.2.4
Social Science (Political Science)	9.3.3.1, 9.3.3.2
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.

Appendices #: Sampled Assessment

SUBJECT: COMPUTER TECHNOLOGY:

Appendices #: Steps in Developing a Rubric
• List the Main parts of the Unit Of Work for the Rubric
• Derive the purpose of Assessing the TASK in the Topic (Benchmark)
• List the Lesson Title and Objective of the assessment task
• Organise how the Assessment Task would be done: Individually or in Groups
• Derive the Performance Standard from the Benchmark
• Describe the Minor Tasks under the Main Task Description
• Rephrase the Minor Tasks to create the Categories
• List Task Descriptions and Categorise them
• Unpack the Essential KSAV to be assessed from Task Descriptions
• Design the Rubric type and decide the point-scale rubric for the assessment task
• Re-word the Task Descriptions including KSAVs and create the Descriptors
• Use Appropriate Qualifiers for Descriptors for each Achievement Level

Unit: COMPUTER ARCHITECTURE

Topic: Simulation Models

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 12.5.1.1: Identify different types of models used for simulations

Learning Objective: By the end of the topic, students will be able to identify different types of simulation models

Purpose of Assessment: To assess whether the students can use their programming skills to simulate real world.

Assessment Strategy: Two to three students sharing one device and swapping ideas and the device back and forth.

Duration: 160 minutes periods

Time/ Date of Administration: Use Assessment Schedule

Due Date/Time: Use Assessment Schedule

Performance Standard: By the end of the project the student will recognise that a model is made up of multiple variables that work together.

Performance Tasks: Students will;

- Do a write up on Simulation models
- Do a model of a real world

Performance Assessment Criteria:

- Do a write up on Simulation models
- Do a model of a real world

Assessment Scoring: 45 marks

Scoring Tool:

Criteria	Excellent	Proficient	Adequate	Score
Write Up	**Innovative** and **well** organised paper with **clarity on the usefulness of models**	**Well** organised paper with **clarity on the usefulness of models**	Organised paper with some **clarity on the usefulness of models**	/15
Model a real world (STEAM Project Criteria)	**Appropriately considered details** on the illustration of the model based on real world	**Considered details** on the illustration of the model based on real world	**Some details** considered for on the illustration of the model based on real world	/ 30
Total Score				/45

Appendices #: Scoring Rubrics

Write Up:

Criteria	Excellent	Proficient	Adequate	Score
Brainstorming examples of Models	**Significant evidence** of relevant ideas presented to show examples of models	**Relevant** ideas presented to show usefulness of models	**Vague** ideas presented to show usefulness of models	/3

Justify the usefulness of models	**Comprehensive** ideas presented to show usefulness of models	**Sufficient** ideas presented to show usefulness of models	**Incomplete** ideas presented to show usefulness of models	/3
State the difference about a model and the world and state reason why models can be valuable tools.	**Innovative** and **well** organised paper with clear difference about a model and the world and **well stated** reason on why models can be valuable tools**.** **Effective** organised paper with clear difference about a model and the world and **appropriate** reason on why models can be valuable tools**.** **Workable** organised paper with clear difference about a model and the world **with no** reason on why models can be valuable tools**.**			/3
Teamwork	Completed required individual tasks that contributed to the success of the team.	Contributed to the success of the team, but could have been more engaged to complete tasks sooner.	or did the project alone without relying on others to do their share of the project.	/3
Submit on Time	Submitted well before deadline	Submitted on time	Submitted late	/3

STEAM Project Assessment

Rubric on Model a Real World:

Category	**innovative**	**effective**	**workable**
	3	**2**	**1**
Quality/ Workmanship	Maximum effort was put forth to complete the project in a professional manner. Project demonstrates a high degree of quality and attention to detail. Workmanship is excellent.	Some effort was made to complete the project to a level that was sufficient for grading, but does not meet a professional level of quality or appearance. Workmanship is of acceptable quality.	Minimal effort was made to complete the project and the quality and workmanship is sub-par, but still meets the minimal standard.
Creativity/ Design	Project reflects many fundamental elements of design and creativity. Project demonstrates an advanced understanding of creative thinking and attention to aesthetics and presentation.	Project reflects some of the elements of design and creativity, but lacks attention to aesthetics and presentation.	Project was completed, but does not reflect the acceptable levels of design and creativity. Effort was minimal and project is mediocre at best.

