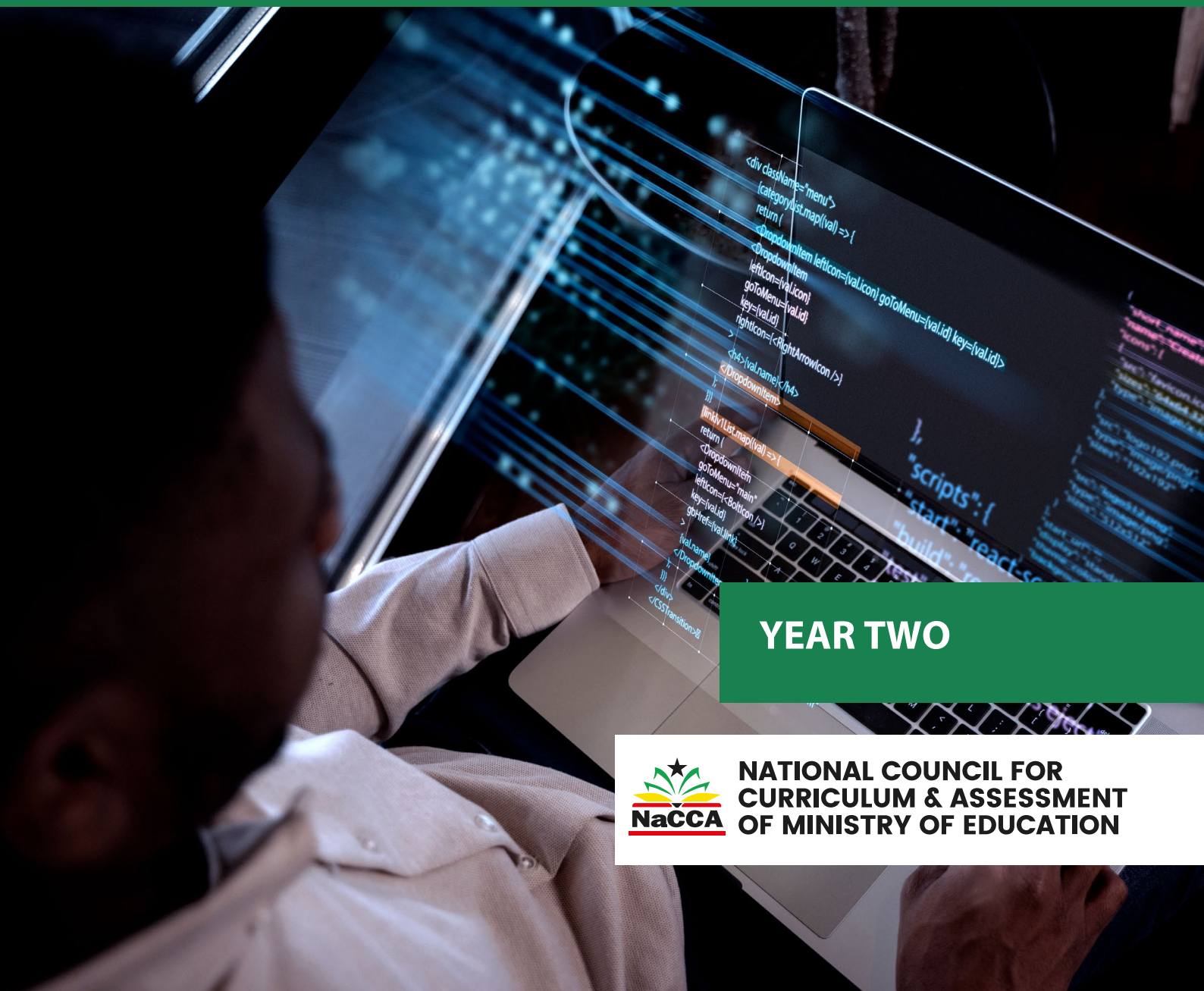
MINISTRY OF EDUCATION

INFORMATION COMMUNICATION TECHNOLOGY

For Senior High Schools

TEACHER MANUAL



YEAR TWO

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

MINISTRY OF EDUCATION

REPUBLIC OF GHANA

Information Communication Technology

For Senior High Schools

Teacher Manual

Year Two

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

INFORMATION COMMUNICATION TECHNOLOGY TEACHER MANUAL

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INTRODUCTION

The National Council for Curriculum and Assessment (NaCCA) has developed a new Senior High School (SHS) curriculum which aims to ensure that all learners achieve their potential by equipping them with 21st Century skills, competencies, character qualities and shared Ghanaian values. This will prepare learners to live a responsible adult life, further their education and enter the world of work.

This is the first time that Ghana has developed an SHS Curriculum which focuses on national values, attempting to educate a generation of Ghanaian youth who are proud of our country and can contribute effectively to its development.

This Teacher Manual for Information Communication Technology is a single reference document which covers all aspects of the content, pedagogy, teaching and learning resources and assessment required to effectively teach Year Two of the new curriculum. It contains information for all 24 weeks of Year Two including the nine Key Assessments required for the Student Transcript Portal (STP).

Thank you for your continued efforts in teaching our children to become responsible citizens.

It is our belief that, if implemented effectively, this new curriculum will go a long way to transforming our Senior High Schools and developing Ghana so that we become a proud, prosperous and values-driven nation where our people are our greatest national asset.

ACKNOWLEDGEMENTS

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SECTION 1: BASICS OF SPREADSHEETS

STRAND: ICTS IN SOCIETY

Sub-Strand: Organising, Managing and Presenting Information Using Essential Productivity Tools

Learning Outcome: *Utilise knowledge of spreadsheet software to create functions for data analysis, interpret graphs, and manipulate tables*

Content Standard: *Demonstrate knowledge and understanding of Analysing numerical data using spreadsheet software*

HINT

- *Assign learners a portfolio assessment by Week 2 to be submitted in Week 22. Refer to **Appendix A** of this Section and Teacher Assessment Manual and Toolkit for more information on how to organise the individual portfolio assessment.*
- ***Assign Group Project** for the academic year by Week 5. The project should be submitted by Week 11. **See Appendix B** of this Section and Teacher Assessment Manual and Toolkit for more information on how to organise a group project.*
- *Inform learners to prepare for **Mid-semester examination** in Week 6. Refer to **Appendix C** for the structure and a Table of Specification to guide you to set the questions for the exams.*

INTRODUCTION AND SECTION SUMMARY

This section is a continuation of year one activities, which focuses on improving learners' understanding of the use of ICTs in society

Weeks 1 to 8 introduce Learners to Spreadsheet Applications, including workbooks, cell referencing, creation and utilisation of formulas and functions, and generation and interpretation of graphs and charts.

The weeks covered by the section are:

Week 1: Describe Spreadsheet software workbooks, worksheets, cell referencing

Week 2: Create and utilise formulas and functions for data analysis

Week 3: Create and utilise formulas and functions for data analysis

Week 4: Generate and interpret graphs and charts to visualise data

Week 5: Generate and interpret graphs and charts to visualise data

Week 6: Apply sorting and filtering operations to manipulate tables

Week 7: Apply sorting and filtering operations to manipulate tables

Week 8: Save and print workbooks and worksheets (Save, Save As, Print)

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section considers various teaching and learning approaches, strategies, and techniques. These include hands-on activities where learners engage in practical tasks to research, explain, and demonstrate spreadsheet applications. Where appropriate, learners should be able to work in groups to find solutions to assigned tasks.

Experiential learning activities with mixed-ability and mixed-gender groupings should dominate these lessons. Regardless of their abilities, all learners should be encouraged to participate fully. Accommodate different learning styles by offering below-average or approaching proficiency learners the chance to make oral presentations when appropriate and providing more challenging extension activities for above-average or highly proficient learners.

Practical sessions and project-based learning will enhance learner engagement, foster valuable collaboration and teamwork skills, and provide opportunities to practise using formulas and generating graphs.

ASSESSMENT SUMMARY

The assessment section (formative and summative) considers all four levels of the Revised Bloom's Taxonomy: Level 1 (Recall/Reproduction), Level 2 (Skills/Conceptual Understanding), Level 3 (Strategic Thinking/Reasoning), and Level 4 (Extended Critical Thinking and Reasoning).

Teachers should note that there are assessment suggestions suitable for different levels of ability learners approaching proficiency (AP), proficient (P) learners, and highly proficient (HP) learners. Beyond traditional practical and written tests and assignments, teachers should introduce learners to other forms of assessment, including demonstrations of activities using a digital device, mind maps or concept maps, multiple-choice quizzes, group projects, self-assessments, oral presentations, peer reviews, portfolios, debates, game-based assessments, digital storytelling, and matching tasks.

Please note that the key assessment items in this manual are intended to guide teachers in establishing learners' understanding of the course material. They do not limit teachers from exploring and creating their questions.

WEEK 1

Learning Indicator: Describe Spreadsheet software workbooks, worksheets, cell referencing

Focal Area: Spreadsheet software workbooks, worksheets, cell referencing

What is a Spreadsheet Application?

A spreadsheet application is software designed for creating, editing, and managing data in tabular form. It is structured in grids of rows and columns to organise, analyse, and manipulate numeric data and can provide a digital simulation of paper accounting worksheets. Spreadsheet software has replaced many paper-based systems, especially in the business world. Microsoft (MS) Excel is the most commonly used spreadsheet application, but other spreadsheet software examples are Google Sheets, Zoho Sheets, LibreOffice Calc, Apple Numbers, etc.

Note

Before learners can effectively use Excel's numerous features, they must first acquire basic skills and concepts. This includes identifying the components of the Excel screen, creating, opening, and saving a workbook, and navigating within it. However, it is crucial first to determine which version of Excel is being used. Knowing the correct version allows both teachers and learners to select the appropriate paper-based or online manuals, which they can use to enhance their Excel skills further.

Familiarity with the names and functions of the various parts of the Excel window is essential. This knowledge is crucial for learners to follow the instructions in this manual effectively.

Workbooks

A workbook in Excel is a collection of worksheets, commonly known as spreadsheets. Each workbook is an Excel file containing one or more worksheets where you can input, organise, and analyse data.

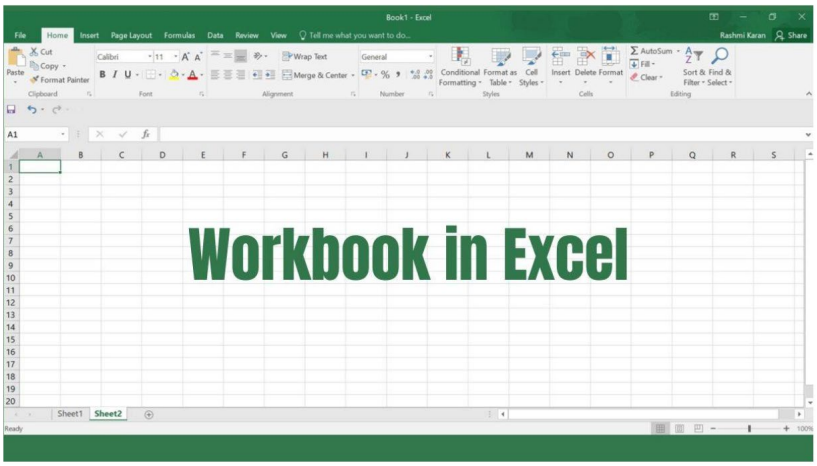


Figure 1.1 Workbook

Features of Excel Workbooks

Workbooks in Microsoft Excel serve as essential tools for managing, organising, and analysing data across various professions and industries. Here are some key uses and purposes of workbooks in Excel.

1. Workbooks organise and manage databases efficiently, allowing easy access and manipulation of information.
2. Workbooks allow you to perform complex calculations and analysis, aiding decision-making and insight generation.
3. They handle budgeting, forecasting and financial modelling tasks accurately.
4. Workbooks format reports and presentations, making data communication effective.

Note

Teachers should not limit themselves to the above definition and uses. Instead, they should allow learners to explore other uses and purposes of workbooks.

How to create and manage workbooks

Creating a new workbook in Excel is fairly straightforward. Teachers are to guide learners through creating workbooks. The following steps could be followed to open Excel:

1. Open Excel on your computer.
2. Click the Start button on the Windows taskbar.
   a. The Start menu opens
3. Point to Programs
   b. The Programs menu opens
4. Click Microsoft Excel
   c. Excel opens a new workbook

Note

An MS Excel icon may be on the desktop or the Office toolbar.

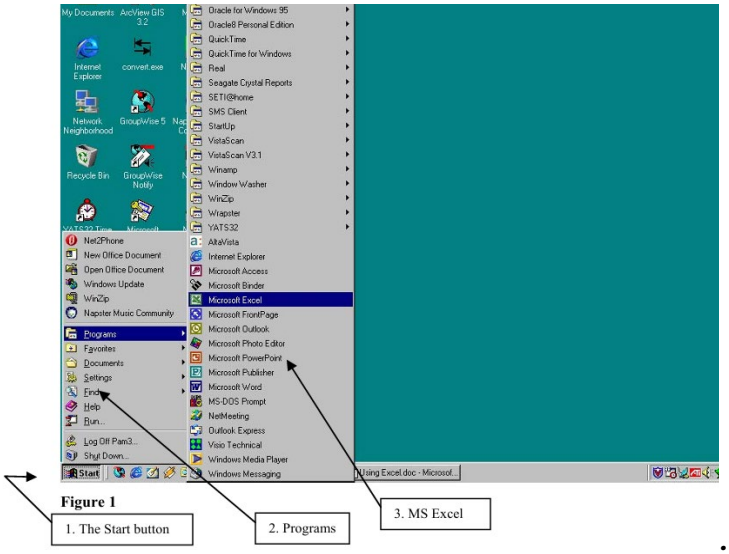


Figure 1.2 Starting a Workbook

5. After the Excel document has been opened, click "**File**" or "**Start**" from the menu.

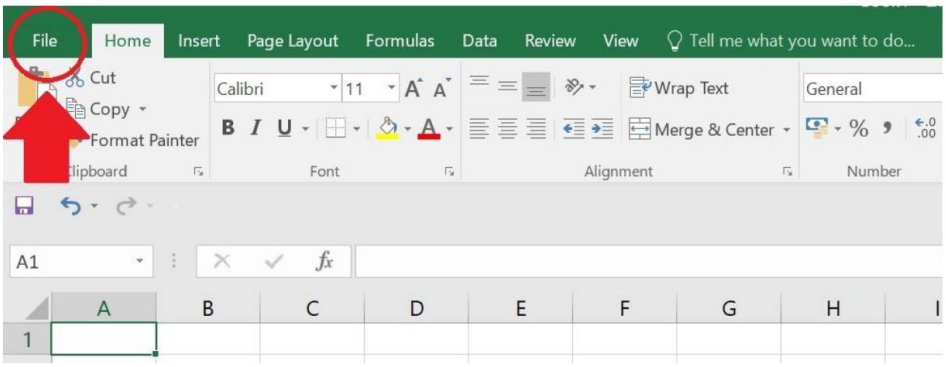


Figure 1.3 Starting a Workbook

6. Select "**New**" to create a new workbook.
7. Choose "**Blank Workbook**" from the available options.

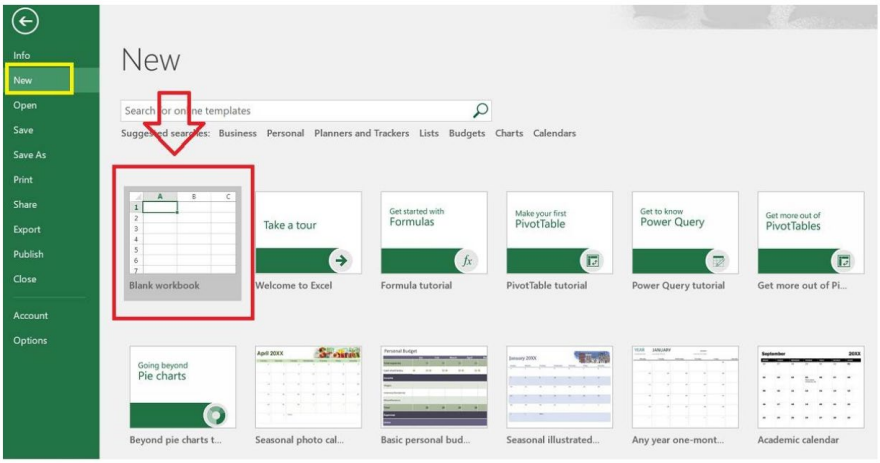


Figure 1.4 Starting a Workbook

Note

You can press the keyboard shortcut Ctrl + N to create a new blank workbook. Before teaching learners the keyboard shortcut, let them go through the main procedure.

Open an Existing Workbook in Excel

To access an existing workbook in Excel, Guide learners to follow the following steps:

Step 1 - Type Excel in the search bar.

Step 2 - Click **"Open"**.

Step 3 - Navigate to the File menu.

Step 4 - You will be redirected to opening your workbook. You can either open a new workbook or search for the workbook within its location on your computer or network.

Step 5 - You can even Browse your saved files. Once you have located the workbook, select it.

Step 6 - Click the "**Open**" button to open the selected workbook in Excel.

Note

Kindly let learners explore other ways of accessing an existing workbook.

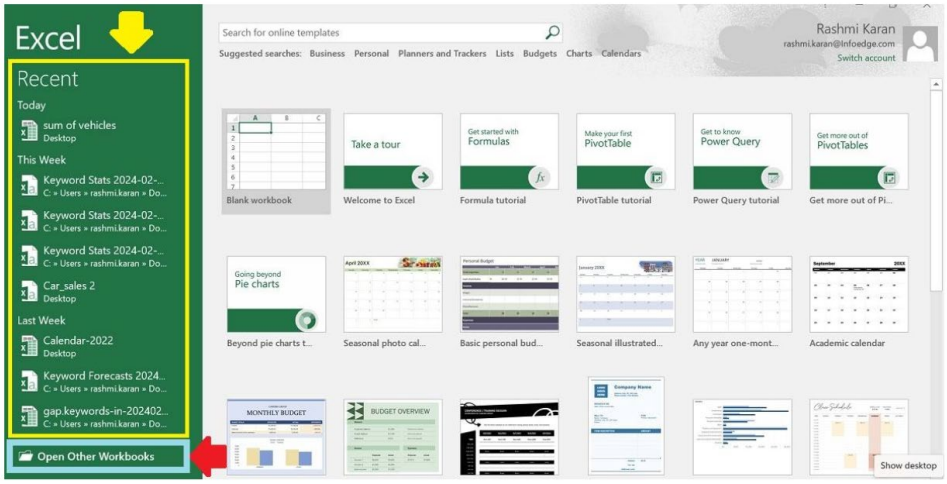


Figure 1.5 Accessing an Existing Workbook

Create a Workbook in Excel from a Template

Excel also allows you to create a Workbook from some already integrated templates. Guide learners to explore such areas.

Features of spreadsheet

As we know, there are many spreadsheet applications available on the market. So, these applications provide the following basic features:

Rows and columns

Rows and columns are two different properties that combine to form a cell, a range, or a table. In general, the vertical portion of a worksheet is known as columns, and there can be 16,384 of them in a worksheet, while the horizontal portion is known as rows, and there can be 1,048,576 of them. These figures are based on Excel 2007 onwards.

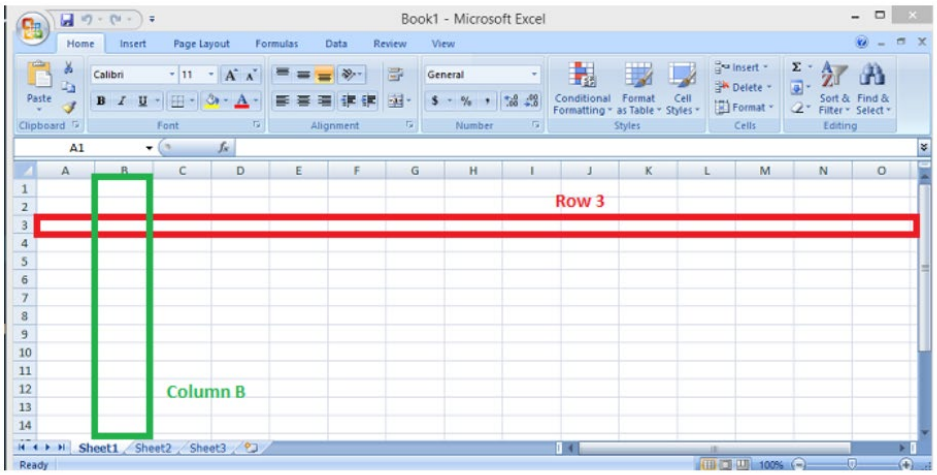


Figure 1.6 Rows and Columns

The green-coloured box shows a highlight/selection of a Column (Column B), while the red-coloured box shows a highlight/selection of a Row (Row 3).

Components of Spreadsheets

Teachers should take the learners through the basic components of a spreadsheet. The diagram below shows the basic components of a worksheet. Guide learners to understand the functions and roles of each component.

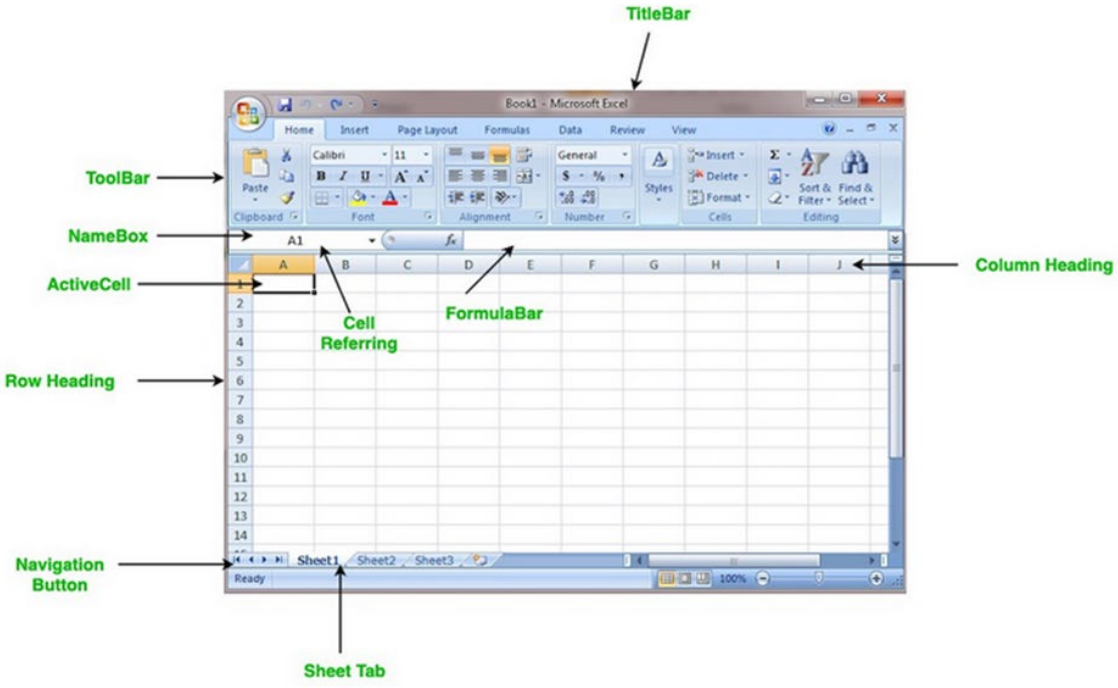


Figure 1.7 Components of a Spreadsheet

Saving The Workbook

In Excel, we can save a workbook using several steps. Teachers can guide learners through the following steps to save a workbook. Learners must be given the option of exploring other options:

Step 1: Click on the top-left Microsoft Office button, and we get a drop-down menu:

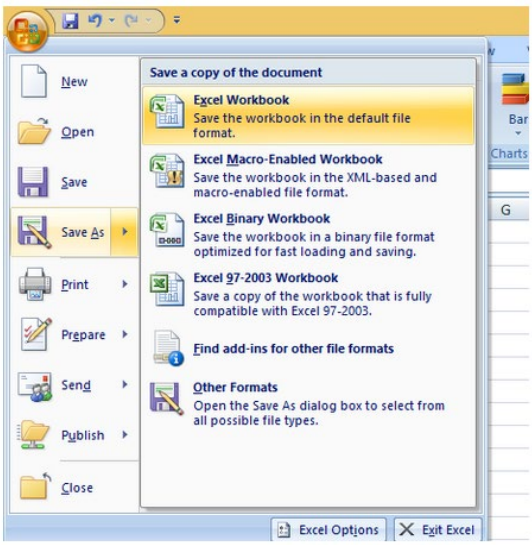


Figure 1.8 Process of saving a workbook

Step 2: Now Save or Save As are the options to save the workbook, so choose one.

- Save As: This option allows you to name and save the spreadsheet to a specific location. Select Save As if you wish to save the file for the first time or with a new name.
- Save: To save your work, select Save/ click ctrl + S if the file has already been named.

Inserting text in Spreadsheet

Teachers can use the following as an introduction to start this section.

"Ready to type in your spreadsheet? Each of those square boxes you see is called a cell. Just like finding your house on a map, cells have addresses! These addresses use letters (for the column) and numbers (for the row). For example, the cell at the top left is called A1 (because it's in column A and row 1).

Whenever you click on a cell, its address appears in the box at the top left of your screen (called the name box). This address is super important because you can use it in special instructions (called formulas) to tell your spreadsheet what to do with the information you enter!

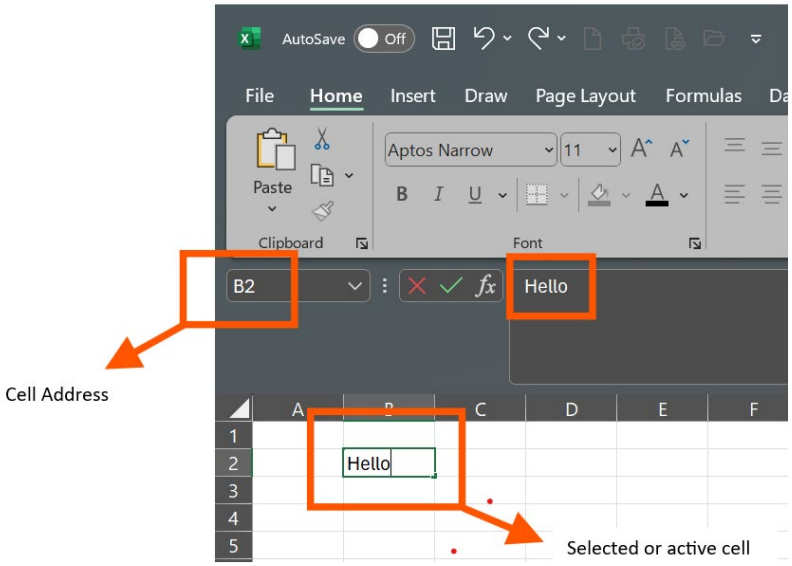


Figure 1.9 Entering Data

Whatever text you type will also be displayed in the formula bar (for that cell).

