FACILITATOR'S GUIDE

2016 TERM 2 TRAINING WORKSHOP

MATHEMATICS

GRADE 4-7

PILO
IMPROVING LEARNER PERFORMANCE

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Just-in-Time Training Workshop
Term 2

Facilitator's Guide

Grade 4 – 7 Mathematics

Jika iMfundo
what I do matters

Programme 5 – 6 hours

Session 1: 1 hour
Focus of workshop, the tracker, links to previous work

PRE-TEST FOR TEACHERS

As participants come into the workshop, give them the Pre-test for teachers. It is a quick test that will take them only 15 minutes to complete. They do not have to put their names on it. If latecomers come in, give them the test as they arrive, unless they are very late.

Ask a participant to collect the tests and explain that the test gives the project a sense of how much learning is happening in workshops and that they will complete another quick test at the end of the workshop. Don't let them know that it is the same test!

Introduce yourself and your involvement with *Jika iMfundo.* Have a positive outlook that the trackers and the workshops have been making a difference in the schools in your district. Give an example of your own experience in a workshop, or in the schools.

1.1 Sharing your experiences

Ask participants to share with someone sitting next to them. If you have started the workshop on time, then there is time to get some feedback to the whole group from a few teachers.

1.2 Notes about training

- Go through the points made in the participants' handout.
- Note that Appendix 1 and Appendix 2 contain some of the notes covered in the Grade 4 workshop and that we will refer to them during this workshop.

1.3 Using the Tracker

This is a very brief check that participants are familiar with the Tracker and know how to find their way around it. So we are only using it to remind participants about how to use the Tracker with their textbooks and with their Year Plan (or Term Plan).

1.4 What we know already about Shape and Space

Go through the points made here. The points are focused on teaching of shape and space, without being specific to any topic. They serve as a reminder about the spirit in which we approach these concepts.

1.5 What is the difference between shapes and objects?

Emphasise that, in the classroom, teachers and learners need to refer to shapes and objects, not to 2-D and 3-D, because the word "dimension" is not well understood and it is not necessary for understanding shapes and objects.

Remind participants of the meaning of polygon and **polyhedron** (plural: polyhedral). A polyhedron is a solid with flat surfaces. **Prisms** and **pyramids** are polyhedra.

Note: A circle is not a polygon. A cylinder is not usually accepted as a prism (or a polyhedron). CAPS discusses cylinders and cones separately from the pyramids and prisms that we study.

1.6 Pictures of 3-D objects

- This needs discussion with a partner. Don't just tell participants! Ask them to work through the notes about the cube and answer the questions about drawings of 3-D objects.
- After the discussion, participants should study what CAPS says about drawing 3-D objects across the grades. Note how the Grade 4 work is extended in Grades 5 and 6.

Answers
Object A has 2 octagon shapes and 8 rectangular shapes = 10 faces

Participants need to point out front, back, inside, outside on the drawings. In object A, the grey face appears to be on the left and outside of the object; the other octagonal face that we see appears to be on the right and inside the object. Point out that it is usual to indicate the back lines with dotted lines.

A is an octagonal prism; B is a hexagonal prism (note the "bases" are actually on the sides); C is also an octagonal prism.

It is important that learners see these prisms in different orientations and sizes. They should not only see the regular polyhedral. Object B is regular.

Session 2: Exploring and discovering the properties of shapes and objects 1½ hours

2.1 Making solids from nets

Please ensure that you have enough scissors, glue and sellotape for this session. Participants use the nets that are included in their handouts.

Participants should work in groups of 8 – 10 teachers. We start this session with making models from nets. Each group member makes one object using a different net from the set of nets, so that the group has one of each object by the end of the activity.

The set includes (in this order in the handout):

triangular prism; cone; square based pyramid; cube; rectangular based pyramid; pentagonal pyramid; hexagonal pyramid; rectangular prism; tetrahedron.

A net for a cylinder is attached to these notes (it was left out of the pack for participants)

In the classroom, it is encouraged to start from 3-D objects such as boxes and cut them open to discover the net. However, in the workshop, we are not able to provide enough objects for participants to cut open. Instead, we create the objects from the nets.