Functionality	Project meets or exceeds the design requirements of purpose and functionality. All elements of the design have been met and the project does what it was designed to do.	Project meets some of the design requirements of purpose and functionality. Not all elements of the design have been met, but the project does what it was designed to do.	Project is somewhat functional, but reflects minimal effort. It is intermittent and doesn't always do what it was designed to do.
Design Process	Project reflects a clear understanding and application of design process including evidence of research, brainstorming, design and problem solving, prototyping and testing.	Project reflects some understanding and application of accepted design loop principles and sequence including evidence of research, brainstorming, design and problem solving, prototyping and testing.	Project reflects minimal understanding and application of design process.
Criteria/ Constraints	Project was completed with all constraints and criteria met or exceeded. Reflects attention to detail and quality.	Project was completed with some of the constraints and criteria met. Reflects some attention to detail, but quality is minimal.	Project was completed with a few of the constraints and criteria met. Reflects minimal effort and lacks detail or quality.
Time Management	Project completed and turned in on time. Student worked diligently when project time was available. Student was on task most of the time.	Project was completed, but had notable errors. Student utilised project time somewhat efficiently, but spent time socializing. Student was on task 70% - 80% of the time.	Project was not turned in on time and/or complete. The student was on task less than 60% of the time.
Resource Management	Always takes responsibility for use and care of all building components and resources. Always returns building components and materials to proper storage compartments.	Consistently takes responsibility for use and care of building components and resources. Somewhat consistent in returning building components to proper storage compartments.	Sometimes takes responsibility for use and care of building components and resources. Inconsistent in returning building components to proper storage compartments.
Teamwork	Notable teamwork shown with a determination to participate/contribute to team success. Completed required individual tasks that contributed to the success of the team.	Teamwork was noted, but was sometimes off task or working on non-related tasks. Contributed to the success of the team, but could have been more engaged to complete tasks sooner.	Notable time off-task with minimal effort given for team success, or did the project alone without relying on others to do their share of the project.
Writing/ Reflection	Writing/reflection is very well organised and explained. Student includes all details in design process. Document has almost no grammatical errors.	Writing/reflection is somewhat organised and explained. Student includes most details in design process. Document has very few grammatical errors.	Writing/reflection is not organised and explained. Student includes only a few details in design process. Document has many grammatical errors.
Presentation	Presentation was well organised and presented in a logical sequence. Presentation reflects a full knowledge of the topic with clear answers and explanations to questions asked.	Presentation was fairly organised and most information presented in a logical sequence. Answers to questions were vague or lacked clarity or accuracy.	Presentation was unorganised and lacked a logical sequence. Presentation reflected little attention to detail. Answers to questions were inaccurate and confusing.

GLOSSARY

Term	Definition
Analog	Analog is an adjective that describes a continuous measurement or transmission of a signal. It is often contrasted with digital, which is how computers store and process data using ones and zeros.
Adobe Acrobat Reader	A software that allows you to view a PDF document (a document that can be seen but not changed). It can be downloaded free of charge from Adobe.
ADSL	Asymmetric digital subscriber line (ADSL) is type of digital subscriber line (DSL) broadband technology that is used to connect to the internet. It uses standard telephone lines to deliver high speed data communication (up to 24 megabytes per second)
Analogue	A conventional method of transmitting data. Standard landline telephones use analogue technology. It is distinct from digital technology which provides for greater quality and speed of data transmission.
Attachment	A document that is sent with an email message. Many types of files can be sent this way. (e.g. Word documents, PDFs, Excel files, JPEGS). Large files may take too long for the recipient to download, therefore it is good practice to compress the file using software such as Winzip before attaching it.
Back-end	Refers to the part of an application that performs an essential task not apparent to the user.
Backward compatible	If software is backward compatible, it is compatible with earlier (superseded) versions of the same software
Bandwidth	Refers to the maximum amount of data that can travel a communication path in a given time, usually measured in seconds.
Bit	A bit (short for binary digit) is the smallest unit of measurement in computing. 8 bits make up 1 byte.
Bluetooth	Is a wireless communications technology intended to replace cables. It allows short-range connections between two or more Bluetooth compatible devices such as mobile phones, tablets, headsets or medical equipment.
Bookmark	Is a saved link to a particular Web page. Microsoft internet Explorer denotes bookmarks as favourites'.
Boolean operators	Most search engines (eg Google) allows one to limit his search or make it more specific by using words such as and, or' and not'. These words are known as Boolean operators because of their origin as terms in logic.
Boot (re-boot)	To boot (or re-boot) is to load and initialize the operating system on a computer. Think of it as starting up a computer in Windows one can use the key combination CNTRL and ALT and DEL as a soft' boot. This means restarting the computer rather than turning it off completely and on again which can cause damage to one's computer's hard disk under some circumstances.

