



هيئة التعليم

EDUCATION INSTITUTE

Mathematics workshop 1 for teachers of Grades 1 to 12

Teacher's pack: Part 2

Developed for the Education Institute by CfBT

Acknowledgements

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Introduction

Aims of the workshop

The purpose of the five-day mathematics workshops is to consider the curriculum standards for mathematics and to discuss the implications for planning the curriculum, teaching, learning and assessment.

The workshops aim to help teachers to:

- become more familiar with the new curriculum standards;
- consider further the implications of the standards for planning, teaching and assessment;
- start or refine the planning of a mathematics scheme of work based on the standards, and related lesson plans;
- support their colleagues as they implement the standards.

Throughout the workshop, time is allowed for you to study sections of the curriculum standards, to consider points for action arising from the sessions, and to make brief notes.

Workshop programme

Day 1: Using the standards

| | | |
|--------------------------|---|------------|
| 08:00 | Registration | |
| Session 1 08:30–10:00 | The mathematics standards General introduction to the standards | 90 minutes |
| Session 2 10:30–12:00 | Teaching and learning 1 Characteristics of effective teaching | 90 minutes |
| Session 3 13:00–14:30 | Planning 1 Planning an overview of a year's teaching based on the standards | 90 minutes |
| Session 4 15:00–16:30 | The reasoning and problem solving strand | 90 minutes |

Day 2: The shape of lessons and effective teaching

| | | |
|--------------------------|---|------------|
| 10:45 | Registration | |
| Session 5 11:10–12:30 | Teaching and learning 2 Beginning lessons | 80 minutes |
| Session 6 13:30–14:50 | Teaching and learning 3 Main teaching activities | 80 minutes |
| Session 7 15:10–16:30 | Teaching and learning 4 Ending lessons | 80 minutes |

Day 3: Planning a unit of work

| | | |
|---------------------------|--|------------|
| 10:45 | Registration | |
| Session 8 11:10–12:30 | Planning 2 Planning a unit of work | 80 minutes |
| Session 9 13:30–14:50 | Continued | 80 minutes |
| Session 10 15:10–16:30 | Assessment Planning assessment activities | 80 minutes |

Day 4: Planning a lesson

| | | |
|---------------------------|---|------------|
| 10:45 | Registration | |
| Session 11 11:10–12:30 | Planning 3 Planning a lesson | 80 minutes |
| Session 12 13:30–14:50 | Continued | 80 minutes |
| Session 13 15:10–16:30 | Selecting resources Evaluating textbooks | 80 minutes |

Day 5: Leading developments

| | | |
|---------------------------|--|------------|
| 10:45 | Registration | |
| Session 14 11:10–12:30 | Leading developments 1 Establishing the role of the subject leader | 80 minutes |
| Session 15 13:30–14:50 | Leading developments 2 Practising microteaching and evaluating lessons | 80 minutes |
| Session 16 15:10–16:30 | Leading developments 3 Action planning and summing up | 80 minutes |

A quiz about the mathematics standards

Handout 1.1a

You have up to 10 minutes to find the answers to as many as possible of the following questions.

Primary schools

| | | |
|----|--|--|
| 1 | What subjects are covered by the new curriculum standards? | |
| 2 | How many strands are there for the mathematics standards? | |
| 3 | What is the recommended minimum number of hours per year for teaching mathematics in Grade 2? | |
| 4 | What is the fifth aim of teaching mathematics listed in the standards? | |
| 5 | How do you recognise the key performance standards? | |
| 6 | What is the recommended percentage of teaching time for <i>geometry and measures</i> in Grade 6? | |
| 7 | How much of the teaching and assessment of number and algebra, geometry and measures and data handling should be devoted to <i>reasoning and problem solving</i> in Grade 2? | |
| 8 | In which grade are students first expected to add and subtract any pair of two-digit numbers mentally? | |
| 9 | When is the use of a basic calculator first introduced? | |
| 10 | What is the name of the sorting diagram shown in the standards for Grade 1? | |
| 11 | Would students in Grade 4 be tested on their ability to find the perimeter of an irregular polygon with whole-number sides? | |
| 12 | When are students first expected to know their multiplication tables to 10×10 ? | |
| 13 | Would students in Grade 5 be tested on their ability to use 24-hour clock times? | |
| 14 | Are students in Grade 6 expected to construct pie charts (circle graphs)? | |

A quiz about the mathematics standards

Handout 1.1b

You have up to 10 minutes to find the answers to as many as possible of the following questions.

Preparatory and secondary schools

| | | |
|----|---|--|
| 1 | What subjects are covered by the new curriculum standards? | |
| 2 | How many strands are there for the mathematics standards? | |
| 3 | Which strand is not included in the advanced mathematics for science standards for Grade 12? | |
| 4 | What is the recommended minimum number of hours per year for teaching mathematics in Grade 9? | |
| 5 | What is the fifth aim of teaching mathematics listed in the standards? | |
| 6 | How do you recognise the key performance standards? | |
| 7 | What is the recommended percentage of teaching time for <i>geometry and measures</i> in Grade 7? | |
| 8 | How much of the teaching and assessment of number and algebra, geometry and measures and data handling should be devoted to <i>reasoning and problem solving</i> in Grade 10? | |
| 9 | When is calculus first introduced? | |
| 10 | When is the use of a graphics calculator first required in a standard? | |
| 11 | Would students in Grade 9 be tested on scatter diagrams and lines of best fit? | |
| 12 | Are students on a Grade 12 foundation course expected to understand exponential growth and decay? | |
| 13 | In which grade are students expected to know a proof of Pythagoras' theorem? | |
| 14 | In which grade do students first meet π ? | |

1 Identify examples from the video lesson. In this lesson, does the teacher ...?

| | |
|---|--|
| Instruct, direct and tell | |
| Demonstrate, model and 'show how' | |
| Explain, clarify and illustrate | |
| Interact, question and lead discussion | |
| Summarise key teaching points | |
| Review progress, assess and give feedback | |

2 Identify examples from the video lesson. In this lesson, do the students ...?

| | |
|-------------------------------------|--|
| Explore, investigate and experiment | |
| Create, invent and use imagination | |
| Enquire and research | |
| Analyse and process information | |
| Explain and reason | |
| Recount and recall | |
| Practise and consolidate | |
| Reflect, criticise and evaluate | |