If participants want to keep their nets for use at school, they will need to trace the outline of one of their nets onto blank paper and use this in the workshop.

Try to limit this activity to 15 minutes.

2.2 Properties of objects

Note: In the teacher's classroom, this game can be played in groups, or in the whole class with the objects displayed in front of the class and asking a few learners. If the teacher has some plastic solids in the classroom, she can put them in a "feely" bag. A learner has to feel a solid in the bag and describe it for others to guess what it is.

The purpose of trying to describe the objects without mathematical terminology is to demonstrate how useful it is to know the terms and names used in mathematics. This is social knowledge (needs to be learnt), but it can be learnt in a practical way, not by rote learning a list of terms.

The first game needs to be adapted for different grades according to CAPS requirements. So, for example, only Grade 6 learners need to describe objects in terms of their angle sizes.

2.3 Further knowledge for teachers

a. This list is not limited to number of edges, number of faces, number of vertices. It can include regular/irregular, right angles, no angles, all lengths equal etc.

b. The three kinds of knowledge overlap in this activity and they are all useful for learning.

The building and making of objects is **physical knowledge**, but in the process of making, learners are learning about the properties of shapes and objects in an intuitive way (what shapes fit together; straight sides are easier to fit together; opposite sides of the shape are equal etc)

The terms needed to describe shapes, objects and their properties are **social knowledge**, but the naming has a logic (conceptual knowledge) to it so that it is not necessary to learn everything by rote.

The process of answering questions about the properties requires **conceptual knowledge**.

c. The Van Hiele level 1 is used to recognise shapes and objects and the names given to them. Level 2 is used when describing the properties of the shapes and objects. There is some use of level 3 in the describing and reasoning, but this is clearer in the second game than in the first game.

Naming 3-D objects: language clues

Teachers can construct this list quite easily. Learners need to recognise the basic difference between any prism and any pyramid (rectangular faces joining two base shapes; triangular faces meeting at the apex) and then use *tri-; quad-; penta- etc* according to the shapes and number of edges in the objects.

Some participants may have useful links to the names of shapes and objects in other South African languages.

2.4 Grouping objects according to properties

These kinds of questions encourage learners to develop reasoning skills. Any activity that includes categorising information into groups involve a reasoning skill at Level 3 of Van Hiele.

2.5 Reasoning about 3-D objects

These questions are based on the set of 3-models that each group has made.

Answers:

a) Cube; rectangular prism; square based pyramid
b) Square based pyramid
c) Cube; rectangular prism; triangular prism – they have two faces of the same shape, joined by rectangular faces.
d) Triangular prism; tetrahedron; square based pyramid; hexagonal pyramid; pentagonal prism.
e) As in d), excluding the triangular prism
f) Triangular prism; square based pyramid (a square is a kind of rectangle!)
g) This is not possible because an object with a triangular base needs to be completed either with triangular faces to make a tetrahedron, or with rectangles and another triangle base for a triangular prism.
However, it could be argued that the triangular prism could be open, without a second triangle.
h) No, it can be open. For example, any containers that can be filled with a liquid are still solids. It can be closed, but empty inside. For example, a vacuum sealed container that contains air.
i) Square
j) Equilateral triangle (this term is only learnt in Grade 7)
k) A pyramid has triangular faces that join at a point or apex and only one base shape. A prism has rectangular faces that join two bases that are the same size and shape.
l) A pyramid's net will always have triangular faces and one base shape; a prism's net will have rectangular faces and two base shapes.
m) The shape of the base; the number of triangular faces needed; the name of the pyramid.
n) The shape of the base; the number of rectangular faces needed; the name of the prism.

2.6 Drawing shapes

Teachers can start this activity, but if it is clear that they don't need much help, they can finish it in their own time.

2.7 Overview of properties of 3-D objects

This activity is seen in most textbooks. If participants are about these properties, they can finish in their own time. The important thing is to note that this activity on its own, is not enough experience of objects for learners!

