# Initial Primary Teacher Education

# Mathematics

## Module 3

Malawi Institute of Education

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# Mathematics

## Module 3

**Malawi Institute of Education**

**Prepared and published by**

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# Foreword

Education is the lifeblood of the nation. It is a prerequisite for individual, community and national development. Education prepares learners to play their roles effectively to promote and sustain a country's socio-economic development. Parents or guardians desire that their children develop into adults with sound minds and healthy bodies through the acquisition of appropriate knowledge, skills and desirable attitudes to enable them to live productive and happy lives.

Education should, therefore, help learners to develop high standards of conduct, attitudes, judgment and a sense of responsibility. Student teachers have to be well prepared in order to be able to take this responsibility of teaching children effectively.

The provision of quality education is based on many factors and a good quality of teachers is one of them. Teachers play a central role because they are the key source of knowledge, responsible for facilitating the learning process and act as role models for the learners.

The function of initial teacher education in Malawi is to prepare student teachers in their aspiration of becoming teachers of high quality. This is achieved by helping the student teachers to acquire the right knowledge, skills and competences to enable them to effectively teach children. In view of this, the Initial Primary Teacher Education curriculum has been reviewed to ensure that student teachers who graduate from this programme are well trained and prepared for their profession.

The process and implementation of this review has been guided by the Teacher Education Philosophy which states as follows:

'To produce a reflective, autonomous, lifelong learning teacher, able to display moral values and embrace learners' diversity.'

It is therefore hoped that Teacher Training Colleges will find this curriculum effective in helping the student teachers to build a solid foundation in their teaching profession.

Executive Director
**Malawi Institute of Education**

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## Contents

# Introduction

The purpose of primary teacher education is to produce and continually develop competent and responsive teachers who effectively deliver quality education to all learners under prevailing conditions and demands in primary schools and promote their desire for life-long learning. IPTE endeavors to educate teachers in sufficient numbers, continually develop their professionalism so that they are able to effectively and efficiently deliver quality and relevant education to primary school learners.

## National goals for primary teacher education

The national goals of primary teacher education in Malawi are to produce teachers who are:

- academically well-grounded and professionally competent
- flexible and capable of adapting to the changing needs and environment of the Malawian society
- capable of adhering to and maintaining the ethics of the teaching profession imaginative in adapting, creating and utilising locally available resources suitable for the needs of their learners.

## Rationale

Mathematics education aims at developing student's critical awareness of mathematical concepts and their relationships and how these are used for solving practical problems in a social, environmental, cultural and economic context.

At an early stage, the learners will be able to count and carry out basic mathematical operations. At a later stage, the learners will be able to make inferences using manipulated data and to apply mathematics for solving practical problems in their daily life.

## Teacher education philosophy

The following has been the guiding principle during the design, development and implementation of the IPTE curriculum.

*To produce a reflective, autonomous, lifelong learning teacher, able to display moral values and embrace learners' diversity.*

## IPTE programme structure

The duration of the teacher education programme is two years. The general outlook of the two years is as follows:

| **Year 1** | | | **Year 2** | | |
|---|---|---|---|---|---|
| **Term 1** | **Term 2** | **Term 3** | **Term 1** | **Term 2** | **Term 3** |
| In college, learning subject content with a special focus on methods for lower classes | In college, learning subject content with special focus on methods for upper classes | Out in teaching practice schools, practising teaching mainly in the lower classes | Out in teaching practise schools, practising teaching mainly in the upper classes | In college, with special emphasis on reflection, inclusion and further practice on teaching methods | In college, with special emphasis on subject content, policies and frameworks |

## Unique features

The features of the reviewed curriculum are as follows:

- The curriculum design is based on reflective and practice principles.
- Early grade teaching methodologies are distinct.
- The delivery of the subject content follows a modular approach.
- Student teachers will be allowed to practise teaching both in the lower classes (Standards 1 to 4) as well as in upper classes (Standards 5 to 8).
- Cross cutting issues, such as Assessment for Learning, Information and Communication Technology, Inclusive Education and Critical Thinking, are integrated.

## IPTE subject matrix

The new curriculum has adopted the reflective practitioner model of teacher education which connects reality and theory and integrates content and pedagogy in teaching and learning. In this structure, student-teachers will be in college for terms 1 and 2 of year 1 and be in primary schools for teaching practice in the third term of year 1 and first term of year 2. Students will be back to college in terms 2 and 3 of year 2 to continue learning subject content, reflecting on their experiences during teaching practice and then wind up their studies.

This curriculum has adopted a modular design and contains eleven subjects. These are Chichewa, English, mathematics, education foundation studies, agriculture, social studies, life skills, science and technology, expressive arts, religious studies and human ecology. In this modular design, a set of units with related content forms a module in a subject. A module consists of 40 contact hours.

Although the programme is modular, four subjects: Chichewa, English, mathematics and education foundation studies will be offered throughout the two years while the remaining subjects will be spread across the two years.

## IPTE outcomes based curriculum

An outcomes-based curriculum is focused on students' achievement. To achieve the outcomes, the students are introduced to new knowledge in the context of their existing knowledge so that they can develop new understandings. Therefore, the process of learning is integral to the final product. These products are the outcomes, which student teachers achieve in terms of teaching competencies and must be clearly stated before they begin teaching. The achievements made at college, however, will only be seen to be truly beneficial when student teachers transfer the knowledge, skills and desirable attitudes beyond college and view learning as a life-long process. This is considered essential to keep pace with the transition from college to practical classroom experiences.

There is need for student teachers to acquire knowledge, skills and desirable values and attitudes to enable them to implement the national primary curriculum. To that end, student teachers should be fully conversant with foundation studies and other subjects taught in schools.

## Learning areas and core elements

A learning area is an organised body of the required knowledge, skills, values and desirable attitudes that serve as a foundation for future learning. Each learning area has a rationale from which core elements are derived. The IPTE curriculum comprises eleven learning areas namely agriculture, science and technology, mathematics, expressive arts, Chichewa, English, foundation studies, social studies, life skills, religious studies and human ecology. Each learning area has four or more core elements.

## Teacher education core element outcomes

Teacher education core element outcomes are descriptions of the competencies to be acquired by the student teacher for successful teaching.

## Progression of learning areas into subjects in the primary senior phase

Student teachers should know that during infant and junior phases of primary school, teaching and learning will centre on learning areas instead of isolated subjects. However, the curriculum will revert to subjects in the senior phase in line with the secondary school curriculum. For this reason, student teachers will study both learning areas and subjects.

## IPTE assessment procedures

In Outcomes-Based Education (OBE), assessment is a significant part of the teaching and learning process. The main purpose of assessment is to facilitate learning by constant monitoring of the progress of individual learners. The process is on-going and it uses clearly defined criteria with a variety of tools, methods and techniques in different situations and contexts. This helps to gather valid and reliable information on the learners' achievement of outcomes.

Assessment in primary teacher education in Malawi comprises two major components: continuous and summative assessment. Both modes involve assessment tasks that measure the student teachers' achievement of knowledge, skills, values and attitudes. These tasks include oral presentations, practical tasks, reports, research, tests and examinations.

In the reviewed curriculum, the weighting of continuous assessment in the final grade will be *60% continuous assessment* and *40% summative assessment.*

The continuous assessment will comprise:

- two assignments based on each module
- end of module examinations excluding terms 2 and 3 of year 2
- teaching practice grades
- school experience journal grade

While the summative assessment will comprise:

- moderated grade from teaching practice in term 3 of year 1 and term 1 of year 2
- national examinations to be administered in term 3 of year 2 based on the modules of terms 2 and 3 of year 2

## Core elements and their outcomes

**Theories, concepts and issues in the teaching and learning of mathematics**

The student teachers will be able to demonstrate an understanding of theories, concepts and issues in the teaching and learning of mathematics and how they will apply these to their teaching of mathematics in primary school.

**Number concepts and operations**

The student teachers will be able to demonstrate appropriate pedagogical knowledge in the teaching and learning of number concepts and operations to enable primary school learners use numbers and their relationships in everyday life

**Measurement**

The student teachers will be able to demonstrate appropriate pedagogical knowledge in the teaching and learning of measurement to enable primary school learners apply appropriate measurement skills in everyday life.

**Data handling**
The student teachers will be able to demonstrate appropriate pedagogical knowledge in the teaching and learning of data handling to enable the primary school learner analyse and interpret data for decision making by using graphs and tables in relation to everyday life.

**Space and shape**
The student teachers will be able to demonstrate appropriate pedagogical knowledge in the teaching and learning of space and shape to enable primary school learners use skills of space and shape in everyday life.

**Accounting and business studies**
The student teachers will be able to demonstrate appropriate pedagogical knowledge in the teaching and learning of accounting and business studies to enable primary school learner acquire basic knowledge and skills on financial management.

**Patterns, functions and algebra**
The student teachers will be able to demonstrate appropriate pedagogical knowledge in the teaching and learning of patterns, functions and algebra to enable the primary school learner use algebraic language and develop skills to solve textual problems.

**Summary of topics for the term and time allocation**

| Term 2 | | |
|---|---|---|
| **Topic** | **Allocated time in hours** | **Core element** |
| Teaching of mass | 4 | Measurement |
| Teaching of time | 5 | |
| Teaching of 3-D and 2-D shapes | 4 | Space and shapes |
| Teaching of lines, angles and triangles | 8 | |
| Teaching of quadrilaterals and circles | 5 | |
| Teaching of perimeter and area | 6 | Measurement |
| Teaching of scale drawing | 4 | Space and shapes |
| Teaching of bearing | 4 | |

# TOPIC 1 Teaching of mass

**Time** 4 hours

## Introduction

The concept of mass is commonly used in everyday life. Young children learn about mass from daily experiences such as lifting light and heavy objects. They also see people comparing masses of commodities such as cabbages, rice, meat and chickens by lifting or weighing them on a balance or scale before buying them. Therefore it is important for teachers to assist learners to develop relevant knowledge and skills of measuring mass accurately. This would provide them with basis for further mathematical concepts that require knowledge and skills of units of mass. In addition, learners would be able to use the knowledge and skills in other subjects such as agriculture and science and technology.

In this topic, you will explore activities that are carried out in the teaching and learning of mass in primary school. You will also identify misconceptions and errors that learners may have on mass and suggest possible strategies to address them.

## Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop the concept of mass
- explore appropriate methodologies in the teaching and learning of mass
- apply appropriate techniques to assess learners on mass

## Background information

Mass refers to amount of matter in an object. An object with more matter (particles) in it has more mass than the one with less. Heavier objects, such as stones, have more particles which are compacted together than lighter ones such as wood. The closeness of particles in heavy objects such as stones give them less volume but more mass. The standard unit for measuring mass is kilogram. Mass is also expressed in smaller units such as grams and milligrams. These units are related such that 1000 milligrams make 1 gram and 1000 grams make 1 kilogram.

Although people use the terms mass and weight interchangeably, the two are different. Weight is the force of gravity on an object. The weight of an object varies according to where the object is. For example, an object on the moon weighs less than it does on earth, but its mass remains unchanged. There is less gravitational force on the moon than it is on earth.

The concept of mass is introduced in early years of primary school using non-standard units such as seeds, coins and bottle tops. As learners measure objects using these non-standard units, they realise their limitations and the need for standard units such as kilograms. Likewise, as learners work with kilograms, they realise the need for smaller units such

as grams and milligrams. In later years, children learn to convert units of mass, carry out basic operations and solve practical problems involving mass.