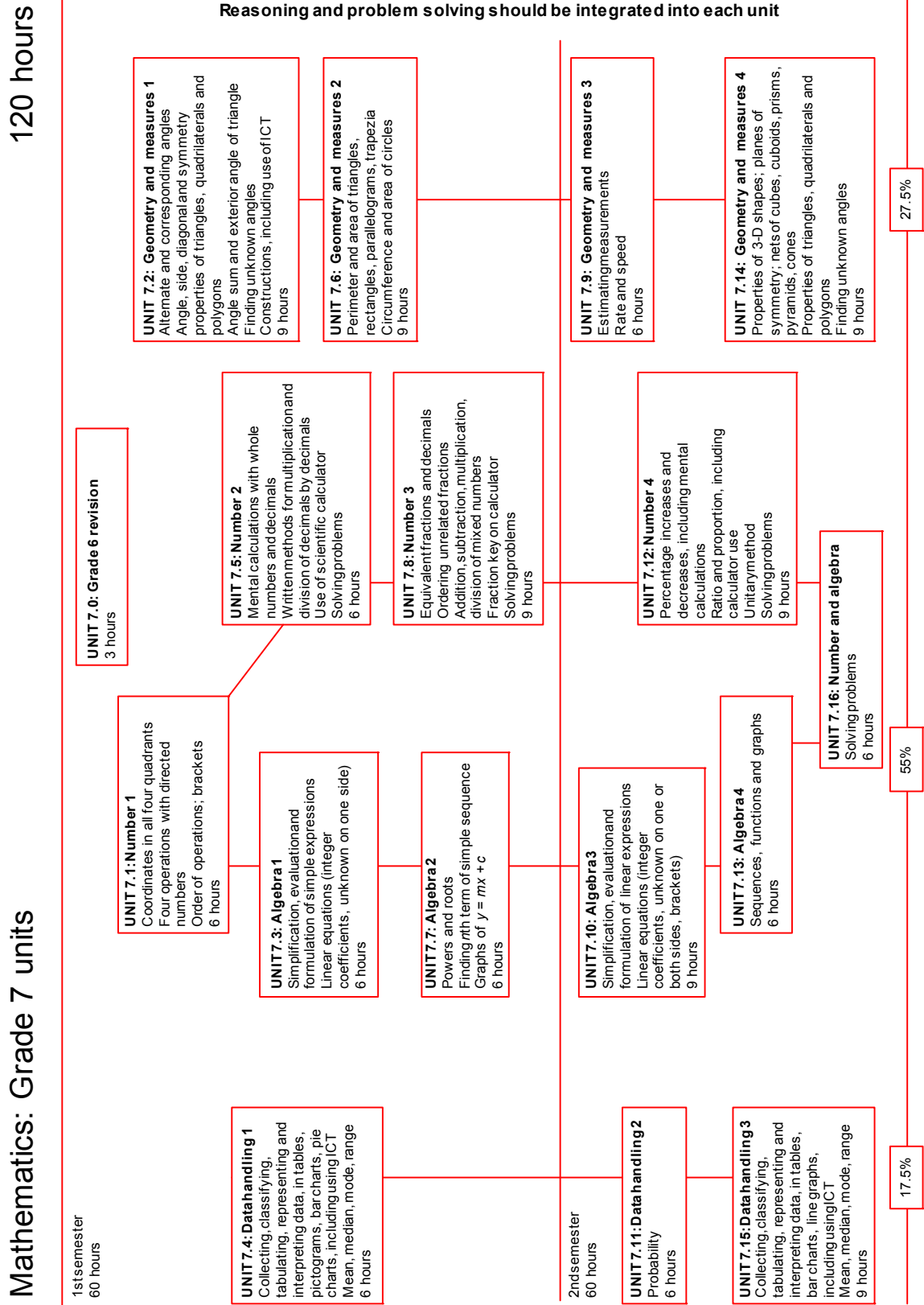
An effective teacher:

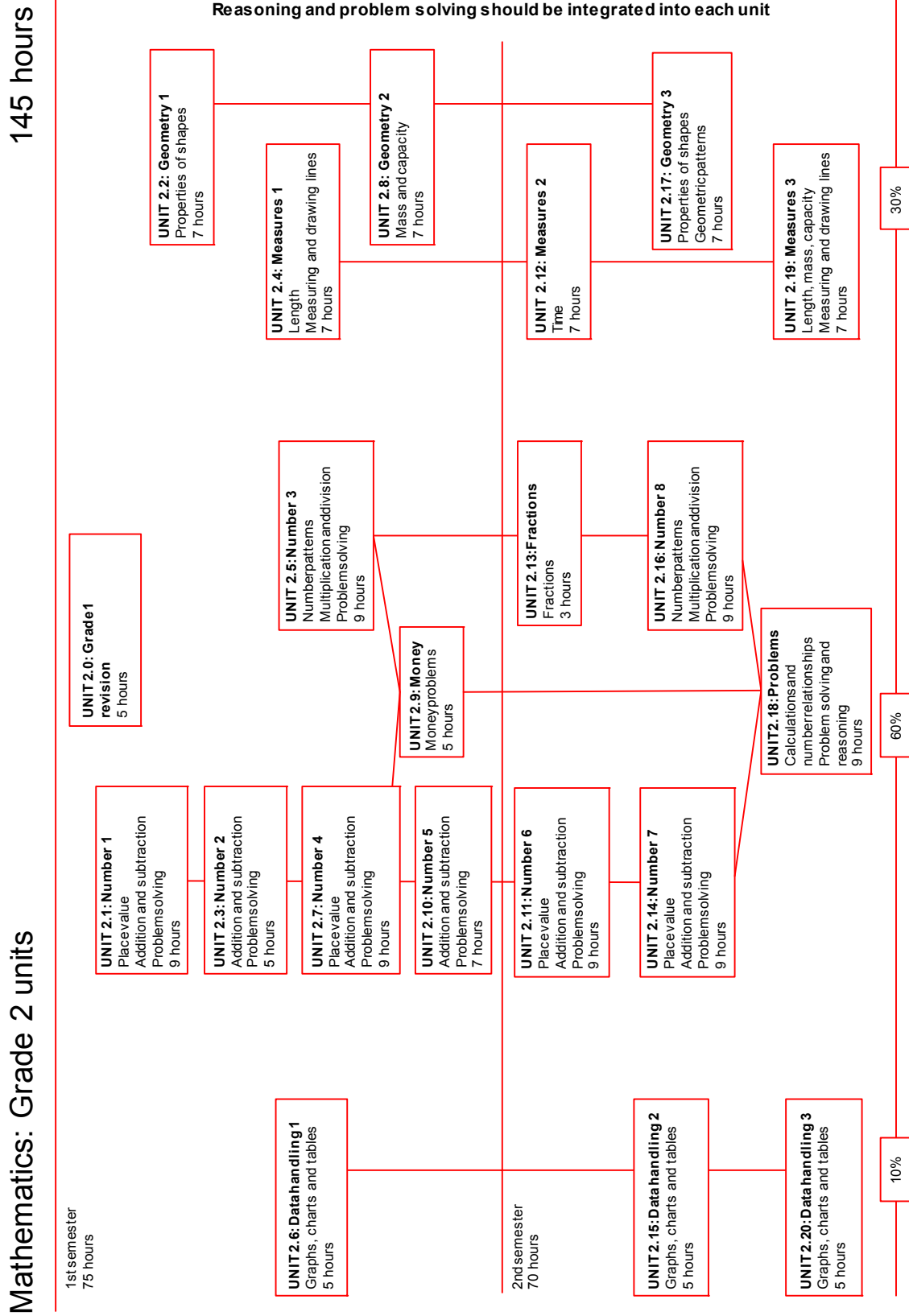
- has clear objectives for each lesson and explains them to students;
- conveys to students an interest in and enthusiasm for the subject, and gives them confidence that they can succeed;
- introduces new topics in well-planned stages, using a combination of demonstration, modelling, instruction, explanation and discussion;
- interacts with students, questions them effectively, gives them time to think, and expects them to explain and justify their answers;
- offers students stimulating tasks that interest and involve them, including:
 - practical work and problem solving to develop students' investigative and enquiry skills and ability to think for themselves;
 - oral and mental work to develop and secure students' speaking and listening skills, their use of technical terms, their recall skills, and their abilities to imagine, visualise and predict;
 - varied reading and writing activities to consolidate and extend the teaching and to further students' communication skills;
- ensures that students have balanced opportunities to work as a whole class, collaboratively in small groups or pairs, or independently as individuals;
- gives extension tasks or extra support to students who need them;
- makes effective use of a range of resources to support teaching and learning, including regular use of information and communication technology (ICT);
- makes links within mathematics, to other school subjects and to the real world, to show students how ideas are often dependent on each other;
- gives all students time to reflect on their learning.