Bounce back	An email message that cannot be delivered and returns as an error notification to the sender. If this happens check if the address has been typed correctly.
Broadband	A type of communications technology whereby a single wire can carry more than one type of signal at once, for example, audio and video. Cable
	TV is one technology that uses broadband and data transmission.
Browser	A software program that allows one to surf the web. Popular browsers. Include Google, Chrome, Mozilla, Frefox, Microsoft Edge and Internet Explorer.
Cache	When you download (read) a web page the data is _cached' meaning that it is temporarily stored on the computer. The next time one wants the page instead of requesting the file from the web server, the web browser just accesses it from the cache so the page loads quickly. The downside to this is if the cached web page is often updated, one may miss the latest version. If this is suspected to be so , use the _refrech' button on the browser.
CAD	Computer-aided design) CAD is a type of software that allows users to create 2D and 3D design and modeling. CAD is used by architects, engineers, artists and other professionals to create precise technical drawings.
Chip	A microprocessor that performs many functions and calculations that make ones computer run. The computer chip is also as the CPU (Central Processing Unit) or the processor.
Cloud computing	Refers to the storing and accessing of data and programs over the internet instead of on another type of hard drive. Examples of Cloud services are iCloud, Google Cloud and Drop box.
Compression	The reduction of the size of a file . Compressed files take up less memory and can be downloaded or sent over the internet more quickly.
Content	Refers to a website's text and information as opposed to its design and structure.
Cookie	A piece of code or data created by a a web server and stored on a a users computer. It is used to keep track of the user's patterns and preferences.
CPU	The central processing unit (CPU) is the brains behind the computer. The CPU is responsible for performing calculations and tasks that make programs work. The higher the speed of a CPU, the faster the CPU undertakes the calculations and tasks.
Cybercrime	Any type of illegal activity that is undertaken (or relies heavily) on a computer. There are thousands of types of cybercrime including network intrusions, identity theft and the spreading of computer viruses.
Device driver	A small program that allows a peripheral device such as a printer or scanner to connect to the PC.

Digital	Digital information is stored using a series of ones and zeros. Computers are digital machines because they can only read information as on or off -- 1 or 0. This method of computation, also known as the binary system, may seem rather simplistic, but can be used to represent incredible amounts of data.
Domain	A set of computers on a network that are managed as a unit.
Download	Is a method by which users access and save or ‗pull down' software or other files to their own computers from a remote computer via the internet.
DV	DV stands for digital video.
Email	Email or electronic mail is a way of sending messages over the internet. Popular email programs include Outlook, Mozilla Thunderbird, Gmail and Yahoo Mail
Encryption	Is the process of converting electronic data to an unrecognizable or encrypted form one cannot be easily understood by unauthorized parties.
Ethernet	The most common way of connecting computers on a network with a
	wired wired connection. It is a type of local area network (LAN) technology providing a simple interface for connecting multiple devices.
Firewall	A barrier that acts as a security system to protect trusted computer systems and networks from outside connections and untrusted networks such as the internet.
FTP	File transfer protocol is a common method of transferring files via the internet from one host to another host.
Gateway	A point within a network that interconnects with other networks.
GIF	Graphics interchange format (GIF) is a graphics file format. Because GIF files are compressed they can be quickly and easily transmitted over a net-work. GIF is one of the main graphics format on the internet.
Hard disk	The physical place where a computer stores information-applications and files-it is known as its hard disk drive(HDD). The bigger the HDD, the more data it can store.
Home page	The page that an internet browser first opens up to. It is usually the starting point of an organisation or individual's website.
HTML	Hyper-text markup language (HTML) is a set of symbols inserted into files intended for display on the world wide web. The symbols tell web browsers how to display words and images –e.g. which colour, font and type size to use-and they direct it to link to other pages on the world wide web via hyperlinks.
Internet	A set of interconnected networks that allow computers in different locations to exchange information. The internet includes services such as the world wide web, electronic mail, file transfer protocol (FTP), chat a remote access to networks and computers.
ISP	An internet service provider (ISP) is a company that provides access to the internet.