The teaching of mass provides opportunities for active learning through a number of hands-on activities. Hence, teachers should apply appropriate teaching techniques to ensure that all learners take an active role in all lesson activities. The use of continuous assessment would help teachers to adjust the teaching process in order to improve learners' achievement. Modifying the lesson activities ensures that learners with special educational needs participate actively in the lesson activities.

## Task 1 Analysing the concept of mass

Children come to school with some knowledge related to the concept of mass. It is important for teachers to utilise this knowledge in the teaching and learning process to ensure that learners develop a deeper understanding of the concept of mass.

### Activity 1 Establishing learners' prior knowledge and importance of mass

1 Explore situations in everyday life that help children learn about mass.
2 Explain the importance of teaching mass to primary school learners?
3 Discuss how the knowledge of mass is applied in everyday life.
4 Report your work to the class for discussion.

### Activity 2 Exploring primary school curriculum expectations for teaching mass

Analyse primary school instructional materials such as syllabuses, teachers' guides and learners' books and:

1 identify the concepts and skills of mass that are taught in primary school. Summarise the concepts in a table:

| Class | Concepts |
|---|---|
| | |

2 determine the expected knowledge and skills that learners would acquire after learning the concept of mass.
3 share your work with the class for discussion.

## Task 2 Exploring appropriate methodologies in the teaching and learning of mass

An in-depth understanding of the concept of mass by learners requires the use of relevant resources and varied teaching and learning methods to carry out hands-on activities.

### Activity 1 Exploring how to teach mass using non-standard units

1 Discuss how people sell and buy commodities such as maize, beans, groundnuts, cassava, sweet potatoes and tomatoes at local markets without using a balance.
2 Identify teaching and learning resources that can be used to teach mass using non-standard units.

3 Explore how you can introduce mass using non-standard units of mass to learners.
4 Explain disadvantages of using non-standard units.
5 Discuss misconceptions and errors that learners may have when learning mass using non-standard units.
6 Discuss effective instructional approaches that you can use to address the misconceptions and errors.
7 Report your work to the class for discussion.

### Activity 2 Exploring how to teach mass using standard units of mass

1 Identify teaching and learning resources that you can use to teach mass using standard units of mass.
2 Explore how you can introduce mass using standard units of mass to learners.
3 Discuss misconceptions and errors that learners may have when learning mass using standard units.
4 Discuss effective instructional approaches that you can use to address the misconceptions and errors.
5 Present your work to the class for discussion.

## Task 3 Appropriate techniques to assess learners on mass

Assessment is an important component in the teaching and learning process as it provides feedback on how well teaching and learning progress. In this task, you will explore appropriate assessment strategies for teaching mass. This will help you acquire skills for developing assessment items for your learners.

### Activity 1 Discussing appropriate ways of assessing learners on mass

1 Identify suitable ways of assessing learners on the concept of mass.
2 Discuss possible challenges that you would face when using the identified assessment ways.
3 Explain ways of overcoming the challenges.
4 Present your work to the class for discussion.

### Activity 2 Microteaching the concept of mass

1 Prepare a detailed lesson plan on any concept of mass. Indicate clearly the assessment strategies that will be used in the lesson.
2 Present the lesson.
3 Evaluate the lesson focusing on the strategies of assessment.

**Tip**

- You need to modify these activities to ensure that learners with special educational needs participate actively in the given tasks. You can do this in several ways such as the following:
  - *using appropriate resources in teaching the activity*
  - *varying teaching strategies to cater for learners with diverse needs.*

## Summary

Mass refers to the amount or quantity of matter in an object. In most cases, mass is expressed in kilograms and grams. A kilogram is the standard unit for measuring mass.

Mass and weight are different and should not be used interchangeably. Weight is the force of gravity on an object. This force is called gravitational force.

In early years of primary school, children learn mass using non-standard units before learning about standard units. The teaching of mass provides opportunities for active learning through a number of hands-on activities.

Modifying activities in the teaching and learning of mass ensures that learners with special educational needs participate actively in all the lesson activities. The use of continuous assessment helps teachers to adjust the teaching and learning process in order to improve learners' achievement.

Appropriate assessment strategies include observation, written exercises and oral questioning.

## Reflection and assessment

1 What prerequisite knowledge and skills do you expect learners to have when introducing mass?
2 Explain how you would introduce the concept of kilogram in early years of primary school.
3 Describe an activity that learners can carry out when learning measuring mass using non-standard units.
4 What knowledge and skills do you expect learners in early and later years of primary school to develop after learning mass?
5 Prepare four questions together with a marking key for assessing learners after teaching mass.
6 a) Identify misconceptions and explain how they can affect learning of the concept of mass.
   b) Describe an activity that you can do with learners to correct the misconceptions.

## Glossary

**Mass** the quantity of matter in an object

**Non-standard units** non-conventional ways of measuring mass of objects such as by feeling or using countable objects

**Simple balance** a simple apparatus that is improvised to compare masses of objects

**Standard units** conventional ways of using established units such as kilogram and gram to measure masses of objects

**Weight** the force of gravity on an object

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## Further reading

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# TOPIC 2 Teaching of time

**Time** 5 hours

## Introduction

Time is an essential resource which regulates human activities on a daily basis. This is why learners are introduced to this concept at an early age. Generally, children have some ideas of time before they start school. Children are familiar with particular times of the day that relate to events such as time to eat, time to play and time to go to bed. When this knowledge is developed further, it becomes easier for learners to know the exact time of events by reading on clock faces and calculating lengths of elapsed time.

An understanding of time is fundamental to the understanding of a wide range of other important mathematical concepts. From the basic knowledge of seconds, minutes and hours, learners can perform complex problems such as calculating speed and other time-related tasks. Therefore, it is important that learners' knowledge and skills be extended to a level where they are able to apply them in further mathematical concepts and other subjects.

In this topic, you will explore activities that are carried out in teaching, learning and assessing time in primary school. You will also identify misconceptions and errors that learners may have on time, and suggest possible strategies to address them.

## Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop the concept of time
- explore appropriate methodologies in teaching and learning of the concept of time
- use appropriate techniques to assess learners on the concept of time

## Background information

Time is an on-going sequence of events. It specifies when an event occurred or will occur and describes how long it lasted or will last. Time is measured in hours, minutes and seconds using a clock or watch. Two types of clocks that are widely used are analogue and digital. An analogue clock or watch has numbers from 1 to 12 around the clock face and hands that move around the numbers. This type of clock is more convenient when teaching learners how to set and read time in hours, minutes and seconds because of the constantly moving hands in relation to the passing time. On the other hand, digital clock or watch displays numbers such as 02.45 which change automatically as time passes. This clock can display time in traditional mode using anti-meridian (am) and post-meridian (pm) and sometimes using 24 hour time. Figure 2.1 shows analogue and digital clocks.

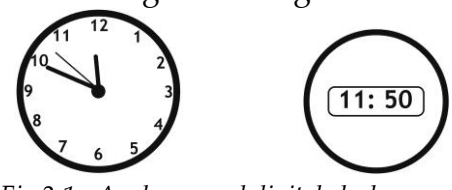


*Fig 2.1: Analogue and digital clocks*

Time interval is another important concept of time which is used in everyday life. This is measurement of elapsed time between two events. Time interval is the definite length of time which is commonly used as a basis for costing, regulating events and competitions. Short-time intervals such as second, minute, hour, day, week, month and year are taught in early years of primary school. Long-time intervals such as fortnight, Olympiad, decade, silver jubilee, human generation, diamond jubilee, century, centenary and millennium are taught in later years of primary school. Time intervals are also related to time before and after the birth of Jesus Christ. BC stands for before Christ's birth and AD stands for Anno Domini, a Latin word that refers to time after the birth of Christ.

The concept of time is introduced in early years of primary school using non-standard units such as position of the sun, length of a shadow and daily events. Later on, learners are introduced to standard units and other time-related tasks such as solving practical problems. Sometimes learners have difficulty in understanding measurement of time because it is intangible. However, by involving them in various time-related activities, learners can experience and appreciate the length of time intervals.

Learners must be assessed continuously as they carry out various activities in order to get feedback on their progress. This would also help teachers to modify teaching instructions in response to learners' needs. Study figure 2.2 of the sun on child and shadow.

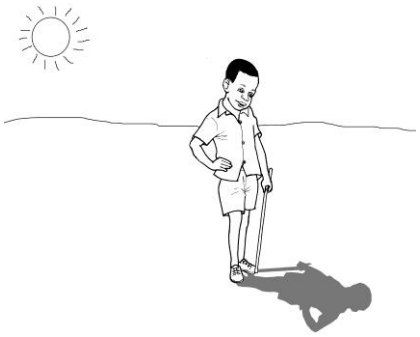

*Fig 2.2: Sun on child and shadow*

Learners have misconceptions and errors on the concept of time. These misconceptions and errors may hinder children's understanding of concepts on time. Eventually, this may affect their achievement in the given tasks. For example, some learners would think that the longer hand represents hour while the shorter one represents minute or second. Other learners may place the hands incorrectly when setting the clock for the given time. In order to address these misconceptions and errors, teachers should use appropriate resources, examples and methods.

## Task 1 Analysing the concept of time

Children have some knowledge and skills related to time which could assist in effective teaching and learning of the concept. In this task, you will explore learners' prior knowledge of time.

### Activity 1 Discussing learners' prior knowledge and importance of time

1 Explore situations in everyday life that help children learn about time
2 Why is it important for primary school learners to learn time?
3 How is time used in everyday life?
4 Present your work to the class for discussion.

### Activity 2 Exploring primary school curriculum expectations for teaching time

Analyse primary school instructional materials such as syllabuses, teachers' guides and learners' books and carry out the following:

1 identify the concepts of time that are taught in primary school. Summarise the concepts in a table

| Class | Concepts |
|---|---|
| | |

2 establish the expected knowledge and skills that learners would acquire after learning time in primary school
3 present your work to the class for discussion

## Task 2 Exploring appropriate methodologies in the teaching and learning of time

Teaching and learning of time demand a lot of activities and resources for learners to understand various concepts of time. In this task, you will explore appropriate methodologies for teaching time.

### Activity 1 Discussing teaching of time using non-standard units

1 Explore traditional ways of telling time (that is, without using standard units).
2 Explain advantages and disadvantages of telling time without using a clock.
3 Discuss how you would introduce telling time using non-standard units
4 Share your work with the class for discussion.

### Activity 2 Discussing teaching of time using standard units

1 Explore ways of telling time using standard units.
2 Explain advantages and disadvantages of telling time using a clock.
3 Discuss how you would introduce telling time using standard units for:
   a reading time in hours
   b reading time to half past the hour
   c reading time to quarter past and quarter to the hour
   d reading time to five minutes and one minute past and to the hour
   e reading time in seconds
4 Discuss how you would modify these activities to suit learners with diverse educational needs.
5 Share your ideas with the class for discussion.

### Activity 3 Analysing learners' misconceptions and errors on time

1 Explore learners' misconceptions and errors on the concept of time.
2 What are the possible causes of the misconceptions and errors?
3 Discuss effective instructional approaches that you would use to address the misconceptions and errors.
4 Present your work to the class for discussion.

**Tips**

- You may use learners' work to analyse learners' strategies, errors and misconceptions
- You may also use your experiences from your teaching practice.

## Task 3 Appropriate techniques for assessing learners on the concept of time

Assessment informs how well teaching and learning progress. So, it helps a teacher make appropriate adjustments to promote teaching and learning. This task will help you explore appropriate assessment methodologies in the teaching and learning of time.