Extract from *Sample lesson plans for mathematics: Grades 1 to 12* (page 10)

How will you encourage mathematics teachers in your school to:

- plan lessons that ensure that students take part actively and do more than listen, give short answers to oral questions and write;
- plan a variety of teaching and learning activities over time (e.g. over the course of a unit of work)?





Grade 7 Unit 7.2: Geometry and measures 1

Objectives for the unit

Unit 7.2: Geometry and measures 1

| | SUPPORTING STANDARDS including Grade 6 standards | CORE STANDARDS Grade 7 standards | EXTENSION STANDARDS including Grade 8 standards |
|--|---|---|--|
| 9 hours | | | |
| 3 hours | 6.8.3 Use the labelling conventions for angles, lines and geometric figures. 6.8.4 Identify angles in a straight line, at a point and vertically opposite angles. | 7.9.1 Identify, sketch, label and describe angle, side, diagonal and symmetry properties of plane shapes: <ul style="list-style-type: none"> triangles (isosceles, equilateral, right-angled, acute- and obtuse-angled scalene triangle); quadrilaterals (square, rectangle, parallelogram, rhombus, trapezium, kite); polygons (pentagon, hexagon, octagon, decagon). | 8.6.2 Identify reflection and rotation symmetry properties of 2-D shapes, including triangles, quadrilaterals and regular polygons, and draw 2-D symmetrical figures. |
| 3 hours | 6.8.6 Identify equal lengths or find unknown angles in geometric figures, involving: <ul style="list-style-type: none"> angles in a straight line, around a point or vertically opposite angles; the angle sum of a triangle; side or angle properties of an isosceles, equilateral, right-angled and scalene triangle; side or angle properties of a square, rectangle or parallelogram. | 7.9.2 Calculate unknown angles in geometric figures, involving: <ul style="list-style-type: none"> angles in a straight line, around a point or vertically opposite angles; corresponding, alternate and supplementary angles; side or angle properties of isosceles, equilateral, right-angled and scalene triangles, including the angle sum and exterior angle properties; side or angle properties of squares, rectangles, parallelograms and rhombuses, including angle properties related to their diagonals; angle bisectors and perpendicular bisectors. | 8.6.1 Calculate interior and exterior angles of polygons. 8.6.3 Use knowledge of angle properties of intersecting and parallel lines, and of the angle, side and symmetry properties of triangles, quadrilaterals and polygons, to conjecture or deduce properties in a given figure. |
| Angles, shapes and geometric reasoning | | 7.1.3 Present and explain solutions and conclusions in the context of the original problem, orally and in writing. 7.1.4 Use logical reasoning to establish the truth of a statement. | 8.1.4 Present a concise, reasoned argument orally and in writing. 8.1.5 Use step-by-step reasoning to deduce properties or relationships in a given geometrical figure. |
| 3 hours | 6.8.8 Use ruler, protractor and set square to: <ul style="list-style-type: none"> measure and draw angles; draw perpendicular and parallel lines; draw rectangles and squares. | 7.9.4 Use a ruler, set square, protractor and compasses to: <ul style="list-style-type: none"> measure and draw line segments and angles; draw parallel and perpendicular lines; draw circles and arcs; construct angle bisectors and perpendicular bisectors; construct simple geometric figures from given data. | 8.6.8 Use ruler, set square, protractor and compasses to construct geometrical figures from given data, on paper and using ICT. |
| Constructions | 6.8.7 Use a ruler and protractor to construct a triangle: <ul style="list-style-type: none"> given two angles and the included side; given two sides and the included angle. | 7.9.5 Use ICT to generate and explore constructions. | |

Objectives for a unit

Handout 3.5

| Unit hours / lessons | EXTENSION STANDARDS including Grade standards |
|--|---|
| | |
| CORE STANDARDS Grade standards | |
| | |
| SUPPORTING STANDARDS including Grade standards | |
| | |
| Topics and time | |

Sixes are banned

Handout 4.1

The 6 key on your calculator is broken.

Find answers to the calculations below.

Work out how to do each one before trying on your calculator.

Record the calculation that you do.

1 $32 + 16$

2 $126 - 58$

3 48×6

4 $146 \div 7$

5 62×16

6 $263 - 76$

7 $263 \div 62$

8 36×0.6

Make up some more calculations like this, and record the calculation that you would do.