Note

Teachers should guide learners to learn and understand

1. How to Enter Numbers, Text, Date/time, Series Using AutoFill
2. Edit and Format a Worksheet
3. Insert and Delete Cells

Learning Tasks

1. Practise the process of opening a new workbook.
2. Practise how to Enter Numbers, Text, Date/time, Series Using AutoFill

3. Edit and Format a Worksheet
4. Insert and Delete Cells
5. Solve questions related to editing, formatting and saving a workbook.

Pedagogical Exemplars

1. **Reflective Learning:** The teacher will facilitate an open class discussion.
2. **Collaboration and Communication:** Learners will work in mixed-ability and gender-sensitive groups (with seating arranged by the teacher), sharing their ideas with peers and accepting constructive feedback on spreadsheet software workbooks, worksheets, and cell referencing.

Key Assessment

Level 1

1. What is a workbook in spreadsheet software?
2. Define a worksheet in a spreadsheet program.
3. What is a cell in a spreadsheet?
4. To enter the current date & time, what are the shortcuts?

Level 2

1. Explain the purpose of using multiple worksheets within a single workbook in spreadsheet software.
2. How do you reference cells in a spreadsheet using relative cell referencing?
3. Describe the process of creating a formula in a cell that references data from another worksheet within the same workbook.

Level 3

1. Discuss the potential impact of using absolute versus relative cell referencing in complex formulas within a spreadsheet.
2. Compare and contrast the advantages and disadvantages of using separate workbooks versus multiple worksheets within a single workbook for organising data in spreadsheet software.
3. Analyse the potential impact of using absolute versus relative cell referencing in complex formulas within a spreadsheet.

Level 4

1. Evaluate the effectiveness of using named ranges in spreadsheet software compared to traditional cell references.
2. Create a comprehensive guide for new users on organising and managing large datasets across multiple worksheets within a single workbook in spreadsheet software.
3. Develop best practices for efficient cell referencing and formula creation in complex spreadsheets, including strategies for minimising errors and improving readability.

HINT

*This week's recommended mode of assessment is **discussion**. Use DoK Level 3 question 1 as a sample. Refer to the Teacher Assessment Manual and Toolkit page 52 for information on how to use the discussion strategy as an assessment mode.*

WEEK 2

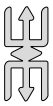
Learning Indicator: Create and utilise formulas and functions for data analysis

Focal Area: How to Cell Reference in Excel

Cell references in Excel allow you to refer to a cell or range of cells in a worksheet and use the value from those cells in your formulas. You can reference cells in the same worksheet, in other worksheets, or even in other workbooks. Here is a step-by-step guide on how to cell reference in Excel:

1. Open the Excel workbook
2. Select the cell that you want to reference
3. Copy the cell address
4. Go to the cell where you want to use the reference
5. Type an equal sign (=) followed by the copied cell address
6. Press the Enter key to complete the cell reference

You can use the cell reference in formulas and other calculations once the cell reference is created. It will be displayed as a regular cell reference in the formula bar, such as "A1" or "B2".



Note

Guide learners to explore other steps in cell referencing.

Formula Using the Arithmetic Operators

Teachers are to note and guide learners to understand that in Excel formulas, standard arithmetic operators are used for calculations. These include:

1. Addition (+)
2. Subtraction (-)
3. Multiplication (*)
4. Division (/)
5. Exponentiation (^) (raising a number to a power)

Some of the commonly used formulas are:

1. =SUM(A1: B1): It is used to find the sum of all the numeric data specified in the given range of numbers.
2. =COUNT(C1: D12): It is used to count all the number of cells(it will count only numbers) specified in the given range of numbers.
3. =MAX(A1: A10): It is used to find the maximum number from the given range of numbers.
4. =MIN(A1: A10): It is used to find the minimum number from the given range of numbers.
5. =TODAY(): It is used to find today's date.
6. =SQRT(A1): It is used to find the square root of the specified cell.

Note

Let learners practise the usage of some of these formulas

Let learners know that in Excel

1. "=" tells Excel that this is a formula, and it should evaluate it.
2. "A2 * D2" refers to cell addresses A2 and D2; the values in these cell addresses are multiplied.
3. "A2 + B2" makes reference to cell addresses A2 and B2 then adds the values in these cell addresses
4. "/" is the division arithmetic operator
5. "2" is a discrete value

For example

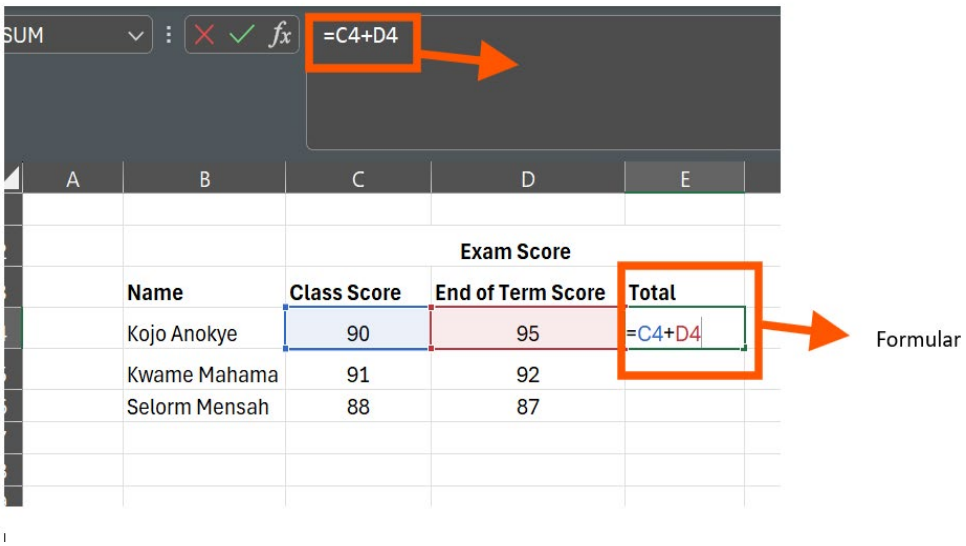


Figure 2.1 Formula

Functions

A function in Excel is a predefined formula that uses specific values in a particular order. It is used for quick tasks like finding the sum, count, average, maximum value, and minimum values for a range of cells. For example, cell A3 below contains the SUM function, which calculates the sum of the range A1:A2.

1. SUM for summation of a range of numbers
2. AVERAGE for calculating the average of a given range of numbers
3. COUNT for counting the number of items in a given range

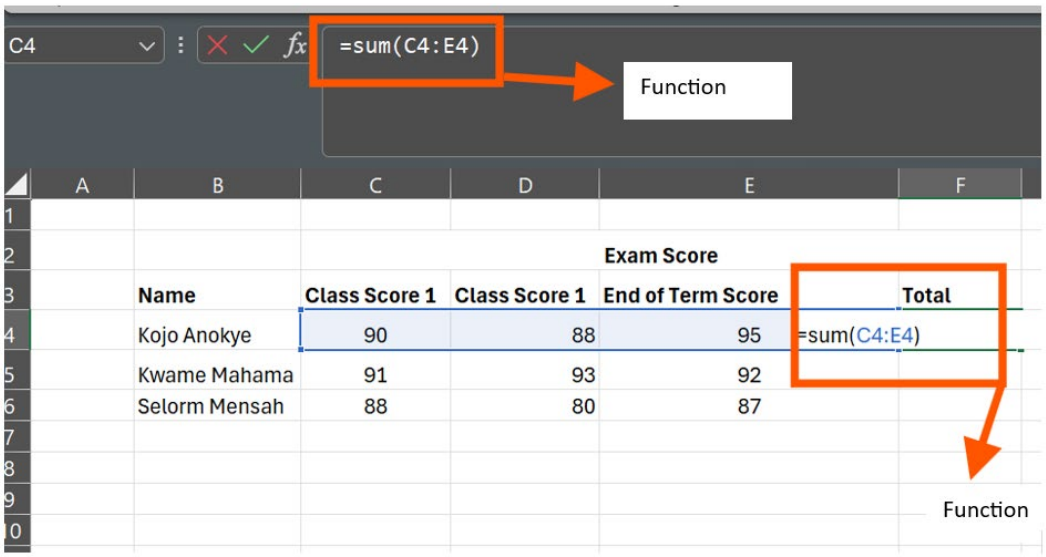


Figure 2.2 Function

Note

With examples, guide learners to understand the difference between functions and formulas.

Learning Task

Learners apply formulas and functions in an activity planned for them by the teacher.

Pedagogical Exemplars

1. **Project-based learning:** within a practical session (Individual and mixed ability/gender sensitive group Work with no stereotyping) to create and use formulas and functions. Use Interactive multimedia presentations and video analysis to discuss the concepts and explore techniques for creating and using formulas and functions such as SUM, AVERAGE, MIN, MAX, IF, and DATE.
2. **Problem-Based:** Present learners with problems related to business, finance, or data analysis and ask them to use Excel functions to find solutions in groups.

Key Assessment

Level 1

1. What are some common formulas used in spreadsheets for data analysis? (e.g., SUM, AVERAGE, COUNT)
2. What does it mean to use a function in a spreadsheet formula?

Level 2

1. How can you use the SUM function to calculate the total sales for a product in a spreadsheet?
2. How can you use the AVERAGE function to find the average age of employees in a company?
3. Explain how you would use cell referencing to create a formula that calculates the difference between two sales figures.

Level 3

1. A spreadsheet contains data on monthly sales figures for different products. How can you use functions to identify the product with the highest sales for a particular month?
2. You are given a dataset on student grades in different subjects. How can you use a combination of formulas and functions to calculate the average grade for each student?

Level 4

1. A company tracks sales data for different regions. How can you create a formula to calculate the percentage?
2. change in sales from one quarter to the next for each region?
3. You are given a large dataset of customer data. How can you use a combination of functions and pivot tables to analyse customer trends and preferences?

Demonstrate how to use the AVERAGE function to find the average age of employees in this companies? Click here to access the data or scan QR code

HINT

*Assign learners a portfolio assessment by Week 2 to be submitted in Week 22. Refer to **Appendix A** of this Section and Teacher Assessment Manual and Toolkit for more information on how to organise the individual portfolio assessment.*

WEEK 3

Learning Indicator: Create and utilise formulas and functions for data analysis

Focal Area: Debugging and Troubleshooting Formulas

Effective formula debugging and troubleshooting are essential skills for working with Excel. As a teacher, you must help your learners appreciate that understanding common errors and methods to resolve them helps ensure accurate and reliable data analysis.

Common Errors in Excel Formulas

1. **#DIV/0!**
    a. **Cause:** Division by zero or an empty cell.
    b. **Solution:** Check and correct the divisor to ensure it is not zero or empty. Use error-checking functions like IFERROR.
2. **#VALUE!**
    a. **Cause:** Incorrect data type used in a formula (e.g., text instead of a number).
    b. **Solution:** Ensure all operands are of the correct type. Convert text to numbers using functions like VALUE.
3. **#REF!**
    a. **Cause:** Invalid cell reference due to deletion of cells or ranges referenced in the formula.
    b. **Solution:** Update the formula to reference the correct cell range. If possible, use Undo to recover deleted cells.
4. **#NAME?**
    a. **Cause:** Unrecognised text in a formula, often due to misspelt function names or undefined named ranges.
    b. **Solution:** Verify the spelling of function names and ensure all named ranges are defined.
5. **#N/A**
    a. **Cause:** A value is not available to a function or formula.
    b. **Solution:** Check the referenced data and ensure it includes the expected values. Use IFERROR to handle missing values gracefully.
6. **#NUM!**
    a. **Cause:** Invalid numeric values in a formula, for example, when results are too large or invalid arguments for functions.
    b. **Solution:** Ensure the values and arguments in the formula are within acceptable ranges.

Debugging Techniques

1. **Using the Formula Auditing Tools**
   a. **Trace Precedents:** Shows all cells that are referenced by the formula.
   b. **Trace Dependents:** Shows all cells that depend on the selected cell.
   c. **Evaluate Formula:** Steps through the formula to see intermediate results and understand how Excel calculates the result.
2. **Checking Cell References**
   a. Ensure all cell references in the formula are correct and refer to the intended cells.
   b. Use absolute references (A1) for fixed references and relative references (A1) for references that change when copied.
3. **Simplifying Formulas**
   a. Break complex formulas into smaller parts and evaluate each part individually.
   b. Use helper columns to calculate intermediate steps and combine results in the final formula.
4. **Using Error-Checking Functions**
   a. **IFERROR(value, value_if_error):** Returns a specified value if the formula results in an error.
   b. **ISERROR(value), ISNUMBER(value), ISTEXT(value):** Functions that test for specific types of errors or data types.
5. **Reviewing Data Types**
   a. Ensure all data used in formulas is of the correct type (numbers, text, dates).
   b. Use functions like **VALUE, TEXT,** and **DATE** to convert data types as needed.
6. **Using Named Ranges**
   a. Define named ranges to simplify formulas and make them easier to read and debug.
   b. Ensure all named ranges are correctly defined and updated as data changes.

Troubleshooting Steps

1. **Identify the Error**
   a. Look at the error code to understand the nature of the problem.
   b. Use the error-checking options available under the Formulas tab.
2. **Inspect Formula Components**
   a. Check each part of the formula for correctness.
   b. Use the Evaluate Formula tool to step through the formula and observe the calculation process.
3. **Check for Common Issues**
   a. Ensure there are no missing or extra parentheses.
   b. Verify that all function arguments are correct and in the proper order.

4. **Correct Data Issues**
    a. Ensure that all data referenced by the formula is complete and correctly formatted.
    b. Update any external links or references to ensure they are valid and accessible.
5. **Test and Validate**
    a. After making corrections, test the formula with various inputs to ensure it works correctly.
    b. Validate the results by comparing them with expected outcomes or using alternative calculations.

Learning Task

Learners apply formulas and functions in an activity planned for them by the teacher.

Pedagogical Exemplars

1. **Peer Learning and Collaboration**: Encourage learners to collaborate and share their knowledge in Excel and organise group activities where they solve problems using functions. Peer teaching can reinforce understanding and build confidence.
2. **Experiential Learning:** Provide Excel templates with pre-built formulas and functions and show how to customise these templates for specific tasks (e.g., expense tracking). Share real-life examples from various fields (finance, marketing, science) where Excel functions are essential.

Key Assessment

Level 3: You encounter a #VALUE! error in an Excel formula. Describe a process to troubleshoot and correct it.

Level 4

1. How would you apply a function across multiple worksheets in a collaborative project with colleagues? Provide an example.
2. You have encountered a #DIV/0! error in your formula. Explain why this error occurs and provide a strategy to handle it (5 marks).

HINT

This week's recommended mode of assessment is class exercise. You may use any of the Key Assessment questions for the class exercise. Refer to the Teacher Assessment Manual and Toolkit page 63 for information on how to go about the class exercise.

WEEK 4

Learning Indicator: Generate and interpret graphs and charts to visualise data

Focal Area: Using graphs and charts to visualise data

1. **Discuss the purpose of Using Graphs and Charts**
   a. Explain that graphs and charts are visual tools used to represent data in a way that is easy to understand and identify patterns, trends, and relationships within the data.
   b. Visual representations make complex data more accessible and engaging.
2. **Discuss the benefits of Using Graphs and Charts**
   a. The teacher explains that:
      i. Graphs and charts simplify data presentation, making it easier to quickly comprehend large volumes of information.
      ii. They allow for easy comparison between different sets of data.
      iii. They help identify trends and patterns over time.
      iv. They Improve the effectiveness of communication by conveying messages clearly and concisely.
      v. They aid in data-driven decision-making processes by highlighting critical insights.
3. **Discuss the considerations in selecting appropriate chart types based on characteristics of Various Chart Types**
   a. Bar charts/Graphs are used to compare quantities across different categories and are ideal for showing discrete data.
   b. Pie Charts represent data as parts of a whole and are useful for showing percentage or proportional data.
   c. Line Graphs and charts display data points over time and best show trends and continuous data.
   d. Scatter Plots show the relationship between two variables and are ideal for correlation analysis.
   e. A histogram shows the frequency distribution of a set of continuous data.

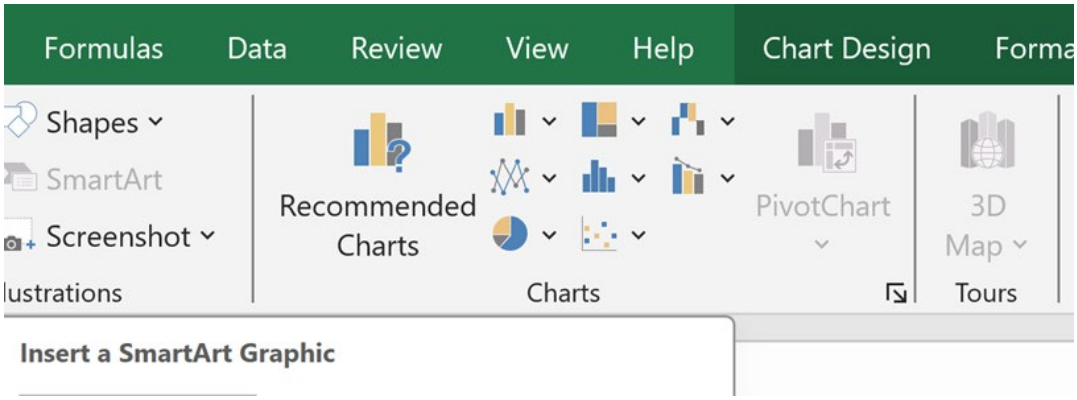


Figure 4.1 Chart Designs

4. **Identifying and Selecting the Most Suitable Chart Types**
    a. Understand the data to determine what type of data you have (categorical, numerical, time-series).
    b. Define the purpose of what you need to communicate (comparison, distribution, relationship, trend).
    c. Select the Chart Type: Choose the chart that best fits the data and the intended message. Bar charts compare categories, and pie charts show parts of a whole. Line charts show trends over time, and scatter plots show relationships between variables.
5. **The teacher guides students to create a chart**
    a. Select the data for which you want to create a chart.
    b. Click INSERT > Recommended Charts.
    c. On the Recommended Charts tab, scroll through the list of charts that Excel recommends for your data, and click any chart to see how your data will look.
    d. If you don't see a chart you like, click All Charts to see all the available chart types.
    e. When you find the chart you like, click it > OK.
    f. Use the Chart Elements, Chart Styles, and Chart Filters buttons command at the upper-right corner of the chart to add chart elements like axis titles or data labels, customise the look of your chart, or change the data shown in the chart.

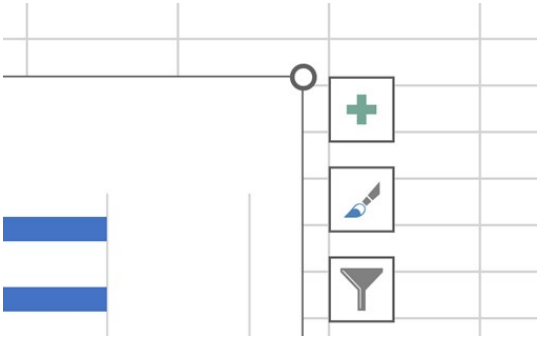


Figure 4.2 Chart tools

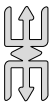
    g. To access additional design and formatting features, click anywhere in the chart to add the CHART TOOLS to the ribbon, and then click the options you want on the DESIGN and FORMAT tabs.

Learning Tasks

1. Learners discuss the purposes of using graphs and charts in Excel.
2. Learners explore the various considerations in choosing a particular graph and chart.
3. Learners discuss the direct benefits of using graphs and charts.

Pedagogical Exemplars

1. **Direct instruction:** Utilise multimedia presentations and videos to explain the purpose, benefits, considerations and process of creating graphs and charts. Show videos/images or other interactive tutorials to explain different chart types and their uses. Use real-world examples to demonstrate the application of each chart type.
2. **Discussion:** Discuss techniques for choosing and creating various chart types to deepen their understanding and clarify doubts.
3. **Project-Based Learning:** Conduct a practical session where students work on individual and group projects to create and interpret various charts in mixed ability/gender-sensitive groups to foster collaboration and ensure inclusivity. Students will choose appropriate chart types and create them using software tools like Excel or Google Sheets to analyse given datasets.



Note

Independent learning should be nurtured so the learners can become confident and competent digital users. Guidance notes and eManuals/ paper-based manuals on Excel should be accessible to learners to refer to when they encounter a problem/have forgotten a step. The learners can be directed to online help if the internet is available. Microsoft has excellent, easy-to-follow guides (including videos) on how to use various Excel tools:

Online resources can be obtained by scanning the QR

Key Assessment

Level 1

1. What are the basic steps to create a bar chart in Excel?
2. Name three different types of charts that can be used to visualise data.

Level 2

1. Explain the difference between a pie chart and a line graph.
2. How do you add a trendline to a chart in Excel?

Level 3

1. Given a dataset of monthly sales figures for 6 products for the past year, describe how you would choose the most appropriate chart type to display the data and justify your choice.
2. Analyse a given bar chart showing the sales of different products and identify which products had the highest and the lowest. Explain how you reached your conclusion.

Level 4: Explain how a school can use visualisation to understand students' performance. Recommend the types of charts to represent various aspects of the data (10 marks).

HINT

*This week's recommended mode of assessment is **homework.** Use DoK level 4 question 1 as a sample. Refer to the Teacher Assessment Manual and Toolkit page 46 for information on how to go about the homework.*

WEEK 5

Learning Indicator: Generate and interpret graphs and charts to visualise data

Focal Area: Add a Chart in Excel

Charts and graphs are visual representations of worksheet data. These graphics help you understand the data in a worksheet by displaying patterns and trends that are difficult to see in the data. The best way to learn about the various charts in Excel is to try them out.

One use case of spreadsheets is to generate quick graphical views of data, a process known as data visualisation.

Data visualisation serves two main purposes

1. To explore and analyse the data you have.
2. To demonstrate and communicate insights from the data.

About the Data

We will start with a well-organised dataset in row and column format. This particular dataset shows learners' examination scores.

Step 1: Open an Excel file and enter the following data

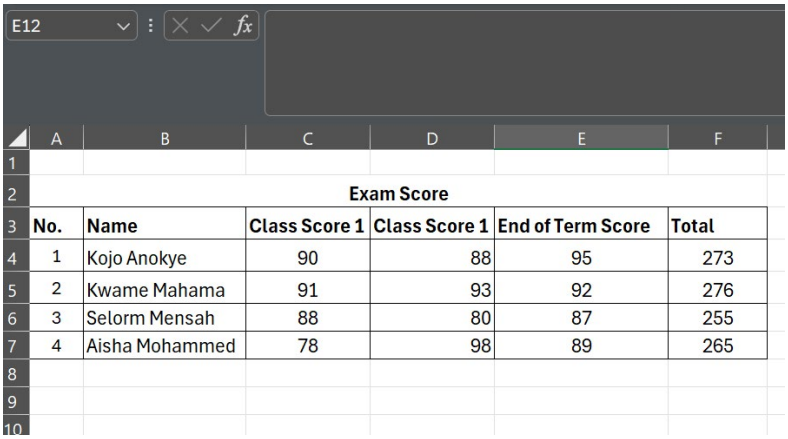


Figure 5.1 Sample Data Set

Step 2: Select the range you want to graph. To select a range, drag from the first cell to the last cell.

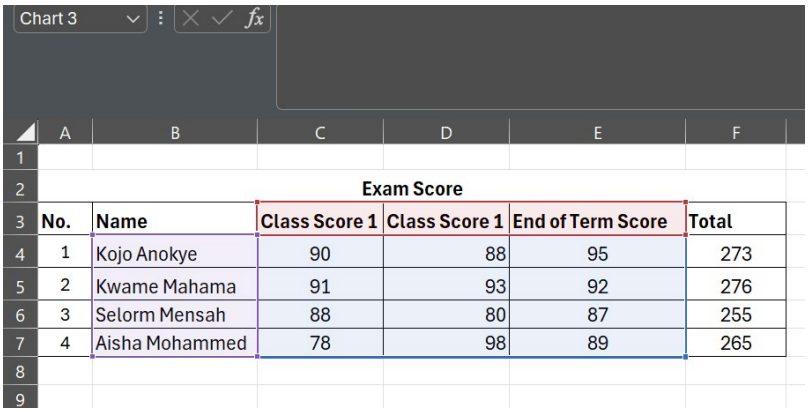


Figure 5.2 Selected range

Step 3: On the ribbon, go to **Insert** and select the desired **Chart Type** to see a menu of available chart formats of that type.

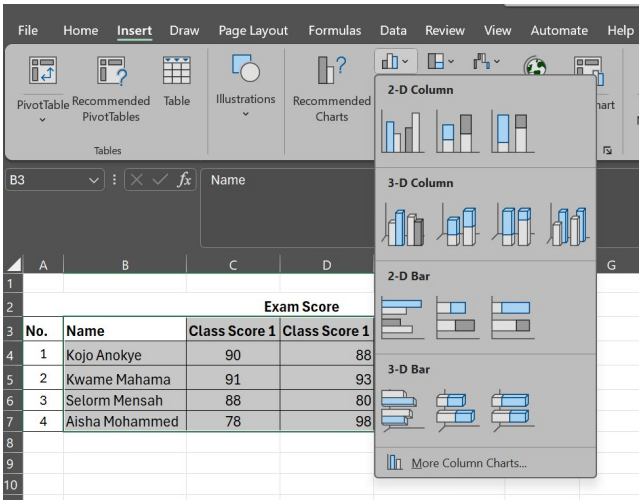


Figure 5.3 Selected range

Step 4: Hover over a chart in the list to see a preview of the chart in the worksheet

Pedagogical Exemplars

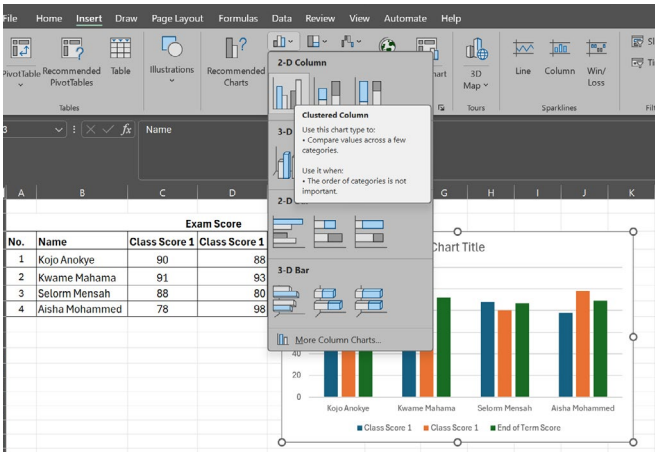


Figure 5.4 Selected range

Step 5: Select the chart format you want to use. The chart is added to the worksheet.

