



TESSA

TEACHER EDUCATION IN SUB SAHARAN AFRICA

OPEN EDUCATIONAL RESOURCES FOR TEACHER EDUCATION IN AFRICA



Module Area: ZAMBIA / Module 2 [NUMERACY/MATHEMATICS] :

Exploring Shape and Space

Section 1:

Exploring shapes

Key Focus Question:

How can you help pupils develop and use a mathematical vocabulary for shape?

Keywords:

object; shape; geometry; language; classification; open-ended activities

Learning Outcomes

By the end of this section, you will have:

- used open-ended sorting activities to explore knowledge of shapes;
- explored practical ways to introduce pupils to the language or 'register' of mathematical terms;
- used practical activities to develop pupils' understanding and use of mathematical descriptions of basic geometric shapes.



Exploring Shape and Space : *Exploring shapes*

Introduction

Investigating shapes or exploring geometry with your pupils can be very rewarding. Using a practical approach and objects from the pupils' environment can help to raise pupils' motivation and interest.

In this section, you use objects from everyday life to help pupils develop important geometrical skills, such as recognising, visualising, describing, sorting, naming, classifying and comparing.

Exploring Shape and Space : *Exploring shapes*

To begin with, you will need to collect a range of resources that you could use for the activities in this section (see **Resource 1: Using feely bags**). It may be helpful to gather and keep a box of such objects as a permanent resource. Your pupils may enjoy helping you collect the resources, and 'looking out for shapes' in everyday life. (Remember to praise the pupils who contribute, and to take the opportunity to discuss the shape of any objects they bring.)

Case Study 1: Planning to study shape

Some primary mathematics teachers in Umtata, South Africa, were planning a geometry scheme of work for the term. As part of their in-service development, they wanted to prepare good, hands-on geometry activities for their pupils.

They decided to invite a mathematics education expert from their nearby higher education institution to help them write their scheme. She agreed, and suggested they start with a sorting activity. They needed to collect as many different objects as possible, such as empty cans, cotton reels, toilet roll tubes and pictures of different shapes in the environment e.g. buildings, fabric patterns and so on. In pairs, they planned an activity using these shapes and tried it themselves.

Back in their classes, the teachers asked their pupils to help them collect similar objects. When they had enough for the pupils to work in groups of five or six, with each group having ten or more different objects to sort, they tried out the activities.

The tasks were all about putting objects into groups that had similar properties, to record what property they shared, and which items had that

Exploring Shape and Space : *Exploring shapes*

property. The teachers were surprised and encouraged by the interest and thinking that the activity produced in their pupils.

At the next in-service meeting, each teacher reported back on what happened.

Activity 1: Helping pupils sort real objects

Collect together as many objects of different shapes as you can. You will need at least two objects for every pupil. You could use pictures of shapes from the environment as well.

- Divide the class into groups of five or six and give each group a selection of objects (see **Resource 1**).
- Explain what a 'set' is –a collection of items with some common features, for example, the class is a 'set' of children, who are all taught by you. This 'large set' can be grouped into smaller sets –one example would be a set of boys, and a set of girls. (You may like to physically separate the pupils into these two sets to illustrate this point.)
- Explain to the groups that they have a set of different objects. You want them to sort these objects into smaller sets. Ask them the following question: How many different ways can you sort these objects into sets? This makes the task an open task, so do not specify how many sets or any criteria.
- Ask them to explain their reasons for their sorting each set.

Exploring Shape and Space : *Exploring shapes*

- As they work, observe them and listen to the discussions they have in their groups, noting carefully what they say. This will help you find out who has clear ideas and who is still exploring the ideas.
- Ask each group to share the different ways they sorted their objects and note the main features on the board.

You may wish to use a double lesson for this activity.

Having introduced the concept of sorting objects, and asking pupils to describe the characteristics in 'everyday' language, it is now time to develop a more mathematical way of describing some of the objects' features.

In every area of activity, people develop special words and terms to describe what they are doing. The special language of mathematics is sometimes referred to as the mathematical register. Introducing pupils to the language of shape will take time and needs to be built into your lessons over time. As your pupils understand the concepts behind the names, this is the time to introduce the mathematical words. As well as using these words in practice, you might also like to ask your pupils to begin making a 'mathematical dictionary' to help them remember the meanings of such terms. **Resource 2: A mathematical dictionary** gives six examples of the kinds of words that pupils might use to describe the shapes they are working with.