### Activity 1 Exploring ways of assessing learners on the concept of time

1 Identify ways of assessing learners that you used during teaching practice.
2 From the given list, identify which ways are suitable for assessing learners on the concept of time?
3 What challenges would you experience when using the ways of assessment on the teaching and learning of time?
4 Discuss how you would overcome the challenges.
5 Share your work in plenary

### Activity 2 Generating questions to assess learners on the concept of time

1 Formulate questions of all levels according to Blooms taxonomy which you would use to assess learners on the concept of time.
2 Develop a marking key for the questions.
3 Present your work to the class for discussion.

## Summary

Time is the length of period between events. It is measured by using a clock. Two types of clocks or watches are used; namely analogue and digital.

The measurement of elapsed time between two events is called time interval. Some examples of time intervals are hour, day, week, year, fortnight, decade, silver jubilee, human generation, diamond jubilee, century and millennium.

In early years of primary school, learners are first taught how to measure time using non-standard units such as position of the sun, length of a shadow and daily events. Non-standard units are not reliable because they are not precise. Later on, learners are introduced to measuring time using standard units such as hours, minutes and seconds.

Sometimes learners have difficulties in understanding measurement of time

because it is intangible. By involving learners in various time-related activities their learning is promoted.

Learners must be assessed continuously during the teaching and learning process using appropriate ways such as questioning. Doing so helps the teacher to understand learners' needs and eventually modify the teaching and learning process.

## Reflection and assessment

1 List down main concepts of time in a logical teaching order.
2 Why is it important to start with non-standard units when teaching time in early years?
3 State differences between analogue and digital clocks.
4 Outline steps that you could follow to introduce a second to learners.
5 Prepare a lesson plan that you could use to teach "reading time to quarter past and quarter to the hour" in Standard 4.
6 Explain how you can teach learners to solve the following question:
   - *Gabriel carried out three activities consecutively. The first one was helping with household work which took 62 minutes. The second one was doing homework for 1 hour 34 minutes. The third one was reading a book for 1 hour 25 minutes. If he started these activities at 3:15 pm, at what time did the last activity end?*
7 Develop five other questions that you can use to assess learners after teaching the concept of time.

## Glossary

**Analogue clock** a device that is used to measure time of the day by the position of hands which move around numbers

**Digital clock** a device that displays numbers which change automatically as time passes

**Time** length of period between events

**Time interval** duration or elapsed time between two events

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# TOPIC 3 Teaching of 3-D and 2-D shapes

**Time** 4 hours

## Introduction

We live in an environment which has plenty of real objects and solid models such as stones, sticks, bottles, toys, boxes and tins. These objects are known as three dimensional (3-D) shapes because they have three dimensions which are length, width and height. Children enjoy playing with these objects which appear in different shapes. For this reason, children have some experiences of 3-D shapes before they start school. These experiences help them in learning 3-D and 2-D shapes by comparing their characteristics.

In this topic, you will explore some activities that are carried out in the teaching, learning and assessment of 3-D and 2-D shapes in primary school. You will also learn about some misconceptions and errors that learners may have and suggest possible strategies to address them.

## Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop concepts of 3-D and 2-D shapes
- apply appropriate methodologies in the teaching and learning of 3-D and 2-D shapes
- use appropriate techniques to assess learners on 3-D and 2-D shapes

## Background information

Most objects exist in three dimensions (3-D) no matter how small they may be. The 3-D shapes have length, width and height (or depth). They take up or occupy space according to their sizes and shapes. Some of these objects have regular shapes while others have irregular shapes. Those with regular shapes have special mathematical names such as cuboids, cylinders and spheres. Irregular shapes such as stones and shoes do not have mathematical names. 3-D shapes have different types of surfaces which can be used to classify them. For example, polyhedron, such as cube and pyramid, have flat (plane) surfaces while other 3-D shapes, such as sphere, cylinder and cone, have curved surfaces. Study figure 3.1.

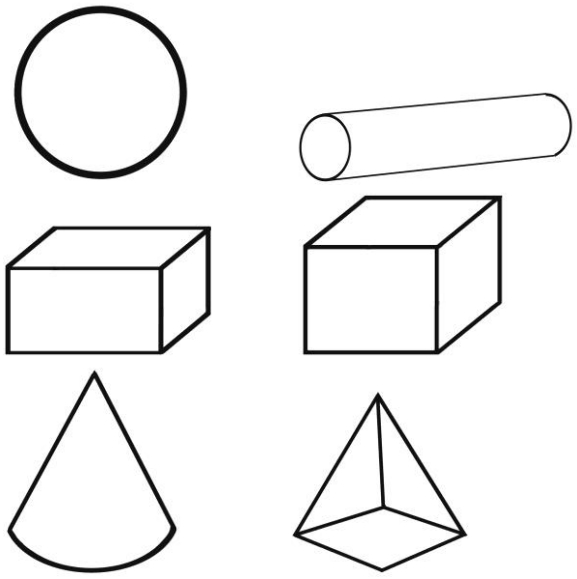
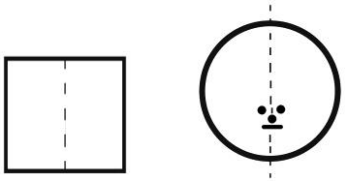


*Fig 3.1: Sphere, cuboid, cylinder, cube, cone and pyramid*

Closed figures that illustrate length and width only are known as two dimensional (2-D) shapes. Some 2-D shapes have curved edges, such as circles, semi-circles and ellipses. Other shapes are polygons which are made up of straight edges. Polygon is a Greek word derived from *poly* meaning 'many' and *gon* meaning 'angle'. Names of polygons are derived from the number of sides that each shape has, for example, triangle (3 sides), quadrilateral (4 sides), pentagon (5 sides), and hexagon (6 sides). Regular polygons have all sides and angles equal, for example, equilateral triangle, square and a regular pentagon.

Most plane shapes have lines (axes) of symmetry which divide them into two halves which are mirror images of each other. These shapes are said to be symmetrical, for example, a rectangle, square and circle. Some shapes have only one line of symmetry, for example, isosceles triangle while others have more than one, for example, rectangle. Plane shapes which do not have any line of symmetry are said to be asymmetrical, for example, a parallelogram. Learners need to observe and state whether plane shapes are symmetrical or asymmetrical. Figure 3.2 shows examples of symmetrical and asymmetrical shapes.



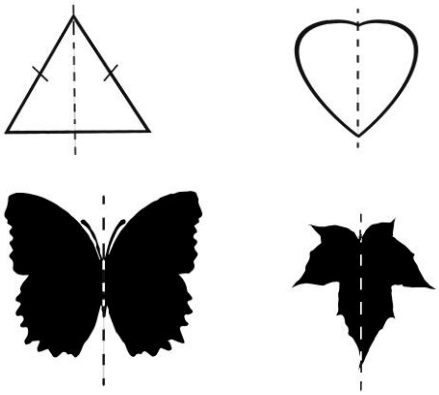


*Fig 3.2: Symmetrical and asymmetrical shapes*

A thorough understanding of 3-D and 2-D shapes is fundamental to successfully learn about various geometrical shapes. The knowledge and skills of geometrical shapes are mostly applied in vocations such as carpentry, bricklaying, metal work, farming and tailoring. For this reason, primary school learners need to be provided with opportunities to explore various shapes in a practical way for them to apply the concepts and skills in everyday life.

3-D and 2-D shapes are introduced in early years of primary school. Teaching and learning of these concepts require active participation of learners in a variety of activities using appropriate resources. These resources should be drawn from the local environment together with physical representations of these shapes. This enables learners to recognise, describe, classify, model and draw various geometric shapes. However, some learners may have some misconceptions and make errors on 3-D and 2-D shapes. Such misconceptions and errors could interfere with children's learning of the concepts if

they are not corrected immediately. For example, learners may think that diagonals of shapes such as a rectangle or parallelogram are lines of symmetry because they divide the shapes into two equal parts. Learners may also not be able to differentiate three dimensional from two-dimensional shapes such as sphere and circle. Hence teachers need to use appropriate strategies to address the misconceptions and errors.

## Task 1 Analysing the concepts of 3-D and 2-D shapes

Children have prior knowledge of 3-D objects such as balls and boxes, and also 2-D shapes such as shapes of playing fields before they learn about them at school. This knowledge can assist in effective teaching and learning of the concepts. In this task, you will explore learners' prior knowledge and importance of 3-D shapes.

### Activity 1 Discussing learners' prior knowledge and importance of 3-D and 2-D shapes

1 Discuss learners' prior knowledge on 3-D and 2-D shapes.
2 Explore situations in everyday life that help children learn about 3-D and 2-D shapes.
3 Discuss the importance of teaching and learning 3-D and 2-D shapes.
4 Explain how the concepts of 3-D and 2-D shapes are applied in everyday life.
5 Share your work with the class for discussion.

### Activity 2 Analysing primary school instructional materials on 3-D and 2-D shapes

Using syllabuses, teacher's guides, learners' books and other relevant sources, carry out the following:

1 identify the concepts of 3-D and 2-D shapes that are taught in primary school. Present your work in a table

| Class | Concepts |
|---|---|
| | |

2 determine the expected knowledge and skills that learners would acquire after learning 3-D and 2-D shapes.
3 report your findings to the class for discussion

**Tip**

Check syllabuses, teachers' guides and learners' books for all classes in the primary school.

## Task 2 Appropriate methodologies in the teaching and learning of 3-D and 2-D shapes

3-D and 2-D shapes are introduced in the early years of primary school. Learners work with a number of concrete objects from the environment before learning about 3-D and 2-D shapes. You may use different objects from the environment in the teaching and learning of 3-D and 2-D shapes. Think of resources from your teaching practice schools' local environment that

you would use in the teaching and learning of 3-D and 2-D shapes.

It is of great value to engage learners in a number of activities using relevant resources for them to develop meaningful knowledge and skills of 3-D and 2-D shapes. In this task, you will discuss appropriate methods and resources for teaching 3-D and 2-D shapes. You will also analyse learners' misconceptions and errors on 3-D and 2-D shapes.

### Activity 1 Discussing how to teach identification and comparison of 3-D and 2-D shapes

1 Collect objects of different shapes from the environment such as plates, tins, stones, bricks, boxes, balls and oranges.
2 Discuss how you can use the objects you have collected to teach identification of 3-D and 2-D shapes.
3 Compare 3-D and 2-D shapes by focusing on their characteristics.
4 Draw 3-D and 2-D shapes using appropriate software such as Geogebra.
5 Present your ideas to the class for discussion.

### Activity 2 Discussing the teaching of lines of symmetry

In the teaching and learning of 3-D and 2-D shapes, one of the activities for learners to do is determine lines of symmetry of plane shapes.

1 Discuss ways that can be used to identify lines of symmetry of plane shapes.
2 Collect various plane objects and demonstrate how you would teach learners to identify lines of symmetry in different orientations of objects.
3 Classify various shapes according to the number of lines of symmetry that they have.
4 Draw lines of symmetry on 3-D and 2-D shapes using appropriate software such as Geogebra.
5 How would you modify this activity to suit learners with diverse education needs?
6 Present your work to the class for discussion.

### Activity 3 Exploring learners' strategies, misconceptions and errors in 3-D and 2-D shapes

1 Explore learners' misconceptions and errors in the learning of 3-D and 2-D shapes.
2 Suggest possible causes of these misconceptions and errors.
3 Discuss effective instructional approaches that you can use to address these misconceptions and errors.
4 Present your work in plenary.