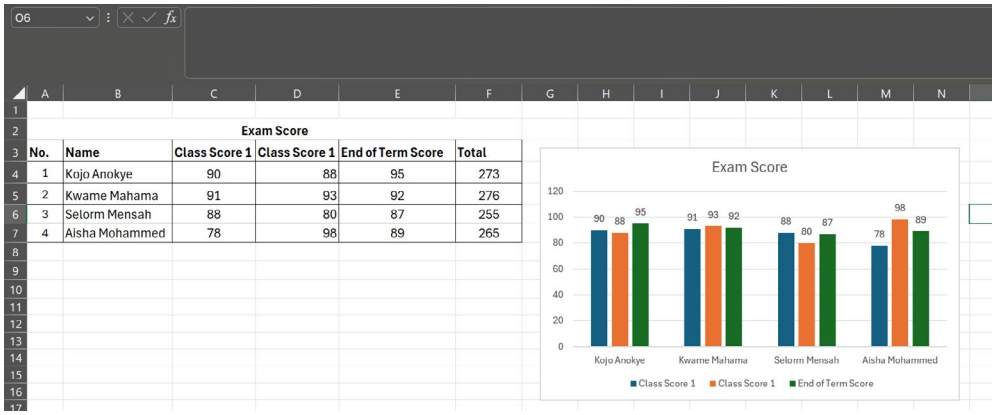


Figure 5.5 Selected Chart

To make changes to the chart, use the Chart Tools (located to the right of a selected chart) or right-click the chart to select the data, choose a different chart format, or format the gridlines and axis.

Note

The above process can be followed to create various charts. Guide learners through these procedures step by step.

Learning Tasks

1. Learners discuss the process of adding and generating charts in Excel.
2. Learners practise the process of entering data into Excel.
3. Learners explore the entering of data to generate charts.

Pedagogy Exemplars

1. **Project-based learning:** within a practical session (Individual and mixed ability/gender sensitive group work with no stereotyping) to explore and understand the basics of graphs and charts. Learners actively engage with data, create charts, and interpret the results.
2. Use Interactive multimedia presentations and video analysis to discuss the concepts and explore techniques such as Bar Charts/Graphs, Pie Charts, Line graphs, and Charts.

Key Assessment

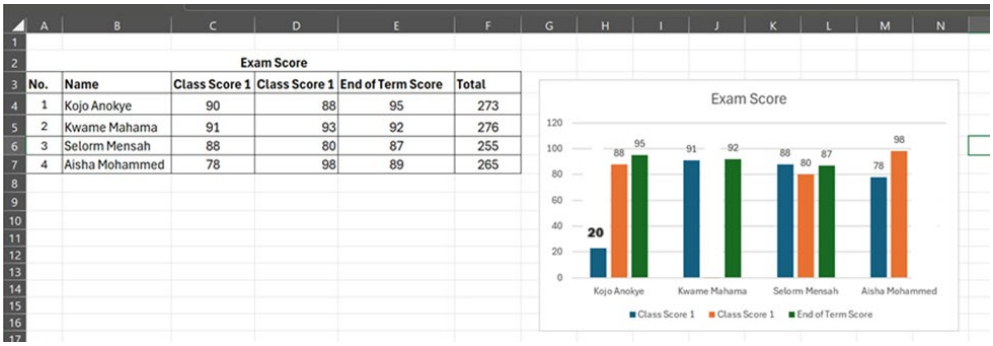
Level 1

1. What different types of charts and graphs are used to represent data (e.g., bar chart, line graph, pie chart)?
2. What are the main components of a graph (e.g., x-axis, y-axis, title, labels)?

Level 2

1. Which chart type would be most appropriate to represent the number of learners enrolled in each grade level at a school (e.g., bar chart)?
2. How can you use the data in a spreadsheet to create a bar graph that shows the sales figures for different products?
3. Explain the difference between a pie chart and a bar chart and when you might use each type.

Level 3: Based on your understanding of visualisation in excel, critique the image below and provide alternative visual representation for the data in the image.



Exam Score

No.	Name	Class Score 1	Class Score 1	End of Term Score	Total
1	Kojo Anokye	90	88	95	273
2	Kwame Mahama	91	93	92	276
3	Selorm Mensah	88	80	87	255
4	Aisha Mohammed	78	98	89	265

HINT

Assign Group Project *for the academic year by Week 5. The project should be submitted by Week 11.* ***See Appendix B*** *of this Section and Teacher Assessment Manual and Toolkit for more information on how to organise a group project.*

WEEK 6

Learning Indicator: Apply sorting and filtering operations to manipulate tables

Focal Area: Sorting and filtering operations to manipulate tables

1. **Understanding Sorting and Filtering**
   a. The teacher introduces learners to the purpose of sorting and filtering.
      i. Sorting is the process of arranging data in a specific order. This order can be alphabetical, numerical, or based on dates. Sorting helps organise data to make it easier to analyse and interpret.
      ii. Filtering displays only the rows in a dataset that meet certain criteria, hiding the other rows. This helps focus on specific subsets of data for detailed analysis.
   b. The teacher discusses the benefits of Sorting.
      i. Improved Data Organisation: Sorting data makes it easier to read and understand, especially in large datasets.
      ii. Enhanced Analysis: Sorted data can reveal patterns and trends that are not obvious when data is unordered.
      iii. Efficiency: Sorting helps locate specific data points quickly, reducing the time spent searching the dataset.
   c. The teacher discusses the benefits of Filtering.
      i. Focused Analysis: Filtering allows you to focus on specific data points that meet certain criteria, making it easier to analyse relevant information.
      ii. Data Cleaning: It helps identify and isolate data that needs correction or further investigation.
      iii. Quick Insights: Filters can provide quick insights by displaying only the necessary information without modifying the original dataset.
   d. The teacher introduces students to the types of sorting.
      i. Alphabetical Sorting: Arrange text data in alphabetical order, either AZ (ascending) or ZA (descending).
      ii. Numerical Sorting: Orders numerical data from smallest to largest (ascending) or largest to smallest (descending).
      iii. Date Sorting: Organises date and time data from oldest to newest (ascending) or newest to oldest (descending).
      iv. Custom Sorting: Uses user-defined lists or criteria to sort data in a specific order.
2. **Sort Data**
   a. The teacher takes learners through the process of sorting Data.
      i. Select the Data Range: Highlight the range of data you want to sort (e.g. B2:G21).
      ii. Click Choose the Sort Column: You can decide which column to sort by clicking on your data tab and then the sort command.

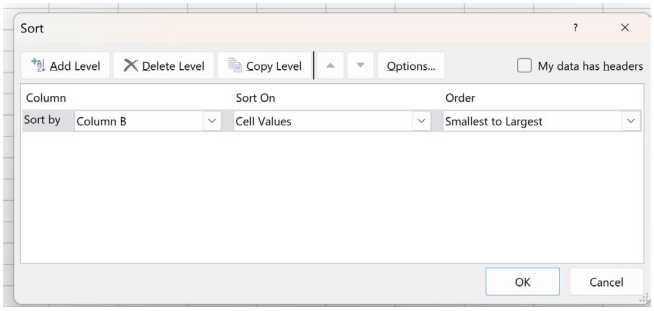


Figure 6.1 Data Sorting

iii. Click Specify the Sort Order: Select whether you want to sort in ascending or descending order.

iv. Apply the Sort: Use the sort functions in Excel to apply the sorting order by clicking ok.

b. Considerations for Sorting.

i. Ensure the data in the column is consistent in format (e.g., all dates, all numbers).

ii. For more complex sorting, apply multi-level sorting, where data can be sorted by more than one column (e.g., first by department, then by employee name).

iii. Sorting can affect the arrangement of other data linked to the sorted column.

Note

it is important to point out that sorting can be done using other methods such as the filter dropdowns, which will be covered later.

3. **Filter Data**

a. Purpose of Filtering.

i. Filtering helps isolate specific rows that meet certain conditions, allowing detailed analysis without altering the original dataset.

b. The teacher takes learners through the process of filtering Data:

i. Select the Data Range: Click on any cell within the range of data you want to filter.

ii. Apply the Filter: Go to the Data tab and click on the Filter button.

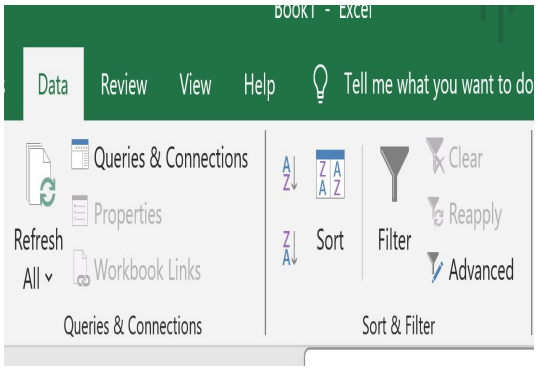


Figure 6.2 Data Filtering

Dropdown arrows will appear in the header of each column.

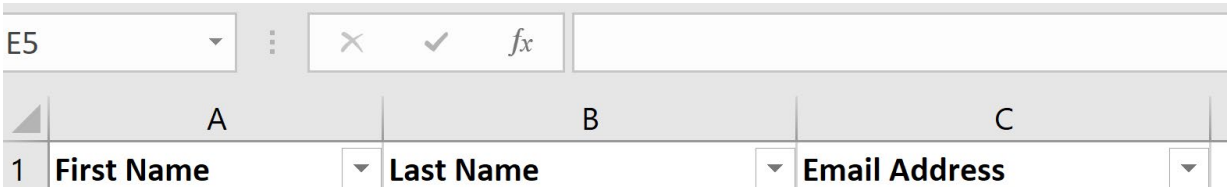


Figure 6.3 Data Filtering

iii. Define Filter Criteria: Click the dropdown arrow in the column you want to filter by and select the criteria (e.g., greater than, less than, contains). Also be aware that filter can be used to search for values such as numbers or text.

iv. View Filtered Data: Excel will display only the rows that meet the selected criteria. This does not remove the rows, simply hides them from view.

Learning Tasks

1. Learners follow along on their own devices, replicating the steps demonstrated for sorting and filtering data. They are encouraged to join the class discussion, ask questions, and provide immediate responses to ensure understanding.
2. Learners choose an appropriate sorting and filtering type and practise how to sort and filter data.

Pedagogical Exemplars

1. **Direct instruction:** Utilise multimedia presentations and videos to explain the purpose, benefits, considerations and process of sorting and filtering. Show videos/images or other interactive tutorials to explain different types of sorting and filtering and their uses. Use real-world examples to demonstrate the application of sorting and filtering.
2. **Discussion:** Discuss techniques for choosing and creating various sorting and filtering types to deepen their understanding and clarify doubts.
3. **Project-Based Learning:** Conduct a practical session where students work on individual and group projects to sort and filter data in mixed ability/gender-sensitive groups to foster collaboration and ensure inclusivity. Students will choose the appropriate sorting and filtering type using software tools like Excel or Google Sheets to sort and filter given datasets.

Note

Independent learning should be nurtured so the learners can become confident and competent digital users. Guidance notes and eManuals/ paper-based manuals on Excel should be accessible to learners to refer to when they encounter a problem/have forgotten a step. The learners can be directed to online help if the internet is available. Microsoft has excellent, easy-to-follow guides (including videos) on how to use various Excel tools:

Online resources can be obtained by scanning the QR

Key Assessment

Level 1

1. What is the purpose of sorting data in a table?
2. What are the basic steps to apply a filter in an Excel table?

Level 2

1. Explain the difference between sorting data in ascending order and descending order.
2. How does filtering data in a table help in data analysis? Provide an example.

Level 3

1. Given a dataset of students' grades, explain how you would use sorting and filtering to identify the top 10 students in a class.
2. How can combining multiple filters help narrow down data to meet specific criteria? Provide a scenario to illustrate your explanation.

Level 4

1. Summarise the identified trends found in your class project and propose actionable insights (e.g., areas for improvement) based on your interpretation of the chart produced.
2. Evaluate the effectiveness of using Excel sorting and filtering operations to manage an inventory system and discuss potential limitations whilst suggesting improvements.

HINT

*The recommended mode of assessment for Week 6 is **Mid-semester examination**. Refer to **Appendix C** for the structure and a Table of Specification to guide you to set the questions for the exams.*

WEEK 7

Learning Indicator: Apply sorting and filtering operations to manipulate tables

Focal Area: Sorting and filtering operations to manipulate tables

1. **Understanding Advanced Filtering Options**
   a. You can use text filters to
      i. Filters rows where a text cell contains a specified substring.
      ii. Excludes rows where a text cell contains a specified substring.
      iii. Filters rows where a text cell begins or ends with specified characters.
      iv. Filter rows are for exact matches or nonmatches of text.

   b. You can use number filters to
      i. Filter rows are based on numeric values greater or less than a specified number.
      ii. Displays rows with numeric values within a specified range.
      iii. Filters the top or bottom 'N' items or percentages in a list based on numerical value.
      iv. Filters rows that are above or below the average value.

   c. Use date filters to
      i. Filters rows with dates before or after a specified date.
      ii. Displays rows with dates within a specified range
      iii. Today/Yesterday/This Week/Last Week: Filter rows are based on relative dates.

   d. Use custom filters to
      i. Combine Multiple Conditions: Use logical operators (AND, OR) to combine multiple filter criteria.
      ii. Advanced Filter Tool: Excel's Advanced Filter tool can define filter conditions using more complex criteria, such as formulas.

2. **How to Apply Advanced Filters**
   a. Select the data range (e.g. B4:H10).
   b. Go to the Data tab and click on Filter.

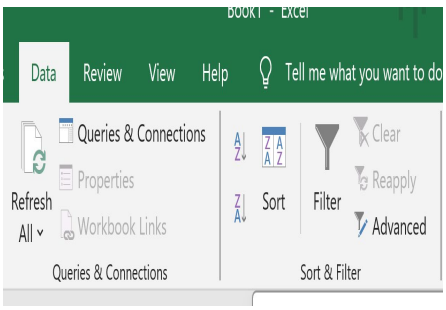


Figure 7.1 Advanced Data Filtering

c. Navigate to the header row and click the dropdown arrow in the column header and choose the appropriate filter type.

d. Define the filter criteria and apply the filter.

e. Sorting and Filtering

Learning Tasks

1. Learners watch tutorials that demonstrate advanced sorting and filtering techniques. They should apply these techniques to new datasets and solving more complex problems.
2. Learners follow along on their devices, replicating the steps demonstrated.
3. Learners are assigned group a project that involve analysing a complex dataset to answer specific questions or solve problems.

Pedagogical Exemplars

1. **Flipped Classroom with Online Resources:** Provide preparatory materials (video tutorials and interactive exercises, Microsoft easy-to-use guide for students to complete at home. Use class time for hands-on practice/project and deeper exploration of advanced sorting and filtering under the teacher's guidance.

2. **Discussion:** Review and discuss materials provided earlier to students. Discuss the techniques for choosing and creating various sorting and filtering types to deepen their understanding and clarify doubts.
3. **Collaborative Problem-Based Learning (PBL):** Give students a real-world problem that requires data analysis, such as optimising sales strategies or improving customer service/ analysing student examination scores. Provide data to students for which they must use advanced sorting and filtering to manipulate the provided dataset and develop a solution. Students in mixed-ability groups explore different sorting and filtering techniques to address the problem.
4. **Group Presentations**: Groups present their findings to the class, explaining the steps they took and the insights they gained.

Key Assessment

Level 1

1. What is the purpose of using sorting operations in Excel?
2. Name two types of filters you can apply to a dataset in Excel.

Level 2

1. Explain applying a custom filter to display data within a specific date range.
2. Describe the process of sorting data in Excel by one column and then by a second column.

Level 3

1. Given a dataset (provided by the teacher) of sales transactions, apply a filter to show only the transactions where the sales amount exceeds GHC500 and sort the results by date in descending order. Explain your steps.
2. Analyse a dataset (provided by the teacher) with multiple columns and describe how you would use advanced filters to extract records where the "Region" is "Northern region" and the "Sales Amount" is between GHC1,000 and GHC5,000.

Level 4: Design an Excel template for managing customer orders for a shop. Include advanced sorting and filtering capabilities to analyse trends and performance metrics. Explain how these features can be used to make data-driven decisions.

HINT

*This week's recommended mode of assessment is **feedback**. Use DoK level 1, question 2 as an example. Refer to the Teacher Assessment Manual and Toolkit page 89 for information on how to use the feedback strategy for assessment.*

WEEK 8

Learning Indicator: Save and print workbooks and worksheets (Save, Save As, Print)

Focal Area: Save and print workbooks and worksheets

1. **Save Workbooks**
    a. The teacher guides students to save Workbooks in Different Formats: Excel Workbook (.xlsx), PDF (.pdf)
        i. Convert workbooks to PDF for easy sharing and printing, ensuring data integrity and fixed formatting, including how to set a Print Area.
        ii. Save workbooks on your Local Computer (hard drive or external storage) for easy offline access. Discuss benefits, including complete control over data and immediate accessibility without internet dependency, faster access speeds, data control, and suitability for sensitive data requiring high security.
        iii. Save workbooks to a cloud service (e.g. OneDrive, Google Drive, or Dropbox) for accessibility from any device with an internet connection. Discuss benefits, including enhanced collaboration, automatic backup, and version history. Accessible from multiple devices and locations, facilitates real-time collaboration and sharing, and provides backup and recovery options.
2. **Print Worksheets**
    a. The teacher guides learners to print worksheets to produce hard copies
        i. Explore print options and page layout settings: Orientation (portrait and landscape), Margins, Paper Size (e.g., A4, Letter), Scaling, Print Area
        ii. Use Advanced Printing Options, including Page Ranges, multiple worksheets, and Entire Workbooks:
        iii. Print specific page ranges within a worksheet to focus on relevant data.
        iv. Select and print multiple worksheets from a workbook in a single print job.
        v. Print entire workbooks to ensure all related data is documented together.
3. **Customise Printing Output**
    a. The teacher guides learners through the adjustment of Print Settings, including Headers and Footers, Page Breaks, Print Areas, and Print Titles.
        i. Add headers and footers to include additional information like titles, dates, or page numbers. Insert or adjust page breaks to control how data is divided across pages. Repeat row and column headers on each printed page for better readability.
    b. Add Page Elements, Headers and Footers, Page Numbers, and Watermarks.
        i. Click the sheet.
        ii. On the Layout tab, in the Page Setup group, click Page Setup.
        iii. Under Print Titles, click on Rows to repeat at the top or Columns to repeat at the left and select the column or row that contains the titles you want to repeat.

iv. Click OK.

c. Click on Print Preview Print to view Output and Make Adjustments.

v. Use print preview to check the layout and content before printing. Adjust settings as needed to ensure the printed output meets expectations.

4. **The teacher guides learners to manage Print Jobs using Pause, Cancel, and Resume Print Jobs**

a. Monitor Print Queues, check the status of print jobs and manage priorities.

b. Discuss Common Printing Problems, including:

i. Paper jams and how to clear them following the printer's instructions to resume printing.

ii. How to resolve Printer Errors by checking printer status, replacing cartridges, or performing maintenance tasks.

iii. Optimise printer resources by ensuring sufficient paper and toner/ink are available and regularly maintaining the printer to prevent issues and improve performance.

Learning Tasks

1. Learners follow along on their devices, replicating the steps demonstrated. They are encouraged to ask questions and provide immediate feedback to ensure understanding.
2. Learners format and finalise their workbooks, applying different save and print options as appropriate.
3. Learners present their workbooks to the class, explaining their saving and printing choices and why.

Pedagogical Exemplars

1. **Demonstrations**: The teacher will begin with a clear, step-by-step presentation on saving and printing workbooks and worksheets in Excel. The teacher will display the Excel interface and key functions using visual aids, such as slides, diagrams, or a projector, and demonstrate on a computer the process of saving different file formats, using 'Save' and 'Save As' options and setting up print options.
2. **Group Project:** Divide learners into small groups and assign each group a project that involves creating and formatting a workbook, then saving and printing it. Each group can be tasked with different documents or file types, such as financial reports, data analysis summaries, or project plans.

Key Assessment

Level 1

1. List three different file formats in which you can save an Excel workbook.
2. What steps would you follow to print an entire workbook in Excel?

Level 2

1. Explain the benefits of saving an Excel workbook to a cloud storage service versus saving it locally.

2. How can you adjust the page layout settings before printing an Excel worksheet to ensure it fits on one page?
3. Using the Kahoot platform, a sample of the gamification is next below

   Click this link or scan the QR code to play this game.

   a. Click on play solo
   b. Select any study mode and play the game
   c. Answer these questions as you play:
      i. What is the difference between the "Save" and "Save As" options in Excel?
      ii. The "Print" option in Excel only allows you to print the entire workbook.

Level 3

1. If you need to prepare a report in Excel for a meeting, describe the steps you would take to save the report in both .xlsx and .pdf formats, then print specific sections of the report.
2. Analyse the impact of printing a large dataset without adjusting the print area and layout settings. What issues might arise, and how can they be mitigated?

Level 4: How will you design a workflow for a team project where multiple team members must collaborate on an Excel workbook? Explain how you would manage the workbook's saving, version control, and printing to ensure accuracy and consistency.

HINT

*This week's recommended mode of assessment is **gamification.** Use DoK level 2, question 3 as a sample. Refer to the Teacher Assessment Manual and Toolkit page 82for information on how to use the gamification strategy for assessment.*

SECTION REVIEW

This section has focused on developing the learners' understanding of spreadsheets as a fundamental tool for organising, analysing, and manipulating data across various fields.

At the end of this section, learners should be able to describe the main features, purpose, and uses of spreadsheets and how they can be used to store vast amounts of data in a structured format, in rows and columns, for efficient organisation.

The teacher would have guided the learners to understand that data can be categorised by labels and headers, making it easy to find specific information. Learners will also appreciate the importance of sorting and filtering data using different criteria and large datasets to focus on specific elements.

Through studying the topics in this section, learners should hopefully have developed an appreciation and a deeper understanding of performing basic and complex calculations using formulas, functions, charts and graphs for data representation.

The suggested activities in the manual strongly focus on critical thinking, problem-solving, and teamwork, three important life skills.

Additional Reading

- O' Leary, T. J., & O' Leary L. I. (2017). *Computing Essentials*, 26th edition. New York: Mcgraw Hill.
- Lambert, J., & Frye, C. (2019). *Microsoft Office 2019 step by step*. Microsoft Press.
- Microsoft. (n.d.). Excel help & learning. Microsoft Support. Retrieved May 22, 2024, from https://support.microsoft.com/en-us/excel

APPENDIX A: INDIVIDUAL PORTFOLIO ASSESSMENT

Task

Use MS word and PowerPoint to create a portfolio containing the following elements:

1. A brief expectation of what you aim to learn about excel and navigating the internet (20-30 words).
2. A weekly summary and pictures of what you have learned from week 1 to week 12 (30-40 words per week).
3. using PowerPoint to highlight your key points.
4. Submit your work in the 15th week of the academic year via email. Ensure to copy your parents in the email.

Learners' works to be included in the Portfolio

1. Class Exercises/Assignments
2. Project works
3. Reflective Pieces
4. Mini-research work
5. Mid-semester examination papers
6. End of semester examination papers, etc.

Organisation

1. Cover Page of learner's full name, index number and class
2. Table of Content
3. Weekly contents

Rubrics

Criteria	*Excellent (6-10 marks)*	*Good (1-5 marks)*	*Need Improvement (0 mark)*	*Examples of Expected Responses*
Expectation Statement (20-30 words)	*States what he/she aims to learn about Excel and using the internet, etc.*	*States what he/she aim to learn about Excel without stating anything about using the internet, etc.*	*States nothing about Excel or the use of the internet, etc.*	*I aim to learn how to organise data using Excel and improve my skills in finding information on the internet, etc.*
Weekly Learning Summary (30-40 words per week)	*Gives a summary of what was learned each week, etc.*	*Gives a summary of what was learned for at most five weeks, etc.*	*Gives no summary of what was learned each week, etc*	*Week 1: Learned how to make basic spreadsheets in Excel, entering data and using simple formulas like SUM. Week 2: Explored formatting options in Excel, etc.*

Organisation of work	*Highlight key points. Using formatting, bullet points, headings, and slide design to present the information. etc.*	*Highlight key points. With some content formatted, bulleted. etc.*	*No formatting is done on the content, etc.*	*Slides use bullet points and images to summarise each week's learning, etc.*

How to Administer

1. Design the assessment task
2. Develop the rubric criteria with learners
3. Set a deadline for collection
4. Administer the task by printing or writing it on the board
5. Intermittently call for the portfolios for evaluation, ensuring that learners are keeping records/evidence of work done as intended
6. Collect the portfolio on the due date
7. Score it and provide feedback to learners

How to give feedback

1. Highlight areas learners performed well
2. Encourage learners to keep record of their academic works for future reference
3. Point out any omissions identified in the portfolio

APPENDIX B: GROUP WORK

Task

1. Create an excel workbook for grading and ranking students' scores in 5 classes in a form and their overall ranking in that form. Ensure each class is on a separate spreadsheet using generic names and scores.
2. Send the completed project via the google form.
3. Submit this task by 11th academic week.

Structure

1. Cover Page with group members names
2. Each sheet should have an appropriate name
3. Formulas/ functions should be visible in cells

Table 5: Rubric for Group Work

Criteria	*Marks*	*Description*
Workbook Structure	*Excellence (3 marks)*	*The Excel workbook is organised with separate spreadsheets for 4 or 5 classes. Each sheet is labelled with a class name.*
	Good (2 marks)	*The Excel workbook is organised with separate spreadsheets for 2 or 3 of the classes. Each sheet is labelled with a class name.*
	Need improvement (1 mark)	*The Excel workbook is organised with a spreadsheet labelled with a class name.*
Data Entry	*Excellent (3 marks)*	*Generic names and scores are entered for all students in each class without any function attached to the scores.*
	Good (2 marks)	*Generic names and scores are entered for 70% students in each class without any function attached to the scores.*
	Need Improvement (1 mark)	*Generic names and scores are entered for 40% students in each class without any function attached to the scores.*
Using the grading formula	*Excellent (3 marks)*	*Correct use of grading formula like "=IFS(D4>=80,"A",D4>74,"B2",D4>69,"B3",D4>60,"C4"), etc.*
	Good (2 marks)	*Use of grading formula with minor errors like omitting of some grading range*
	Need Improvement (1 mark)	*Use of grading formula that leads to errors*
Grading and Ranking within Classes	*Excellent (3 marks)*	*The sheet(s) includes a column for rank, with the correct ranking formula like "=rank(H1:H60)" students based on their scores.*

	Good *(2 marks)*	*The sheet(s) includes a column for rank, with a minor mistake in the ranking formula like "=rank(H1,H60)" students based on their scores.*
	Need Improvement *(1 mark)*	*The sheet(s) includes a column for rank, with mistake in the ranking formula like "rank(H1,H60)".*
Overall Ranking Across Classes	*Excellent* *(3 marks)*	*An overall ranking sheet from the classes, showing all the following* 1. *the names of students* 2. *their total score* 3. *rank number across the classes*
	Good *(2 marks)*	*An overall ranking sheet from the classes, showing any two of the following* 1. *the names of students* 2. *their total score* 3. *rank number across the classes*
	Need Improvement *(1 mark)*	*An overall ranking sheet from the classes, showing any of the following* 1. *the names of students* 2. *their total score* 3. *rank number across the classes*
Clarity and Presentation	*Excellent* *(3 marks)*	*The workbook is presented with all the following* 1. *correct spelling* 2. *alignment* 3. *formatting.*
	Good *(2 marks)*	*The workbook is presented with any two of the following* 1. *correct spelling* 2. *alignment* 3. *formatting.*
	Need improvement *(1 mark)*	*The workbook is presented with any the following* 1. *correct spelling* 2. *alignment* 3. *formatting.*
Submission	*Good* *(2 marks)*	*Submitted by 11th week*
	Need Improvement *(1 mark)*	*A week after submission week*

How to administer

1. Group learners by mixed ability and gender
2. Print or write the task on the board
3. Develop a rubric that does not have leading answers with learners
4. Set the submission date
5. Assist groups who need support but ensure to deduct small marks based on the number of visits and assignments seek

How to provide feedback

1. Provide targeted feedback to each group based on areas they have done well and areas they need improvement
2. Guide learners to self-evaluation their work and suggest how they can improve

APPENDIX C: MID-SEMESTER EXAMINATION

Structure

1. Cover content from weeks 1-5. Taking into consideration DOK levels (adapt the table of specification below as a guide)
2. The test should include
   a. Section A- Multiple Choice (10 questions, 10 marks)
   b. Section B- (4 Essay questions, 2 to be selected, 20 marks)
   c. Section C- Practical (3 questions, 1 to be selected, 10 marks).
3. Time: 1 hours 30minutes.
4. Total Score: 40 marks to be scaled down to 5% for submission.