Case Study 2: Using mathematical terms to sort objects

Exploring Shape and Space : *Exploring shapes*

Mrs Nsofu asked her pupils to sort a collection of different shaped objects that she had provided. Some pupils decided to group the objects according to where they would be used in the home, such as the bedroom, kitchen and bathroom. Other pupils were looking at whether the objects looked alike. Some groups found it difficult to describe the features of their objects, for example, they said that some shapes were flat, but could only describe the other shapes as 'not flat'.

Drawing the whole class around her, Mrs Nsofu examined some of these problematic 'not flat' objects with the pupils. Not using the mathematical terms at first, she began pointing out certain features (like curves, edges and corners) and asked pupils to describe these in their own words. Then, when a few pupils had described these features, and thought of all the words they could use, Mrs Nsofu began to introduce the correct mathematical terms, and agreed with the class how they would describe such terms in their own words. She explained that they were beginning to learn 'the beautiful language of mathematics' (see **Resource 2** for some terms to use).

Mrs Nsofu made a large sheet for the wall and wrote the new mathematical words on it, and the definitions they had agreed. She asked the pupils to start to write their own mathematical dictionary at the back of their exercise books, drawing diagrams to show the meanings of these words. They added to this dictionary during subsequent mathematics lessons.

Exploring Shape and Space : *Exploring shapes*

Activity 2: Describing shapes

Introduce and practise using words for shapes through a 'sorting' activity (see **Activity 1**).

- Use a game to give pupils more practice. The game should be at the right level of difficulty for your pupils. **Resource 3: Pictures for cards** and **Resource 4: Games** give examples of the kinds of games that can be easily adjusted for different ability levels.
- Use the pictures in **Resource 3** to make sets of cards.
- Using the instructions from **Resource 4**, demonstrate how the games are played.
- Put the pupils into pairs (or small groups if you have a large class) and give each pair/group a set of cards.
- After doing the activity with one set of cards, the sets can be passed around so that everyone has a new set.
- As the pupils play the games, go around the room and monitor what they say. Don't interrupt unless they ask for help, but make a note of anything you want to tell the whole class afterwards.

Exploring Shape and Space : *Exploring shapes*

One way to assess how well your pupils have learned to understand and use language to describe shapes is to use 'feely bags' (see **Resource 1** for more detail). One pupil must carefully describe an object hidden inside a bag. The pupil should use the special words they have learned, and other pupils must try and guess which object is being described.

In this way, pupils have to visualise the shape in the bag, and correctly use the simple geometric terms they have learned, if they are to 'win' in the feely bag game. How you organise this, so that all pupils are engaged in the activity, is important because if done well, the learning of more pupils will be enhanced.

Case Study 3: Playing a feely bag game to practise mathematical terms

Mrs Nsofu made some cloth bags big enough for a pupil's hand to fit into, and with a drawstring around the top to close the bag up.

She put one of the objects from her collection into each bag, having carefully chosen the objects to give variation.

Mrs Nsofu explained the game to her class and chose the pupil who would feel and describe the shape of the object in the first bag. This pupil had to describe the object using their newly learned words. The other pupils had to put their hands up when they thought they knew what the object was. Being able to feel and describe the object in the next feely bag was the reward for the pupil who guessed correctly.

When doing the activity, Mrs Nsofu made sure all the pupils were paying attention, only allowing one to speak at a time so that pupils could think about what each person was saying.

Exploring Shape and Space : *Exploring shapes*

Key Activity: Using a feely bag to think about shapes

First prepare your feely bag or box. You need a bag or box in which you put an object and the pupil can put a hand in to feel the object but not see it (see **Resource 1**).

You could have one feely bag for the class or, if your class is big, have more than one so that several groups can work at once. This will help more pupils participate.

Then proceed with the game.

- One pupil should feel one object in the bag/box and, without taking it out, describe it very carefully to the others. The pupil must not name the object.
- They should say things like, 'it has all flat surfaces, it has so many corners, it has so many flat surfaces,' etc.
- This carries on until one pupil thinks they can name the object.
- If it is the correct answer, the object is pulled out of the bag and the successful pupil is the next to do the feeling (but allowing only one chance per pupil).

Encourage your pupils to use the vocabulary they have learned in the previous activities to describe their objects. Ask them to add them to their mathematical dictionaries.