What skills did you use?

Handout 4.2

Reasoning

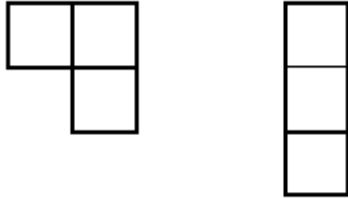
Communicating

Problem solving

Handout 4.3 will be given out during Session 4.

Activity 1

Triominoes are shapes made from three identical squares touching edge to edge. There are just two triominoes, discounting reflections and rotations.



Tetrominoes are shapes made from four identical squares touching edge to edge. How many tetrominoes are there?

Activity 2

Discuss the truth of the statement ‘Multiplication makes a number bigger’.

Activity 3

The perimeter of a triangle is 48 cm.
The length of the shortest side is x cm and of another side is $2x$ cm.
Prove that $8 < x < 12$.

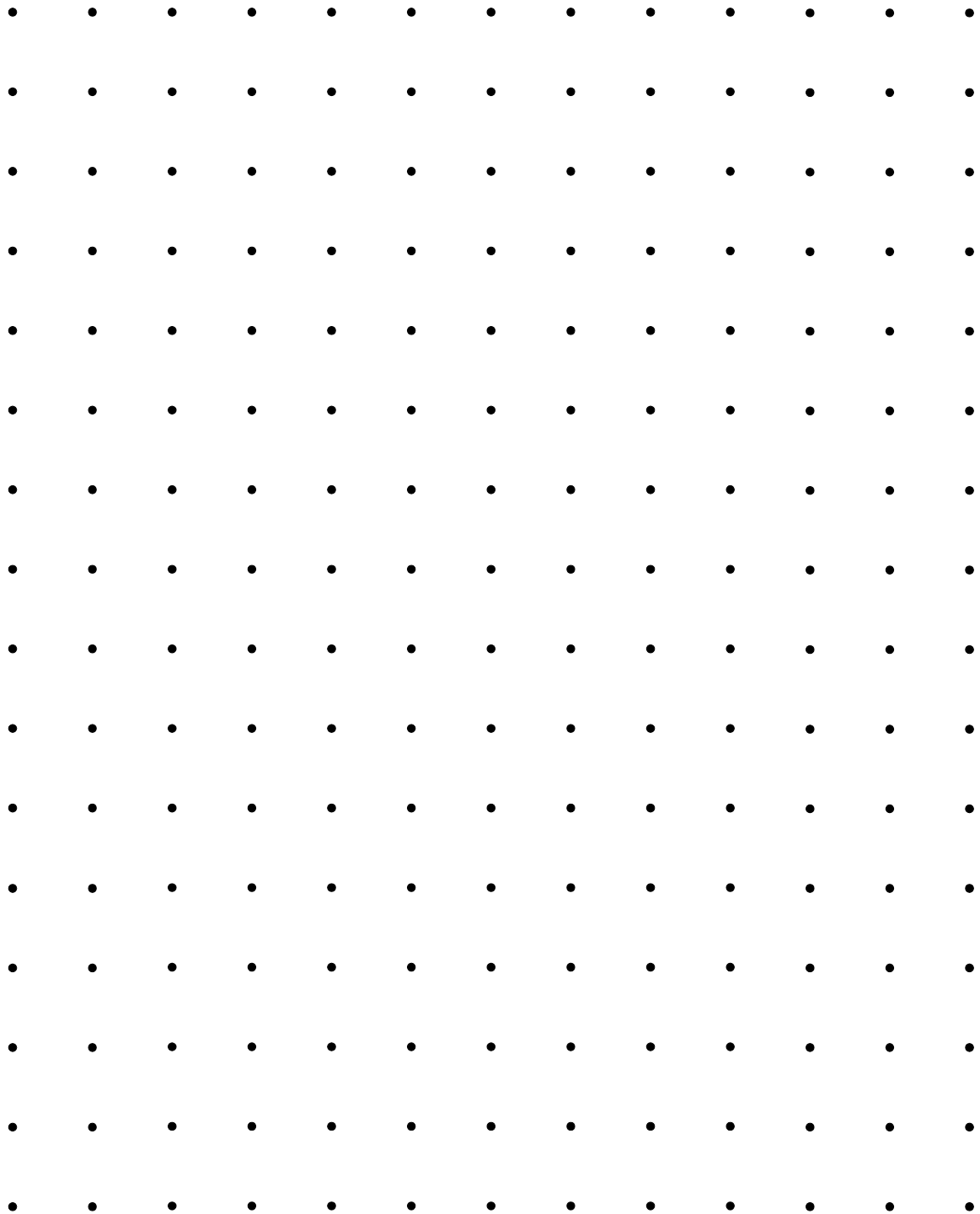
Activity 4: Perimeter dots

Draw some polygons that have only one dot inside them.

Investigate the relationship between the number of dots on the perimeter of each polygon and its area.

Now investigate the relationship for polygons with two dots inside them.

If you have time, find a relationship between the area of a polygon with 12 dots on its perimeter and the number of dots inside it.



Work in school groups. Make notes of the tasks that you need to go away and do.

What are the main points of today's sessions that you will discuss with your principal?

| |
|--|
| |
|--|

What points about today's session will you discuss with your colleagues?

| |
|--|
| |
|--|

When and how will you strengthen your colleagues' understanding of the standards?