Resources

a) Computers with MS office installed.
b) Answer booklets
c) Learning Material
d) Teachers Manual
e) Assessment Toolkit

Table of specification

Week	Focal Area	Type of Question	DoK Level				Total
			1	2	3	4	
1	What is a Spreadsheet Application?	Multiple Choice	1	1	1	–	3
		Essay	–	1	–		1
2	How to Cell Reference in Excel	Multiple Choice	1	–	1	–	2
		Essay	–	–	1		1
		Practical	–	1	–		1
3	Debugging and Troubleshooting Formulas	Multiple Choice	1	–	–	–	1
		Essay	–	1	–	–	1
		Practical					
4	Using Graphs and Charts in Excel	Multiple Choice	1	1	–	–	2
		Essay	1	–	–	–	1
		Practical		1	–	–	1
5	Using Graphs and Charts in Excel	Multiple Choice	–	1	1	–	2
		Essay					
		Practical	–	–	1		1
	Total		5	7	5		17

Sample questions

1. **Multiple Choice**

   What are the main components of a graph?

   A. Axis labels, Data points, Title, Legend

   B. Axis labels, Page margins, Title, Footnotes

   C. Font size, Paragraph spacing, Axis labels, Data points

   D. Header, Footer, Data points, Title

2. **Essay**

   What is the purpose of sorting data in a table?

3. **Practical**

   Analyse the test scores of ten students in five subjects (Mathematics, English, Science, History, Geography) using Excel. Use the information below to complete the tasks:

Click here or scan the QR code before question (ii) to access the data, use cell references to calculate the total and average scores for each student. Use both absolute and relative cell references.

   a. Create a bar chart to display total scores of all students. Include titles, axis labels and a legend.

   b. Create a pie chart to show the percentage contribution of each subject to the total scores. Include titles, axis labels, and a legend.

   c. Write a brief analysis (100 words maximum) on the performance trends observed in the charts.

   d. Save your Excel file as "Fullname_Class" and save it in the mid_semester_folder on the desktop.

Marking Scheme for Multiple Choice

Answer – A (1 mark each)

20 questions

Rubric for Essay

Look out for any explanation similar to these:

   i. Explanation that sorting organises data in a specific order – 1 mark

Criteria	*Good (3)*	*Satisfactory (2)*	*Needs Improvement (1)*
Sorting Benefits	*Explains 3 ways sorting aids in data analysis with good examples*	*Explains 2 ways sorting aids in data analysis with good examples*	*Explains one way sorting aids in data analysis with good examples*

ii. Identifies that sorting can be ascending or descending – 1 mark, etc.

Rubrics for practical's

Criteria	*Excellent (3 marks)*	*Good (2 marks)*	*Need Improvement (1 mark)*
use of cell references to calculate total_ score	*"=sum($C2:$G2)"*	*"=sum(C2:G2)" or "=C2+... .+G2*	*"=sum(C2:F2)" or "C2+... .+E2"*
use of cell references to calculate average_score,	*"=AVERAGE($C2:$G2)" or "=$H2/5", etc.*	*"=AVERAGE(C2:G2)" or "=H2/5", etc*	*"=AVERAGE(C2:D2)" or "=H2/5", etc*
Bar Chart Creation	*Bar chart formatted with all the following* 1. *student names on the x-axis* 2. *scores on the y-axis.* 3. *Inclusion of chart title like "Student Scores"*	*Bar chart formatted with any two of the following* 1. *student names on the x-axis* 2. *scores on the y-axis.* 3. *Inclusion of chart title like "Student Scores"*	*Bar chart formatted with any of the following* 1. *student names on the x-axis* 2. *scores on the y-axis.* 3. *Inclusion of chart title like "Student Scores"*
Pie Chart Creation	*Pie chart shows the percentage contribution of at least three subject like "Maths 12.9%", etc.*	*Pie chart shows the percentage contribution of two subject like "Maths 12.9%", etc.*	*Pie chart shows the percentage contribution of a subject like "Maths 12.9%".*
Performance Analysis	*Pie chart shows all the following* 1. *A title like "Subject Contribution"* 2. *Axis labels,* 3. *A legend*	*Pie chart shows any two of the following* 1. *A title like "Subject Contribution"* 2. *Axis labels,* 3. *A legend*	*Pie chart shows any of the following* 1. *A title like "Subject Contribution"* 2. *Axis labels* 3. *A legend*
	Identify and discuss three trends and insights from the bar and pie charts like "Raphael had the highest score", or "The students performed well in Science as compared to English, etc.	*Identify and discuss two trends and insights from the bar and pie charts like "Raphael had the highest score", or "The students performed well in Science as compared to English, etc.*	*Identify and discuss one trend from the bar and pie charts like "Raphael had the highest score", or "The students performed well in Science as compared to English, etc.*
File Saving and Organisation	*The following instruction are followed* 1. *File is saved with the naming convention format like "RaphaelSenyo_Form1_ HomeEconomics1"* 2. *File is saved in the 'mid_ semester_folder' on the desktop.*	*The following instructions are followed with minor errors* 1. *File is saved with the naming convention format like "RaphaelSenyo_Form1_ HomeEconomics1"* 2. *File is saved in the 'mid_ semester_folder' on the desktop.*	*Only one of the following instruction is followed* 1. *File is saved with the naming convention format like "RaphaelSenyo_ Form1_ HomeEconomics1"* 2. *File is saved in the 'mid_semester_folder' on the desktop.*

SECTION 2: USE OF TECHNOLOGY IN EVERYDAY LIFE

STRAND: ICTS IN THE SOCIETY

Sub-Strand: Emerging Technologies and Applications

Learning Outcomes

1. *Evaluate the applications and implications of technology in various sectors of society*
2. *Identify and analyse technology usage patterns across different user categories*

Content Standard: *Demonstrate knowledge and understanding of Emerging Technologies*

HINT

*The Recommended Mode of Assessment for Week 12 is **End of Semester Examination.** Refer to **Appendix D** at the end of Section 2 for further information on how to go about the end of semester examination.*

INTRODUCTION AND SECTION SUMMARY

This section is a continuation of year one and year two section one activity, which focuses on improving learners' understanding of the use of ICT in society.

Weeks 9 to 12 introduce learners to emerging technologies and applications and the use of these technologies in everyday life. This includes the use of ICT in education, healthcare, manufacturing, government, finance, entertainment, transport, and business; identifying technologies used by home users, office users, mobile power users and enterprise users.

The weeks covered by the section are:

Week 9: Discuss the use of technology in education, health care, manufacturing, government, finance, entertainment, transport, and business.

Week 10: Discuss the use of technology in education, health care, manufacturing, government, finance, entertainment, transport, and business.

Week 11: Identify technologies used by home users, small/home office users, mobile users, power users and enterprise users

Week 12: Identify technologies used by home users, small/home office users, mobile users, power users and enterprise users.

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section considers various teaching and learning approaches, strategies, and techniques. These include hands-on activities where learners engage in practical tasks to research, explain, and demonstrate the use of some ICT tools and applications. Where appropriate, learners should be able to work in groups to find solutions to assigned tasks.

Experiential learning activities with mixed-ability and mixed-gender groupings should dominate these lessons. Regardless of their abilities, all learners should be encouraged to participate fully. Accommodate different learning styles by offering below-average or approaching proficiency learners the chance to make oral presentations when appropriate and providing more challenging extension activities for above-average or highly proficient learners.

Practical sessions and project-based learning will enhance learner engagement, foster valuable collaboration and teamwork skills, and provide opportunities for learners to appreciate the use of ICT in education, manufacturing, etc and identify various technologies used by home users, office users, etc.

ASSESSMENT SUMMARY

The assessment section (formative and summative) considers all four levels of the Revised Bloom's Taxonomy: Level 1 (Recall/Reproduction), Level 2 (Skills/Conceptual Understanding), Level 3 (Strategic Thinking/Reasoning), and Level 4 (Extended Critical Thinking and Reasoning).

Teachers should note that there are assessment suggestions suitable for different levels of ability—learners approaching proficiency (AP), proficient (P) learners, and highly proficient (HP) learners. Beyond traditional practical and written tests and assignments, teachers should introduce learners to other forms of assessment, including demonstrations of activities using a digital device, mind maps or concept maps, multiple-choice quizzes, group projects, self-assessments, oral presentations, peer reviews, portfolios, debates, game-based assessments, digital storytelling, and matching tasks.

Teachers can consult the Teacher Assessment Manual and Toolkits (TAMTK) on how to use the Assessment Strategies effectively in the classroom (TAMTK, NaCCA 2023).

Please note that the key assessment items in this manual are intended to guide teachers in establishing learners' understanding of the course material. They do not limit teachers from exploring and creating their questions.

WEEK 9

Learning Indicator: Discuss the use of technology in education, health care, manufacturing, government, finance, entertainment, transport, and business

Focal Area: Application of technology in education, health manufacturing and governance

1. **Education**
    a. Discuss how technology can transform traditional teaching methods by incorporating interactive and multimedia content using digital tools and online platforms, including tools/platforms like learning management systems (LMS) like Google Classroom for curriculum delivery, student engagement and administrative tasks, MOOCs such as Khan Academy for maths and science or Duolingo for language learning. Discuss the use of AI-driven tools in education.
    b. Discuss the effectiveness of these tools, including their ability to provide flexible learning opportunities, personalise learning experiences, and enhance cognitive and problem-solving skills.
2. **Health Care**
    a. Discuss how technology is used in patient monitoring, diagnosis, and treatment, including using smart beds, infusion pumps, and robotic surgery. Explore how big data and analytics accelerate medical research and drug development. Discuss options like Telemedicine, Health Monitoring, Wearable Devices and Electronic Health Records
    b. Examine the benefits and challenges of these technologies in improving patient data accessibility, accuracy, and care coordination, as well as the expansion of telehealth services, enabling remote consultations, diagnostics, patient management and managing chronic diseases.
3. **Manufacturing**
    a. Discuss how technology improves efficiency, reduces waste, and enhances product quality in manufacturing. Explore technologies like Radio Frequency Identification (RFID), Internet of Things (IoT), 3D Printing and blockchain for tracking and managing supply chains.
    b. Discuss the benefits of using automation including increasing efficiency, streamlining manufacturing processes and reducing human error using industrial robots among others.
4. **Government**
    a. Discuss how ICT improves the efficiency, accessibility, and transparency of government services. Explore the role of technology in enhancing decision-making, policy formulation, and administrative processes.
    b. Examine technology systems like online portals for services, electronic voting systems, and digital identity management and discuss how they promote transparency, innovation, and citizen participation and promote communication and collaboration between governments and citizens.

5. **Others**
    a. Discuss the potential of technologies like blockchain for secure and transparent government transactions, recordkeeping, and identity verification, cybersecurity measures to protect sensitive data and infrastructure and the use of data analytics for policy analysis and decision support

Learning Tasks

1. The learners listen to and interact with teachers and peers while sharing their ideas and experiences on the application of technologies in education, health manufacturing, and governance. Learners work together to propose solutions to a real-world problem in their community.
2. Learners take notes and ask questions to clarify their understanding.

Pedagogical Exemplars

1. **Interactive Presentation and Discussion:** The teacher uses an Interactive presentation with multimedia (images, video) to introduce students to the concepts and to facilitate a discussion on the application of ICTs in education, health manufacturing and governance.
2. **Peer Learning and Collaboration:** In mixed ability/gender-sensitive groups, encourage learners to discuss and share their experiences of how the application of the technologies have been used in education, health manufacturing and governance.
3. **Problem-Based learning:** Each group in given a problem in their community and tasked to brainstorm and suggest ways that ICTs can be used to help alleviate the effects of the problem

Key Assessment

Level 1

1. What are some examples of technology used in schools? (Tablets, computers, online learning platforms)
2. What are some medical devices that use technology? (X-ray machines, electronic health records)
3. What is a robot used for in manufacturing?
4. How do governments use websites to communicate with citizens?

Level 2

1. How can teachers use interactive whiteboards to enhance student learning?
2. How can online voter registration increase voter participation?
3. How can 3D printing technology be used to create prototypes of new products?
4. How do mobile payment apps work?

Level 3

1. Discuss the advantages and disadvantages of using online learning platforms for education.

2. Discuss how electronic health records can improve patient care coordination.
3. Discuss the impact of automation on manufacturing jobs

Level 4

1. How can technology be used to personalise learning for learners with different needs?
2. How can businesses use big data analytics to gain insights into customer behaviour and improve their marketing strategies?

HINT

*This week's recommended mode of assessment is **project.** Use DoK level 3, question 4 as a sample task. Refer to Teacher Assessment Manual and Toolkit pages 27–29 for more information on how to administer this assessment mode.*

WEEK 10

Learning Indicator: Discuss the use of technology in education, health care, manufacturing, government, finance, entertainment, transport, and business

Focal Area: Application of ICTs in finance, entertainment, transport, and business

1. **Financial Services**
    a. Discuss the integration of ICT in banking operations, customer services, and investment management to enhance efficiency, security, and customer experience.
    b. Discuss electronic payment systems and how online banking platforms allow customers to perform transactions, manage accounts, and access financial services remotely. Examine specific payment platforms like Apple Pay, Google Wallet, and PayPal.
    c. Discuss Fintech Innovations like cryptocurrencies like Bitcoin and Ethereum and their impact on traditional banking and financial systems.
2. **Entertainment Industry**
    a. Examine the evolution and transformation of video games (advanced graphics, online multiplayer capabilities, and mobile gaming), Streaming Media (Platforms like Netflix, Spotify, and YouTube), Digital Content Creation tools (creation, editing, animation, etc), Virtual Reality (VR) and Augmented Reality (AR).

Figure 10.1 Wearing Virtual Reality Goggles

3. **Transport**
    a. Discuss Intelligent Transportation Systems to enhance traffic management, safety, and efficiency. Discuss autonomous vehicles (self-driving cars) and Ride-Sharing Platforms (Lyft, Uber, Bolt, etc.) in providing convenient and cost-effective transportation options.
    b. Discuss the importance of digital mapping and GPS technology in navigation, route optimisation, and fleet management. Explore Traffic Management Technologies for real-time traffic monitoring, congestion management, and incident detection.
4. **Business**
    a. Examine how ICT fosters innovation through new product development, process improvements, and business model transformation.

b. Discuss the role of technology tools like Cloud Computing, Enterprise Resource Planning (ERP) systems, Digital Marketing and CRM Systems in enhancing business productivity, operational efficiency, flexibility, scalability and service delivery.

c. Discuss Digital Marketing, including social media marketing, search engine optimisation (SEO), etc. Explore how Data Analytics and Machine Learning use data insights to inform decision-making.

Learning Tasks

1. The learners listen to and interact with teachers and peers while sharing their ideas and experiences on the application of technologies in finance, entertainment, transport, and business. Learners work together to propose solutions to a real-world problem in their community.
2. Learners take notes and ask questions to clarify their understanding.

Pedagogical Exemplars

1. **Interactive Presentation and Discussion:** The teacher uses an Interactive presentation with multimedia (images, video) to introduce students to the concepts and to facilitate a discussion on the application of ICTs in finance, entertainment, transport, and business.
2. **Peer Learning and Collaboration:** In mixed ability/gender-sensitive groups, encourage learners to discuss and share their experiences of how the application of the technologies have been used in finance, entertainment, transport, and business.
3. **Problem-Based learning:** Each group in given a problem in their community and tasked to brainstorm and suggest ways that ICTs can be used to help alleviate the effects of the problem

Key Assessment

Level 1

1. What are some examples of technology used in financial services? (integrated banking apps, contactless payments)
2. What devices are changing the way people enjoy entertainment? (VR gaming, Online streaming)
3. How has technology changed the way that transport works? (Apps such as Uber, Mapping, Traffic updates in maps – Waze)
4. How do businesses use technology to keep in contact with their customers? (Marketing, email newsletters, CRM systems).

Level 2

1. How have mobile payment systems transformed the way that people pay for services?
2. How can new technologies be used to make an audience feel immersed in an entertainment?
3. What are the key features of how GPS works with a mobile device?
4. What are the benefits of Cloud based technologies for an organisation?

Level 3

1. Discuss the advantages and disadvantages of integrating finances with ICT.
2. Discuss the impact of Ride Sharing platforms on other forms of transport.
3. Prepare a report on how technology is currently being used in each of the following sector (education, healthcare, manufacturing, government, finance, entertainment, transport, and business).
4. What impact could online voter registration have on increasing voter turnout and engagement in elections?

Level 4

1. How can technology be used to understand potential options within the finance industry for both an organisation and an individual?
2. How can businesses make use of Digital Marketing, including SEO?

HINT

*This week's recommended mode of assessment is **peer assessment.** Use DoK level 3 question 4 as a sample. Refer to Teacher Assessment Manual and Toolkit pages 72–73 for more information on how to administer this assessment mode.*

WEEK 11

Learning Indicator: Identify technologies used by home users, small/home office users, mobile users, power users and enterprise users

Focal Area: Examining the ICTs used by home users, small/ home office users, mobile users, power users and enterprise users

1. **Home Users**
    a. The teacher explains that home users are individuals and families who use ICT daily for personal computing, communication, entertainment, and productivity. These users typically interact with technology non-professionally within a household setting.
    b. The teacher discusses the technologies they use, including devices, software applications, and online services that cater to their everyday needs. ICT devices used in the home include desktop computers and laptops for work, education, and entertainment, as well as tablets and smartphones for web browsing, communication, and multimedia consumption. Other devices include smart speakers, home automation systems, and security cameras to manage the home. They also use wearable devices, including smartwatches, fitness trackers, and health monitoring devices, to track health metrics, provide notifications, and integrate with other smart devices.
    c. The teacher explains that popular software applications and online services include web browsers (Google Chrome, Mozilla Firefox, Microsoft Edge) and social media Interaction platforms (Facebook, X, Instagram, TikTok) for social interaction and content sharing. They also use streaming services like Netflix, Disney, YouTube, and Spotify to provide entertainment options.
    d. Home users also shop online from e-commerce platforms like AliExpress, Jumia, Amazon, and eBay, and local online stores offer convenience. They usually pay for such services using payment solutions (e.g., mobile money, Apple Pay, Google Wallet) to facilitate secure transactions.
2. **Small/Home Office Users**
    a. Small/Home Office Users are individuals or small business owners who run their professional activities and operations from a small office space or home. They leverage technology to enhance productivity and efficiency, manage business tasks, and communicate effectively, often with limited resources and infrastructure compared to larger enterprises.
    b. The teacher explains technologies used by small businesses and home-based workers like entrepreneurs. The teacher explains that they use office Productivity Tools (word processors, spreadsheets, and presentation software like MS Office), Email Clients and Calendars for communication, scheduling, and task management (E.g. MS Outlook, Google Calendar, and Apple Mail). They also use online collaboration tools Like Slack, Microsoft Teams, and Zoom.) and cloud storage services like Google Drive, Dropbox, and OneDrive for secure and accessible storage

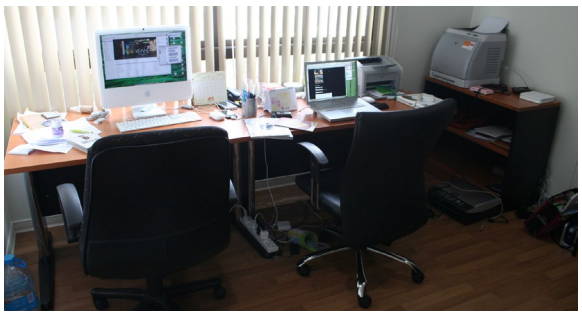


Figure 11.1 Small Office Home Office

Learning Tasks

1. Learner present and discuss their findings from the group to the class
2. The learners listen to and interact with teachers and peers while sharing their ideas and experiences on the different types of users (mobile, power and enterprise users). Learners take notes and ask questions to clarify their understanding.

Pedagogical Exemplars

1. **Interactive Presentation and Group Discussion:** The teacher uses an Interactive presentation with multimedia (images, video) to analyse and discuss the technologies used by small/home users.
2. **Peer Learning and Collaboration:** In mixed ability/gender-sensitive groups, the teacher tasks learners to discuss activities they do at home and what ICT tools are used to support them. The groups share their results in a presentation.

Key Assessment

Level 1: What are some basic technologies used by most home users? (e.g., web browsers, email clients)

Level 2

1. How can a small/home office user use video conferencing software to collaborate with clients remotely?
2. What types of mobile apps might be beneficial for a mobile user on the go? (e.g., navigation apps, messaging apps)
3. Explain the different technologies used by these groups of people: home users, small/home office users, mobile users, power users, and enterprise users. For each group:
   a. Give examples of the technologies they use.
   b. Describe how these technologies work and what they are used for.
   c. Explain how these technologies meet the needs of the group.
   d. Discuss the benefits and challenges of these technologies for each group.

HINT

This week's recommended mode of assessment is portfolio. Use DoK level 2, question 3 as a sample. Refer to Teacher Assessment Manual and Toolkit pages 22–25 for more information on how to administer this assessment mode.

WEEK 12

Learning Indicator: Identify technologies used by home users, small/home office users, mobile users, power users and enterprise users

Focal Area: Examine the ICT used by home users, small/home office users, mobile users, power users and enterprise users

1. **Mobile Users**
   a. The teacher explains that mobile users are individuals who primarily depend on mobile technology and access digital resources, services, and applications for communication, productivity, entertainment, and various other daily activities, often while on the go.
   b. Discuss the characteristics of mobile users and the devices that they can use (laptops, smartphones). Identify technologies for mobile users, including mobile operating systems (iOS and Android) and their features. Discuss with examples mobile applications, including mobile productivity tools (messaging, navigation apps, office suites, task management tools). Discuss mobile-friendly websites and the importance of responsive web design for optimal user experience on mobile devices. Also, the importance of cloud storage and mobile payment solutions (mobile money, Apple Pay, Google Wallet, and Samsung Pay) will be discussed.
2. **Power Users**
   a. The Teacher explains that power users are individuals with advanced technical skills and knowledge, enabling them to use, configure, and often customise software, hardware, and systems to solve complex problems and innovate beyond the capabilities of typical users (e.g., software developers, and data scientists).
   b. The teacher explains that some of the technologies they use are data analysis tools and languages like Python, R, and SQL, graphic design and video editing software (e.g., Adobe Creative Suite), High-Performance Computing (HPC), and Integrated Development Environments (IDEs) like Visual Studio, Eclipse, and PyCharm.
3. **Enterprise Users**
   a. The Teacher explains that enterprise users are individuals within large organisations and corporate environments who use technologies to support business operations, collaboration, and information management.
   b. The teacher explains that these users rely on enterprise-grade hardware, software, and systems to perform their job functions efficiently and effectively.
   c. The teacher explains the common technologies in corporate environments, including servers/storage systems, networking equipment, server rooms/data centres, enterprise software solutions (including enterprise resource planning (ERP) systems, customer relationship management (CRM) software, business intelligence tools) and how they are used to support the work of an organisation.

Figure 12.1 Networking Equipment

Pedagogical Exemplars

1. **Flipped Classroom:** Share some pre-class learning materials (e.g. videos) on mobile technologies and follow them with in-class discussions and activities.
2. **Group work:** In mixed ability/gender-sensitive groups, encourage learners to discuss their observations from the pre-class learning materials and share and discuss their results with the class. The teacher facilitates the learner class presentation on technologies for mobile users.
3. **Interactive Presentation and Group Discussion:** The teacher uses an interactive presentation with multimedia (images, video) to explain technologies used by power users and enterprise users and discuss their differences and similarities. In mixed ability/gender-sensitive groups, the teacher encourages learners to discuss and share their understanding of the technologies used by these users

Learning Tasks

1. Learners listen to and interact with teachers and peers while sharing their ideas and experiences on the different types of users (mobile, power and enterprise users). Learners take notes and ask questions to clarify their understanding.
2. Learners present and discuss their findings from the group to the class.

Key Assessment

Level 3

1. Why might a power user prefer a desktop computer with high-performance specifications over a laptop?
2. How can enterprise users leverage cloud computing services for better data storage and scalability?

Level 4

1. Imagine you are a power user setting up a smart home. Analyse the different technologies (e.g., smart speakers, connected appliances) that can be used to create an automated and personalised living environment.
2. Discuss the security considerations for a company (enterprise user) when allowing employees to use their personal mobile devices for work purposes (BYOD - Bring Your Own Device).

HINT

*The Recommended Mode of Assessment for Week 12 is **End of semester Examination.** Refer to **Appendix D** at the end of Section 2 for further information on how to go about the end of semester examination.*

SECTION REVIEW

This section has focused on developing the learners' understanding on the use of some ICT tools and applications in education, health care, manufacturing, government, finance, entertainment, transport and business, and identifying various technologies used by home users, small/home office users, mobile users, power users and enterprise users.

At the end of this section, learners should be able to demonstrate knowledge, understanding and usage of emerging technologies and be able to identify and analyse technology usage patterns across different sectors of society and user categories.

The teacher would have guided the learners to understand and appreciate that technology is evolving, and the use of ICT is important for enhancing productivity in the various sectors of society. Learners will also explore commonly used technologies, software applications and online tools and services used for various tasks.

Through studying the topics in this section, learners should hopefully have developed an appreciation and a deeper understanding of emerging technologies and their usefulness to society.

The suggested activities in the manual strongly focus on critical thinking, problem-solving, and teamwork, three important life skills.

APPENDIX D: END OF 1ST SEMESTER EXAMINATION

Structure

1. Cover content from weeks 1-5. Taking into consideration DOK levels (adapt the table of specification below as a guide)
2. The test should include
   a. Section A- Multiple Choice (40 questions)
   b. Section B- (5 Essay questions, 3 to be selected)
   c. Section C- Practical (2 questions, 1 to be selected).
3. **Time:** 3 hours 30 minutes.
4. **Total Score:** 100 marks to be scaled down to 20% for submission.