**Tips**

- You may reflect on your experiences from teaching practice to explore learners' strategies, errors and misconceptions.
- You may use learners' work to analyse learners' strategies, errors and misconceptions.
- You may watch a video lesson on 3-D and 2-D shapes and analyse learners' strategies, errors and misconceptions.

## Task 3 Appropriate techniques to assess learners on 3-D and 2-D shapes

Assessment is an important component in the teaching and learning process. It provides feedback to both teachers and learners about how well teaching and learning process progress. In this task, you will explore appropriate assessment strategies for teaching 3-D and 2-D shapes. This will help you acquire skills for developing assessment items for your learners.

### Activity 1 Generating questions for assessing learners on 3-D and 2-D shapes

1. Discuss suitable ways of assessing learners on 3-D and 2-D shapes.
2. Formulate questions based on Blooms taxonomy which you would use to assess learners on 3-D and 2-D shapes.
3. Develop a marking key for each of the questions.
4. Share your work with the class for discussion.

## Summary

Most objects exist in 3-D shapes. They have length, width and height (or depth). They take up or occupy space according to their sizes and shapes.

3-D shapes are made up of different types of surfaces. For example, polyhedron such as a cube and pyramid are made up of flat surfaces. Other shapes such as a sphere, cylinder and cone have curved surfaces.

2-D shapes have length and width only. Some shapes, such as circles, semi-circles and ellipses, are made up of curved edges. On the other hand, polygons, such as triangles, quadrilaterals and pentagons, are made up of straight edges.

Some plane shapes have lines of symmetry which divide them into two halves which are mirror images of each other. Some shapes have more than one line of symmetry while others have none at all.

3-D and 2-D shapes are introduced in the early years of primary school. Teaching and learning of these concepts require active participation of learners to enable them to recognise, describe, classify, model and draw various geometric shapes. Learners may have some misconceptions and errors which

must be addressed immediately in order to achieve quality teaching and learning.

## Reflection and assessment

1 What could be the pre-requisite knowledge for introducing 3-D shapes to primary school learners?

2 Describe one activity that you would carry out with learners for teaching 3-D shapes in early the years of primary school.

3 a) Explain how you would introduce 3-D and 2-D shapes in the early years of primary school.
   b) Suggest relevant resources that you could use for introducing 3-D and 2-D shapes.
   c) Develop a checklist that you could use to assess learners after teaching 3-D and 2-D shapes.

4 Suggest problems that learners may experience when learning names of 3-D and 2-D shapes.

5 Using appropriate resources, explain how you would teach learners to draw the following geometric shapes:
   a) a circle
   b) a cube
   c) a sphere

6 What could be the rationale for teaching 3-D and 2-D shapes to primary school learners?

7 Using relevant resources, explain ways that learners can use to identify lines of symmetry of plane shapes.

8 Generate questions that you can use to assess learners after teaching 3-D and 2-D shapes.

9 Investigate lines of symmetry of the following shapes: rectangle, circle, octagon, square, rhombus, isosceles trapezium, scalene trapezium, parallelogram, equilateral triangle, isosceles triangle and scalene triangle.

10 Collect learners' work of any class from Demonstration or any nearby primary school on 3-D and 2-D shapes.
   a) Examine errors and misconceptions that learners make or may have.
   b) Write down possible causes of these errors and misconceptions
   c) Suggest possible strategies that you can use to correct them

## Glossary

| | |
|---|---|
| **3-D shapes** | solids that have length, width and height (or depth) |
| **2-D shapes** | figures that have length and width only |
| **Plane** | a set of points which form a flat surface |
| **Cylinder** | a three dimensional shape that consists of two identical circular ends joined by one continuous curved surface |

**Polyhedron** a three-dimensional shape with only straight edges and plane surfaces

**Line of symmetry** a line that divides a shape into two equal halves which are mirror images of each other

**Symmetry** the exact likeness in size, shape, and so on of opposite sides of an object to each other

**Sphere** a set of points in space such that every point is the same distance from the centre

**Polygon** any closed shape that consists of straight sides

**Regular polygon** a polygon in which all sides are equal in length and all angles equal in size

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# TOPIC 4 Teaching of lines, angles and triangles

**Time** 8 hours

## Introduction

Lines, angles and triangles are common features in many objects in the environment. Children are familiar with these features before they formally learn about them at school. They see them on some objects such as buildings, clocks, roofs of houses, bicycle, road signs and furniture. When playing, children form angles and shapes of different sizes using objects such as sticks, wires and bricks. In this way, children develop ideas of lines, angles and triangles although they may not be able to describe them.

In this topic, you will learn about activities that can be carried out in the teaching and learning of lines, angles and triangles in primary school. You will also learn about some misconceptions and errors that learners may have and suggest possible strategies to address them.

## Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop concepts of lines, angles and triangles
- explore appropriate methodologies in the teaching and learning of angles, parallel lines and triangles
- apply appropriate techniques to assess learners on angles, parallel lines and triangles

## Background information

A line is a collection of dots which are attached to each other. On the other hand, a straight line is a long and thin mark on the surface which extends indefinitely in two opposite directions. Part of a line is called line segment. A line segment is determined by two distinct end points. A ray is a line that has a starting point but no end point. Straight lines in a plane that never meet throughout their lengths are called parallel lines. These lines are the same distance apart throughout their lengths. Usually a line segment is measured in centimetres or millimetres using a ruler. Figure 4.1 shows a line, ray, line segment and parallel lines.

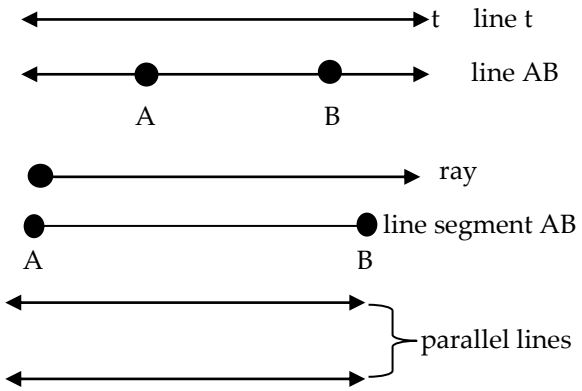


*Fig 4.1: A line, a ray, a line segment and parallel lines*

An angle is a measure of the amount of turn or rotation at a point from one direction to another. It is formed at a point where two lines, rays or line segments meet or intersect. An angle consists of two arms and a vertex. It is measured in degrees (°) using a protractor and is measured from 0° to 180° either clockwise or anti-clockwise.

The origin of a degree unit can be traced to early Babylonians who reckoned the year to consist of 360 days. A complete turn is 360° while a quarter turn is equal to 90° and is called a right angle. Angles can be named according to their sizes, for instance, acute angle, right angle, obtuse angle and reflex angle. Other angles can be named according to their position in relation to other angles on the intersection of same line and parallel lines. For example, alternate angles, allied angles, corresponding angles and adjacent angles are named based on their position. Angles can be constructed, copied or bisected using a ruler, protractor and a pair of compasses. Study figure 4.2.

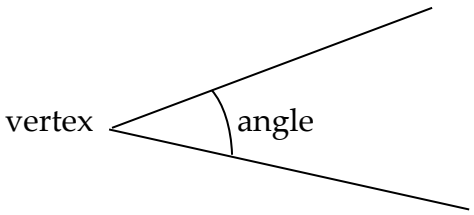


*Fig 4.2: An angle and a vertex*

A triangle is a closed plane figure with three straight sides, three angles and three vertices. The word triangle is derived from Latin word *triangulus* which means 'three-cornered' (*tri* means 'three' and *angulus* means 'cornered'). There are different kinds of triangles. These are classified according to special properties that they have. The properties relate to sides, angles or their combination. For example, isosceles, equilateral and scalene triangle. A triangle with a right angle is called a right-angled triangle. Those without any right angle are called oblique triangles. The sum of interior angles of a triangle is 180°.

Lines and angles are building blocks of geometrical shapes such as triangles and quadrilaterals. An understanding of these concepts enables learners to describe and construct different geometrical shapes which they use in their everyday life such as carpentry, construction and painting.

Lines, angles and triangles are taught in senior classes of primary school. Learners are involved in various activities to help them understand these concepts. Some activities involve learners drawing and constructing parallel lines, angles and triangles. The use of technology, such as computers, projectors, cell phones and tablets can provide extensive opportunities to enhance quality of teaching and learning of lines, angles and triangles. These facilities also allow learning experiences to be more innovative and motivating.

In teaching lines, angles and triangles, learners may have misconceptions and make errors which could interfere with the learning of the concepts if they are not addressed immediately. For example, some learners could associate the size of an angle with the lengths of lines that form the angle. In this case, teachers should apply effective instructional approaches to address such misconceptions and errors to enhance children's learning.

Through regular assessment, teachers are able to get feedback from learners which would help to improve learners'

achievement. It is important for a teacher to use different assessment techniques during and after the course of teaching. The assessment results could help the teacher to modify the teaching process in order to address the needs of all learners. In this task, you will analyse learners' prior knowledge on and importance of lines, angles and triangles.

## Task 1 Lines, angles and triangles

Children have prior knowledge of lines, angles and triangles before they learn about them at school. This knowledge is fundamental for effective teaching and learning of these concepts.

### Activity 1 Discussing lines, angles and triangles

1 Explore situations in everyday life that help children learn about lines, angles and triangles.
2 Discuss the importance of teaching lines, angles and triangles to primary school learners?
3 How is the knowledge of lines, angles and triangles applied in everyday life?
4 Present your work to the class for discussion.

### Activity 2 Analysing primary school instructional materials on lines, angles and triangles

Analyse primary school instructional materials, such as syllabuses, teacher's guide, learners' books and other relevant resources and carry out the following:

1 identify the concepts of lines, angles and triangles that are taught in primary school. Summarise your work in a table.

| Class | Concepts |
|---|---|
| | |

2 determine the expected knowledge and skills that learners would acquire after learning lines, angles and triangles
3 share your work with the class for discussion

## Task 2 Appropriate methodologies in the teaching and learning of lines, angles and triangles

It is important to engage learners in a number of activities for them to have an in-depth understanding of lines, angles and triangles. In this task, you will explore activities and appropriate teaching and learning methodologies in the teaching and learning of lines, angles and triangles.

### Activity 1 Exploring how to teach construction of lines, angles and triangles

1 Using appropriate tools, demonstrate how you would assist learners to perform the following activities:
   - drawing and constructing parallel lines *(using a set square, folded paper, a ruler and a pair of compasses)*
   - copying angles
   - constructing an angle of 30°, 45°, 60°, 90° and 120°
   - constructing triangles

2 Discuss how you would modify each of the activities to suit learners with diverse education needs.
3 Present your work to the class for discussion.

### Activity 2 Using technology in the teaching and learning of lines, angles and triangles

The integration of information and communication technology (ICT) in the teaching and learning process has attracted a lot of attention in recent years. The use of technology allows learning experiences to become more innovative, enriching, motivating and engaging. ICT resources like computers, projectors, cell phones and tablets, provide extensive opportunities to enhance quality of teaching and inspire students in learning mathematics.

Geo Gebra is a free mathematical software that is effective for teaching geometric shapes. Using this software, you would be able to construct, drag or apply many geometrical shapes, a thing which is not possible to do using paper and pencil. Geo Gebra software can be downloaded from www.geogebra.org.