| |
|--|
| |
|--|

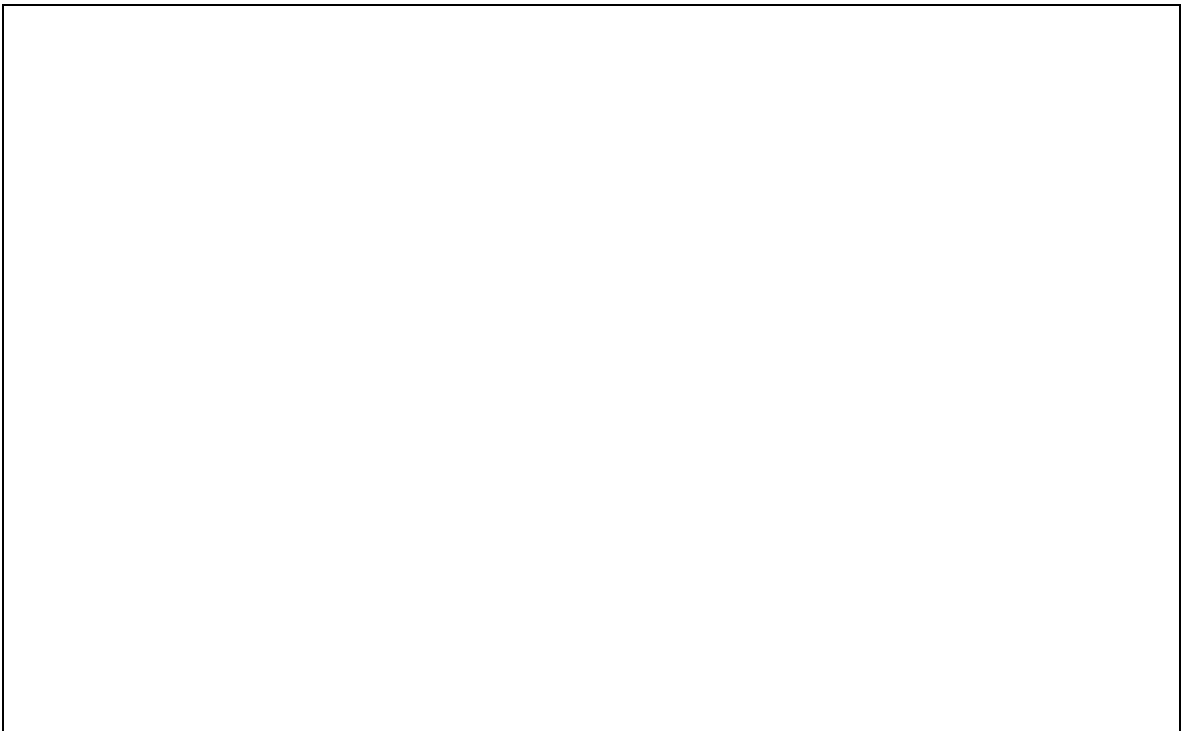
When and how will you refine your scheme of work?

| |
|--|
| |
|--|

- 1 Suggest ways of getting a lesson off to a good start and focusing students' attention.



- 2 Suggest ways of ending a lesson effectively.



Video task

To what extent did teachers in the video clip:

- have high expectations of students?
- provide a purposeful start of the lesson and identify clear learning outcomes?
- ensure that all students could and did take an active part in the lesson?
- prepare a range of open and closed questions, suitably differentiated?
- target individuals, pairs or small groups with particular questions?
- use students' responses to make an informal assessment of their progress?

Examples of oral and mental work

Handout 5.3

Identify examples of these oral and mental starter activities in *Sample lesson plans for mathematics: Grades 1 to 12*. Add more examples of your own.

| | |
|---|--|
| Recalling mathematical facts | |
| Explaining mental calculation strategies | |
| Using approximations to estimate | |
| Applying number facts and calculation skills in real-world situations | |
| Estimating or converting measurements | |
| Linking the laws of number and algebra | |
| Visualising shapes, movements and constructions | |
| Drawing inferences from data in a variety of forms | |
| Using correct mathematical terms | |
| Generalising, reasoning and proving | |

In effective teaching of the main part of the lesson, teachers:

- share the objectives of the lesson with students to set expectations and make connections;
- give clear explanations, illustrations and demonstrations, and use resources effectively to help students to visualise;
- involve students through discussion and questioning, and providing opportunities for students to demonstrate, explain and justify their methods and solutions, orally and in writing;
- pitch the work at an appropriate level for the class, ensuring challenge and success;
- address students' mistakes and misunderstandings as they arise;
- promote problem solving and reasoning skills;
- manage the lesson well, including pace and purpose.

Video task

To what extent were the features of effective teaching evident in the video lessons?

Hazards of ends of lessons

Handout 7.1

| | |
|--|--|
| Class time runs short | |
| Students don't treat it seriously | |
| It's always the same routine | |
| 'Show and tell' sessions result in low-level exchanges | |
| The learning that has taken place is not drawn out | |

- 1 Plan the plenary or consolidation phase as a distinct element of the lesson specifically designed to help teach the lesson's objectives.
- 2 Choose activities for the consolidation phase that best fit the lesson's purposes. Aim to incorporate higher order skills from the reasoning and problem solving strand.
- 3 Expect all students to contribute to and be involved in the plenary or consolidation phase.
- 4 Provide opportunities for students to review and clarify their learning.
- 5 Allow and encourage reflection on *what* has been learned and *how*.
- 6 Use the time to identify and correct errors and misconceptions.
- 7 Use varied strategies rather than a repeated routine.
- 8 Extend students' feedback and avoid low-level reiteration by probing and extending questioning. For example, ask students to explain, justify and prove, ...
- 9 Help students to generalise what they have learned so that it can be applied in new contexts.
- 10 Make sure that the plenary or consolidation phase draws out the progress made in the current lesson and extends thinking further, particularly over a series of plenaries.
- 11 Develop students' strategies to organise and remember what they have learned.
- 12 Make sure that the place of the plenary is secure – ensure that the time needed is not taken up by other activity.

The consolidation phase can be used effectively to:

- **review the lesson's objectives and summarise key learning points**
review the learning objectives for the lesson, and draw together the key points that students should know and be able to recall;
- **consolidate, reinforce and extend earlier work**
reinforce what has been learned, give extra examples, consolidate the vocabulary and notation students have met in the lesson, set short tasks that draw on students' knowledge, and encourage students to describe and explain how they tackled a particular case;
- **discuss and correct errors and misunderstandings**
engage students in discussion, identifying and rectifying any misunderstandings and errors noted during earlier parts of the lesson;
- **assess the extent of students' learning**
use probing questions to judge students' understanding and extend their learning from the main part of the lesson;
- **make links to other work, look ahead to the next lesson and set homework**
make links to other work in mathematics, other subjects or the real world, look forward to what students could do next, and, where appropriate, set homework based on what had been learned in the lesson.

Video task

How did the teacher on the video use this phase of the lesson?

What key questions did the teacher ask?

Work in school groups. Make notes of the tasks that you need to go away and do.

What are the main points of today's sessions that you will discuss with your principal?

What points about today's session will you discuss with your colleagues?