Resources

1. Computers with MS office installed.
2. Answer booklets
3. Learning Material
4. Teachers Manual
5. Assessment Toolkit

Table of Specification

Week	Focal Area	Type of Question	DoK Level				Total
			1	2	3	4	
1	Describe Spreadsheet software workbooks, worksheets, cell referencing	Multiple Choice	2	4	1	-	7
		Essay					
2 & 3	Create and utilise formulas and functions for data analysis	Multiple Choice	2	2	1	-	5
		Essay		1			1
		Multiple Choice	1	2	1	-	4
		Essay					
4 & 5	Generate and interpret graphs and charts to visualise data	Multiple Choice	1	1	1		3
		Essay			1		1
		Multiple Choice	1	1	1		3
		Essay					
		Practical			1		1

6 & 7	Apply sorting and filtering operations to manipulate tables	Multiple Choice	2	1			3
		Essay			1		1
		Practical			1		1
		Multiple Choice	1	1	1		3
		Essay					
8	Save and print workbooks and worksheets (Save, Save As, Print)	Multiple Choice	1	1	1		3
		Essay					
9 & 10	Discuss the use of technology in education, health care, manufacturing, government, finance, entertainment, transport, and business.	Multiple Choice	1	1	1		3
		Essay			1		1
		Multiple Choice	1	1	1		3
		Essay					
11 & 12	Identify technologies used by home users, small/home office users, mobile users, power users and enterprise users.	Multiple Choice		1			1
		Multiple Choice	1	1			2
		Essay		1			1
	Total		14	19	14		47

Sample Questions

1. **Multiple Choice**

   What is the primary difference between a pie chart and a line graph?

   A. A pie chart displays data as a proportion of a whole, while a line graph shows how data changes over time.

   B. A pie chart is used for comparing quantities across categories, while a line graph is used to show relationships between variables.

   C. A pie chart is used to display continuous data, while a line graph is used to display categorical data.

   D. A pie chart shows how data changes over time, while a line graph displays data as a proportion of a whole.

2. **Essay**

   What is a cell in a spreadsheet?

3. **Practical**

   Given a dataset (click here or scan QR code to access the dataset) of monthly sales figures for 6 different products over the past year, create a visual representation of the data using Excel.

Follow these steps

i. Analyse the dataset to identify trends, patterns, and comparisons between the products' sales over the 12 months.

ii. Based on your analysis, select the most appropriate chart type (e.g., line chart, bar chart, or pie chart) to effectively display the sales data.

iii. Provide a brief explanation (2-3 sentences) for your choice of chart, detailing how it best represents the data and supports your analysis.

iv. Create the selected chart in Excel, ensuring that it includes appropriate titles, axis labels, and legends.

v. Save your Excel file as "Fullname_Class_date.xlsx" and save on the desktop.

Marking Scheme and Rubrics

1. **Multiple Choice (40 items, one mark each)**

   Answer: A—1 mark

2. **Essay (3 marks – 1 mark for each set of words)**

   Look out for words like "basic unit", "where data is entered", "intersection of a row and a column."

3. **Practical**

Criteria	*Excellent (3 marks)*	*Good (2 marks)*	*Need Improvement (1 mark)*
Analysis of Dataset	*Able to identify and analysis these three items:* *1. Trends* *2. Patterns* *3. comparisons between product sales over the 12 months) from the dataset*	*Able to identify and analysis any two items:* *1. trends* *2. patterns* *3. comparisons between product sales over the 12 months) from the dataset*	*Able to identify and analysis one item:* *1. trends* *2. patterns* *3. comparisons between product sales over the 12 months) from the dataset*
Selection of Chart Type	*Uses all three of these.* *1. A line chart for trends* *2. A bar chart for comparison* *3. Uses a heatmap for patterns*	*Uses any two of these.* *1. A line chart for trends* *2. A bar chart for comparison* *3. Uses a heatmap for patterns*	*Uses any one of these.* *1. A line chart for trends* *2. A bar chart for comparison* *3. Uses a heatmap for patterns*

Explanation of Chart Choice	*Provides explanation for the use of all the charts selected*	*Provides explanation for the use of any two charts selected*	*Provides explanation for the use of any charts selected*
Chart Features	*Chart includes all these three:* *1. title,* *2. labelled axes* *3. colours for distinction*	*Chart includes any two of these:* *1. title,* *2. labelled axes* *3. colours for distinction*	*Chart includes any of these:* *1. title,* *2. labelled axes* *3. colours for distinction*
File Saving and Formatting	*File is saved with the right format "Fullname_Class_ date.xlsx"*	*File is save with a minor error in format like* *"Fullname Class" without date*	*File is save with a errors in format like* *"Fullname" without class and date*

SECTION 3: WEB NAVIGATION & FEATURES

STRAND: ICTS IN THE SOCIETY

Sub-Strand: Connecting and Communicating Online

Learning Outcome: *Navigate the web effectively using web addresses, browsers, web apps, and mobile platforms*

Content Standard: *Demonstrate knowledge and understanding of the World Wide Web*

HINT

*It is recommended that teachers assign **Individual Project** work to learners in Week 14. This individual project is to be submitted by Week 20. Refer to Appendix E for more information.*

INTRODUCTION AND SECTION SUMMARY

This section is a continuation of year 1, and year 2 section 1 activities, which focuses on improving learners' understanding of the use of ICTs in society.

Weeks 13 to 16 introduce Learners to connecting and communicating online. This includes navigating the web effectively and understanding website features and multimedia contents used on websites.

The weeks covered by the section are:

Week 13: Navigate the web effectively using web addresses, browsers, web apps, and mobile platforms.

Week 14: Navigate the web effectively using web addresses, browsers, web apps, and mobile platforms.

Week 15: Analyse and discuss website features and multimedia content. (Graphics, Audio, Videos, Plug-ins)

Week 16: Analyse and discuss website features and multimedia content. (Graphics, Audio, Videos, Plug-ins)

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section considers various teaching and learning approaches, strategies, and techniques. These include hands-on activities where learners engage in practical tasks to research, explain and navigate the web effectively using web addresses, browsers, web apps, and mobile platforms. Again, learners engage in practical tasks to analyse website features and multimedia content found on websites. Where appropriate, learners should be able to work in groups to find solutions to assigned tasks.

Experiential learning activities with mixed-ability and mixed-gender groupings should dominate these lessons. Regardless of their abilities, all learners should be encouraged to

participate fully. Accommodate different learning styles by offering below-average or approaching proficiency learners the chance to make oral presentations when appropriate and providing more challenging extension activities for above-average or highly proficient learners. Practical sessions and project-based learning will enhance learner engagement, foster valuable collaboration and teamwork skills, and provide opportunities for learners to navigate web browsers, web apps and mobile platforms, use audio and visual tools for communication and engagement, understand website features and common plug-ins.

ASSESSMENT SUMMARY

The assessment section (formative and summative) considers all four levels of the Revised Bloom's Taxonomy: Level 1 (Recall/Reproduction), Level 2 (Skills/Conceptual Understanding), Level 3 (Strategic Thinking/Reasoning), and Level 4 (Extended Critical Thinking and Reasoning).

Teachers should note that there are assessment suggestions suitable for different levels of ability—learners approaching proficiency (AP), proficient (P) learners, and highly proficient (HP) learners. Beyond traditional practical and written tests and assignments, teachers should introduce learners to other forms of assessment, including demonstrations of activities using a digital device, mind maps or concept maps, multiple-choice quizzes, group projects, self-assessments, oral presentations, peer reviews, portfolios, debates, game-based assessments, digital storytelling, and matching tasks.

Teachers can consult the Teacher Assessment Manual and Toolkits (TAMTK) on how to use the Assessment Strategies effectively in the classroom (TAMTK, NaCCA 2023).

Please note that the key assessment items in this manual are intended to guide teachers in establishing learners' understanding of the course material. They do not limit teachers from exploring and creating their questions.

WEEK 13

Learning Indicator: Navigate the web effectively using web addresses, browsers, web apps, and mobile platforms

Focal Area: Understanding Web Addresses

The teacher guides learners to understand web addresses with focus on the structure and components of a Uniform Resource Locator (URL) or web address**,** parts of a URL, including the protocol (e.g., HTTP, HTTPS), domain name, subdomain, path, and parameters and discuss the significance of domain extensions (e.g., .com, .org, .edu) and how they relate to the type and purpose of websites.

The web address was developed by Sir Tim Berners-Lee and the URL working group of IEFT (Internet Engineering Task Force) in the year 1994. It is a name that points to the location of a particular web page in the internet world. It can be the address of anything like the address of a particular file, directory, photo, video, etc. Every web page on the internet has a unique web address, with the help of which the user accesses those web pages. It is the same as the address of your house or school or any place on this planet. Web Address is also known as URL i.e. uniform resource locator.

Figure 13.1 Web Address or URL

Protocol

Every web address starts with a protocol, which acts like a language. It tells your browser how to communicate with the website you're trying to visit. The most common protocols are HTTP (used for basic web browsing) and HTTPS (the secure version for sensitive information). While other protocols exist for different purposes (like RTP for streaming and DNS for domain name translation), HTTP and HTTPS are the ones you will see most often in web addresses.

Sub-domain name

A sub-domain is a prefix added to a domain name, creating a separate section of the website while still being part of the main domain. It allows for organisation and separation of content without needing to register a new domain name. Sub-domains are typically used to manage different sections of a website, such as a blog, store, or support area.

Domain Name

A domain name is a human-readable address used to access websites on the internet, replacing the need for numerical IP addresses, which are harder to remember. It is part of the URL (Uniform Resource Locator) used to access web pages and consists of two main parts: the name itself and the domain suffix, or top-level domain (TLD)

Pedagogical Exemplars

Note

Guide learners to explore the functions of the trailing slash.

Uses of Web Browsers

Guide the learners to

- Explore with popular web browsers such as Google Chrome, Mozilla Firefox, Microsoft Edge, Safari, and Opera.

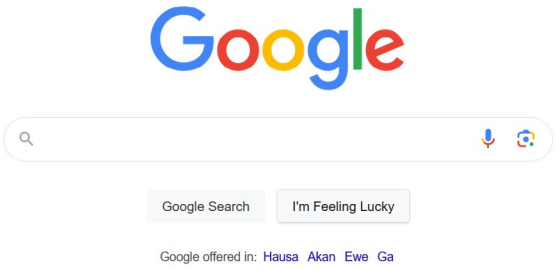


Figure 13.2 Google browser

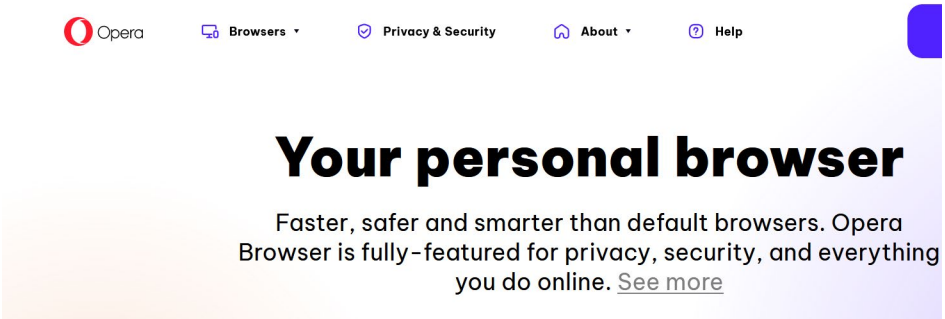


Figure 13.3 Opera Web browser

In addition to the above, guide learners to:

- Explore browser features and functionalities, including tabbed browsing, bookmarks, history, extensions, and developer tools.
- Understand browser settings and preferences for customisation, privacy, security, and accessibility.
- Compare different browsers to allow them to understand the different features that they may have.

Accessing Web Apps

Identify differences between web apps and traditional desktop applications. Let learners understand that the difference between web apps and traditional desktop applications boils down to where they run and how you access them. Web apps reside on servers connected to the internet and they are accessed through a web browser.

Characteristics of Web Apps

Web Apps can be accessed from any device with an internet connection. No downloads or installations required. Updates are handled by the developer, ensuring you always have the latest version.

Aside from the above, guide learners to understand that the usage of Web Apps requires internet connection. You can't use them offline unless they're specifically designed as progressive web apps (PWAs). Also, they are reliant on internet speed, which can affect performance compared to desktop apps.

Characteristics of Traditional Desktop Applications

With traditional desktop applications, they are downloaded and installed directly onto your computer, making the application software and data stored on your device. They work even without an internet connection and generally run faster compared to web apps.

Learning Tasks

1. Learners take notes and ask questions to clarify their understanding.
2. Learners practically explore the web browsers such as Google Chrome, Mozilla Firefox, Microsoft Edge, Safari, and Opera etc.
3. Learners ask open-ended questions about Web Apps and Traditional Desktop Applications for clarity.

Pedagogical Exemplars

1. **Problem-based learning and practical sessions** (Individual and Group Work) to use web addresses, browsers, web apps and mobile platforms to communicate. For example, using any of the following web browsers - Opera mini, Google Chrome, Mozilla Firefox, Safari, Internet Explorer/Microsoft Edge to find the public universities in Ghana and the programs they offer and share their searched results with their colleagues through their emails.
2. **Collaboration and Communication:** Learners will work in mixed ability groups (teachers identify abilities and position their sitting to ensure mixed ability) and share their ideas with peers and accept constructive feedback on how to navigate the web effectively. using web addresses, browsers, web apps, and mobile platforms to communicate.

Key Assessment

DoK Level 1

1. What is a web address (URL)?
2. What is a web browser?
3. What are some examples of web apps? (e.g., online banking, social media platforms)
4. Create a poster on how to identify a valid web address

DoK Level 2

1. How can you identify a valid web address (URL)? (Look for ".com", ".org", etc. after the website name)
2. How can you use a search engine to find information on the web? (Enter keywords and use search filters)
3. What are some basic navigation features in a web browser? (Back button, forward button, refresh button, bookmarks/favourites)

HINT

*The recommended mode of assessment for the week is **poster**. Use DoK level 2, question 4 as a sample question to assign to learners. Refer to Teacher Assessment Manual and Toolkit pages 76-78 for more information on how to administer this assessment mode.*

WEEK 14

Learning Indicator: Navigate the web effectively using web addresses, browsers, web apps, and mobile platforms

Focal Area: Navigating Mobile Platforms

Guide learners to understand the unique features and user interfaces of mobile web browsers on smartphones and tablets.

Learners should appreciate the fact that mobile web browsers on smartphones and tablets have several unique features and user interfaces designed to enhance the user experience on smaller, touch-sensitive screens.

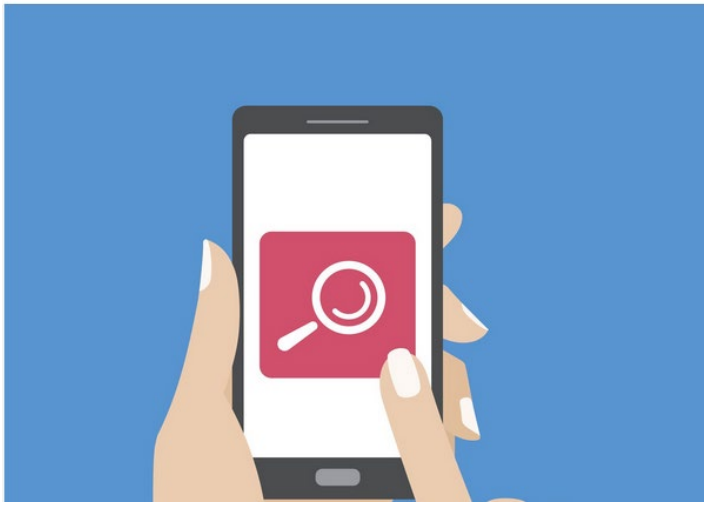


Figure 14.1 Mobile interface

Some of the features include Touch and Gesture Controls such as Pinch-to-Zoom which allows users to zoom in and out of web pages using a pinching gesture. It also has the Swipe Navigation which enables users to swipe left or right to navigate backward and forward in their browsing history.

Teachers should guide learners to explore adaptive layouts which also automatically adjust the web page layout to fit the screen size and orientation.

Explore mobile-specific web design principles, responsive web design techniques, and adaptive layouts for different screen sizes and orientations.

1. Discuss the availability of mobile apps for popular websites and services, as well as considerations for mobile app usability and performance.
2. Effective Web Navigation:
3. Explore the use of search engines effectively to find relevant information on the web.
4. Understand basic search operators, filters, and advanced search techniques to refine search queries and obtain accurate results.
5. Explore strategies for evaluating the credibility, reliability, and relevance of web content, including identifying reputable sources and fact-checking information.

Learning Tasks

1. Learners take notes and in groups, discuss how to effectively navigate mobile platforms.
2. Learners practically explore the features and user interfaces of mobile web browsers on smartphones and tablets.
3. Learners ask open-ended questions about the features and interfaces for more clarity.

Pedagogical Exemplars

1. **Problem-based learning and practical sessions (Individual and Group Work)** to use web addresses, browsers, web apps and mobile platforms to communicate. For example, using any of the following web browsers - Opera mini, Google Chrome, Mozilla Firefox, Safari, Internet Explorer/Microsoft Edge to find the public universities in Ghana and the programs they offer and share their searched results with their colleagues through their emails.
2. **Collaboration and Communication:** Learners will work in mixed ability groups (teachers identify abilities and position their sitting to ensure mixed ability) and share their ideas with peers and accept constructive feedback on how to navigate the web effectively. using web addresses, browsers, web apps, and mobile platforms to communicate.

Key Assessment

Level 3

1. Why is it important to use reliable and trustworthy websites when searching for information online? (Consider source credibility and potential bias).
2. How can you navigate a complex website with multiple menus and subpages? (Look for site maps, utilise breadcrumbs).
3. Explain the difference between using a web app and a downloaded software program.

Level 4

1. You are researching a specific topic. How can you evaluate the quality and credibility of information found on different websites? (Look for author credentials, publication dates, reputable sources cited).
2. Imagine you are planning a trip. How can you effectively use a combination of web browsers, mobile travel apps, and online booking platforms to research destinations, book flights and accommodations, and create a travel itinerary?
3. Discuss the advantages and disadvantages of using mobile platforms for web browsing compared to traditional desktop computers. Consider factors like accessibility, screen size, and available features.

HINT

*It is recommended that teachers assign **individual project work** to learners in Week 14. This individual project is to be submitted by Week 20. Refer to **Appendix E** for more information.*

WEEK 15

Learning Indicator: Analyse and discuss website features and multimedia content. (Graphics, Audio, Videos, Plug-ins

Focal Area: Website Features

Teachers should guide learners to understand the layout and design elements of a website, including navigation menus, headers, footers, sidebars, and content areas.

As a teacher, you can recall your own experiences and share them with your learners. Websites that impressed you were engaging, uniquely eye-catching, smooth and easy to use.

Homepage

The home page of a website is the opening page, usually located at your main website URL. Its goals are usually to:

1. Welcome visitors
2. Help them realise they are in the right place
3. Immediately make it clear what you do
4. Guide visitors further into the website

Keep in mind that the home page is not always the first page that visitors land on when they enter your website So every page on your website should lead visitors to learn more about you and act, not just the home page

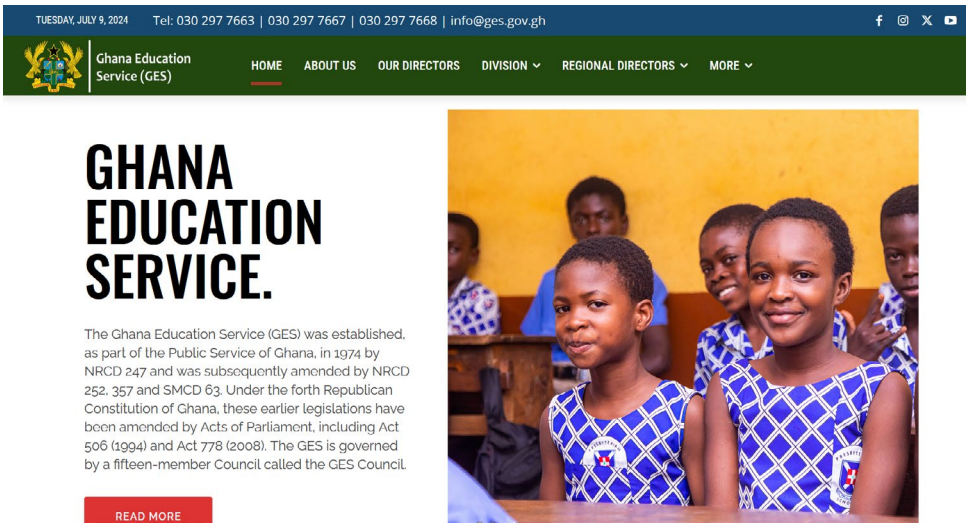


Figure 15.1 Homepage of the Ghana Education Service official Website

Slider

Guide learners to appreciate the fact that the slider can also be referred to as the "slideshow" or "image rotator". A slider on a website is a changing content area with different "slides" of visuals or information. The slides may include a large image, and they may also include text and buttons overlaid on top.

Header

The header of a website is the consistent area at the top of the site that includes the logo and navigation menu. A header might include:

1. Logo
2. Navigation menu
3. Tagline
4. Phone number
5. Address
6. Search box
7. Buttons
8. Social media icons
9. Login or My Account link
10. Opt-in box

Let learners understand that it is always a good practice to keep the header very simple.

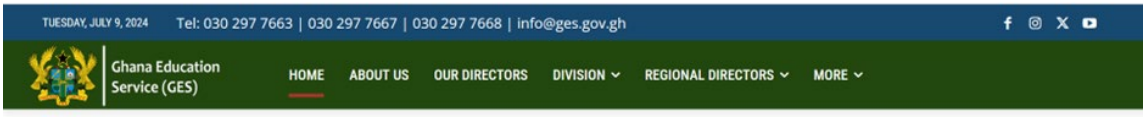


Figure 15.2 Header

Navigation Menu

The navigation is part of the header and includes the links that take visitors to other parts of your website.

Figure 15.3

- Analyse the organisation of information, hierarchy of content, and visual aesthetics to assess the user experience (UX) and user interface (UI) design.

Sidebar

A sidebar is a section of the website used to display information that is not part of the main content of the page.

A sidebar can include an opt-in, call to action, links to other parts of the website, links to popular or recent blog posts, advertisements, social media links, or a brief “About” paragraph for context.

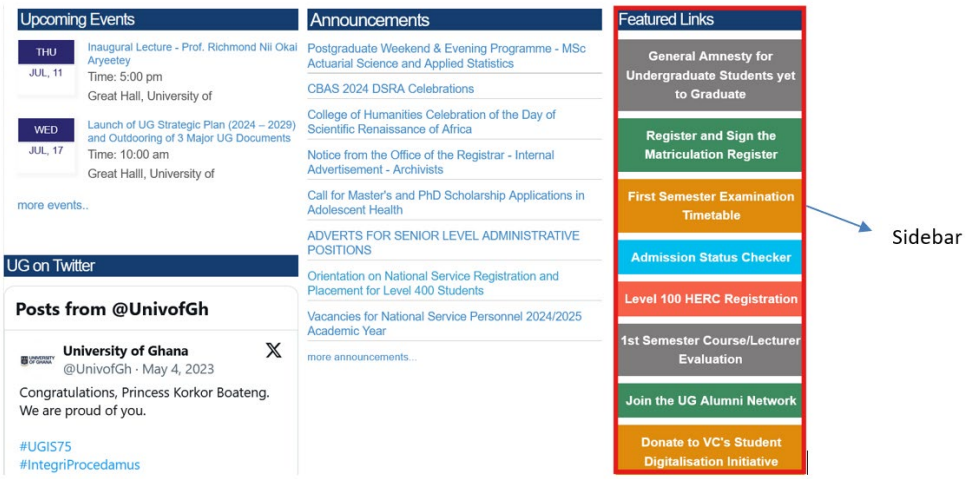


Figure 15.4 Sidebar

Note

Guide learners to understand that sidebars are popular areas to highlight important information you don't want visitors to miss.

Footer

The website footer is a consistent content area at the bottom of every page. It can range from a single line of copyright information to a multi-section area featuring contact details, a map, links, opt-ins, social icons, a search box, and more.

Figure 15.5 Footer

The footer is a great place to catch the users' attention and guide them deeper into your website when they reach the bottom of the page.

Website responsiveness

One major thing to consider as a designer is the responsiveness of your website. The main purpose is to create a user-friendly website for those who use mobile devices.

Smartphones, tablets and other mobile devices have smaller screens. This means that images and text incorporated into the desktop websites with large screens cannot be seen in the same way on the tiny screens. And there are a very wide range of screen sizes and resolutions, making this job even harder for website developers.

Guide learners to understand that websites must be redesigned especially in a way that it responds to the scaling requirements of the small screens of mobile devices. The design and development of a website must respond to the user's environment and behaviour based on the screen size, orientation, and platform.

Note

Let learners appreciate the fact that adaptive and responsive web design almost have the same meaning. The term responsive means to react instantly to any change or request. Adaptive means the website should be easily modified for a new situation or purpose. A responsive design website changes continually based on the user's viewport width and other factors. An adaptive website is specially built to preset factors.

Types of image file formats

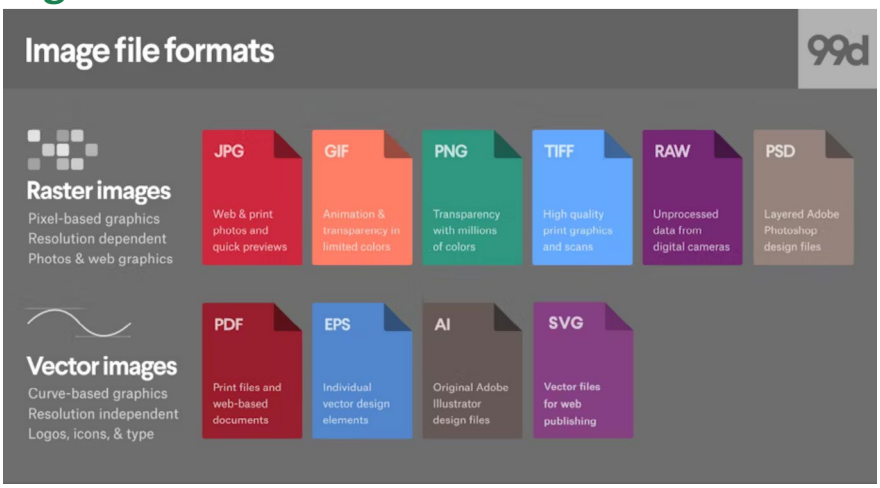


Figure 15.6 Types of image file formats

Image files are classified into two general categories. These are Raster files and Vector files.

Raster Files

Raster images are made up of a set grid of dots called pixels where each pixel is assigned a colour. Raster images are resolution dependent, meaning they exist at one size. When a raster image is transformed, one ends up stretching the pixels themselves, which results in the image becoming "pixelated" or blur.

Uses of Raster images include photographs, digital artwork and web graphics (such as banner ads, social media content and email graphics).

Examples include Joint Photographic Experts Group (JPEG), Graphics Interchange Format (GIF), Portable Network Graphics (PNG), Tagged Image File Format (TIFF/TIF) etc.

Note

Expand on the above examples by guiding learners to identify their merits and demerits.