1 Suggest ICT resources that can be used in the teaching and learning of lines, angles and triangles in primary school.
2 Explore ways of using each of the suggested ICT resources.
3 Demonstrate how you would use one of the suggested ICT resources in the teaching and learning of lines, angles and triangles.
4 Discuss how you would ensure that the use of ICT resources meet the needs of learners with diverse abilities.

**Tip**

You may refer to online and other relevant sources on how to use ICT resources in the teaching and learning process.

### Activity 3 Exploring learners' strategies, misconceptions and errors in the teaching and learning of lines, angles and triangles

1 Analyse strategies that learners use when carrying out tasks involving lines, angles and triangles.
2 Explore learners' misconceptions and errors in the teaching and learning of lines, angles and triangles.
3 What do you think are the causes of these misconceptions and errors?
4 Discuss effective instructional approaches that you can use to address the misconceptions and errors.

**Tip**

You may use learners' work to analyse learners' strategies, errors and misconceptions on lines, angles and triangles.

### Task 3 Appropriate techniques for assessing learners on lines, angles and triangles

Assessment is an integral part of teaching and learning process. It informs how well teaching and

learning progress. It will also help you get necessary feedback from your learners and use appropriate techniques to adequately support them. This task will help you explore appropriate assessment methodologies in teaching and learning of lines, angles and triangles.

### Activity 1 Exploring appropriate assessment methodologies in teaching and learning of lines, angles and triangles

1 Prepare a lesson plan on any of the three concepts: lines, angles and triangles. In your lesson plan, include not less than three assessment methods.
2 Develop relevant assessment tools you will use in the lesson.
3 Peer teach the lesson.
4 Evaluate the lesson focusing mainly on assessment methods used.

## Summary

Lines and angles are building blocks of geometrical shapes such as triangles. A line is measured in centimetres or millimetres using a ruler whereas an angle is measured in degrees (°) using a protractor.

A triangle is a closed plane figure with three straight sides, three angles and three vertices. Some examples of triangles are isosceles, equilateral and scalene. The sum of angles in a triangle is 180°.

Angles, parallel lines and triangles are taught in later years of primary school. Learners practise drawing and constructing parallel lines and some geometric shapes. The use of technology provides extensive opportunities to enhance quality of teaching and learning of these concepts.

Learners may have misconceptions and make errors which could interfere with the learning of lines, angles and triangles. Hence, teachers need to apply effective instructional approaches to address them.

Through regular assessment, teachers are able to get feedback from learners which would help to improve learners' achievement. The results of continuous assessment help teachers modify their lessons in order to address the needs of all learners in class.

## Reflection and assessment

1 a) Suggest resources that you can use to draw parallel lines.
   b) Explain how you can teach learners to use the suggested resources to draw parallel lines.
2 Explain how you can teach learners construction of the following angles:
   a) 15° b) 135° c) 105°
3 Prepare a checklist that you would use to assess learners when introducing angles in primary school.
4 a) Suggest relevant resources that you can use in the teaching and learning of modelling angles.
   b) Describe activities that you can carry out with learners on modelling angles.

5 What could be the pre-requisite knowledge for introducing triangles?
6 Explain how learners can use the following resources to copy angles.
   a) Protractor b) tracing paper
   c) a pair of compasses and a ruler
7 How would you teach learners to construct triangle ABC in which $\angle ABC = 45°$, AB = 8cm and BC = 7cm. Measure line AC.
8 With the aid of illustrations, explain how you can teach learners that the sum of interior angles of a triangle is 180°.
9 Visit a Demonstration or any nearby primary school and examine learners' work on lines, angles and triangles.
   a) Analyse misconceptions and errors that learners make.
   b) Write down possible causes of these misconceptions and errors.
   c) Suggest possible strategies that you can use to correct them.

## Glossary

**Angle** a measure of turn or rotation at a point from one direction to another

**Construction** drawing accurately using mathematical instruments such as ruler, pair of compasses protractor and set square

**Equilateral triangle** a triangle with all sides and angles equal

**Isosceles triangle** a triangle with two sides and two angles equal

**Line segment** part of a line with two end points

**Parallel lines** lines that never intersect or cross each other

**Perpendicular lines** intersecting lines that form right angles

**Ray** part of a line that starts at one point and extends forever in one direction.

**Right angle** an angle that is exactly 90 degrees (90°)

**Scalene triangle** a triangle with no sides equal

**Triangle** a three-sided polygon

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# TOPIC 5 Teaching of quadrilaterals and circles

**Time** 5 hours

## Introduction

From an early age, children get exposed to a number of objects in the environment. These objects are of different shapes, such as quadrilateral, circular and triangular. Children manipulate these objects as they play or when doing other daily activities. In so doing, they gain some experiences of geometric shapes before they start school. Geometric shapes are very important in design and construction works. Therefore, an understanding of them would prepare children for further mathematical concepts and future careers, such as builders, designers and architects.

Effective teaching of quadrilaterals and circles requires learners to carry out a number of activities using a variety of teaching and learning resources to ensure maximum participation of all learners. In this topic, you will explore some activities that can be carried out in the teaching and learning of quadrilaterals and circles in primary school. You will also identify misconceptions and errors that learners may have and how to address them.

## Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop the concept of quadrilaterals and circles
- explore appropriate methodologies in the teaching and learning of quadrilaterals and circles
- apply appropriate techniques to assess learners on quadrilaterals and circles

## Background information

A quadrilateral is a closed plane with four straight sides, four angles and four vertices. The term quadrilateral is derived from the word 'quad' which means four. There are different types of quadrilaterals; namely rectangle, square, rhombus, parallelogram, kite and trapezium. These quadrilaterals are classified according to special properties that they have. The properties relate to sides, angles, diagonals or their combination. Regardless of the type, the interior angles of a quadrilateral always add up to 360°. There are two diagonals in a quadrilateral which divide it into two triangles. Since the sum of the interior angles of a triangle is 180°, the sum of the angles of a quadrilateral is 360° (that is 180° x 2). Figure 5.1 shows a quadrilateral.

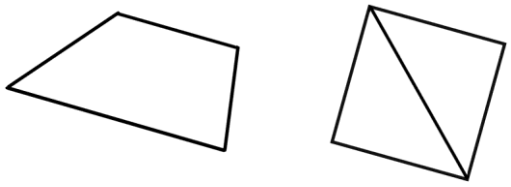

*Fig 5.1: A quadrilateral divided into two triangles*

Unlike quadrilaterals which are made up of straight lines, a circle is formed by a curved line called circumference. This is the length of the whole circle. The circle has a special property that every point on the circumference is the

same distance from the centre of the circle. A circle has various other parts such as diameter, radius, sector, chord, centre and segment. Half of a circle is known as semicircle. For every circle, the circumference divided by the diameter gives a constant ratio of $\frac{22}{7}$ or 3.14 (rounded to 2 decimal places). This is known as Pi and its symbol is $\pi$. See Figure 5.2.

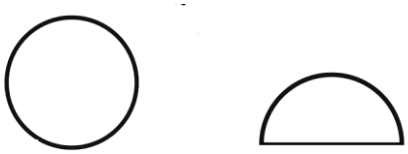

*Figure 5.2: A circle and a semicircle*

Learners may have some misconceptions and make errors which may interfere with the learning of quadrilaterals and circles. Some of the misconceptions and errors include recognising shapes by appearance alone: a learner would call any four sided figure 'a parallelogram' or 'rectangle' without looking at other properties such as sides and angles; and some learners would think that changing the orientation of an object changes the type of an object as well. For example, a learner could say that the following shapes in Figure 5.3 are different:

.

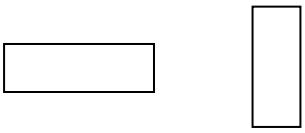

*Figure 5.3: Shapes*

It is important for teachers to address these misconceptions and errors immediately in order to achieve meaningful learning. Effective teaching of quadrilaterals and circles should help learners analyse the shapes, construct them, compare their properties and develop geometric reasoning. To achieve this, teachers need to apply appropriate teaching and learning approaches and also a variety of assessment techniques in the lessons. Furthermore, teachers should modify lesson activities to ensure that learners with special educational needs participate actively in lessons.

The use of different forms of assessment is essential for effective teaching and learning. For instance, formative assessment which is conducted during the process of teaching and learning provides feedback which helps teachers adjust the on-going teaching process in order to improve learners' achievement. On the other hand, summative assessment, which is mostly administered at the end of a unit or term, helps to assess what learners have learnt.

## Task 1 Analysing quadrilaterals and circles

Children have some knowledge and skills related to various geometric shapes before they start school. The knowledge and skills are fundamental for effective teaching and learning of quadrilaterals and circles which are very important in everyday life. In this task, you will determine learners' prior knowledge on and importance of quadrilaterals and circles.

### *Activity 1* *Establishing learners' prior knowledge and* importance of quadrilaterals and circles

1 Discuss learners' prior knowledge on quadrilaterals and circles.
2 Explore situations in everyday life that help children learn about quadrilaterals and circles.
3 Discuss the importance of learning quadrilaterals and circles.
4 Explain how knowledge of quadrilaterals and circles is applied in everyday life.
5 Share your work in plenary.

### Activity 2 Analysing primary school instructional materials on quadrilaterals and circles

Using primary school instructional materials, such as syllabuses, teachers' guides and learners' books, carry out the following:

1 identify the concepts of quadrilaterals and circles that are taught in primary schools. Present the concepts in a table.

| Class | Concepts |
|---|---|
| | |
| | |

2 establish the expected knowledge and skills that learners would acquire after learning quadrilaterals and circles.
3 report your findings to the class for discussion.

## Task 2 Appropriate methodologies in the teaching and learning of quadrilaterals and circles

Effective teaching and learning of quadrilaterals and circles require learners to carry out a number of activities using a variety of resources.

In the early years of primary school, learners acquire various skills of handling different shapes by sorting, classifying, comparing and drawing them. These skills are used in the teaching and learning of quadrilaterals and circles for learners to relate new ideas to what they already know. It is important to use locally available resources to help learners understand these concepts.

### Activity 1 Discussing how to teach types and properties of quadrilaterals

1 Collect a wide range of objects with four faces from the school environment such as bricks, match boxes, books and rulers.
2 Discuss how you can use the objects you have collected to teach each of the following on quadrilaterals:
   - properties of quadrilaterals
   - calculating angles in quadrilaterals
   - constructing quadrilaterals
3 Present your discussions to the class for discussion.

**Tip**

Prepare a variety of cut-outs for different quadrilaterals

### Activity 2 Discussing how to teach parts and properties of a circle

1 Identify relevant resources that you could use to teach parts of a circle.
2 Discuss how you can use the resources you have identified to teach the following on circles:
   - parts of a circle
   - constructing circles
   - how to find pi
3 Make rulers, protractors and pair of compasses from locally available resources
4 Share your work with the class for discussion

**Tip**

Modify the activities to ensure that learners with special educational needs participate actively in the given tasks.