Intranet	An internet is basically private, internal internet specific to an organisation or group.
Java	A programming language that is commonly used in the development of client server web applications.
JPEG	Joint Photographic Experts Group (JPEG) which was the committee that created the file format known as JPEG. The format is commonly used for photos displayed on the world wide web.
LAN	A local area network is a system that connects computers and other devices that share a common communications line and wireless links generally within a limited geographical area such as a home or office building.
Malware	Malware' is short for malicious software. It refers to a software program that has been developed to do harm to other computers. Types of malware include viruses, worms and spyware.
Megabyte	A measure of computer processor storage and real and virtual memory. A megabyte (Mb) is 2 to the 20th power bytes or 1,048,576bytes in decimal notation.
Megahertz	Is the unit used to measure the speed of a computer's processor (e.g. 2.8Ghz)
Modem	Is a device that allows computers to transmit information to each other via ordinary telephone lines.
Online	If a computer (computer user) is online, it is connected to a network or to the internet. Online also refers to resources and services available on the internet-e.g. online banking, online dictionary

Operating system	An operating system(OS) is the software that manages all of a computer's processes and allows programs and applications to run. The most prominent operating system is Microsoft Windows. Others include Mac OS X and Linux
PDF	Portable document format (PDF) is a file type created by Adobe Systems Inc. PDFs can be read using free software called Adobe Acrobat Reader or another PDF reader.
Phising	Is a type of email fraud in which the perpetrator sends out emails that appear to come from a legitimate service or reputable company such as a bank or an email service provider. These emails aim to lure recipients to reveal confidential information that the perpetrator can use for their financial advantage.
Plug-in	A software plug-in is a component that adds to a software program's functionality.
POP	A Post office protocol (POP) is an internet protocol used by an internet service provider (ISP) to handle email. A POP account is an email account.
PPM	Pages per minute (PPM) generally refers to the speed of a printer.

Processor	Is the brains of the computer. It is responsible for performing calculations and tasks that make programs work. The faster the processor, the faster the computer works.
Protocol	Is a standard or set of rules that computers and other devices use when communicating with one another.
RAM	Random access memory (RAM) is usually referred to as the computer memory- it stores information used by programs. Generally the larger the computer's RAM, the more programs it can run at once without slowing down.
Read-only	A read only file cannot be edited, modified or deleted.
Resolution	Refers to the number of distinct pixels that make up the display on a computer monitor. It is denoted in DPI (dots per inch). The higher the resolution, the finer and smoother the images appear when displayed at a given size.
ROM	Read only memory. It is the part of a computer's memory that cannot be changed by a user. The contents of ROM remain even when the computer is turned of.
Search engine	A search engine enables a computer user to search information on the internet. It is a type of software that that creates indexes of databases or internet sites based on the titles of files or the full text of files, keywords, or the full text of files.
SSL	SSL or secure sockets layer is a protocol that allows internet users to send encrypted messages across the internet. It is generally used when transmitting confidential information e.g. personal data or credit card details. A web address that begins with _https' indicates that an SSL connection is in use.
Server	Is a computer that handles requests for data, email, file transfers and other network services from other computers.
Spam	refers to unsolicited email messages sent for marketing purposes.
Unzip	To unzip a file is to extract and decompress compressed files from it. If sent a zip file via email one will need to unzip it before the files can be accessed inside it.
URL	A URL (unique resource locator) or web address is the string of characters typed into a browser to access a particular website or other resource on the internet.
Viral	An online video, photo or article experiences a sudden spike in popularity in a short period of time is said to have gone viral.
Virus	A piece of programming code inserted into other programming to cause damage. Viruses can be sent in many forms but are often transmitted via email messages that when opened may erase data or cause damage to a hard disk.

WEP	Wired equivalent privacy (WEP) is a security protocol used in wi-fi networks. It is designed to provide a wireless local area network (LAN) with a level of security similar to that of a regular wired LAN. WEP- secured networks are usually protected by passwords.
Wi-Fi	Wi-Fi is a technology that allows computers and other devices to communicate via a wireless signal. Essentially it means one can browse the internet without tripping over phone cords.
WPA	Wi-Fi protected access(WPA) is a security protocol used in wi-fi networks. It is an improvement on WEP because it offers greater protection through more sophisticated data encryption.
Zip	To zip files is to archive and compress them into one file of smaller size using a programsuchasWinZip.It'sahandywaytomakefilessmaller before sending them via email.