Resource 1:

Using feely bags



Teacher resource for planning or adapting to use with pupils

Feely bags or boxes, which can easily be made by you or your pupils (see below) can be used across the curriculum to help develop your pupils' observations and language skills. In mathematics, it is good way to help pupils explore the properties of shapes and objects. In science, you might explore the textures of materials. Using a feely bag or box is a great motivator for pupils as the involvement in the game, the need to listen carefully and the desire to guess the right answer excites and interests them.

Suggestions for objects for shapes activities

You may use a selection of cubes (dice, blocks), rectangular prisms (boxes, wooden blocks), triangular prisms (wooden wedges, fancy chocolate boxes), spheres (balls), pyramids (wooden or plastic), cylinders (toilet rolls, pens, dowel sticks), cones (party hats, ice cream cones). You may also like to include one or two irregular or semi-irregular objects (stones, shells, leaves) to provoke discussion. All of these could be collected locally to help to link mathematics to the local environment.

Making a feely bag

For this you could use a paper bag that you cannot see through or you could sew a bag out of fabric about 30 cm by 30 cm with an opening at one end. The top of the bag needs to be able to be closed and opened to put in the objects and to allow the pupil to put in their hand to feel the object but ensure that no one else sees what is in the bag. You could use an elastic band or a drawstring to keep the top closed.

Making a feely box

Any medium-sized cardboard box will do for a feely box. You have to cut a hand-sized opening in one side of the box. This is so that a

pupil can put a hand into the box and pick up something to feel. Some people cut two holes so that a pupil can put two hands into the box to feel for something. You need to keep the opening away from the rest of the class so they cannot see what is in the box.

How to play the game

The idea of the game is to hide some interesting, different things (which are familiar to your pupils) in the feely bag/box. You could use regular shaped bowls or pots, tools, or even tins of food.

A pupil comes to the front and feels for something in the feely bag/box. He/she doesn't take the object out or show it to the other pupils.

Instead, the pupil then thinks very carefully of ways to describe the thing, without mentioning its name. He/she uses the sense of touch to list and describe observations. At the same time, the pupil has to be quite scientific/mathematical. He/she has to consider the properties the object is made of. He/she also has to think carefully about the shape, size and form of the item.

Each time the pupil makes an observation, another pupil in the class is given a chance to try to work out what the object is.

While this is happening, the teacher can act as a scribe (or secretary) and record the observations and the inferences on the board, or on a large sheet of paper. They list the main points only.

This carries on until someone actually works out what the item is. Then the item can be pulled out of the box and is shown to the rest of the class.

It is important that a little time is spent discussing the accuracy of the observations – mathematical language skills, the effectiveness of the descriptions, communication skills and the quality of the inferences.



Resource 2:

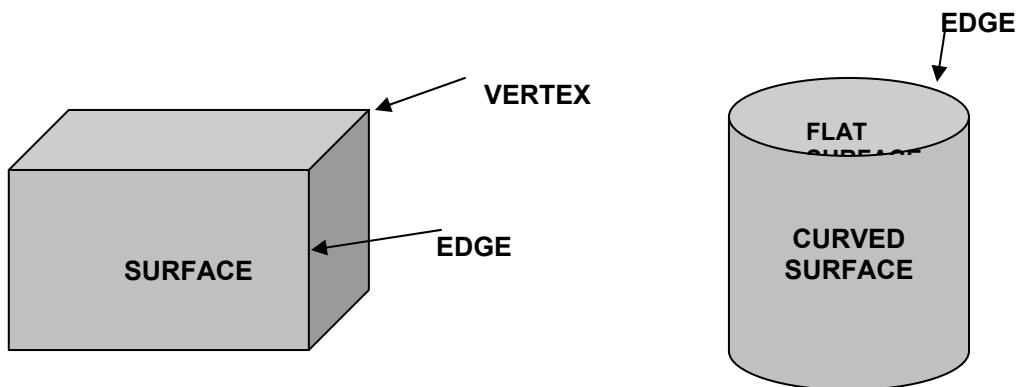
A mathematical dictionary



Teacher resource for planning or adapting to use with pupils

There are many on the market. A good one is published by Oxford University Press.