When and how will you help to develop and support the teaching and learning of mathematics in your school?

| | | |
|---|---|--|
| <p>Grade:</p> <p>Unit:</p> <p>Title:</p> | <p>Resources</p> <p>The main resources needed for this unit are:</p> | <p>Key vocabulary and technical terms</p> <p>Students should understand, use and spell correctly:</p> |
| | <p>Expectations</p> <p>By the end of the unit, most students</p> <p style="text-align: center;">Students who progress further</p> <p style="text-align: center;">Students who make slower progress</p> | |
| <p>About this unit</p> | | |

Handout 8.1 will be given out during Session 8.

Objectives for a unit

Handout 8.3

| Unit | hours / | lessons |
|-----------------|--|---|
| Topics and time | SUPPORTING STANDARDS including Grade standards | EXTENSION STANDARDS including Grade standards |
| | CORE STANDARDS Grade standards | |
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Activities for a unit

Handout 8.4

| | | |
|--|---|--|
| Grade: Unit: Title: | Objectives | |
| | Possible teaching, learning or assessment activities | |
| | Notes | |
| | School resources | |

| | | |
|---|--|--|
| <p>A senior teacher who teaches only two lessons per week of mathematics prefers to continue to teach from an old textbook and is not prepared to follow the scheme. The teacher does not attend subject team meetings due to pressure of other responsibilities.</p> | <p>In looking at the work and assessments for one class over one semester, you notice that the work and progress achieved is of good quality but that the class is seriously behind in covering the agreed scheme of work. The teacher concerned is adamant that things are going fine and that everything will get done in due course.</p> | <p>There is a marked disparity between the level of detail written down in lesson plans by different teachers of mathematics. Informal discussion suggests that this is causing resentment on the part of some staff who see themselves as more organised and conscientious.</p> |
| <p>As subject leader, you observe a lesson or two in which non-mathematical work and class organisation take up a great deal of time and where objectives and learning outcomes are not at all clear. The teacher concerned asks for feedback and says how well he thought things were going with this class.</p> | <p>Two units of work in the existing scheme are not producing the response or student progress you had hoped for – you are the subject leader in a small school and have no time to help.</p> | <p>A newly qualified teacher asks you if she can substitute a unit of work from the agreed scheme for one of the grades in the school with one she taught extremely successfully during her teaching practice. She has all the resources and materials to show you and has a set of detailed lesson plans. The unit is linked in topic area but covers different (and far fewer) learning objectives than the one to be substituted.</p> |
| <p>In discussion between primary and preparatory colleagues it becomes clear that there is a great deal of overlap in the schemes of work for Grades 6 and 7. Discussion with students reveals that some coverage has been repetitious and demotivating for them. Nevertheless, most teachers in the preparatory school do not feel that students have made adequate progress in these areas.</p> | <p>Your scheme of work is thorough and well designed, and has worked well. However, major staff turnover has resulted in an influx of temporary and some non-specialist teachers who express anxiety about their mathematical knowledge in relation to some areas of the scheme. Their lack of confidence is justified – their short-term plans reveal some fundamental gaps and misconceptions.</p> | <p>The scheme of work that you have devised and agreed clearly allocates homework in each unit of work. This varies in length and style – depending on the objectives and activities being undertaken. The principal announces that the school’s homework policy is to be 35 minutes of written work per subject per week. Parents will be asked to monitor that this is set consistently.</p> |

Reviewing lesson plans

Handout 11.1

| Key elements | Action points |
|--|---------------|
| Lesson objectives that can be shared with students | |
| Clear structure | |
| References to resources needed | |
| Key vocabulary to stress | |
| Brief notes on teaching input, including key questions | |
| Brief notes on student activities | |
| Brief notes on how to assess what students achieve in the lesson | |
| Summary of main learning points | |
| Notes on how any support teacher will be used | |
| Indication of any homework to be set | |
| Any other comment | |

Criteria for choosing textbooks – content

Criteria for choosing textbooks – usefulness to the teacher

Criteria for choosing textbooks – usefulness to the student

Handout 13.2 will be given out during Session 13.

There is widespread agreement that school leadership is about improving the quality of teaching and learning. The principal and senior staff have particular roles responsibilities for managing and leading the school, and so do subject leaders. Where leadership is effective, staff and students are better motivated, people feel they are working towards a shared aim, and teaching and learning improve.

The subject leader has a special role to play in implementing the curriculum standards successfully. Strong leadership of the team of teachers teaching the subject will ensure that the team operates effectively and that the standards are introduced smoothly in a planned way.

The four main responsibilities are providing **curriculum leadership**, the **monitoring** role, carrying out **an annual evaluation of progress** in implementing the standards, and **liaison and dissemination of information**.

Curriculum leadership

The subject leader needs to find ways for all teachers of the subject to meet regularly to discuss their work and develop a common understanding of how to teach certain topics or particular groups of students. At times, the discussions might involve teaching 'micro-lessons' for colleagues to observe and discuss, or watching and discussing a video together. At other times, they will involve disseminating ideas learned on training by talking through and trying out ideas together. These discussions can lead to the development and refinement of a scheme of work and the preparation of lesson plans and classroom teaching resources that all teachers of the subject can use.

In providing curriculum leadership, a subject leader will be responsible for:

- briefing subject teachers on the standards;
- building and maintaining a subject teaching team who cooperate and support each other in their professional activities;
- delegating appropriate tasks to members of the team, for example, coordinating the work for a particular grade or group of grades;
- leading the development and refinement of:
 - a scheme of work based on the standards and, if relevant, any external examination requirements;
 - related teaching resources such as lesson plans and homework tasks;
- matching existing books, equipment and materials to the scheme of work and standards, and identifying and making requests for any extra resources needed;
- ensuring provision of suitable extra-curricular activities linked to the subject to extend students' learning beyond the classroom;
- inspiring and enthusing subject teachers and supporting their professional development, for example, by encouraging the team to discuss and debate teaching and learning of the subject.

Monitoring

A subject leader must be aware of the quality of teaching in the team and the teaching methods team members are using, and advise and support teachers

accordingly. In a thriving team, the subject leader will from time to time observe and give feedback on the lessons taught by other teachers of the subject. In turn, they will be given an opportunity to observe the subject leader teaching and to see each other at work.

The subject leader also reviews regularly with the team the written work of students in different classes in order to monitor the progress of each class and to check that marking and other assessments are being carried out satisfactorily. These observations are best when they are followed up with feedback and collective discussion, and can be of particular help when a new scheme of work is being developed and introduced.

In the monitoring role, a subject leader will generally be responsible for:

- monitoring teachers' planning and teaching of the subject and the degree to which these reflect the standards and the scheme of work;
- monitoring the quality and consistency of teachers' assessments of students' work and progress;
- ensuring that good records of students' progress are maintained.