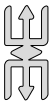
Adobe Photoshop is one of the most common industry-standard image editors for professionals and is used to create, design and edit raster images as well as to add effects, shadows and textures to existing designs.

Vector file formats

Vector images are digital artwork in which points, lines and curves are calculated by the computer.

Unlike raster images, vector images are resolution **in**dependent. When you shrink or enlarge a vector image, your shapes get larger, but you won't lose any detail or get any pixelation. Because

your image will always render identically, no matter the size. Vector images are typically used for logos, icons, typesetting and digital illustrations. Examples include Portable Document Format (PDF), Encapsulated PostScript (EPS), Scalable Vector Graphics (SVG) etc.



Note

Expand on the above examples by guiding learners to identify their merits and demerits.

Learning Tasks

1. Learners take notes and in groups, discuss website responsiveness, accessibility features, and compatibility with different devices and screen sizes.
2. Learners Identify and evaluate the use of graphics, images, icons, and illustrations on websites for visual communication and engagement.
3. Learners ask open-ended questions about the features and interfaces for more clarity.
4. Learners explore and ask open-ended questions on graphic file formats (e.g., JPEG, PNG, GIF, SVG) and considerations for optimising images for web display, including file size, resolution, and compression techniques.

Pedagogical Exemplars

Introduce learners to the usage of a simple website (www.ges.gov.gh) and let them explore the various sections

In their mixed ability groups, let learners differentiate between Raster images and Vector images with given examples

Key Assessment

Level 1

1. What are some common website features? (e.g., navigation menus, search bars, contact forms)
2. What are some different types of multimedia content used on websites? (graphics, audio, videos)

Level 2

1. Identify the purpose of graphics (image, icon) on a website. (e.g., logo for branding, call to action button)
2. Explain how a website uses audio or video content to enhance the user experience (e.g., background music to create atmosphere, product demonstration video)
3. Identify potential barriers for users with disabilities and suggest improvements related to website features and multimedia content in analysing a website for accessibility.

HINT

The recommended mode of assessment for the week is class exercise. You may use any of the Key Assessment questions for the class exercise. Refer to the Teacher Assessment Manual and Toolkit page 63 for information on how to go about the class exercise.

WEEK 16

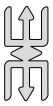
Learning Indicator: Analyse and discuss website features and multimedia content. (Graphics, Audio, Videos, Plug-ins)

Focal Area: Integration of Audio and Video content to websites

Integrating multimedia (audio and video) into your website is an effective strategy for attracting more viewers and strengthening your brand. Integrating audio and video to your website comes with a lot of advantages. Some of them include the provision of interactive content. Audio and video make the website more interactive, capturing users' attention more effectively than text alone. They also increase the time visitors spend on your page thereby reducing bounce rates.

Audio

Audio can be referred to as sound, especially when recorded, transmitted, or reproduced. Adding audio to your website helps convey complex information more clearly and concisely, thereby enhancing user understanding.



Note

teachers should guide learners in exploring accessibility considerations for audio content, including options for captioning, transcripts, and audio descriptions for users with disabilities.

Video

Video refers to the recording, reproducing, or broadcasting of moving visual images. In digital media, video encompasses the combination of moving images and audio to create dynamic visual content that can be stored, transmitted, and viewed on various devices.

Adding videos to websites evoke emotions and create a stronger connection with the audience.

Videos are particularly effective for demonstrating products, services, or processes. Videos can be in the format of cartoon-based imagery or real-life videos, both have their own uses.

Learning Tasks

1. Learners explore accessibility considerations for audio content, including options for captioning, transcripts and audio descriptions.
2. Learners discuss the integration of video content, (e.g. promotional videos, tutorials, interviews, and presentations, into website layouts).
3. Learners examine video quality, resolution, playback controls, and streaming performance for optimal viewing experiences.
4. Learners explore video production techniques, editing tools, and best practices for creating engaging and compelling video content for the web.

1. Learners discuss the use of plug-ins, extensions and add-ons that enhance website functionality and extend the capabilities of web browsers.
2. Identify common plug-ins (e.g., Adobe Flash Player, Java applets, PDF viewers and multimedia players, and their impact on web interactivity and multimedia content delivery).

Pedagogical Exemplars

Collaboration and Communication: Learners will work in mixed ability groups (teachers identify abilities and position their sitting to ensure mix ability) and share their ideas with peers and accept constructive feedback website features and multimedia content. (Graphics, Audio, Videos, Plug-ins)

Key Assessment

Level 3

1. Analyse how the layout and design of a website, including its multimedia content, contributes to its overall effectiveness. (e.g., is it easy to navigate? Does it visually represent the brand identity?)
2. Discuss the potential benefits and drawbacks of using plug-ins on a website. (e.g., increased functionality vs. security concerns, compatibility issues)
3. Explain how the choice of multimedia content (e.g., files size, format) can impact website loading speed and user experience.

Analyse, write how the layout and design of the website in the link below including its multimedia content, contributes to its overall effectiveness (click here, or scan QR code to access link).

Level 4

1. You are tasked with designing a website for a specific audience. How can you strategically use website features and multimedia content to achieve the desired goals (e.g., inform, engage, persuade)?
2. Imagine you are analysing a website for accessibility. Identify potential barriers for users with disabilities and suggest improvements related to website features and multimedia content. (e.g., providing alternative text descriptions for images, offering transcripts for audio content)
3. Discuss the emerging trends in website design and multimedia content (e.g., responsive design, interactive elements, use of artificial intelligence). How can these trends improve user experience and website effectiveness?

HINT

The recommended mode of assessment for the week is case study. You may use Key Assessment level 4 question 2 for the class exercise. Refer to the Teacher Assessment Manual and Toolkit page 25 for information on how to go about it.

SECTION REVIEW

This section has focused on developing the learners' understanding on navigating web browsers, web apps and mobile platforms, the use of audio and visual tools for communication and engagement, website features and common plug-ins.

At the end of this section, learners should be able to demonstrate knowledge, understanding and usage of web browsers, web apps and mobile platforms, audio and visual tools for communication and engagement, website features and common plug-ins.

The teacher would have guided learners to understand, appreciate and demonstrate knowledge and understanding of the World Wide Web. Learners will also analyse and discuss website features and multimedia content found on websites (e.g., Graphics, Audio, Video, Plug-ins).

Through studying the topics in this section, learners should hopefully have developed an appreciation and a deeper understanding of the World Wide Web, website features and multimedia content found on websites.

The suggested activities in the manual strongly focus on critical thinking, problem-solving, and teamwork, three important life skills.

APPENDIX E: INDIVIDUAL PROJECT

Sample of Project Task

a. How can the risks of using ICT, like cyberbullying, malware, denial-of-service attacks, and hardware theft, be understood and evaluated by the public?

b. What are the primary factors that make botnets the most widespread and severe malware threat, and how do they impact the overall security of network infrastructures in comparison to other types of malwares?

Note

this project work should be submitted latest by the 20th week. Ensure to document your findings in word document and create a PowerPoint for presentation.

Rubrics

Criteria	*Excellent (3 marks)*	*Good (2 marks)*	*Need Improvement (1 mark)*
Understanding Key ICT Risks	*Demonstrates understanding of any three of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*	*Demonstrates understanding of any two of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*	*Demonstrates understanding of any one of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*
Risk Evaluation	*Provides explanation evaluating any three of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*	*Provides explanation evaluating any two of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*	*Provides explanation evaluating any one of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*
Application of Preventative Measures	*Provides preventive measures for any three of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*	*Provides preventive measures for any three of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*	*Provides preventive measures for any three of these ICT risks* 1. *Cyberbullying* 2. *Malware* 3. *DoS attacks* 4. *hardware theft*

How to administer

1. Print or write the task on the board
2. Develop a rubric that does not have leading answers with learners
3. Assist learners who need support but ensure to deduct small marks based on the number of visits and assignments seek

How to provide feedback

1. Provide targeted feedback to each learner based on areas they have done well and areas they need improvement
2. Guide learners to self-evaluation their work and suggest how they can improve

SECTION 4: COMPUTER NETWORKS & NETWORK COMMUNICATION PROTOCOLS

STRAND: NETWORK SYSTEMS FOR TRANSMITTING INFORMATION

Sub-Strand: Guided and Unguided Network Systems

Learning Outcomes

1. *Understand the concepts and differences between Client/Server and Peer-to-Peer Networks.*
2. *Describe and explain common network communication protocols and standards, such as Ethernet, TCP/IP, HTTP(s), SMTP, FTP, Wi-Fi, LTE, Bluetooth, IrDA, RFID, and NFC*

Content Standard: *Demonstrate basic knowledge and understanding of guided and unguided network systems.*

HINT

*The recommended mode of assessment for Week 18 is **mid-semester examination**. Refer to **Appendix F** for the structure and a Table of Specification to guide you to set the questions for the exams.*

INTRODUCTION AND SECTION SUMMARY

This section is a continuation of year two section two and three activities, which focuses on improving learners' understanding of computer networks and communication technologies, protocols and standards.

Weeks 17 to 20 introduce learners to network systems for transmitting information. This includes understanding concepts of client/ server and peer-to-peer networks, guided and unguided network systems.

The weeks covered by the section are:

Week 17: Understand the concepts and differences between Client/Server and Peer-to-Peer Networks.

Week 18: Understand the concepts and differences between Client/Server and Peer-to-Peer Networks.

Week 19: Describe and explain common network communication protocols and standards, such as Ethernet, TCP/IP, HTTP(s), SMTP, FTP, Wi-Fi, LTE, Bluetooth, IrDA, RFID, and NFC.

Week 20: Describe and explain common network communication protocols and standards, such as Ethernet, TCP/IP, HTTP(s), SMTP, FTP, Wi-Fi, LTE, Bluetooth, IrDA, RFID, and NFC.

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section considers various teaching and learning approaches, strategies, and techniques. These include hands-on activities where learners engage in practical tasks to research, explain, and demonstrate understanding in network systems for transmitting information between client/server, peer-to-peer networks, and guided and unguided network systems.

Where appropriate, learners should be able to work in groups to find solutions to assigned tasks. Experiential learning activities with mixed-ability and mixed-gender groupings should dominate these lessons. Regardless of their abilities, all learners should be encouraged to participate fully. Accommodate different learning styles by offering below-average or approaching proficiency learners the chance to make oral presentations when appropriate and providing more challenging extension activities for above-average or highly proficient learners.

Practical sessions and project-based learning will enhance learner engagement, foster valuable collaboration and teamwork skills, and provide opportunities for learners to appreciate various network systems, communication protocols and standards.

ASSESSMENT SUMMARY

The assessment section (formative and summative) considers all four levels of the Revised Bloom's Taxonomy: Level 1 (Recall/Reproduction), Level 2 (Skills/Conceptual Understanding), Level 3 (Strategic Thinking/Reasoning), and Level 4 (Extended Critical Thinking and Reasoning).

Teachers should note that there are assessment suggestions suitable for different levels of ability—learners approaching proficiency (AP), proficient (P) learners, and highly proficient (HP) learners. Beyond traditional practical and written tests and assignments, teachers should introduce learners to other forms of assessment, including demonstrations of activities using a digital device, mind maps or concept maps, multiple-choice quizzes, group projects, self-assessments, oral presentations, peer reviews, portfolios, debates, game-based assessments, digital storytelling, and matching tasks.

Teachers can consult the Teacher Assessment Manual and Toolkits (TAMTK) on how to use the Assessment Strategies effectively in the classroom (TAMTK, NaCCA 2023).

Please note that the key assessment items in this manual are intended to guide teachers in establishing learners' understanding of the course material. They do not limit teachers from exploring and creating their questions.

WEEK 17

Learning Indicator: Understand the concepts and differences between Client/Server and Peer-to-Peer Networks

Focal Area: Architecture and functionality of client/server networks

The client-server model, or client-server architecture, is one of the most important concepts of computer networks. Majority of today's networks rely on this exact model.

Client-server architecture is basically a type of computer network where multiple clients request and receive files and services from a centralised server over a local area network or internet connection.

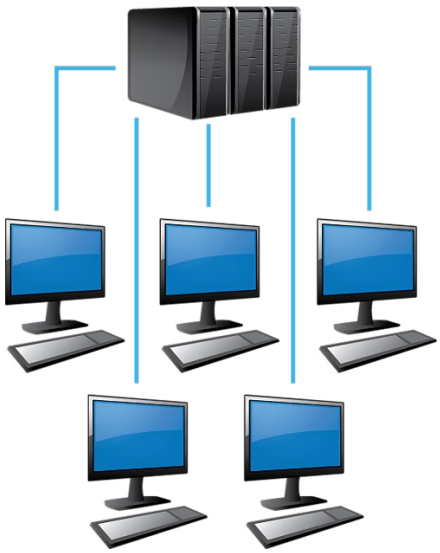


Figure 17.1 Sample Client-Server Architecture

How Does the Client-Server Model Work?

The model works in three steps stated below. Kindly explain the three steps for better understanding of your learners.

1. The client, such as a workstation or smartphone, connects to the network using a physical or wireless LAN or internet connection.
2. The client sends various requests to the server in order to submit, retrieve, or modify the data located on the server.
3. The server processes each client request.

In addition, guide learners to understand the three basic layers to client-server architecture stated below:

1. The presentation layer is the part of the application that the user interacts with, also known as the user interface.
2. The business logic layer represents the actual code of an application and connects and instructs the presentation and data layers.
3. The data layer is made out of database tables and the logic required to operate on them.

Types of Client-server Networks

1-tier architecture

In 1-tier architecture, the presentation, business logic, and data layers are all stored on a single device or a shared storage device. A good example is a desktop application that works offline and stores all its data on the same device it is running from.

2-tier architecture

In 2-tier architecture, the presentation and business logic layers are stored on the client while the data layer is stored on a server. So as long as the code of an application is fully executed on the client and some of the data is being stored in a remote database, that application fits the 2-tier architecture criteria. A desktop application that requires you to log into an online account is a good example.

3-tier architecture

The presentation layer is stored on the client, the business logic layer is stored on one server, and the data layer is stored on another server. For example, you use a smartphone app's user interface to interact with an app while an application server executes most of the app's code and a database server stores the data

N-tier architecture

In N-tier architecture, the presentation and data layers are left untouched, compared to the 3-tier architecture. The difference is that N-tier architecture splits the business logic layer into multiple layers to improve performance, management, and stability.

Advantages

1. Centralised file storage makes it easier for multiple clients to share, store, and operate on files.
2. Centralised databases improve data organisation, security, and management.
3. Server scalability allows for easier hardware and performance management as well as cost savings.
4. Device management is more effective when done from a single server instead of individual clients.

Disadvantages

1. It is easier to infect a single server than individual clients.
2. Since centralised servers store the software and data, users lose all access if those servers fail.
3. Too many client requests can overload the server, causing performance issues and service outages.
4. Buying and running a server and networking equipment is an additional expense.

Peer-to-Peer (P2P) Networks

Peer-to-peer (P2P) network is a group of computers, each of which acts as a node for sharing files within the group. Each computer acts as the server for the files instead of having a central server to act as a shared drive.

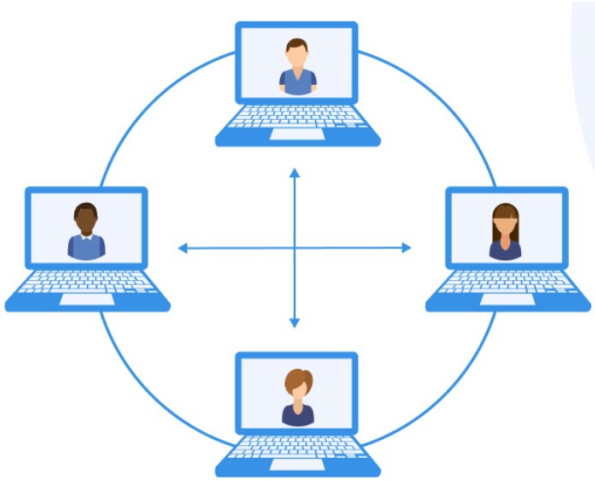


Figure 17.2 Peer-to-Peer (P-2-P)

Teachers can further explain peer-to-peer networks by referring to a simple network where each computer doubles as a client (requesting files) and server (providing files).

Guide your learners to do a practical example by connecting their mobile phones to any available computer and share a file. This will be a simple example of a P2P network.

Advantages

1. P2P networks offer decentralisation, enhancing their robustness and resistance to censorship.
2. Storage can be increased by adding more devices.
3. Network load for large or frequently accessed files can be distributed efficiently.

Disadvantages

1. Open access can enable malware distribution, potentially disguised as legitimate files.
2. The number of peers available to serve content can affect speed.
3. There is the difficulty of enforcing security policies or manage usage.

Learning Tasks

1. Learners watch, as the teacher carry-out a live demonstration on configuring a Client/ Server and
2. Peer-to-Peer network by using his/her mobile phone and computer.
3. Learners in their mix-ability groupings go through the process of setting up the Client/ Server and Peer-to-Peer network
4. Learners share their experience and challenges during the practical.
5. Learners discuss the advantages and disadvantages of both Client/Server and Peer-to-Peer networks.

Pedagogical Exemplars

1. Learners identify the roles and responsibilities of clients (e.g., user devices, workstations) and servers (e.g., file servers, application servers) in a client/server network environment.
2. Learners discuss the advantages of client/server networks, such as centralised management, scalability, security and resource sharing.
3. Learners in their mixed ability groups explore the architecture and operations of peer-to-peer networks, where peers (individual devices) communicate and share resources directly with each other without the need for centralised servers.

Key Assessment

Level 1

1. What are the two main types of network architectures? (Client/Server, Peer-to-Peer)
2. What is the basic role of a client in a network? (Requests resources/services from a server)
3. Tick the appropriate option (true/ false) from the table below

s/n	Question	True	False
1	The two main types of network architectures are Client/Server and Peer-to-Peer.		
2	The basic role of a client in a network is to provide resources and services to other devices.		
3	In a Client/Server network, the key difference is that the client is dedicated to providing resources, while the server requests resources.		
4	Accessing email through a webmail service is an example of a Client/ Server network model.		

Level 2

1. Identify the key difference between a client and a server in a Client/Server network. (Server is dedicated to providing resources, client requests resources).
2. Give an example of a common application that uses a Client/Server network model. (e.g., accessing email through a webmail service).

HINT

The recommended mode of assessment for the week is Group discussion. You may use any of the Key Assessment questions for the class exercise. Refer to the Teacher Assessment Manual and Toolkit page 52 for information on how to go about it.

WEEK 18

Learning Indicator: Understand the concepts and differences between Client/Server and Peer-to-Peer Networks

Focal Area: Concepts and differences between Client/Server and Peer-to-Peer Networks

What is a P2P Network Architecture?

Peer-to-peer network architecture refers to the type of P2P network in use and which elements allow peer-to-peer interaction.

For example, in an unstructured P2P network, each computer or node acts as both a client (requesting files and data) and a server (providing files and data).

Guide learners to appreciate the fact that unlike centralised network architectures in which a server provides data based on client requests, there is no central point.

Any node or computer in a Peer-to-Peer network can communicate with any other node, sharing files or data according to permissions.

However, hybrid P2P networks are another type of P2P network architecture. In hybrid P2P networks. peers may interact and share data in limited ways while querying a centralised server for permission data or larger data sets.

Teachers are to guide learners through the other types of P2P such as:

1. Pure P2P Network
2. Structured P2P Network
3. Federated P2P Network
4. Hierarchical P2P Network

Key Applications of P2P Networks

P2P removes the middleman between users, allowing for applications such as file-sharing, social networking, messaging, and even financial transactions.

Learning Tasks

1. Learners explain what they remember about P2P and Client/Server Architecture.
2. Learners research on Client/Server and P2P applications in everyday life.
3. Compare the key characteristics and differences between client/server and peer-to-peer network architectures in terms of topology, scalability, resource management, and data access.
4. Analyse the advantages and disadvantages of each network architecture for different use cases and organisational requirements.
5. Discuss real-world examples and applications of client/server and peer-to-peer networks in various contexts (enterprise networks, file sharing, multimedia streaming, and online collaboration).

Pedagogical Exemplars

1. Learners discuss the key applications of P2P networks
2. Learners discuss the types of P2P networks
3. Learners explore the roles and interactions of peers in a peer-to-peer network (file sharing, collaborative computing, and distributed processing).
4. Learners discuss the benefits and challenges of peer-to-peer networks (decentralised architecture, scalability, resilience, and potential security risks).

Key Assessment

Level 3

1. Explain why a Client/Server network might be a better choice for a large organisation with many users compared to a Peer-to-Peer network. (Centralised control, better security, scalability).
2. Discuss the advantages and disadvantages of using a Peer-to-Peer network for sharing files among a small group of friends. (Easy setup, no central server needed, security concerns, limited scalability).

HINT

*The recommended mode of assessment for Week 18 is **Mid-semester examination**. Refer to **Appendix F** for the structure and a Table of Specification to guide you to set the questions for the exams.*

WEEK 19

Learning Indicator: Describe and explain common network communication protocols and standards, such as Ethernet, TCP/IP, HTTP(s), SMTP, FTP, Wi-Fi, LTE, Bluetooth, IrDA, RFID, and NFC

Focal Area: Common network communication protocols and standards

The teacher will introduce students to the basics of communicating on a network using the TCP/IP suite. The teacher will focus on explaining and discussing the basic communication processes and some of the basic differences in the protocols.

Basics of Ethernet Technology

The teacher explains a brief history of the ethernet. Developed in the 1970s by Robert Metcalfe at Xerox PARC. It started with 10 Mbps speed (10BASE5) and evolved to 100 Mbps (Fast Ethernet), 1 Gbps (Gigabit Ethernet), and now 10 Gbps (10 Gigabit Ethernet). The standards that govern ethernet, ensuring interoperability and adherence to a standard set of protocols and specifications, is IEEE 802.3. Ethernet variants and standards include 10BASET, 100BASETX (Fast Ethernet),1000BASET (Gigabit Ethernet), and 10GBASET (10 Gigabit Ethernet). There is a start frame delimiter (SFD), destination MAC address, and source MAC Address: 6 bytes, specifying the sender's address, payload size and length, and error checking. There are Collision Detection Mechanisms (CSMA/CD) Carrier Sense Multiple Access with Collision Detection.

Figure 19.1 MAC Address

1. **TCP/IP (Transmission Control Protocol/Internet Protocol)**
   a. Layers of TCP/IP model
      i. Application Layer: Responsible for providing network services to applications. It uses protocols like HTTP, FTP, SMTP, and DNS.
      ii. The Transport Layer is responsible for data transfer between devices. It includes TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).
      iii. Internet Layer: Responsible for routing packets across networks. Protocols include IP (Internet Protocol) and ICMP (Internet Control Message Protocol).
      iv. Network Access Layer: Handles physical transmission of data over network media.

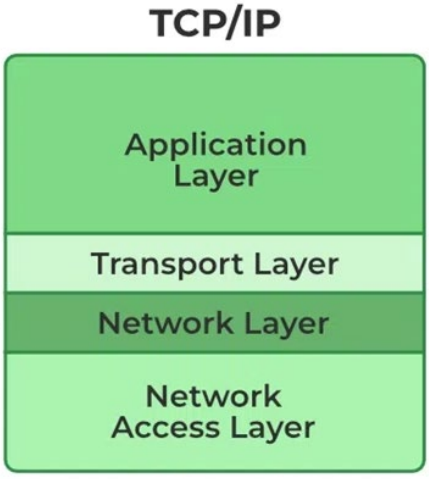


Figure 19.2: *TCP/IP model*

2. **TCP/IP Protocol**
   a. TCP (Transmission Control Protocol) ensures reliable, ordered data delivery and provides flow control, error detection, and correction.
   b. IP (Internet Protocol): Responsible for addressing and routing packets to their destination. Defines IP addresses and packet structure.
   c. The TCP/IP protocol is essential because it ensures end-to-end Communication between devices across different networks and interoperability of devices from different manufacturers. It is scalable and supports a large and growing number of devices on the Internet, and it is flexible.

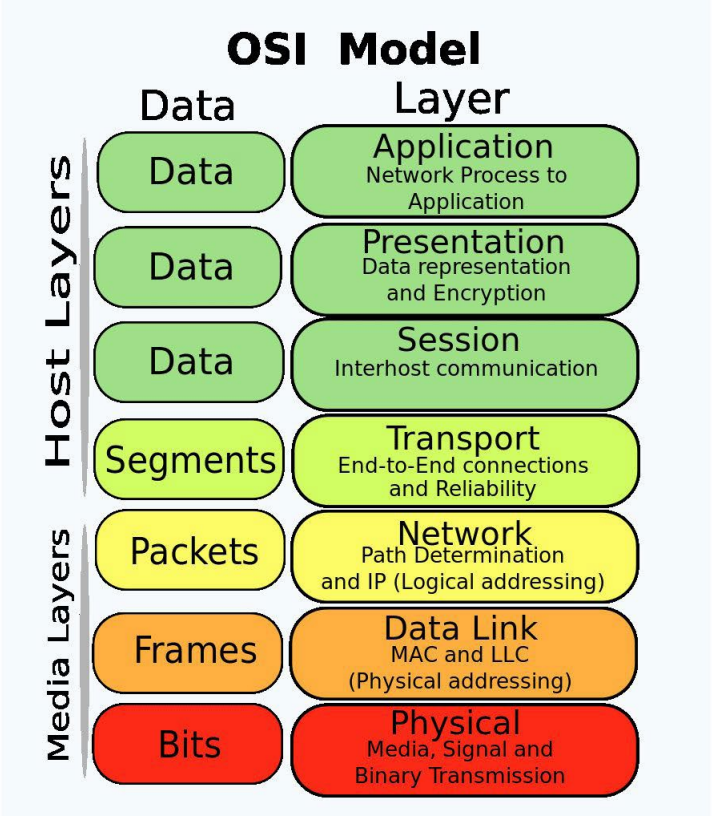


Figure 19.3 OSI Model

3. **OSI Model**
   a. The OSI (Open Systems Interconnection) Model is a conceptual framework that standardises the functions of a telecommunication or computing system into seven abstraction layers, facilitating interoperability between diverse systems.
   b. The Seven Layers
      i. Physical Layer: Deals with the physical connection between devices. It defines hardware specifications, transmission mediums, signal types, and data rates. Examples include cables, hubs, and network interface cards.
      ii. Data Link Layer: Responsible for node-to-node data transfer and error detection/correction from the physical layer. It manages MAC (Media Access Control) addresses and switches, ensuring reliable data transfer between adjacent network nodes.
      iii. Layer 3 – Network Layer: Manages data routing, switching, and addressing between networks. It determines the best physical path for data transfer and handles logical addressing with IP addresses and routing protocols like IP, ICMP, and IGMP.
      iv. Transport Layer: Ensures reliable data transfer between systems with flow control, segmentation and error checking. Protocols like TCP (Transmission Control Protocol) and UDP (User Datagram Protocol) operate at this layer to provide end-to-end communication services.
      v. Session Layer: Manages sessions between applications, establishing, maintaining, and terminating connections. It controls dialogues between computers, handling session restoration and authentication.
      vi. Presentation Layer: Translates data between the application layer and the network format. It handles data encryption/decryption, compression, and conversion, ensuring that data from the application layer of one system is readable by the application layer of another.
      vii. Application Layer: Provides network services directly to end-user applications. It includes protocols like HTTP (HyperText Transfer Protocol), FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), and DNS (Domain Name System) that facilitate user interface functionalities.
   c. Importance of the OSI Model
      i. Standardisation: It provides a universal set of guidelines that enable different networking devices and software to communicate effectively, ensuring interoperability across various manufacturers and platforms.
      ii. Modularity: By dividing network communication into seven layers, it allows for modular engineering, making it easier to develop, modify, and troubleshoot individual components without affecting the entire system.
      iii. Troubleshooting: The layered approach helps network administrators isolate issues to a specific layer, simplifying the diagnostic process and reducing downtime.
      iv. Flexibility and Scalability: The OSI Model supports the integration of new technologies and protocols within its framework, allowing networks to adapt and scale with evolving communication needs.