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APPENDICES

(Samples of Student Response System Applications)

These are web based apps that work with a multitude of devices and operating systems. Here are the 4 best student response systems that interface with multiple devices.

Kahoot

Kahoot is a utility that allows teachers to create quizzes and surveys, and then send them to students. Teachers may allow students an unlimited amount of time to respond to questions, or they may set a time limit on each question.. Points are awarded to students both for correct answers and for responding quickly with those correct responses. Teachers can track students as they make progress.

Socrative

Socrative works excellently both for students working on their own or for students who are collaborating with one another. Socrative offers several different ways for instructors to engage their students. There are space races in which students can compete in teams or as individuals to answer questions as quickly and accurately as possible. Polls allow instructors to receive student feedback.

Infuse Learning

Infuse learning is (was!) an excellent student response system for teachers who must support students with a variety of learning styles. With infusion a teacher can create questions, quizzes and writing prompts and send them to students who are participating in virtual classrooms or in an online learning program. What makes Infuse Learning unique is that it allows the teacher to give the student multiple response options.

Verso

This is a free utility that teachers can use to create virtual classrooms. Verso works with the teacher's Google Drive account. This means that links, files, videos, images, and documents from the instructor's Google Drive can be added to the Verso classroom for students to access. Students who enter the classroom will be shown new items that have been added to the classroom since their last visit.

https://www.emergingedtech.com/2015/09/top-5-multi-platform-student-response- systems/

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, hypothesise, 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, prioritise, provoke, rank, rate, select, support, monitor,

ANALYSING Can the student distinguish between the different parts?	Analysing, characterise, classify, compare, contrast, debate, criticise, deconstruct, deduce, differentiate, discriminate, distinguish, examine, organise, outline, relate, research, separate, experiment, question, test,
APPLYING Can the student use the information in a new way	Apply, change, choose, compute, dramatise, 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 summarising 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 follow-up 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 prices.	Go into groups and organize. Follow the instructions and play to win
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 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. Students • Observe and ask essential questions • Record • Interpret
PEER TEACHING & LEARNING *(power point presentations, pair learning)* Students teach 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; • …… • …….....
Knowledge; • …… • …….
Skills; • …… • …….
Values; • …… • ……
Attitudes; • …… • …….

Teacher will …..	**Student will ….**
Introduction (time in minutes)	

Body (time in minutes)	
Modelling	
- -	
Guided Practice	
Independent Practice	
Conclusion (time in minutes)	
Assessment	

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 organise 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.

APPENDIX 6: TIME ALLOCATION FOR JUNIOR AND SENIOR HIGH

Grade 9 & 10		Gr 11 &12		Gr 11 &12	
Lessons/wk	**Min/ week**	**Lessons/ wk**	**Min/ week**	**Lessons/ wk**	**Min/week**
English		Applied English		HPE	
6	6 x 40=240	6	6x40=240	6	6x40=240
Math		L &L		PE	
5	8 x 40 = 320	6	6x40=240	6	6x40=240
Science		Advance Math		RE	
5	5 x 40 =200	8	8 x 40 = 320	1	1 x 60=60
Social Science		Gen Math		Business Studies	
5	5 x 40 =200	6	6x40=240	6	6x40=240
PD		Physics		Accounting	
5	5 x 40 =200	6	6x40=240	6	6x40=240
Business Studies		Biology		Economics	
5	5 x 40 =200	6	6x40=240	6	6x40=240
Design & Technology		Chemistry		Design & Tech	
5	5 x 40 =200	6	6x40=240	6	6x40=240
Arts		Applied Science		Computer Studies	
5	5 x 40 =200	6	6x40=240	6	6x40=240
CCVE		Geology		ICT	
3	3 x 40=120	6	6x40=240	6	6x40=240
RI		Geography		CCVE	
1	1x60=60	6	6x40=240	2	3x40=120
Agriculture		History		ANRM	
5	5 x 40=200	6	6x40=240	6	6x40=240
		Legal Studies			
		6	6x40=240		
Totals:		**Total:**		**Total:**	

Topic 1: Simulation Models

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 12.5.1.1: Identify different types of models used for simulations

Learning Objective: By the end of the topic, students will be able to identify different types of simulation models

Essential questions:

1. What are simulation models?

2. Explain the purpose of simulation models
3. What are the different types of simulation models?

Skills, Knowledge, Attitudes and Values:

Key Concepts(SKAV)	
Skills	Identify different types of simulation models
Knowledge	Simulation Models
Attitudes	Creativity in designing different types of simulation modeling
Values	Rationality

Lesson 1: Simulation Modeling

Lesson Objective: By the end of the lesson the student will recognise that a model is made up of multiple variables that work together.