Session 3: Quadrilaterals 15 minutes

If you are not able to provide straws or sticks, ask teachers to make four strips of paper of differing lengths. In their groups, they must exchange a strip with another group member, and exchange again with another group member. This way, they should end up with different lengths of strips to make a closed shape with four sides.

Some teachers will need some time to think about the discovery that squares and rectangles are types of quadrilaterals.

The questions at the bottom of page 13 require a simple logic to answer.

Session 4: Misconceptions 20 minutes

In order to ensure that learners are really understanding shape, space and measurement concepts, we look at what things are often misunderstood, why this happens and how to teach so that there is better understanding.

Refer teachers to the article in Appendix C about common misconceptions. The discussion here focuses on misconceptions 2, 9 and 12, but you will notice that we have already dealt with some of the other misconceptions. Partners need to focus on how to modify their teaching so as to avoid these misconceptions developing.

Grade 7 teachers should focus on misconceptions numbered 1, 3, 6, 7 and 13.

The bullet points after question 2 summarise the key ways to improve teaching of these concepts.

Activity: Looking for shapes in the classroom

The conversation between a teacher and her students shown here provides an excellent model for asking learners to explain themselves and a model of the way a teacher can use language accurately and lead learners on to introduce new concepts to them.

Ask teachers to rate their own teaching on the scale provided in terms of discovery and teaching.

The quote provide is very important: *Activity is not enough; it is the sense we make of it that matters.*

Session 5: Year Plan and CAPS 30 minutes

1. In pairs, teachers should reflect on the year plan provided, which only shows the topics for Shape, space and measurement. Let them read through the points made and reflect on them.
2. Teachers talk through the key developments using the table provided.
3. Drawing of 2-D shapes and creating 3-D models: This is emphasised across the grades. It is more accurate to draw shapes on a squared grid, or on dotty paper, so that angles and lengths are accurate. It is an important part of experiencing shape in order to understand the properties. Creating 3-D models is just as important and must be part of a teacher's plans, otherwise she is not covering the curriculum! Use cardboard boxes to create cut out polygons and use the nets provided here. a. and b. serve to remind us again of how important practical experience is! Teachers refer to the tables to note the grades and levels for questions c. to f.

Session 6: Measurement 40 minutes

6.1 Measuring tools

Not having all the measuring tools does not prevent teachers from discussing them and what they are used for. Your textbooks provide enough information about this. As far as possible, they should at least be demonstrated in the class. If possible, learners need to have activities to do using these tools.

6.2 Units of measurement:

This is another example of social knowledge based on a logical progression of measurements.

Note for Grade 7:

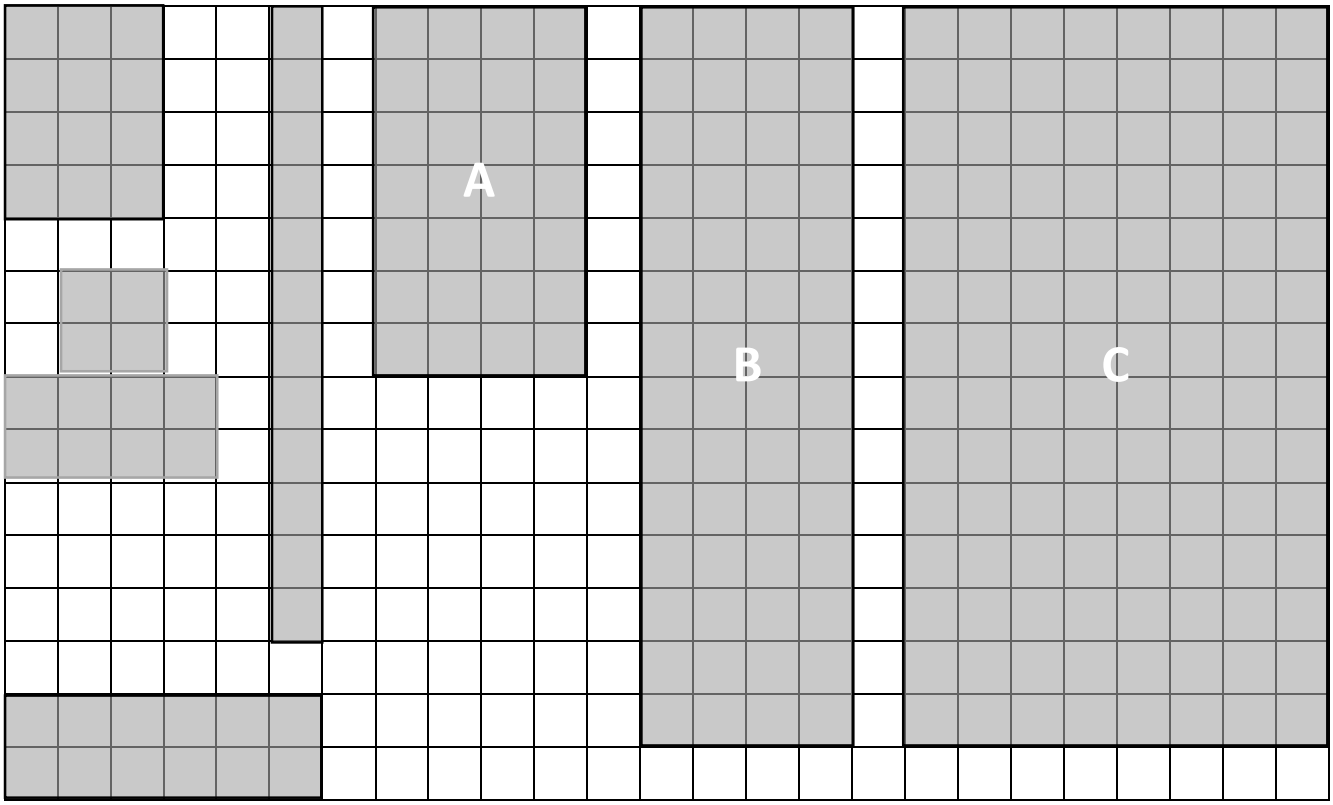
1 cm^2 = 10 mm × 10 mm = 100 mm^2 1 cm^3 = 10 mm × 10 mm × 10 mm = 1 000 mm^3

1 m^2 = 100 cm × 100 cm = 10 000 cm^2 1 m^3 = 100 cm × 100 cm × 100 cm = 1 000 000 cm^3

Length, perimeter and area

Here is an example of what kind of answers to expect. The shapes made will differ for each participant, but the calculations will be the same. If participants find that they do not have enough blocks on their square grids, they can draw one shape over another!

1. Perimeters (from top left to bottom): 14 cm; 26 cm; 16 cm; 16 cm.
   Areas are all 12 square units because we constructed them like that. So the perimeter changes depending on the type of shape, even when the area remains the same.
2. Area: 28 cm^2 (or square units) Perimeter: 22 cm (or units)
3. Area Rectangle B: 56 cm^2 because the length has doubled so it is the size of two of Rectangle A.
   Perimeter Rectangle B: 36 cm.
   We have added 7 cm to each of the longer sides, so we add 22 + 14 = 36.
4. Area Rectangle C: 112 cm^2 We have doubled length and doubled the breadth of Rectangle A.
   This makes 4 rectangles the size of Rectangle A. So we need to multiply 28 × 4 = 112.
   Rectangle B is half the size of Rectangle C.
   Perimeter of Rectangle C: 44 cm



POST-TEST FOR TEACHERS: Hand out copies of the same test as the pre-test. Make sure you collect them and keep them separate from the pre-test collected at the beginning of the workshop.

Session 7: Reflection and evaluation 20 minutes

There is enough time in this workshop to cover every session and to make time for this reflection at the end. Encourage participants to reflect because learning stays with us for longer when we reflect on it. Give them time to summarise their learning and to complete the table provided.

Ask for some participants to share their reflections with their group, or with the whole group. Ask for feedback about anything about space, shape and measurement that participants are still wanting to know, or want clarity about.