4. **HTTP and HTTPS Protocols**
    a. HTTP (Hypertext Transfer Protocol) is a protocol for transmitting hypertext (web pages) over the Internet. It uses a request-response model, where a client (browser) sends a request to a server, and the server responds with the requested resource or an error message. The Request-Response Model of HTTP Communication is the GET, which requests data from a specified resource; POST, which submits data to be processed to a specified resource; PUT, which updates a current resource with new data; and finally, DELETE, which removes the specified resource.
    b. A web server sends messages to the browser to indicate whether or not that request can be fulfilled. They include:
        i. 200 OK: The request was successful, and the server returned the requested resource.
        ii. 404 Not Found: The requested resource was unavailable on the server.
        iii. 500 Internal Server Error: The server encountered an error and could not complete the request.
    c. HTTPS (Hypertext Transfer Protocol Secure) is an extension of HTTP that adds a layer of security. It uses SSL/TLS (Secure Sockets Layer/Transport Layer Security) to encrypt data transmitted between the client and server, ensuring data integrity and privacy. Its role is to protect data from being intercepted or tampered with during transmission since data is encrypted before transmission and decrypted upon receipt. HTTPS relies on certificate authorities (CAs) to issue a digital certificate to verify the server's identity.

Learning Tasks

1. The learners listen to and interact with teachers and peers while sharing their ideas and experiences on the different types of protocols in their use of the internet.
2. In mixed-ability groups, learners analyse and compare Ethernet variants and their applications in real-world use cases. They will explore the historical development and future trends of HTTP and HTTPS.
3. Learners take notes and ask questions to clarify their understanding.

Pedagogical Exemplars

1. **Interactive Multimedia Presentations:** Use multimedia presentations to explain the history and evolution of Ethernet. Show visual representations/simulations of some concepts (e.g., MAC addresses, TCP/IP and OSI layered architecture). Encourage discussions during the presentation to link content to real-life use cases.
2. **Group Discussions and Collaborative Learning:** Learners will work in mixed-ability groups (teachers identify abilities and position their sitting to ensure mixed ability) to discuss the impact of Ethernet technology and the significance of TCP/IP in modern networking.

Key Assessment

Level 1

1. What is a network communication protocol? (Set of rules that govern how devices communicate over a network)
2. What does the acronym TCP/IP stand for? (Transmission Control Protocol/Internet Protocol)
3. Which protocol is used by web browsers to navigate the World Wide Web?
   A. FTP
   B. HTTP
   C. POP3
   D. SMTP
4. What is the primary difference between HTTP and HTTPS?
   A. HTTP is used for secure websites, while HTTPS is used for non-secure websites.
   B. HTTP uses encryption, while HTTPS does not.
   C. HTTPS uses encryption to secure data, while HTTP does not.
   D. There is no difference; they are the same protocol.

Level 2

1. Identify the protocol used by web browsers to traverse the world wide web.
2. Explain the difference between HTTP and HTTPS.

Level 3

1. Discuss why the HTTPS protocol is more suitable in e-commerce websites than the HTTP protocol.
2. Discuss how the OSI and the TCP/IP Model relate to each other.

HINT

*The recommended mode of assessment for the week is **multiple choice**. Use DoK level 1, questions (3 and 4) as samples. Refer to the Teacher Assessment Manual and Toolkit page 66 for information on how to go about it.*

WEEK 20

Learning Indicator: Describe and explain common network communication protocols and standards, such as Ethernet, TCP/IP, HTTP(s), SMTP, FTP, Wi-Fi, LTE, Bluetooth, IrDA, RFID, and NFC

Focal Area

The teacher will introduce students to some network communication technologies/protocols/standards. The teacher will focus on explaining and discussing their uses and highlight their advantages and limitations and the basic differences.

1. **SMTP Overview**
    a. The teacher explains that the Simple Mail Transfer Protocol (SMTP) is the standard protocol used for the transmission and delivery of email messages between mail servers. It facilitates the sending of emails from a client to a server or between servers, ensuring proper routing and delivery.
    b. The structure of the SMTP Message Format is
        i. Envelope: Contains sender and recipient information.
        ii. Header: Includes fields like From, To, Subject, Date, and more.
        iii. Body: The main content of the email message.
        iv. Command Response Interaction:
        v. Commands: HELO/EHLO, MAIL FROM, RCPT TO, DATA, QUIT, etc.
        vi. Responses: SMTP servers respond to commands with numeric codes and messages (e.g., 250 OK, 550 No such user).
    c. Sending an SMTP message goes through the following phases
        i. Client Initiation: The email client establishes a connection with the SMTP server.
        ii. Handshake: The client introduces itself using HELO/EHLO.
        iii. Mail Transaction: The client sends the sender's address (MAIL FROM) and recipient's address (RCPT TO).
        iv. Message Transfer: The client sends the message data (DATA command), including headers and body.
        v. Termination: The client ends the session with the QUIT command.
2. **FTP Overview**
    a. The teacher explains that the File Transfer Protocol (FTP) is a standard network protocol used to transfer files from one host to another over a TCP based network, such as the Internet. FTP enables users to upload, download, and manage files on a remote server.
    b. Sending an FTP a file using FTP uses the following Commands and Responses

    Commands

        i. USER: Send username to the server.
        ii. PASS: Send password to the server.

iii. LIST: List files and directories.

iv. RETR: Retrieve a file from the server.

v. STOR: Store a file on the server.

vi. QUIT: Terminate the session.

vii. Responses: FTP servers respond to commands with numeric codes and messages (e.g., 220 Service ready, 331 Username okay, need password, 550 Requested actions not taken).

c. There are secure FTP Variants including SFTP (SSH File Transfer Protocol) which uses SSH to encrypt the transfer, providing secure file access, transfer, and management. There is also FTPS (FTP Secure) which adds SSL/TLS encryption to FTP, securing data in transit.

3. **Wireless Communication Technologies and Standards**

a. The teacher introduces learners to some common Wireless Communication Technologies and Standards and discusses their transmission medium, range and uses.

Technology/ Standard	Description	Transmission Medium	Frequency	Range	Uses
Wi-Fi (IEEE 802.11)	A family of wireless networking protocols	Ultra-high frequency (UHF) radio waves	2.4/5/6 GHz.	100m (indoors), 300m (outdoors)	Primarily used for local area networking (LAN) of devices
LTE (Long Term Evolution)	A standard for wireless broadband communication for mobile devices.	Ultra-high frequency (UHF) radio waves	700-2600 MHZ	Several kilometres depending on cell tower density	Mobile internet, VoLTE (Voice over LTE) application
Bluetooth	Short-range wireless technology standard for exchanging data over short distances	ultra-high frequency (UHF) radio waves	2.4 GHz	Typically, up to 10 metres (Class 2), up to 100 metres (Class 1)	Used to connect peripheral devices (e.g. keyboards, mice), audio devices or file transfer. Can also be used to share internet between different devices.

IrDA (Infrared Data Association)	A standard for wireless communication using infrared light	Infrared light	850 nm to 900 nm Spectrum.	Up to 1 metre	Remote controls and short-range data transfer between devices. This is very rarely used due to low speed and line of sight requirement.
RFID (Radio Frequency Identification)	A technology that uses electromagnetic fields to automatically identify and track tags attached to objects	Radio	Low frequency of (125134 kHz), high frequency (13.56 MHz) or ultrahigh frequency (860960 MHz)	Passive tags have a range of several metres whilst active tags have tens of metres	Inventory tracking, access control, and contactless payments
NFC (Near Field Communication)	A set of communication protocols for communication between two electronic devices over a short distance	Electromagnetic induction	13.56 MHz	up to 10 cm	Contactless payments (in EPOS systems), access control, data exchange between devices.
Satellite Internet	Satellite internet is a wireless internet service that uses satellite communication to deliver broadband speeds to remote areas. Data is sent to and from satellites orbiting the Earth.	Satellite signals	Ku-band (12–18 GHz), Ka-band (26.5–40 GHz), C-band (4–8 GHz)	Global (thousands of kilometers)	Remote areas, rural connectivity, emergency services, maritime and aeronautical internet access

Learning Tasks

1. Learners listen to and interact with teachers and peers, sharing their ideas and experiences on the various technologies/protocols/standards and identifying their advantages and limitations.
2. Learners analyse their assigned technology/protocol/standard and identify its advantages and limitations in their experience using it.
3. Learners take notes and ask questions to clarify their understanding.

Pedagogical Exemplars

1. **Interactive Multimedia Presentations:** Use multimedia presentations to explain the protocols, technologies, and standards. Encourage discussions during the presentation to link the content to the learner's experiences and real-life use cases.
2. **Group Discussions and Collaborative Learning:** Learners will work in mixed-ability groups (teachers identify abilities and position their sitting to ensure mixed ability) to discuss the advantages and limitations of each technology. Each group will be assigned at least one technology/protocol/standard. Each group will present findings on their assigned technology/protocol/standard, such as RFID in inventory management or LTE in mobile communications.

Key Assessment

Level 1

1. What is the SMTP protocol?
2. Describe the process for a message being sent using the SMTP protocol?

Level 2

1. Describe one real life situation which may use the FTP protocol.
2. Which protocol will you use to transmit sensitive personal data when using the internet?

Click here or scan QR code to assess to task items

Level 3

1. Why is it important for different devices to use compatible network protocols to communicate effectively?
2. What are the benefits to using ethernet to allow devices to communicate?
3. Discuss the role of Wi-Fi and LTE protocols in providing wireless internet access. (Wi-Fi - local area network, LTE - cellular network)

Level 4

1. Imagine you are setting up a home network. Explain how different protocols (e.g., Wi-Fi, TCP/IP) work together to allow your devices to connect to the internet and access online resources.
2. Analyse the trade-offs between different wireless communication protocols like Bluetooth and NFC. (Bluetooth - wider range, more power consumption; NFC - shorter range, lower power consumption, used for contactless payments)
3. Discuss the emerging trends in network communication protocols, such as the development of faster and more secure protocols for the Internet of Things (IoT) and 5G networks. How can these advancements impact our future communication methods?

HINT

*The recommended mode of assessment for the week is **e-assessment**. Use DoK level 2 question 3 as a sample. Refer to the Teacher Assessment Manual and Toolkit page 68 for information on how to go about it.*

SECTION REVIEW

This section has focused on developing the learners' understanding of network systems for transmitting information between client/ server, peer-to-peer networks, and guided and unguided network systems.

At the end of this section, learners should be able to demonstrate knowledge, understanding of the various network systems and communication technologies, protocols and standards.

The teacher would have guided learners to understand, appreciate and demonstrate practical knowledge and understanding of network systems, communication technologies, protocols and standards.

Through studying the topics in this section, learners should hopefully have developed an appreciation and a deeper understanding of network systems, communication technologies, protocols and standards.

The suggested activities in the manual strongly focus on critical thinking, problem-solving, and teamwork, three important life skills.

APPENDIX F: MID-SEMESTER EXAMINATION

Structure

1. Cover content from weeks 1-5. Taking into consideration DOK levels (adapt the table of specification below as a guide)
2. The test should include
   a. Section A- Multiple Choice (10 questions; 20 marks)
   b. Section B- (3 Essay questions, 2 to be selected; 20 marks)
3. **Time:** 1 hours 30minutes.
4. **Total Score:** 40 marks to be scaled down to 5% for submission.

Resources

1. Answer booklets
2. Learner Material
3. Teacher Manual
4. Assessment Toolkit

Table of Specifications

Week	Focal Area	Type of Question	DoK Level				Total
			1	2	3	4	
13	Understanding Web Addresses	Multiple Choice	1	–	1		2
		Essay	–	1	–		1
14	Navigating Mobile Platforms	Multiple Choice	1	1	–		2
		Essay	–	–	1		1
15	Website Features	Multiple Choice	1	1	–		2
		Essay	–	–	–		
16	Integration of Audio and Video content to websites	Multiple Choice	–	1	–		1
17	Architecture and functionality of client/ server networks	Multiple Choice	1	1	1		3
		Essay	–	–	1		1
	Total		4	5	4		13

Sample Questions: Multiple Choice (20 items, 1 mark each)

1. The basic role of a client in a network is to .....
   A. act as the central point of control for the network.
   B. manage network traffic and ensure data is routed correctly.
   C. provide resources and services to other devices on the network.

D. request and utilise resources or services from a server.

2. One primary purpose of using audio or video content on a website is to .....
   A. enhance user engagement, provide additional information, and improve accessibility.
   B. ensure that users spend less time interacting with the website.
   C. make the website load faster by replacing images with videos.
   D. reduce the need for text and make the website less informative.
3. Which of the following best describes an effective use of video or audio content on a website?
   A. Adding audio or video content only for decorative purposes, with no connection to the site's goals.
   B. Including a video that auto-plays loudly without user consent.
   C. Using audio or video that requires specialised software to play and isn't accessible to all users.
   D. Using videos or audio clips that are relevant, accessible and help explain complex information.

Marking Scheme

1. D
2. A
3. D

How to Administer

1. Prepare a table of specification like the sample attached to session's appendix F
2. Ensure resources for the mid-semester examination are available
3. Set a duration for the examination, etc.

Refer to Teacher Assessment Manual and Toolkit pages 66-67 and 74-76 for information on how to administer the assessment

How to give Feedback

1. Identify common areas needing improvement and provide general feedback to the class or conduct a remedial when necessary.
2. Encourage learners to reflect on their performance and identify areas for improvement, etc.

SECTION 5: COMPUTER NETWORK SECURITY & NETWORK SECURITY RISKS

STRAND: NETWORK SYSTEMS FOR TRANSMITTING INFORMATION

Sub-Strand: Computer and Information Security

Learning Outcome: *Understand and evaluate the risks associated with the use of ICT and suggest possible preventive mechanisms to mitigate them*

Content Standard: *Demonstrate knowledge and understanding of Safety and security Issues in ICT*

HINT

*Learners are to prepare for end of semester examination. Refer to **Appendix G** for more information on how to conduct the examination by Week 24.*

INTRODUCTION AND SECTION SUMMARY

This section is a continuation of section four activities, which focuses on improving learners' understanding of computer network security and network security risks.

Weeks 21 to 24 introduce Learners to network systems for transmitting information. This includes understanding safety and security issues in ICT.

The weeks covered by the section are:

Week 21: Understand and evaluate the risks associated with using ICT, including internet and network attacks (e.g., cyberbullying, malware, botnets, denial-of-service attacks, spoofing, hardware theft, firewalls).

Week 22: Understand and evaluate the risks associated with using ICT, including internet and network attacks (e.g., cyberbullying, malware, botnets, denial-of-service attacks, spoofing, hardware theft, firewalls).

Week 23: Discuss and implement preventive mechanisms to mitigate computer network attacks (e.g., antivirus software, hardware and software firewalls).

Week 24: Discuss and implement preventive mechanisms to mitigate computer network attacks (e.g., antivirus software, hardware and software firewalls).

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section considers various teaching and learning approaches, strategies, and techniques. These include hands-on activities where learners engage in practical tasks to research, explain, and demonstrate understanding of risks associated with using ICT, including internet and network attacks and mechanisms to mitigate computer network attacks.

Where appropriate, learners should be able to work in groups to find solutions to assigned tasks. Experience learning activities with mixed-ability and mixed-gender groupings should dominate these lessons. Regardless of their abilities, all learners should be encouraged to participate fully. Accommodate different learning styles by offering below-average or approaching proficiency learners the chance to make oral presentations when appropriate and providing more challenging extension activities for above-average or highly proficient learners.

Practical sessions and project-based learning will enhance learner engagement, foster valuable collaboration and teamwork skills, and provide opportunities for learners to appreciate various risks associated with using ICT and the mechanisms to mitigate computer network attacks.

ASSESSMENT SUMMARY

The assessment section (formative and summative) considers all four levels of the Revised Bloom's Taxonomy: Level 1 (Recall/Reproduction), Level 2 (Skills/Conceptual Understanding), Level 3 (Strategic Thinking/Reasoning), and Level 4 (Extended Critical Thinking and Reasoning).

Teachers should note that there are assessment suggestions suitable for different levels of ability—learners approaching proficiency (AP), proficient (P) learners, and highly proficient (HP) learners. Beyond traditional practical and written tests and assignments, teachers should introduce learners to other forms of assessment, including demonstrations of activities using a digital device, mind maps or concept maps, multiple-choice quizzes, group projects, self-assessments, oral presentations, peer reviews, portfolios, debates, game-based assessments, digital storytelling, and matching tasks.

Teachers can consult the Teacher Assessment Manual and Toolkits (TAMTK) on how to use the Assessment Strategies effectively in the classroom (TAMTK, NaCCA 2023).

Please note that the key assessment items in this manual are intended to guide teachers in establishing learners' understanding of the course material. They do not limit teachers from exploring and creating their questions.

WEEK 21

Learning Indicator: Understand and evaluate the risks associated with using ICT, including internet and network attacks (e.g., cyberbullying, malware, botnets, denial-of-service attacks, spoofing, hardware theft, firewalls)

Focal Area: Cyberbullying

Cyberbullying is a serious issue that can have lasting negative effects on victims, especially students and those within the youth bracket.

It can simply be described as the use of digital technologies to harass, threaten, or humiliate someone. This can occur through various platforms, especially social media, messaging apps, gaming platforms, and other online forums. It can have serious emotional and psychological effects on the victims.

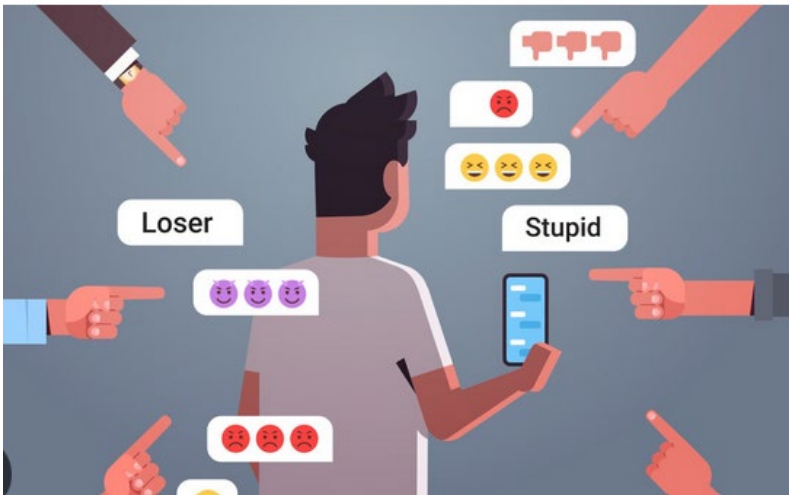


Figure 21.1 Cyberbullying

Forms of Cyberbullying

There are several forms of cyberbullying. Some of them include:

1. Harassing someone or a group of people through the sending of offensive, rude and insulting messages repeatedly.
2. Spreading false information or rumors to damage someone's reputation.
3. Pretending or impersonating someone else to post harmful content or messages.
4. Sharing a friend or someone's private information, photos, or videos without their consent.
5. Excluding someone from online groups or activities intentionally.
6. Monitoring someone's online activity to intimidate or threaten them. This is called Cyberstalking.

Effects of Cyberbullying

Cyberbullying can have several effects on an individual. This becomes worse when the person finds him or herself within the youth bracket. It can cause:

1. Emotional distress, which can lead to feelings of sorrow, anxiety, fear and depression. It can also lead to low self-esteem and feelings of hopelessness. This can lead to manifestations of physical symptoms such as headaches or stomach aches.
2. Bullied people, especially students, may find it difficult to concentrate and learn at schools. This can also happen to anyone in a workplace.
3. People who are bullied often withdraw from everyday social interactions and avoid certain people or places.

Preventing Cyberbullying

1. **Parental Control:** Teachers are to guide students to appreciate the usage of "parental control" options in Windows, Android and Mac operating systems. This can prevent unauthorised access to pornographic and other objectionable materials on the Internet by children below the age of 18. One option is to use the parental controls available with the Windows and Mac operating systems. These can often be applied across the whole home internet or to a specific device.
2. Think about the content you share. Ideally, the internet should be an essential tool and a safe space for doing your research, browsing and sharing information. However, its usage comes with threats that students must be aware of. Awareness of the potential consequences of sharing information or content online is essential. Always think before you post and consider whether the content is appropriate to share, as harmful words can backfire on you or those around you.
3. Policies and Regulations on anti-bullying policies at schools, workplaces, and online platforms must be drafted and implemented. Encourage students to report activities of cyberbullying and provide clear consequences for cyberbullying behaviour.

https://www.nea.org/professional-excellence/student-engagement/tools-tips/helping-students-deal-cyberbullies

Malware

Malware, which is the shortened form of malicious software, refers to any software intentionally designed to cause damage to a computer, server, client, or computer network. It remains a pervasive and effective threat to IT security. Malware can take several forms, each with its own method of infiltration and damage.

Types of Malwares

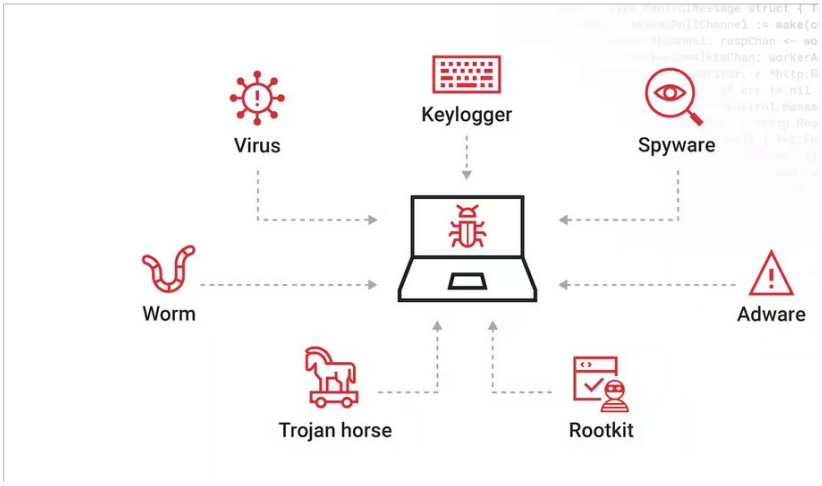


Figure 21.2 Types of Malware

1. A virus is malicious code/software that attaches itself to a document or file and spreads when those programs are executed, open, or downloaded. They can corrupt or delete Good data and spread to other systems.
2. A worm is a standalone malicious software/programs that replicate themselves to spread to other computers or devices within a network, without the need for a host program to disseminate it. They cause network overload and data destruction.
3. Trojan horses are disguised as legitimate software but perform harmful activities once installed on a system. They can open backdoors, steal data, or give unauthorised access to attackers.
4. Spyware secretly monitors and collects sensitive user data and information without consent and knowledge. This can lead to identity theft and privacy breaches.
5. Adware tracks a user's browser history and automatically displays or downloads advertising material when a user is online. This allows advertisers to target advertisements to the user with greater precision.
6. Ransomware Description encrypts a victim's data and demands payment for the decryption key. They can cause significant financial loss and data unavailability.
7. Keyloggers track everything that a user does on a computer, including keystrokes, web pages opened, emails sent, and more.
8. Rootkit is a type of malware that gives an attacker authorisation over a system in order to control it and potentially disrupt the efforts of antivirus software or security software.

How Malware Spreads

Malware can spread through infected email attachments, visiting malicious websites, when one downloads or installs infected software from untrustworthy sources.

They can also spread through network vulnerabilities, that is, exploiting security flaws in network protocols and through removable media such as USB drives or other external storage devices carrying malware.

Prevention and Protection

Malwares can be prevented by:

1. Use Antivirus Software. Users must ensure regular update and scanning of systems with reliable antivirus programs such as Microsoft Defender.
2. Operating Systems browsers and applications must be updated regularly to fix security vulnerabilities.
3. Users must avoid clicking on suspicious links or downloading files from untrusted sources.
4. Employees and individuals must be trained on recognising phishing attempts and safe online practices.
5. Use firewalls to block unauthorised access to your network.
6. Regularly backup important data to minimise the impact of potential ransomware attacks.
7. Implement strong, unique passwords and consider using a password manager.
8. Implement Multi-Factor Authentication (MFA) by adding an extra layer of security to sensitive accounts and systems.

Response to Malware Infection

1. Disconnect from the Network and Isolate the infected system to prevent the spread of malware.
2. Run a Full System Scan by using updated antivirus software to detect and remove the malware.
3. Restore from a backup If data is lost or corrupted.
4. Change all passwords after removing the malware to secure accounts.
5. Review and update security measures to prevent future infections.

Learning Tasks

1. Learners discuss strategies for preventing and addressing cyberbullying (education, awareness campaigns, and reporting mechanisms).
2. Learners discuss among themselves in their mixed ability groups with clearly chosen leaders, the methods of malware propagation (email attachments, malicious websites, and removable media).
3. Learners discuss and present on the effects of malware infections on computer systems and data security with emphasis on data loss, system corruption, and unauthorised access.

Pedagogical Exemplars

1. Guide Learners to recap by Identifying the impact of cyberbullying on individuals and communities (psychological effects and social consequences).
2. In their mixed ability groups where every learner is given the opportunity to present, guide learners to discuss Malware and its various types.

Key Assessment

Level 1

1. What are some common threats associated with using the internet? (e.g., malware, cyberbullying)
2. What is the purpose of a firewall? (Security software that controls incoming and outgoing network traffic)

Level 2

1. Identify basic security measures to protect against malware (e.g., using antivirus software, keeping software updated)
2. Explain how cyberbullying can occur online and its potential consequences.
3. Is the primary purpose of a firewall to protect against external threats or to control internal network traffic?

HINT

*This week's recommended mode of assessment is **display and exhibition.** Refer to the Teacher Assessment Manual and Toolkit page 43 for information on how to go about it.*

WEEK 22

Learning Indicator: Understand and evaluate the risks associated with using ICT, including internet and network attacks (e.g., cyberbullying, malware, botnets, denial-of-service attacks, spoofing, hardware theft, firewalls)

Focal Area: Botnet

Botnets are armies of compromised devices controlled by a single attacker. These devices, called bots, can be anything from computers to smartphones to even smart refrigerators. They can also be described as a network of compromised computers. Compromised computers are also called Zombies or Bots. Among malware, botnets are the most widespread and severe threat.