Lesson Procedure:

Teacher will …..	Student will ….
Introduction (time in minutes)	
Ask students to brainstorm what they think a "model" is in science and examples of models they know of. Explain that a model is a representation of something in the real world that can't be experienced directly, such as climate change.	• Note their ideas in their exercise books. • Recognise that the models can represent an idea, an object, a process, or a system.
Body (time in minutes)	
Modelling	
Give examples of Simulation models - Computer Model - Play Grow a Tree - Illustrate how the gravitational force controls the motion of the planets	Discuss their ideas on different simulation models using the examples given.
Guided Practice	
Guide students to Illustrate how the gravitational force controls the motion of the planets.	Using the program, they are familiar with, they draw, code and simulate the gravitational force that controls the motion of the planets.
Independent Practice	
Allow students to explore the different motions that a group of planetary bodies can have.	Using the online program explore the different motions that a group of planetary bodies can have.
Conclusion (time in minutes)	
What are computer models good for?	To computer models are good for illustrating ideas, process or system that represent real world.
Assessment	

Confirm students understanding on models with the following; • Why are models useful? • How can computer models be used to learn about the real world? • What can be different about a model vs. the world?	Affirm understanding on models by; 4. Justify the usefulness of models 5. Model a real world 6. State the difference about a model and the world.

Appendices 9: Sampled Assessment

SUBJECT: COMPUTER TECHNOLOGY

Appendices #: Steps in Developing a Rubric
• List the Main parts of the Unit Of Work for the Rubric • Derive the purpose of Assessing the TASK in the Topic (Benchmark) • List the Lesson Title and Objective of the assessment task • Organise how the Assessment Task would be done: Individually or in Groups • Derive the Performance Standard from the Benchmark • Describe the Minor Tasks under the Main Task Description • Unpack the Essential KSAV to be assessed from Task Descriptions
• Design the Rubric type and decide the point-scale rubric for the assessment task • Re-word the Task Descriptions including KSAVs and create the Descriptors • Use Appropriate Qualifiers for Descriptors for each Achievement Level

Unit 1: Computer Architecture

Topic: Simulation Models

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 12.5.1.1: Identify different types of models used for simulations

Learning Objective: By the end of the topic, students will be able to identify different types of simulation models

Purpose of Assessment: To assess whether the students can use their programming skills to simulate real world.

Assessment Strategy: Two to three students sharing one device and swapping ideas and the device back and forth.

Duration: 160 minutes periods

Time/ Date of Administration: Use Assessment Schedule

Due Date/ Time: Use Assessment Schedule

Performance Standard: By the end of the project the student will recognise that a model is made up of multiple variables that work together.

Performance Tasks: Students will

- Do a write up on Simulation models
- Do a model of a real world

Performance Assessment Criteria:

- Do a write up on Simulation models
- Do a model of a real world

Assessment Scoring: 45 marks

Scoring Tool:

Criteria	Excellent	Proficient	Adequate	Score
Write Up	Innovative and well organised paper with clarity on the usefulness of models	Well organised paper with clarity on the usefulness of models	Organised paper with some clarity on the usefulness of models	/15
Model a real world (STEAM Project Criteria)	Appropriately considered details on the illustration of the model based on real world	Considered details on the illustration of the model based on real world	Some details considered for on the illustration of the model based on real world	/ 30
Total Score				/ 45