### Activity 3 Exploring the use of information and communication technology in the teaching and learning of quadrilaterals and circles

Technology provides additional opportunities for teaching and learning that are consistent with modern times. With technology, learners can construct and manipulate various geometric shapes. Therefore, teachers need to take advantage of the available technology to facilitate the teaching and learning of quadrilaterals and circles. For example, using a computer, learners can produce different kinds of geometric shapes as follows:

- Microsoft Word has drawing tools which can be used to draw some quadrilaterals, circles and several other geometric shapes
- With Geo Gebra software, learners can construct and manipulate different geometric shapes including quadrilaterals and circles

1 Suggest ICT resources that can be used in the teaching and learning of quadrilaterals and circles in primary school.
2 Explore ways of using each of the suggested ICT resources.
3 Demonstrate how to use some of the suggested ICT resources.
4 Explain how you would ensure that the use of ICT resources meets the needs of learners with diverse abilities.
5 Report your work to the class for discussion.

**Tip**

You may refer to online articles and other relevant sources of information on how to use technology in the teaching and learning of quadrilaterals and circles.

### Activity 4 Exploring learners' strategies, misconceptions and errors in the teaching and learning of quadrilaterals and circles

1 Analyse strategies that learners use when carrying out tasks involving quadrilaterals and circles.

2 Explore learners' misconceptions and errors in the teaching and learning of quadrilaterals and circles.
3 What do you think are the causes of these misconceptions and errors?
4 Discuss effective instructional approaches that you would use to address the misconceptions and errors.
5 Present your work to the whole class.

**Tip**

You may use learners' work to analyse learners' strategies, errors and misconceptions on quadrilaterals and circles.

### Task 3 Appropriate techniques to assess learners on quadrilaterals and circles

Assessment is an important component in the teaching and learning process. It provides feedback to both the teacher and learners on how well the teaching and learning process progress. In this task, you will explore appropriate assessment strategies for teaching quadrilaterals and circles. This will help you acquire skills for developing assessment items for the learners.

### Activity 1 Discussing appropriate ways of assessing learners on quadrilaterals and circles

1 Identify suitable ways of assessing learners' competencies on quadrilaterals and circles.
2 Explain challenges you would face when using the identified ways.
3 Discuss effective instructional strategies that you would use to address the challenges.
4 Present your work in plenary.

### Activity 2 Micro-teaching of quadrilaterals and circles

1 Prepare a detailed lesson plan on either quadrilaterals or circles. Indicate clearly the assessment strategies that you will use in the lesson.
2 Present the lesson.
3 Evaluate the lesson focusing on assessment strategies.

## Summary

A quadrilateral is any four sided figure. Examples of quadrilaterals include rectangle, square, rhombus, kite, parallelogram and trapezium. The sum of angles in a quadrilateral is 360°. Quadrilaterals have two diagonals and each divides the shape into two triangles.

A circle is formed by a curved line called circumference. Parts of a circle include circumference, diameter, radius, sector, chord, centre and segment. The circumference of a circle divided by the diameter gives the constant ratio which is known as Pi ($\pi$). A semicircle is half of a circle.

By involving learners in various hands-on activities, learners acquire knowledge of quadrilaterals and circles with understanding. Teachers should apply appropriate teaching and learning resources such as using

TALULAR and ICT to enhance quality of teaching and learning.

The use of continuous assessment helps teachers modify the on-going teaching and learning process in order to improve learners' achievement. Modifying activities also ensures that learners with diverse educational needs participate actively in lessons.

## Reflection and assessment

1 Outline steps that you would follow to introduce quadrilaterals or circles to primary school learners.
2 Discuss the sequence of concepts on quadrilaterals and circles in a logical teaching order.
3 Imagine that you are going to teach drawing of circles to primary school learners but you do not have a pair of compasses.
   a. Which other resources would you use for learners to draw the circles accurately?
   b. Explain how you would use the resources.
4 Using a ruler and a pair of compasses only, show how you would teach learners construction of a trapezium PQRS in which PQ is parallel to RS, PQ = 8 cm, RS =10 cm, PS = 5 cm and $\angle RSP = 45°$.
5 What mathematical games can be used in the teaching and learning of quadrilaterals and circles?
6 Construct a checklist which you can use to assess learners when teaching the following:
   a. Modeling of quadrilaterals
   b. Teaching of parts of a circle

## Glossary

| | |
|---|---|
| **Arc** | part of the circumference of a circle |
| **Centre** | a point that is equidistant (equal distance) from every point of the circumference (sides) of a circle |
| **Chord** | a straight line joining any two points on the circumference of a circle |
| **Circle** | round space enclosed by a curved line which is equidistant from the centre |
| **Circumference** | distance around the circle |
| **Diagonal** | a straight line that is drawn from one vertex of a polygon or polyhedron to the opposite vertex. |
| **Diameter** | a chord that passes through the centre of a circle |
| **Isosceles trapezium** | trapezium whose opposite non-parallel sides are equal and base angles are also equal |
| **Quadrilateral** | four sided figure or polygon |
| **Radius** | a straight line from the centre of a circle to the circumference |
| **Sector** | part of a circle bounded by two radii and an arc |
| **Segment** | part of a circle bounded by a chord and an arc |
| **Semicircle** | half of a circle |

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# TOPIC 6 Teaching of perimeter and area

**Time** 6 hours

## Introduction

Ideas of perimeter and area are used widely in everyday life. For example, these ideas are largely used by builders, architects, painters and farmers. Most children have some experiences of perimeter and area before they start school. They have seen people making flower beds, fences or making paths around their homes. Learners can also describe things as long or short and small or big. These activities are related to perimeter or area. The knowledge and skills of these concepts enable people to be more exact when carrying out various activities. For instance, a contractor has to know the perimeter of land in order to establish the cost of fencing it. Likewise, a farmer needs to know the area of a garden in order to determine the amount of seed and fertilizer that are needed. Therefore, it is important for learners to develop a sound understanding of perimeter and area which they can apply in daily life.

In this topic, you will explore some activities that are carried out in the teaching and learning of perimeter and area in primary school. You will also explore how to use problem solving as a strategy of teaching perimeter and area. Furthermore, you will analyse learners' misconceptions on perimeter and area and suggest possible strategies to address them.

## Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop the concepts of perimeter and area
- explore appropriate methodologies in the teaching and learning of perimeter and area
- use appropriate techniques to assess learners on perimeter and area

## Background information

Perimeter is the distance around a figure or an object. The word perimeter is derived from the Greek words *per* which means around and *metro* which means measure. Perimeter of a figure is found by adding the lengths of all the outer edges that make up the figure. Length is the distance between any two points. The standard unit for measuring length is a metre (m).

Perimeter of circular shapes is called circumference. Calculating circumference requires the use of pi ($\pi$) whose value is $^{22}/_{7}$ or 3.14 rounded to two decimal places. Pi is the ratio of circumference to the diameter of a circle or $\frac{circumference}{diameter}$. This ratio is the same for every circle regardless of its size. Perimeter of a semicircle is found by halving the circumference plus its diameter (that is, $P = \left[\frac{C}{2}\right] + D$, where P is perimeter, C circumference and D diameter)

Area is the measurement the amount of surface that is covered by a 2-dimensional figure. Finding the area of a given figure requires an understanding of basic unit of area such as one square centimetre (1 $cm^2$) which is the area of a 1 centimetre square. Once this is established, it becomes easier to find areas of different shapes just by counting the number of unit squares (in this case, square centimeters ($cm^2$) within the boundary of each shape. Eventually, different formulae are derived which help to calculate areas of different shapes such as rectangle, circle, kite and trapezium. The standard unit for measuring area is square metre ($m^2$).

Perimeter and area are introduced in later years of primary school. An effective way to introduce these concepts is to engage learners in various hands-on activities starting with non-standard units before bringing the idea of standard units. For example, learners can describe the perimeter of a chalkboard in terms of other objects such as sticks. They can also describe the area of a table or desk in terms of number of smaller objects that can fit on it such as leaves or notebooks. In this way, learners can realise the limitations of using non-standard units and appreciate the importance of standard units in measuring perimeter and area. However, it is important for teachers to modify teaching and learning activities to ensure that learners with special educational needs participate actively in the lessons.

An understanding of learners' misconceptions and errors is an important aspect of mathematical pedagogy. Once the misconceptions and errors are recognised, teachers can decide on appropriate strategies that they can use to address them. The following are examples of learners' common misconceptions and errors on perimeter and area:

- thinking that all shapes with the same area have the same perimeter
- attempting to find area of a rectangle by adding length and width rather than multiplying them
- applying the same formula to calculate areas of different shapes
- calculating perimeter of a semicircle by dividing the circumference by 2.

Teachers should apply appropriate assessment techniques to gather information and feedback which would help improve the quality of teaching and learning. The use of continuous assessment helps teachers adjust the teaching and learning process whereas summative assessment helps to assess learners' mastery of content at the end of a period of learning.

## Task 1 Developing the concepts of perimeter and area

Children have some knowledge of perimeter and area which would assist in effective teaching of the concepts. In this unit, you will discuss learners' prior knowledge on and importance of perimeter and area.

### Activity 1 Establishing learners' prior knowledge and importance of perimeter and area

1 Discuss learners' prior knowledge on perimeter and area.
2 Explore situations in everyday life that help children learn about perimeter and area.
3 Discuss the importance of learning perimeter and area to primary school learners?
4 How are perimeter and area applied in everyday life?
5 Report your work to the class for discussion.

### Activity 2 Analysing primary school instructional materials on perimeter and area

Analyse primary school instructional materials, such as syllabuses, teacher's guides, learners' books and other relevant resources and do the following:

1 identify the concepts of perimeter and area that are taught in particular classes in primary school. Present your work in a table

| Class | Concepts |
|---|---|
| | |

2 determine the expected knowledge and skills that learners would acquire after learning perimeter and area
3 present your work to the class for discussion

## Task 2 Appropriate methodologies in the teaching and learning of perimeter and area

Perimeter and area is introduced using non-standard units. Thereafter, learners are involved in calculating perimeter and area of different shapes using standard units. In this task, you will explore suitable resources and methods for teaching perimeter and areas.

### Activity 1 Discussing the teaching and learning of perimeter and area in non-standard units

1 Identify teaching and learning resources that can be used to teach perimeter in non-standard units.
2 Discuss how you would teach perimeter in non-standard units using the identified resources.
3 Discuss advantages and disadvantages of teaching perimeter and area in non-standard units.
4 Suggest ways of overcoming the disadvantages of teaching and learning perimeter and area in non-standard units.
5 Present your work to the class for discussion.

### Activity 2 Discussing the teaching and learning of perimeter in standard units

1 Identify teaching and learning resources that can be used to teach perimeter in standard units.

2 Discuss how you would use the identified resources to teach the following:
   a) deriving formulae for perimeter of different shapes such as rectangle, triangle and circle
   b) solve problems involving perimeter
3 Share your work in plenary.

### Activity 3 Discussing the teaching and learning of area in standard units

1 Identify teaching and learning resources for teaching area in standard units.
2 Explain how you would use the identified resources to teach the following:
   a) deriving formulae for area of different shapes such as rectangle, triangle and circle
   b) solve problems involving area
3 Present your work to the class.

**Tip**

Modify activities to suit learners' diverse abilities.

## Task 3 Exploring appropriate assessment methodologies in the teaching and learning of perimeter and area

Assessment is an important component in the teaching and learning process. In this task, you will explore appropriate assessment strategies for teaching perimeter and area. This will help you acquire skills for developing assessment items for your learners.

### Activity 1 Exploring learners' strategies, misconceptions and errors on perimeter and area

1 Analyse strategies that learners use when carrying out tasks involving perimeter and area.
2 Identify learners' misconceptions and errors in the teaching and learning of perimeter and area.
3 Discuss possible causes of the misconceptions and errors.
4 Discuss effective instructional approaches that you can use to address the misconceptions and errors.
5 Share your work with the class.