Evaluation of progress

A further part of the role is to identify strengths and areas for development in the subject by leading an annual evaluation of the implementation of the standards for the principal, school managers and the subject team.

In the annual evaluation, a subject leader will generally be responsible for:

- leading an annual evaluation of students' attainment and the quality teaching and learning in the subject, including an analysis of the results of the national tests;
- producing an annual plan outlining what needs to happen to strengthen developments;
- identifying the support that teachers would welcome from their School Support Organisation.

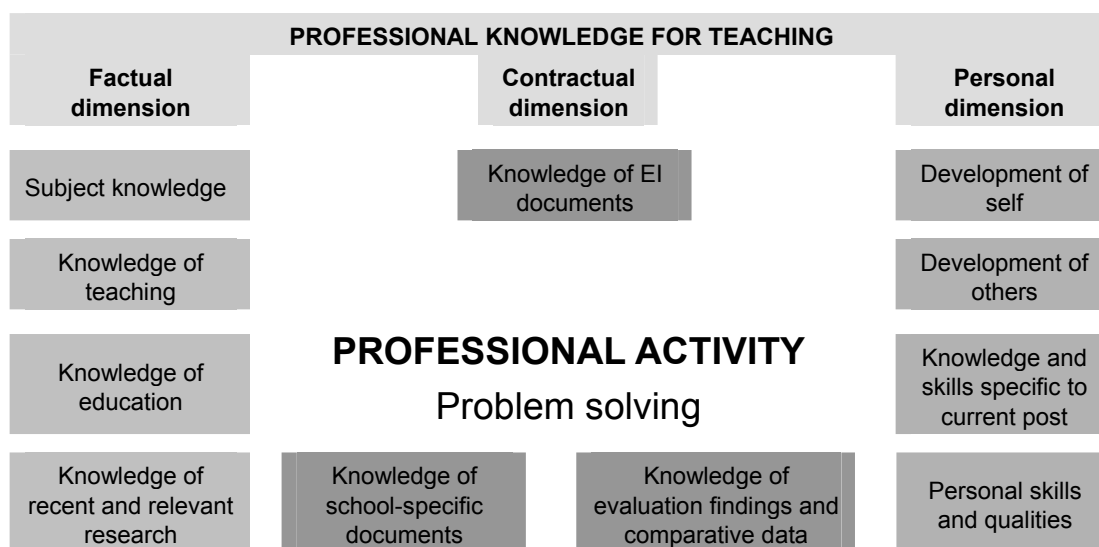
Establishing links and keeping everyone informed

The subject leader is at the centre of communications about the subject and has a responsibility to ensure that everyone is kept well informed. Links need to be established within the school, with partner schools and with higher education to ensure that the introduction of the standards is coherent and effective.

In establishing links and disseminating information, a subject leader will generally be responsible for:

- keeping the subject team informed about developments related to the standards;
- briefing the principal and vice-principal on work in the subject;
- helping to keep parents informed about the school's approaches to the subject;
- liaising with partner schools to ensure good continuity in teaching and learning;
- liaising with other subject leaders on matters related to the standards, for example, how teaching should be adapted when students are taught in English;
- keeping up-to-date with subject developments nationally and worldwide, and briefing the team on significant developments.

Teaching is a multifaceted, complex and intellectual activity; the professional knowledge required for this activity includes knowledge, skills and understanding. Teachers often undervalue their own knowledge and expertise partly because their practice has become automatic. Assisting others in their professional development requires teachers to reflect on and review their own practice. When teachers engage in coaching and mentoring activities to assist others in their professional development they say that they are also improving their own practice. The diagram below provides a framework for talking about professional knowledge for teaching.



The acquisition of professional knowledge requires two levels of transformation of the individual. The first level is external as demonstrated in a successful performance. The second level is internal as demonstrated in the ability to understand and apply what has been learned to new situations and to assist in the development of others. Success at the first level can motivate individuals to engage in a programme of continuing professional development to move themselves to the second level.

Programmes of continuing professional development need to take account of these two levels. Any programme should include opportunities for:

- courses to update knowledge;
- coaching to assist performance;
- mentoring to guide and promote professional development;
- study to promote understanding.

Schools need to recognise the expertise within their own institutions and identify the expertise that is needed from outside to provide fully integrated professional development programmes for members of staff and student teachers.

One of the key sites for acquiring professional knowledge is acknowledged as the workplace. Working alongside experienced professionals is recognised as a major component of learning and developing knowledge and skills. However, such learning does not happen by accident. It needs deliberate planning and preparation by both novice and expert and a framework for development. Professional

knowledge in teaching is acquired throughout a teacher's career but the acquisition of specific knowledge and skills can be planned for at different stages.

Developing professional knowledge in the workplace assumes that experienced teachers are able to assist colleagues in its acquisition. Being a good practitioner is not in itself sufficient for this purpose. It is likely that all teachers and teaching assistants will be called upon to work with another professional at some time. There are generic skills needed by any teacher working with another professional on their acquisition of professional knowledge and specific skills for those with special roles relating to particular stages of development.

Coaching and mentoring activities

In recent years the teaching profession, along with many other professions, has adopted the terms *coaching* and *mentoring* when describing professional development activities in the workplace. Both terms are used to describe a variety of activities designed to assist others in their personal development. For the purpose of this article, the terms are defined as follows.

***Coaching** is a process in which someone with the necessary expertise assists a colleague, through direct discussion and guided activity, in developing knowledge, skills and understanding in an area that has been identified as needing development. Most often, guided activities include joint planning, demonstration of teaching, and observation of teaching with feedback and joint analysis.*

***Mentoring** is a process in which someone assists a colleague, mainly through direct discussion and scrutiny of a portfolio of evidence, in critical reflection and in identifying the colleague's own personal development requirements. A mentor is normally someone who has knowledge of the availability of professional development activities.*

Successful coaching and mentoring are dependent on the development of an atmosphere of trust and respect. Anyone who is being coached or mentored is vulnerable and it is crucial that the institution supports and promotes the development of a model of assisting performance that empowers the learner and enables that individual to attain success. Motivation for pursuing personal professional development derives from success and constructive support.

Demonstration teaching

One way in which teachers can provide support is by demonstrating lessons to their colleagues. It is not sufficient merely to invite colleagues into a classroom and ask them to observe. It is necessary to talk through the lesson in advance, identifying a focus for observation, and provide time after the lesson for joint analysis.