Appendices 10: Scoring Rubrics

Write Up

Criteria	Excellent	Proficient	Adequate	Score

4. Brainstorming examples of Models	Significant evidence of relevant ideas presented to show examples of models	Relevant ideas presented to show usefulness of models	Vague ideas presented to show usefulness of models	/3
5. Justify the usefulness of models	Comprehensive ideas presented to show usefulness of models	Sufficient ideas presented to show usefulness of models	Incomplete ideas presented to show usefulness of models	/3
6. State the difference about a model and the world and state reason why models can be valuable tools.	• Innovative and well organised paper with clear difference about a model and the world and well stated reason on why models can be valuable tools. • Effective organised paper with clear difference about a model and the world and appropriate reason on why models can be valuable tools. • Workable organised paper with clear difference about a model and the world with no reason on why models can be valuable tools.			/3
7. Teamwork	Completed required individual tasks that contributed to the success of the team.	Contributed to the success of the team, but could have been more engaged to complete tasks sooner.	or did the project alone without relying on others to do their share of the project.	/3
8. Submit on Time	Submitted well before deadline	Submitted on time	Submitted late	/3

STEAM Project Assessment

Rubric on Model a Real World:

Category	innovative	effective	workable
	3	2	1
Quality/ Workmanship	Maximum effort was put forth to complete the project in a professional manner. Project demonstrates a high degree of quality and attention to detail. Workmanship is excellent.	Some effort was made to complete the project to a level that was sufficient for grading, but does not meet a professional level of quality or appearance. Workmanship is of acceptable quality.	Minimal effort was made to complete the project and the quality and workmanship is sub-par, but still meets the minimal standard.
Creativity/ Design	• Project reflects many fundamental elements of design and creativity. • Project demonstrates an advanced understanding of creative thinking and attention to aesthetics and presentation.	Project reflects some of the elements of design and creativity, but lacks attention to aesthetics and presentation.	• Project was completed, but does not reflect the acceptable levels of design and creativity. • Effort was minimal and project is mediocre at best.

Functionality	• Project meets or exceeds the design requirements of purpose and functionality. • All elements of the design have been met and the project does what it was designed to do.	• Project meets some of the design requirements of purpose and functionality. • Not all elements of the design have been met, but the project does what it was designed to do.	Project is somewhat functional, but reflects minimal effort. It is intermittent and doesn't always do what it was designed to do.
Design Process	Project reflects a clear understanding and application of design process including evidence of research, brainstorming, design and problem solving, prototyping and testing.	Project reflects some understanding and application of accepted design loop principles and sequence including evidence of research, brainstorming, design and problem solving, prototyping and testing.	Project reflects minimal understanding and application of design process.
Criteria/ Constraints	• Project was completed with all constraints and criteria met or exceeded. • Reflects attention to detail and quality.	• Project was completed with some of the constraints and criteria met. • Reflects some attention to detail, but quality is minimal.	• Project was completed with a few of the constraints and criteria met. • Reflects minimal effort and lacks detail or quality.
Time Management	• Project completed and turned in on time. • Student worked diligently when project time was available. • Student was on task most of the time.	• Project was completed, but had notable errors. • Student utilised project time somewhat efficiently, but spent time socialising. • Student was on task 70% - 80% of the time.	• Project was not turned in on time and/or complete. • The student was on task less than 60% of the time.
Resource Management	Always takes responsibility for use and care of all building components and resources. Always returns building components and materials to proper storage compartments.	Consistently takes responsibility for use and care of building components and resources. Somewhat consistent in returning building components to proper storage compartments.	Sometimes takes responsibility for use and care of building components and resources. Inconsistent in returning building components to proper storage compartments.
Teamwork	Notable teamwork shown with a determination to participate/contribute to team success. Completed required individual tasks that contributed to the success of the team.	Teamwork was noted, but was sometimes off task or working on non-related tasks. Contributed to the success of the team, but could have been more engaged to complete tasks sooner.	Notable time off-task with minimal effort given for team success, or did the project alone without relying on others to do their share of the project.
Writing/ Reflection	Writing/reflection is very well organised and explained. Student includes all details in design process. Document has almost no grammatical errors.	Writing/reflection is somewhat organised and explained. Student includes most details in design process. Document has very few grammatical errors.	Writing/reflection is not organised and explained. Student includes only a few details in design process. Document has many grammatical errors.

Presentation	Presentation was well organised and presented in a logical sequence. Presentation reflects a full knowledge of the topic with clear answers and explanations to questions asked.	Presentation was fairly organised and most information presented in a logical sequence. Answers to questions were vague or lacked clarity or accuracy.	Presentation was unorganised and lacked a logical sequence. Presentation reflected little attention to detail. Answers to questions were inaccurate and confusing.