**Tip**

You may use learners' work to analyse learners' strategies, errors and misconceptions on quadrilaterals and circles.

### Activity 2 Generating questions on perimeter and area

1 Develop questions on perimeter and area which require problem solving skills.
2 Prepare a marking key for each question.
3 Present your work to the class.

## Summary

Perimeter is the measure of distance around a figure or an object. Perimeter of a given figure is calculated by adding the lengths of all the outer edges that make up the figure.

Perimeter of circular shapes is called circumference. The metre is the

standard unit for measuring lengths which make up perimeter.

The area of a plane figure is the measurement of the surface that is covered by the figure. The standard unit for measuring area is square metre ($m^2$).

Perimeter and area are introduced in later years of primary school. An effective way to introduce these two concepts is to start with non-standard units before bringing in the idea of standard units.

As teachers, you need to have knowledge and skills of generating questions to supplement those in the learners' book.

## Reflection and assessment

1 What could be the pre-requisite knowledge for teaching and learning area of a circle?
2 With the aid of illustrations, explain how two different shapes can have the same area but different perimeters.
3 Explain how you would introduce a metre as a standard unit for measuring length in primary school.
4 Describe an activity that you could carry out with learners to derive the formula for the following:
   a. perimeter of a rectangle
   b. area of a trapezium
   c. area of a circle
5 Outline the steps that you could follow to introduce the perimeter of a figure to learners in primary school.
6 Explain the relationship between area of a triangle and area of a rectangle.
7 Discuss advantages and disadvantages of using non-standard units for teaching area of a given figure.
8 Prepare a checklist that you would use to assess learners when teaching area in a particular class in later years of primary school.
9 Standard 7 learners are asked to solve the following question:
   A rectangular shaped swimming pool with dimensions 30 m × 20 m has 5 m wide cemented path along its length and 8 m wide path along its width. Find the cost of cementing the path at the rate of K400 per square metre.
   Discuss problem solving strategies that learners could use to find solution to the problem.

## Glossary

**Area** 2-dimensional surface covered by an object
**Circumference** the distance around a circle
**Metre square** a square with all sides measuring one metre
**Non-standard unit** any unit of measure with which one chooses to compare the quantity to be measured
**Perimeter** distance around a figure
**Semi-circle** half of a circle
**Square metre** the area of a square whose sides measure 1 metre

**Unit** quantity chosen as a standard in terms of other quantities

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# TOPIC 7 Teaching of scale drawing

**Time** 4 hours

## Introduction

Scale drawing is mostly used in engineering, geography, construction, carpentry and architecture. Scaled drawings are a means of communication between designers and contractors.

Maps are drawn on paper to a scale. Scale drawing is an ideal way of storing and utilising information. It focuses on representing real objects on different platforms like paper and interpreting designs, sketches and drawings using enlargement. Enlargement involves increasing and decreasing objects. As learners progress with their education, they may have a choice of career that would greatly depend on their competencies in scale drawing. As teachers, you need to have relevant knowledge and skills in order to effectively teach learners scale drawing.

## Success criteria

By the end of the topic, you must be able to:

- analyse how learners develop the concept of scale drawing
- use appropriate methodologies in teaching and learning of scale drawing
- apply appropriate techniques to assess learners on scale drawing

## Background information

As secondary school graduates, scale drawing is not new to you. You learnt similar and congruent triangles. Your knowledge from secondary school will prove to be of great value as you pursue the theory and practice in teaching scale drawing. Figure 7.1 shows congruent and similar shapes.

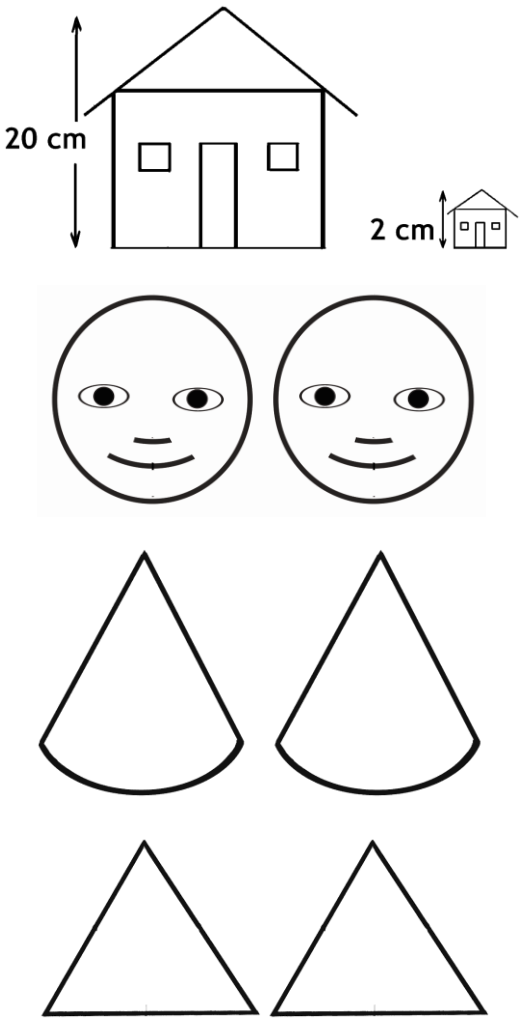



*Fig 7.1: Congruent and similar triangles*

Scale drawing involves interpreting scales for different maps and building

plans. Real objects or shapes are drawn to a scale on pieces of paper for easy representation and manipulation. The use of scale assists different professionals to reduce or enlarge objects which in turn makes it easier for them to work with samples, sketches or models of the real objects.

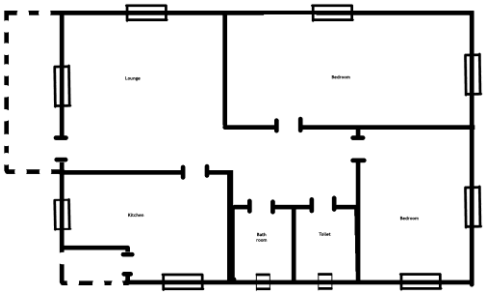


*Fig 7.2: A plan of a house*

In everyday life, scale drawing is applied in many areas such as in building, zooming out and zooming in of pictures on smart phones and in enlarging images. For example, advertisers post pictures of the same object of different sizes on posters.

Enlargement involves increasing or decreasing the size of an object. In an enlargement, an object and its image are similar. Objects are enlarged using a scale factor. A scale factor is a ratio of corresponding sides of an object and its image. In similar shapes, corresponding angles are equal and corresponding sides are proportional. The scale factor is found by the following formula:

$$scale\ factor = \frac{image\ length}{object\ length}$$

When areas of two similar shapes are given, the scale factor is determined by calculating the square root of the ratio of the corresponding areas of the two shapes, that is,

Scale factor = $\sqrt{\frac{image\ area}{object\ area}}$

Figure 7.3 shows enlarged picture of a child.

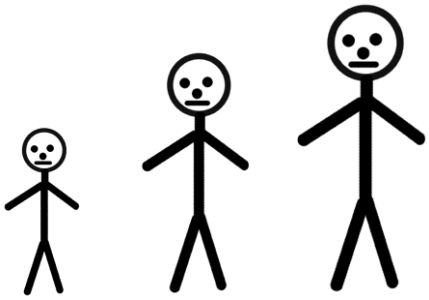


*Fig 7.3: Enlarged picture of a child*

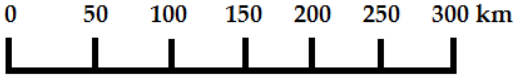
It is important to note that an enlargement can maintain, increase or reduce the size of an object.

There are three ways of expressing a scale, namely:

a) using simple statement, such as 1 cm represents 1 km or 1cm to 1 km
b) using a representative fraction like 5 cm to 1 km. This, in representative fraction, is

$$\frac{5cm}{100\ 000cm} = \frac{5}{100\ 000} = \frac{1}{20\ 000}$$

c) using a line or linear scale. This scale appears at the bottom of most maps. A ruler or a string is used to measure any distance on the map and then measure the actual distance on the scale




Scale is calculated by the formula:

$$Scale = \frac{distance\ on\ the\ map}{distance\ on\ the\ actual\ ground}$$

It is important to assume that some learners are aware of activities that

involve scale drawing. Their knowledge comes in their everyday activities such as games, drawings, working with computers and cell phones, and songs. It is important as a teacher to establish learners' prior knowledge on scale drawing such as zooming pictures on a computer (or phone), drawing maps on an area and sketching houses in their exercise books. This will help you build on what learners already know.

## Task 1 Learners' prior knowledge and importance of scale drawing

Learners have some knowledge of scale drawing which would assist in effective teaching and learning of the topic. In this task, you will discuss learners' prior knowledge on and importance of scale drawing.

### Activity 1 Exploring learners' prior knowledge on scale drawing

1 Discuss learners' prior knowledge on scale drawing.
2 Explore situations in everyday life that help learners acquire knowledge of scale drawing.
3 Discuss the importance of learning scale drawing to primary school learners?
4 How is knowledge of scale drawing applied in everyday life?
5 Share your ideas with the class.

### Activity 2 Analysing primary school instructional materials on scale drawing

Analyse curriculum instructional materials such as syllabuses, learners' books and teachers' guides from the college library or demonstration school.

1 Identify the concepts of scale drawing that are taught in primary school. Summarise your work in a table.

| Class | Concepts |
|---|---|
| | |

2 Determine the expected knowledge and skills that learners would acquire after learning scale drawing.
3 Present your findings to the class for discussion.

## Task 2 Appropriate methodologies in teaching and learning of scale drawing

Scale drawing is taught in later years of primary school. It is of great value to engage learners in a number of activities using relevant resources for them to develop meaningful knowledge and skills of scale drawing. In this task, you will explore activities and appropriate teaching and learning methodologies in the teaching and learning of scale drawing.

### Activity 1 Discussing the teaching and learning of scale drawing

1 Identify teaching and learning resources that can be used to teach scale drawing.
2 Discuss how you would use the identified resources to teach the following:
   a. interpreting scale

b. drawing shapes to a given scale
c. enlarging shapes to a given scale factor
d. solve practical problems involving scale drawing

3 Share your work with the class

### Activity 2 Using technology in the teaching and learning of scale drawing

1 Suggest ICT resources that can be used in the teaching and learning of scale drawing.
2 Explore ways of using each of the suggested ICT resources
3 Demonstrate how to use the suggested ICT resources in the teaching and learning of scale drawing.
4 Present your ideas to the class.

**Tips**

- You may refer to online and other relevant sources on how to use ICT resources in the teaching and learning of scale drawing.
- Modify the activities to accommodate learners with diverse abilities.

## Task 3 Exploring appropriate assessment strategies for teaching and learning of scale drawing

As a teacher, you need to have knowledge of the challenges that learners may have on scale drawing in order to assist them accordingly. In this task, you will explore appropriate assessment methodologies for teaching and learning of scale drawing.

### Activity 1 Analysing learners' strategies, misconceptions and errors on scale drawing

1 Discuss errors and misconceptions learners may have on scale drawing.
2 Discuss possible causes and solutions to the errors and misconceptions.
3 Present your work to the class for discussion.

### Activity 2 Discussing appropriate ways of assessing learners on scale drawing

1 Prepare a lesson plan on any concept of scale drawing.
2 Develop an observation checklist for assessing learners during the lesson.
3 Share your work with the class.