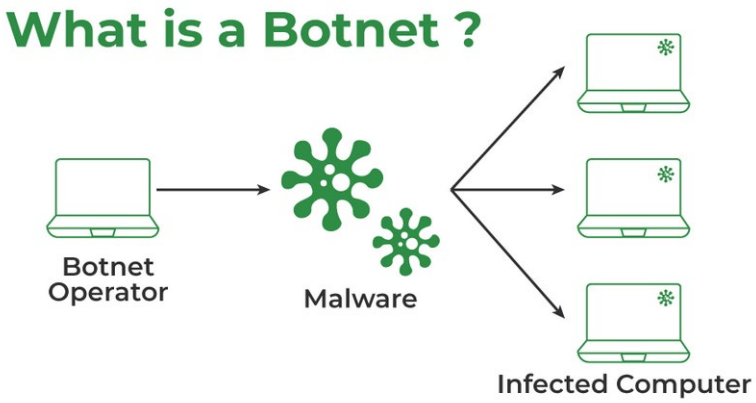


Figure 22.1 Botnet

Denial-of-Service (DoS) Attacks

A denial-of-service (DoS) attack is when legitimate users are unable to access the network they use as well as websites, emails and other services that rely on the network. The attack is launched using a single computer, typically flooding the network with traffic until the network cannot respond or crashes. The goal is to make the target inaccessible to its intended users, thereby denying the service.

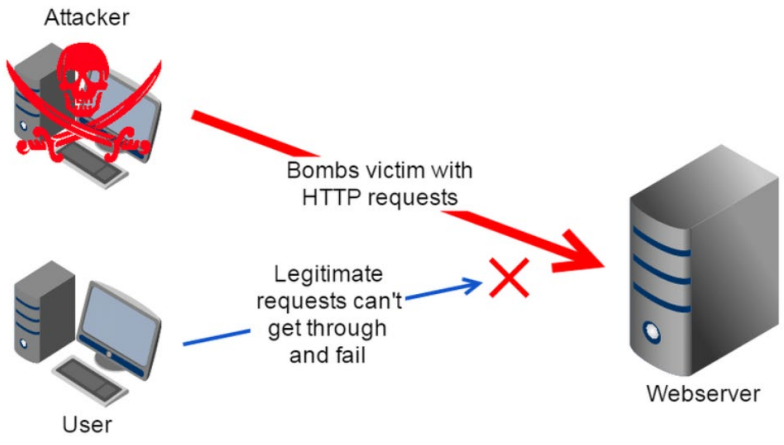


Figure 22.2 A DoS attack

Characteristics of a DoS attack

Teachers are to guide learners through the key characteristics of a DoS attack for learners' comprehension. Some of them include:

1. **Overloading Resources:** DoS attacks typically involve overwhelming the target's resources, such as bandwidth, memory, or CPU, causing it to slow down or crash.
2. DoS attacks originate from a single source, making it easier to trace compared to Distributed Denial-of-Service (DDoS) attacks.

Types of DoS Attacks

Teachers are to guide learners through the following types of DoS attacks.

Buffer Overflow

This is a common type of DoS attack that involves sending traffic to a network resource in volumes that exceed the system's default processing capacity.

Ping of Death

Attackers send spoofed packets that ping every computer on the targeted network. The target responds and becomes flooded with responses from the malicious packet. It is also known as Internet Control Message Protocol (ICMP) Flood and Smurf Attack.

SYN Flood

A SYN Flood attack exploits the Transmission Control Protocol (TCP) handshake – a method used for the TCP network to create a connection with a local host/client/server. Unfortunately, the handshake is left incomplete, leaving the connected host in an occupied status and unavailable to take further requests. Attackers will double down on the requests, saturating all open ports and preventing anyone from connecting to the network.

Teardrop

In a teardrop attack, IP data packet fragments are sent to the target network. The network then reassembles the fragments into the original packet. The process of reassembling these fragments exhausts the system and it ends up crashing. It crashes because the fragments are designed to confuse the system so it can never be put back together.

Protection Against DoS Attacks

Teachers should let learners understand that the following measures could be taken to protect and prevent DoS attacks.

Pre-emptive Measure

DoS attacks should be identified before they cause harm by the usage of network monitoring. Systems should be checked to test their readiness and how they will fare against an actual attack so you can refine your overall strategy.

Post-Attack Response

A Disaster Recovery Plan must be created to ensure proper communication, mitigation and recovery of data. A good plan can be the difference between an inconvenient attack or a devastating one.

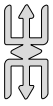
Effects of DoS Attacks

1. DoS attacks can lead to service disruptions**.** Users will not be able to access the intended service, which can potentially lead to revenue loss and customer trust.
2. DoS attacks can put pressure on resources such as bandwidth and processing power. This can affect overall performance.
3. Organisations may incur significant costs in terms of mitigating the attack, restoring services, and implementing stronger defences.
4. Prolonged unavailability of services can damage an organisation's reputation and lead to loss of customer confidence.

Difference between DoS and DDoS

DoS and DDoS are two different names for the same attack.

DoS	Points of Difference	DDoS
A single computer and IP address is used to launch an attack.	Source	The source of the attack comes from multiple locations that include compromised computers, webcams and IoT devices.
DoS attacks are slower to execute.	Delivery Speed	DDoS attacks are faster to execute.
Easier to block.	Blocking Attack	More difficult to block due to the volume of machines used to execute the attack.
Easier to trace since only a single device is in play.	Traceability	Tracing the true party is challenging since they can hide behind compromised systems
Buffer Overflow, Ping of Death, Teardrop	Attack Types	Volumetric, Fragmentation, Application Layer



Note

Teachers are to research further, especially techniques used in DoS attacks, such as flooding, resource exhaustion, and amplification so they will be able to explain this to the understanding of learners.

Spoofing

In the context of cybersecurity, spoofing is where an attacker disguises themselves as a trusted entity to earn our trust, obtain access to our systems, steal data, steal money, or transmit malware.

How Does Spoofing Work

For Spoofing to be successful, there are usually two components involved. The first one is the spoof itself. This can be a fraudulent email or website, and secondly, the social engineering portion, which encourages victims to act.

For example, spoofers may send an email that looks to be from you to your bankers requesting them to transfer funds from your account to pay a customer of yours online. Their email will offer compelling justification for the request which is sometimes difficult to detect.

Spoofers often know how to lure a victim into doing the necessary action, in this case, approving a fake funds transfer, without arousing suspicion. It can lead to the loss of sensitive and personal and classified information.

TYPES OF SPOOFING

Email spoofing

This is one of the most common types of cyberattacks. It happens when the attacker sends emails that appear to come from a trusted source, such as a colleague, friend, or reputable organisation, to trick the recipient into disclosing personal information or clicking on malicious links.

IP Spoofing

IP spoofing is mainly directed toward a network. This is the situation where an attacker attempts to obtain unauthorised access to a system/network by sending messages with a fake or spoofed IP address to make it seem as if the message originated from a trustworthy source, such as a computer on the same internal network.

Website Spoofing

This is a situation whereby an attacker mimics or creates a fake website to deceive users into providing sensitive information, such as login credentials, personal details, or financial information.

Caller ID or Phone Spoofing

Caller ID spoofing, also known as phone spoofing, occurs when con artists misrepresent the information supplied to your caller ID to conceal their identity.

Hackers use specialised software or services to change the phone number and name that appear on the recipient's caller ID display. The recipient sees a familiar or trusted number, such as a name saved on his or her phone and is more likely to answer the call.

They do this because they are aware that you are more likely to answer your phone if it seems to be a local number rather than an unfamiliar one.

Text Message Spoofing

This is also known as SMS spoofing. It occurs when the attacker manipulates the sender information displayed on a recipient's mobile device to make it appear as though the message is coming from a trusted source. The SMS message will often contain an urgent or attractive message designed to trick the recipient into taking a specific action by clicking on a malicious link or downloading malware.

Learning Tasks

1. Learners describe Denial-of-Service (DoS), Distributed Denial-of-Service (DDoS) attacks and their objectives of disrupting or degrading service availability.
2. Explain the techniques used in DoS attacks, such as flooding, resource exhaustion, and amplification.
3. Explain the techniques used in DoS attacks, such as flooding, resource exhaustion, and amplification.
4. Present on spoofing attacks and their methods of deceiving users or systems by falsifying information or identities and identify different types of spoofing attacks, including IP spoofing, email spoofing, and DNS spoofing.

Pedagogical Exemplars

Collaborative Learning

1. Guide learners to recap botnets, DoS, DDoS, Spoofing and their characteristics
2. Learners collaborate among themselves in their mixed ability groups with identified leaders to discuss the effects of Botnets, DoS, DDoS, and Spoofing.

Key Assessment

Level 1

1. Why is it important to be cautious about opening attachments or clicking on links in emails from unknown senders? (Potential phishing attacks to steal personal information)
2. Discuss the impact of denial-of-service attacks on websites and online services (Can overload servers and make them unavailable to legitimate users).

Level 2: Explain how hardware theft a security risk can be and what steps can be taken to mitigate it (e.g., data encryption, physical security measures)

Level 3: Imagine you are creating a social media account. How can you configure your privacy settings and online behaviour to minimise the risk of cyberbullying and identity theft?

Level 4

1. Analyse the growing threat of botnets (networks of compromised devices) and their potential role in launching large-scale cyberattacks. How can we improve network security to defend against such threats?
2. Discuss the ethical implications of social engineering tactics used by attackers to trick users into revealing sensitive information. How can we raise awareness and develop strategies to combat these tactics?

HINT

*This week's recommended mode of assessment is **display and exhibition.** Refer to the Teacher Assessment Manual and Toolkit page 43 for information on how to go about it.*

WEEK 23

Learning Indicator: Discuss and implement preventive mechanisms to mitigate computer network attacks (e.g., antivirus software, hardware and software firewalls)

Focal Area: Preventive mechanisms to mitigate computer network attacks

The teacher will introduce students to various mechanisms that can reduce network security attacks.

1. **Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS)**
    a. The teacher will explain that Intrusion Detection Systems (IDS) are security technologies designed to monitor network traffic for suspicious activity and issue alerts when such activity is detected, and Intrusion Prevention Systems (IPS) are security technologies that monitor network traffic for suspicious activity and take proactive steps to prevent potential threats by blocking or mitigating them.
    b. The key difference between IDS and IPS is that IDS passively monitors and analyses network traffic, sending alerts but not taking direct action to prevent threats, whilst IPS actively monitors and can take immediate action to block or mitigate threats in real-time.
    c. They use two main detection methods
        i. Signature-based Detection relies on predefined signatures of known threats to identify malicious activity. This could lead to false negatives where malicious activity is not detected because threats are new or unknown.
        ii. Behaviour-based Detection relies on analysing network behaviour to detect anomalies or deviations from normal patterns. This can identify unknown or zero-day threats but may generate more false positives.
    d. IDS are often placed outside the firewall or in a demilitarised zone (DMZ) to monitor traffic entering and leaving the network and they require less processing power as they are passive. IPS are typically placed inline within the network to inspect and they require more power as they actively control traffic flow directly.
    e. Both of them need to integrate with other security tools and systems for effective incident response and management.
2. **Network Access Control (NAC)**
    a. The teacher will explain NAC is a security solution that enforces policies to control access to network resources based on endpoints' identity and security posture (devices attempting to connect to the network). NAC ensures that only authorised and compliant devices can access network resources, enhancing overall security.
    b. The components of NAC Systems authentication, authorisation and remediation:
        i. Authentication refers to verifying the professed identity of users and devices attempting to access the network. Passwords, digital certificates, and biometrics could be used for authentication.

ii. Authorisation uses access control to determine what resources a user or device is allowed to access based on predefined policies. This could be based on the role of the subject.

iii. Remediation ensures that devices comply with/enforce security policies whilst non-compliant users/devices are excluded.

c. Network Access Control (NAC) to ensure only authorised devices access the network, reducing the risk of malicious activity. NAC achieves endpoint security by ensuring all devices on a network meet security standards. It automatically ensures compliance with the policy for all devices. It provides detailed logs and reports for compliance audits. It ensures that network administrators are clear about devices' security status and can dynamically respond to security threats.

3. **Security patch management**

a. It is the ongoing process of applying software updates that help resolve code vulnerabilities or errors for applications across your system. It addresses security vulnerabilities and ensures that software applications and operating systems function correctly. It requires regular assessment of operating systems, identifying vulnerabilities, and prioritising patches based on potential severity and impact. Patches are then tested to ensure they are ok before they are rolled out. Systems are monitored to confirm that patching is successful. In large organisations, patching can be automated using software.

Learning Tasks

1. The learners listen to and interact with teachers and peers. They relate the content to their experiences on IDS/IPS/NAC/Patch Management and identify its uses, advantages, and limitations, relating it to their own ideas and experiences.
2. In mixed-ability groups, learners conduct research on the web for an assigned security control (IDS/IPS/NAC/Patch Management), analyse their findings and identify its advantages and limitations.
3. Learners take notes and ask questions to clarify their understanding.

Pedagogical Exemplars

1. **Interactive Multimedia Presentations:** Use multimedia (images, videos, animations) presentations to explain the IDS/IPS/NAC/Patch Management. Encourage discussions during the presentation to link the content to the learner's experiences and real-life use cases.
2. **Group Discussions and Collaborative Learning**

a. Mixed-ability groups are assigned a technology to explore and then debate other groups on the advantages and disadvantages of IDS and IPS.

b. Have students in groups discuss scenarios where patching and access controls are required and their effectiveness.

c. If the internet is available in the school, groups can also conduct online research on the latest advancements in IDS/IPS/NAC/Patch Management technologies, focusing on emerging trends and the issues they address.

Key Assessment

Level 1

1. What does NAC stand for in network security?
2. List two primary functions of NAC systems.
3. What does IDS stand for?
4. What is the primary function of an IPS?
5. Name one challenge associated with patch management.

Level 2

1. Describe the importance of testing patches before deployment.
2. Explain the difference between signature-based and behaviour-based detection in IDS.
3. Describe how an IDS passively monitors network traffic.
4. Explain how NAC systems determine whether a user can be granted access to a network.
5. Describe the difference between authentication and authorisation in the context of NAC.

Level 3

1. Compare the deployment considerations for IDS and IPS in an enterprise network.
2. Assess the operational challenges of patching in a large educational district
3. Compare and contrast NAC with traditional network security methods.
4. Analyse how NAC can improve overall network security posture in an enterprise environment.

Level 4

1. Design a NAC implementation plan for a midsized school considering their specific needs.
2. Evaluate the effectiveness of a NAC system in preventing unauthorised access and maintaining network security over one year.
3. Design a comprehensive security strategy for an organisation that includes a patch management solution.
4. Evaluate the long-term effectiveness of IDS/IPS in preventing network security breaches and protecting sensitive data.

HINT

*The recommended mode of assessment for the week is **questioning**. Use DoK level 1, question 5 as a sample question. Refer to the Teacher Assessment Manual and Toolkit page 30 for information on how to go about it.*

WEEK 24

Learning Indicator: Discuss and implement preventive mechanisms to mitigate computer network attacks (e.g., antivirus software, hardware and software firewalls)

Focal Area: Preventive mechanisms

The teacher explains computer protections (antivirus and firewall) to help students understand its types, uses, and the basics of its operations.

1. **Antivirus**
    a. The teacher will explain that an antivirus is a kind of software used to prevent, scan, detect, and delete viruses from a computer. Antiviruses monitor files and activities as they occur to detect threats immediately. Using algorithms to identify suspicious behaviour patterns that may indicate new, unknown malware or comparing files to a database of known malware signatures for identification, known as heuristic-based or signature-based.

    It allows regular, automated scans of the entire system or specific files. Infected files are isolated to prevent the spread of malware. It regularly updates virus definitions to protect against the latest threats.
2. **To obtain the best protection**
    a. Select a reputable antivirus program with high detection rates and good reviews.
    b. Follow installation instructions carefully to ensure all features are activated.
    c. Keep the antivirus software and its definitions updated to defend against new threats.
    d. Customise settings to match specific needs, such as frequency of scans and types of notifications.
    e. Schedule regular scans to ensure the entire system is periodically checked for malware.
3. **Firewalls**
    a. The teacher will explain that a firewall is a computer network security system that restricts internet traffic into, out of, or within a private network. It monitors and filters incoming and outgoing network traffic based on predefined security rules derived from an organisation's previously established security policies.

    They provide a robust layer of defense against unauthorised access, cyber threats, and network attacks. Hardware firewalls are physical devices, whilst software firewalls are security applications installed on individual computers.

    b. Hardware Firewalls
        i. Hardware firewalls can divide a network into segments, each with its security policies. This helps contain potential breaches and limit the spread of threats. It can also regulate who or what can access parts of the network, ensuring that only authorised users and devices can communicate with the network. Hardware firewalls can detect and block malicious activities, including attempts to exploit vulnerabilities, through integrated intrusion prevention systems (IPS). They inspect network traffic at a granular level, allowing or blocking data packets based on the security policies set by the administrator. Dedicated hardware firewalls

often offer higher performance and reliability than software firewalls, handling larger traffic volumes with lower latency.

Figure 24.1: *Hardware Firewall*

c. Software firewalls

   i. Software firewalls usually come with graphical user interfaces (GUIs) that make it easy for users to configure settings, manage rules, and monitor activity. They inspect each data packet that tries to enter or leave the device it is installed on. They filter packets based on predefined rules, such as source and destination IP addresses, port numbers, and protocols. Software firewalls can block or restrict access to specific ports, preventing certain types of network traffic. They can also monitor and control the network access of specific applications. They allow or deny network connections based on the application's behaviour and security policies. Some advanced software firewalls include features to detect and prevent intrusion attempts, alerting users to suspicious activities.

   ii. They keep logs of all network traffic and security events, which can be reviewed for analysis and troubleshooting and generate reports on blocked attempts and detected threats.

d. Deployment Scenarios and Configuration Options

   i. In Small Office/Home Office (SOHO) Environments, hardware firewalls protect small networks from external threats, often with simplified configuration options for ease of use. In larger organisations, however, hardware firewalls are deployed at multiple points in the network to enforce comprehensive security policies, manage traffic flow, and ensure high availability through redundancy and failover mechanisms. Hardware firewalls can also be integrated into cloud infrastructures to protect virtual networks and resources. They are configured to work seamlessly with cloud service providers' offerings and ensure secure access to cloud applications and data.

   ii. A small business or home office network with a few devices, such as computers, printers, and mobile devices, can install a software firewall on each device to monitor and control traffic. For common services, basic inbound and outbound traffic rules, application-specific rules, and port blocking can be configured.

   iii. Alternatively, a hardware firewall on the network router can provide centralised security.

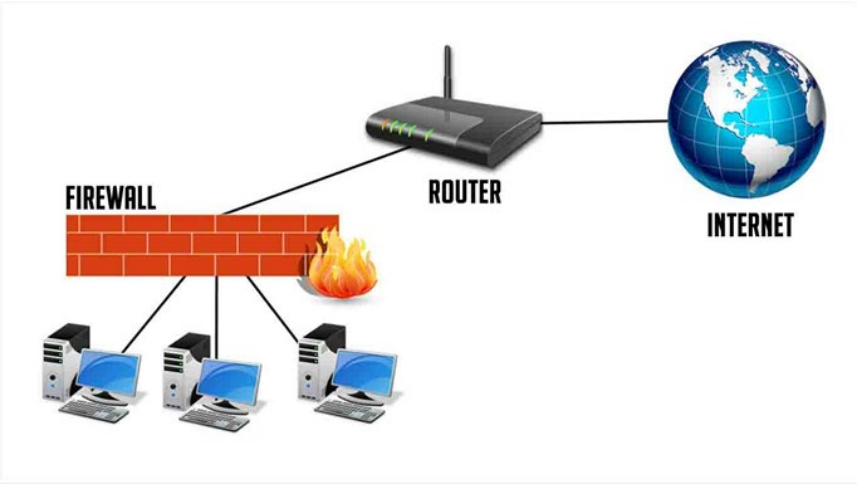


Figure 24.2: *Deployment of a Firewall in a SOHO*

Learning Tasks

1. Learners listen to the multimedia presentation that includes videos, animations, and infographics on antivirus and firewall technologies and take notes on key points. They will also engage in discussions and all interactive activities.
2. Learners describe their personal experiences with viruses or firewalls, pair up with a classmate, and share their thoughts.
3. Investigate the features, strengths, and weaknesses of their assigned task. Develop a comprehensive security plan, choosing appropriate antivirus software and firewall solutions and develop a presentation highlighting their findings justifying their choices based on the scenario's specific needs, such as budget constraints and data sensitivity.

Pedagogical Exemplars

1. **Interactive Multimedia Presentation and Discussion:** Use a multimedia presentation and a discussion to introduce key concepts of antivirus software and firewalls. Use real-life examples to illustrate how these technologies protect computer systems and networks from threats and to facilitate a class discussion to explore learners' experiences with viruses in pairs and share with the class how they were resolved and how a firewall can protect their data. Use interactive polling tools like Kahoot! or Mentimeter to conduct quick polls on students' views and experiences on the content covered in the presentation.
2. **Demonstrations/Hands-On Activities:** Use video to demonstrate the installation and configuration of an antivirus program hardware and software firewalls. Do hands-on activity if a virtual lab or a simulation environment is available. Highlight features like scanning, updating virus definitions, and quarantine options.
3. **Group Projects and Collaborative Learning:** Assign students to mixed ability groups and have them research different antivirus programs and firewalls. They can present their findings on features, strengths, and weaknesses. They can create a security plan as a Project for a small business or home office, considering both antivirus and firewall solutions. They should justify their choices based on the specific needs of the scenario.

Key Assessment

Level 3

1. Discuss the advantages and disadvantages of relying solely on antivirus software for network security. (Antivirus may not detect all threats, firewalls offer broader protection)
2. How can strong passwords and user authentication practices help prevent unauthorised access to computer systems?
3. Explain the importance of keeping software applications and operating systems updated with the latest security patches.

Level 4

1. You are tasked with securing a home network. How can you combine preventive mechanisms like antivirus software, firewalls, and secure Wi-Fi encryption to create a layered defense against cyberattacks?

   Imagine you are a network administrator for a small business. Discuss additional security measures beyond basic software like firewalls that can be implemented to enhance network protection. (e.g., intrusion detection/prevention systems, user access controls, employee security training).

HINT

The recommended mode of assessment for Week 24 is the end of semester examination. Refer to Appendix G at the end of this section for the structure and a table of specification to guide you in setting the questions.

SECTION REVIEW

This section has focused on developing the learners' understanding of risks associated with using ICT, including internet and network attacks and mechanisms to mitigate computer network attacks.

At the end of this section, learners should be able to demonstrate knowledge, understanding of the various risks associated with using ICT and the mechanisms to mitigate computer network attacks.

The teacher would have guided learners to understand, appreciate and demonstrate practical knowledge and understanding of the risks and the mechanisms to mitigate the risks and attacks.

Through studying the topics in this section, learners should hopefully have developed an appreciation and a deeper understanding of network security systems and network attacks.

The suggested activities in the manual strongly focus on critical thinking, problem-solving, and teamwork, three important life skills.

APPENDIX G: END OF 2ND SEMESTER EXAMINATION

Structure

1. Cover content from weeks 1- 5. Taking into consideration DOK levels (adapt the table of specification below as a guide)
2. The test should include
   a. Section A- Multiple Choice (40 questions)
   b. Section B- (5 Essay questions, 3 to be selected)
   c. Section C- Practical (2 questions, 1 to be selected).
3. **Time:** 3 hours 30 minutes.
4. **Total Score:** 100 marks to be scaled down to 20% for submission.

Resources

1. Computers with MS office installed.
2. Answer booklets
3. Learning Material
4. Teachers Manual
5. Assessment Toolkit

Table of Specification

Week	Focal Area	Type of Question	DoK Level				Total
			1	2	3	4	
13	Understanding Web Addresses	Multiple Choice	1	1	1		3
		Essay	–				
14	Navigating Mobile Platforms	Multiple Choice	1	1	1		3
		Essay					
15	Website Features	Multiple Choice	1	–	1		2
		Essay		1			1
16	Integration of Audio and Video content to websites	Multiple Choice	1	1	–		2
		Essay		1			1
17	Architecture and functionality of client/server networks	Multiple Choice		1	1		2
		Essay					
		Practical		1			1

18	Understanding P2P Network Architecture	Multiple Choice	1	2	2		5
		Essay			1		1
		Practical			1		1
19	basics of communicating on a network using the TCP/IP suite	Multiple Choice	1	1	1		3
		Essay					
20	introduction to network communication technologies/ protocols/standards	Multiple Choice	2	2	1		5
		Essay			1		1
21	Cyberbullying	Multiple Choice	1	2	1		4
		Essay					
22	Botnet	Multiple Choice	1	2			3
		Essay					
23	Introduction to mechanisms that reduce network security attacks.	Multiple Choice	2	1	1		4
		Essay			1		1
24	Computer protections (antivirus and firewall)	Multiple Choice	2	2			4
		Essay					
	Total		14	19	14		47

Sample Questions

1. **Multiple Choice**

   What is a web browser?

   A. A program used to write and edit code for websites.

   B. A server that hosts and delivers websites to users.

   C. A software application used to access and view websites on the internet.

   D. A type of computer hardware that stores website data.

2. **Essay**

   How can strong passwords and user authentication practices help prevent unauthorised access to computer systems.

3. **Practical**

   i. Draw a diagram of a client server network architecture. Label the components, including the server, clients, network switch, and any other necessary hardware.

   ii. Explain the function of each component in the network

Sample Marking Scheme and Rubrics

1. **Multiple Choice**

   Answer: C—1 mark

2. **Essay**

   2 marks: Explanation of what makes a password strong, including length, complexity, and character diversity.

   2 marks: Explanation of how strong passwords resist guessing or cracking attempts, such as brute force attacks.

   2 marks: Description of user authentication methods like two-factor authentication (2FA), biometric authentication, and multi-factor authentication (MFA).

   1mark: example of strong password (W0rK@#1_45@you)

3. **Practical**

Rubric for practical questions

Criteria	Excellent (3 marks)	Good (2 marks)	Need Improvement (1 mark)
Diagram Accuracy	Provides a diagram that has at least three labels of the following essential components: Server Clients Network switch, and any other necessary hardware such as routers	Provides a diagram that has two labels of the following essential components: Server Clients Network switch, and any other necessary hardware such as routers	Provides a diagram that has one label of the following essential components: Server Clients Network switch, and any other necessary hardware such as routers
Explanation of Functionality	Provides at least three explanations of how each essential components function.	Provides two explanations of how each essential components functions.	Provides one explanation of how an essential component functions.
Neatness and Clarity	The diagram has the following qualities: neat Clear easy to understand	The diagram has two of the following qualities: neat Clear easy to understand	The diagram has one of the following qualities: neat Clear easy to understand

How to Administer

1. Allocate time for the examination
2. Ensure to give additional time for learners with SEN, etc.

How to Provide Feedback

1. Provide targeted feedback to individual learners focusing on their strengths and weaknesses
2. Give remedials to areas needing improvement the following academic year, etc.

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