Here are a few words for geometry



Curved surface

Edge

Surface

Flat surface

Vertex

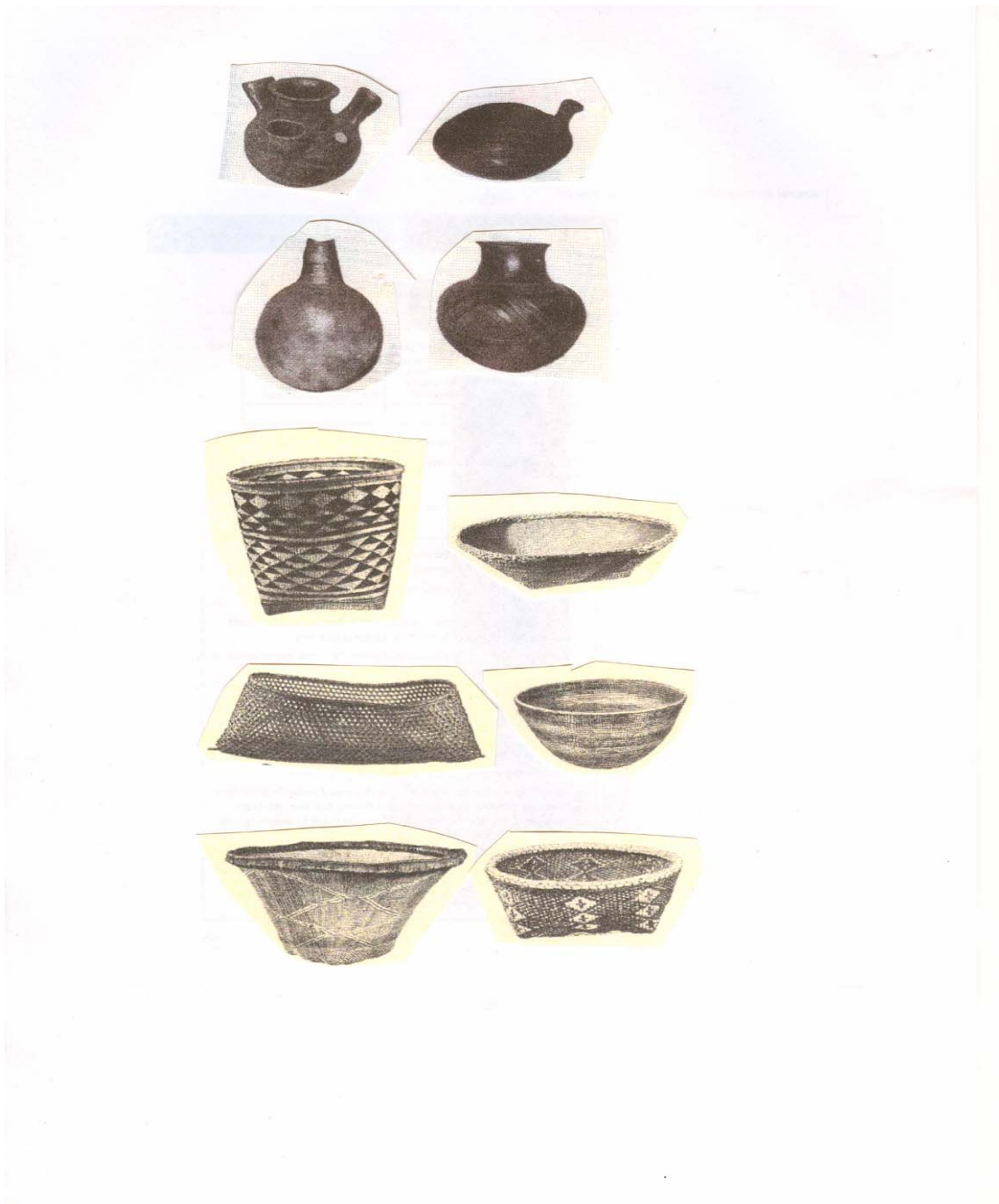
Pupils could fill in their own definitions for each word and check these with their classmates or you if they are not sure their definitions are correct.

Resource 3:

Pictures for cards



Teacher resource for planning or adapting to use with pupils



Exploring Shapes: Resources page 5



Resource 4:

Games



Teacher resource for planning or adapting to use with pupils

Find the difference

Equipment: Pairs of pictures with different, but similar, objects. Each picture should be folded so that it can't be seen by the other player.

Instructions: Without showing their pictures to each other, or using gestures, players describe their pictures and ask each other questions until they identify a given number of differences between them (e.g. three). When they have done this, they reveal their pictures to each other.

Draw it

Equipment: Simple pictures mounted inside a piece of folded card. (The pictures should not be visible to the other player.) Paper and pencil.

Instructions: Without showing his/her picture to the other player, or using gestures, one player describes his/her picture while the other player tries to draw it. When the drawing is finished, the player with the picture shows it to the other one.