## Summary

Scale drawing involves enlargement of objects or figures. Enlargement involves increasing or decreasing the size of an object or figure using a scale factor. When a figure is reduced in size, the dimensions are proportionally reduced to the given scale. In reducing objects, the nature of the scale is that a smaller number begins or is the numerator and the second number or the denominator is greater, for example, $3:7 = \frac{3}{7} = 3\ to\ 7$. When a figure is increased in size, the dimensions are proportionally increased to the given scale. In increasing objects, the nature of the scale is that a greater number begins or

is the numerator and the second number or the denominator is smaller, for example, $7:3 = \frac{7}{3} = 7\ to\ 3$.

Scale drawing is used in many fields like surveying, carpentry, navigation and engineering.

## Reflection and assessment

1 PT and QT are two streets. If P and Q are 180m and 270m respectively from T, and the distance between P and Q is 108m. Make a scale drawing of the streets and find the angle between the streets at T.

2 The height and width of a classroom door are 400cm and 160cm respectively. Using a scale of 1 cm to represent 80cm, draw the plan of the door.

3 The scale on a map is $\frac{1}{100\ 000}$. Find, in km, the distance between two rivers represented on the map by 4.5 cm.

4 a) Draw to a scale of 2:5 a fish pond that is 45 m by 30 m.
   b) Prepare a marking key for the question.

5 A photograph measuring 8cm by 10cm costs K800.00.
   a) What will be the cost of an enlargement measuring 28cm by 35cm?
   b) Describe a procedure that you can follow to teach learners how to solve the problem.

## Glossary

**Scale** ratio of image size relative to object size

**Ratio** a comparison between two numbers equal to one divided by the other that is, $2:5 = \frac{2}{5}$

**Model** simplified representation of a physical object intended to allow one to more easily analyse and understand the objects

**Scale factor** the number by which each dimension of the model is multiplied to modeled object's actual size. Or the scale factor is the constant of proportionality

**Transform** changing the size or appearance of something or an object

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## Further reading


Malawi Institute of Education (2008). *Initial primary teacher education Numeracy and mathematics. Lecturer's handbook*. Domasi: MIE.

# TOPIC 8 Teaching of bearing

**Time** 4 hours

## Introduction

Bearing is one of the mostly used concepts in applied mathematics. Ship captains, pilots, tourists and as well as geographers use bearing to move from one point to another and locate places of objects when traveling. Bearing is also used in weather stations. Captains in ships use bearing to navigate or travel safely in the oceans and lakes. Bearing reveals their position and positions of other vessels in the area they are operating. Tools like protractors and radar system in planes and ships assist to calculate bearing of objects or places located in two points. Map readers are able to locate places of interest using bearing. The use of bearing provides precise location. As learners progress with their education, they can pursue a career that will greatly depend on their competency in bearing. As teachers, you need to have relevant knowledge and skills in order to teach learners effectively.

In this topic, you will analyse how learners develop knowledge of bearing, apply appropriate teaching, learning and assessment methodologies in the teaching and learning of bearing.

## Success criteria

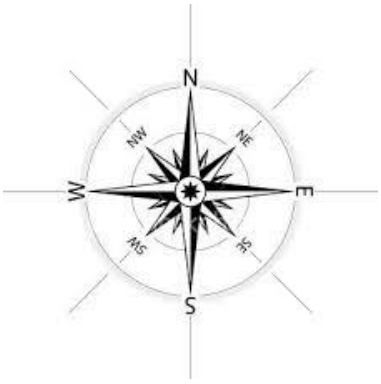
By the end of the topic, you must be able to:

- analyse how learners develop the concept of bearing
- apply appropriate methodologies in teaching and learning of bearing
- use appropriate techniques to assess learners on bearing

## Background information

As secondary school graduates, you learnt about direction and bearing. You also learnt about using a compass to determine position of an object in relation to another. The activities involved points on a map like towns but also location of ships in oceans and lakes. Your knowledge from secondary school is important as you pursue the theory and practice of teaching bearing.

Directions and bearing are terms we use to communicate where one location is relative to another. We can name the position of town A based on its location with reference to town B, written as bearing of town A from town B. For example, Salima is to the east of Lilongwe (or that Lilongwe is to the west of Salima). Directions are described using north, south, east and west (N, S, E and W) and north-east, south-east, south-west and north-west (NE, SE, SW and NW). Figure 8.1 shows directions.




or


*Fig 8.1: Directions*

There are four cardinal points of the compass: north, south, east and west. Significantly, north on the compass means the direction that a compass points to as magnetic north. The opposite of the north is the south. East and west are directions that move around the earth parallel to the poles. A direction between two points, for example, a direction halfway between north and east is called north east. Similarly, a direction halfway between west and south would be called south west.

Bearing is the direction of one place from another, measured in degrees either clockwise or anticlockwise. It gives a more precise way of indicating direction. There are two types of bearing: three-figure and compass bearing. Three-figure bearing is given as the amount of turn clockwise from the north. As such, it is always an angle measured in degrees, measured from the north, turning clockwise, and given from 000° to 360°. A direction of north is a bearing of 000°; a direction of east is a bearing of 090°; a direction of south is a bearing of 180°; a direction of west is a bearing of 270°; a complete turn (revolution) is 360°. See Figure 8.2.

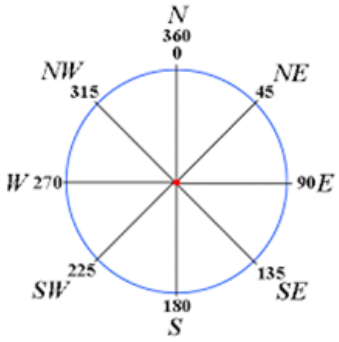



*Fig 8.2: Bearing*

Bearing can be calculated using a protractor. The following steps help in doing this:

- draw cardinal points on the reference point
- draw a line between the two points which will be longer enough to see using your protractor
- place the protractor on the two points with 0° pointing the north and the centre of the protractor on the starting point
- Measure the angle between the two points.

Compass bearing, on the other hand, is based on the cardinal points. With compass bearing, we measure the angle east or west from the north or south (whichever is nearer) turning east or west. The acute angle is always taken.

## Task 1 Developing the concept of bearing

It is always important to assume that some or all learners have some knowledge of and skills on bearing. They acquired these from the topics that deal with construction of angles

and triangles in mathematics and geography. It is important as a teacher to find out learners' prior knowledge on bearing like degree of an angle, clockwise movement of objects and cardinal points of the compass. As a teacher, you need to build on what learners already know in order to teach them effectively.

### Activity 1 Exploring learners' prior knowledge and importance of bearing

1 Develop a task that you will use to solicit learners prior knowledge on the following:
   a) size of angles
   b) position of an angle
   c) units for measuring angles
   d) points on a compass as learnt in geography
2 Discuss the importance of bearing in learners' everyday life.
3 Present your work to the class for discussion.

### Activity 2 Determining primary school curriculum expectations on bearing

Analyse curriculum instructional materials such as syllabuses, learners' books and teachers' guide from the college library or demonstration school.

1 Identify the concepts in the primary curriculum on bearing. Summarise your work in a table.

| Class | Concepts |
|---|---|
| | |

2 Determine the expected knowledge and skills that learners would acquire after learning bearing.
3 Present your work to the class for discussion.

## Task 2 Appropriate methodologies for teaching and learning of bearing

Teaching bearing requires use of appropriate teaching and learning methodologies. Many teachers teach bearing depending on their content and pedagogical knowledge (PCK). Teachers need to understand the instructional materials and skills expected at each level in primary school. In this task, you will explore activities and appropriate teaching and learning methodologies for teaching bearing.

### Activity 1 Teaching how to locate objects using cardinal points and calculate bearing

1 Identify resources that you can use in the teaching and learning of bearing.
2 Discuss how you would teach the following concepts on bearing using the identified teaching and learning resources:
   a. locating objects using cardinal points
   b. calculating bearing
3 Present your ideas in plenary.

### Activity 2 Using technology in the teaching and learning of bearing

1 Suggest ICT resources that can be used in the teaching and learning of bearing.
2 Explore ways of using each of the suggested ICT resources.
3 Demonstrate how you would use the suggested ICT resources in the teaching and learning of bearing.
4 Share your ideas with the class.

**Tips**

- You may refer to online and other relevant sources on how to use ICT resources in the teaching and learning of bearing.
- Modify the activities to accommodate learners with diverse abilities.

### Activity 3 Exploring learners' strategies, misconceptions and errors on bearing

1 Analyse learners' strategies on bearing.
2 Discuss learners' misconceptions and errors on bearing.
3 Suggest possible causes of the misconceptions and errors.
4 Discuss strategies you would use to address the misconceptions and errors.
5 Present your findings to the class for discussions.

**Tips**

- You may use your experiences from your teaching practice to come up with misconceptions and errors.
- You may also analyse learners' work or a video lesson on bearing.

## Task 3 Appropriate techniques to assess learners on bearing

Assessment is an integral part of teaching and learning process. In this task, you will explore appropriate assessment methodologies in the teaching and learning of bearing. This will help you get necessary feedback from your learners and eventually use appropriate methodologies to adequately assist them.

### Activity 1 Discussing appropriate ways of assessing learners on bearing

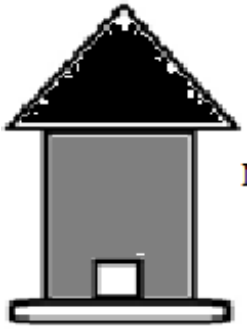
1 Prepare a lesson plan on any concept on bearing.
2 Develop questions based on Bloom's Taxonomy that you would use to assess learners during lesson presentation.
3 Peer teach the lesson.
4 Evaluate the lesson by focusing on levels of questions used.

## Summary

Bearing is the direction of one place from another measured in degrees. A Compass is used to find directions of places. A compass has four cardinal points: north, south, east and west. Bearing is calculated from a point of reference to the direction of an object either clockwise or anticlockwise, for example 60° and N$39^0$ E.

## Reflection and assessment

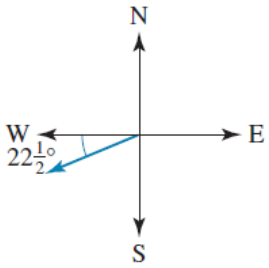
1 Draw a tree to the south west of the following:



2 Explain how you would teach learners to draw diagrams for each of the following bearings:
   a. S$15^0$ W
   b. N$55^0$ W
   c. N$135^0$ E

3 Discuss how you would teach learners to write down the bearing represented in each of the following illustrations:

a.

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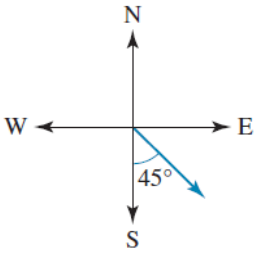
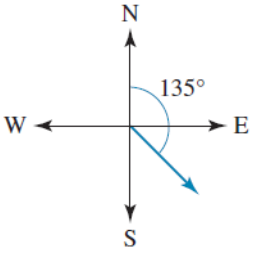
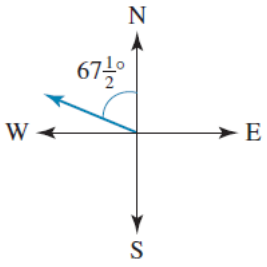



c.




d.




## Glossary

**Bearing** direction from one place to another, measured in degrees

**Compass** an instrument for determining direction an object relative to another

## References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