When teachers have received a demonstration of teaching from a colleague they need to practise the ideas for themselves and then invite the colleague to observe their teaching and provide feedback. The observation should be focused and planned for in advance. All teachers need some training in how to conduct observations and how to provide constructive feedback.

Methods of support

Handout 16.1

Work in school groups. Make brief notes in the boxes.

| | Benefits | Limitations | When to use | How to ensure that it is effective |
|--|-----------------|--------------------|--------------------|---|
| Involve teachers in planning the scheme of work | | | | |
| Study and discuss sample lesson plans | | | | |
| Help a teacher to plan a lesson or unit of work | | | | |
| Watch and discuss a video of a lesson | | | | |
| Do some 'micro-teaching' using colleagues as 'the class' | | | | |

Handout 16.1 (continued)

| | Benefits | Limitations | When to use | How to ensure that it is effective |
|---|-----------------|--------------------|--------------------|---|
| Invite a teacher to observe you teach a lesson in which you will focus on a particular aspect of teaching | | | | |
| Make paired lesson observations and discuss them | | | | |
| Plan and team-teach a lesson or series of lessons | | | | |
| Discuss a teacher's planning, observe a lesson and give constructive feedback | | | | |
| Other | | | | |

Before the second workshop, aim to complete these tasks.

- 1 Finish your discussion of the action points to follow up the workshop. You may like to involve your School Support Organisation in this task.

Discuss relevant points with your principal, and what would help to maximise the benefits to other teachers.

- 2 Tell other colleagues what you learned on the workshop and discuss with them the implications for what you need to do as a subject team.
- 3 Refine your scheme of work. Bring one detailed unit for each grade in your school to the second workshop to discuss with colleagues.
- 4 Plan, teach, demonstrate and evaluate a lesson based on your new scheme of work. (A lesson evaluation form is on Handout 16.4.)
- 5 Try to read these articles, which can be found the Internet. They are written in Arabic:
 - an article about problem solving
<http://www.mathdar.com/search11.htm>
 - a general article about learning
<http://www.almoultaqa.com/ar13.html>

You may also find the articles on this website to be of interest:
<http://www.almekbel.net/>

NOTE:

When you return for the second workshop, please bring with you:

- *Curriculum Standards for mathematics: Grades K to 12*
- *Sample lesson plans for mathematics: Grades 1 to 12*
- a writing pad on which to make notes.

Lesson evaluation form

Handout 16.4

Please attach your lesson plan.

| | | | |
|------------------------------|--|--------|--|
| Number of students involved: | | Grade: | |
|------------------------------|--|--------|--|

| |
|--|
| What preliminary knowledge and skills did students need to benefit from this lesson? |
| How was reasoning and problem solving involved in the lesson? |
| Which part of the lesson was most successful? Why? |
| What, if any, difficulties did students experience and how did you resolve these? |
| How would you change the lesson if you were teaching it again? Why? |

Teacher's evaluation form: Workshop 1 Day 1

For completion by teachers by the end of Day 1

Please give your evaluation of Day 1, today's sessions.

What were the most successful aspects of today's sessions?

What changes would you suggest if today's sessions were repeated?

Please grade each session according to how useful it was.

| Session | Grade: please ring | | | | | |
|--|--------------------|---|---|---|---|-----------|
| The mathematics standards | Very good | A | B | C | D | Very poor |
| Teaching and learning 1 | Very good | A | B | C | D | Very poor |
| Planning 1 | Very good | A | B | C | D | Very poor |
| The reasoning and problem solving strand | Very good | A | B | C | D | Very poor |
| Overall grade for the day | Very good | A | B | C | D | Very poor |

Further comment (optional)

School:

Name:

Please return this form to your trainer before leaving.

Teacher's evaluation form: Workshop 1 Day 2

For completion by teachers by the end of Day 2

Please give your evaluation of Day 2, today's sessions.

What were the most successful aspects of today's sessions?

What changes would you suggest if today's sessions were repeated?

Please grade each session according to how useful it was.

| Session | Grade: please ring | | | | | |
|---------------------------|--------------------|---|---|---|---|-----------|
| Teaching and learning 2 | Very good | A | B | C | D | Very poor |
| Teaching and learning 3 | Very good | A | B | C | D | Very poor |
| Teaching and learning 4 | Very good | A | B | C | D | Very poor |
| Overall grade for the day | Very good | A | B | C | D | Very poor |

Further comment (optional)

School:

Name:

Please return this form to your trainer before leaving.

Teacher's evaluation form: Workshop 1 Day 3

For completion by teachers by the end of Day 3

Please give your evaluation of Day 3, today's sessions.

What were the most successful aspects of today's sessions?

What changes would you suggest if today's sessions were repeated?

Please grade each session according to how useful it was.

| Session | Grade: please ring | | | | | |
|-----------------------------|--------------------|---|---|---|---|-----------|
| Planning 2 (double session) | Very good | A | B | C | D | Very poor |
| Assessment | Very good | A | B | C | D | Very poor |
| Overall grade for the day | Very good | A | B | C | D | Very poor |

Further comment (optional)

School:

Name:

Please return this form to your trainer before leaving.

Teacher's evaluation form: Workshop 1 Day 4

For completion by teachers by the end of Day 4

Please give your evaluation of Day 4, today's sessions.

What were the most successful aspects of today's sessions?

What changes would you suggest if today's sessions were repeated?

Please grade each session according to how useful it was.

| Session | Grade: please ring | | | | | |
|-----------------------------|--------------------|---|---|---|---|-----------|
| Planning 3 (double session) | Very good | A | B | C | D | Very poor |
| Selecting resources | Very good | A | B | C | D | Very poor |
| Overall grade for the day | Very good | A | B | C | D | Very poor |

Further comment (optional)

School:

Name:

Please return this form to your trainer before leaving.

Teacher's evaluation form: Workshop 1 Day 5

For completion by teachers by the end of Day 5

Please give your evaluation of Day 5, today's sessions.

What were the most successful aspects of today's sessions?

What changes would you suggest if today's sessions were repeated?

Please grade each session according to how useful it was.

| Session | Grade: please ring | | | | | |
|---------------------------|--------------------|---|---|---|---|-----------|
| Leading developments 1 | Very good | A | B | C | D | Very poor |
| Leading developments 2 | Very good | A | B | C | D | Very poor |
| Leading developments 3 | Very good | A | B | C | D | Very poor |
| Overall grade for the day | Very good | A | B | C | D | Very poor |

Further comment (optional)

School:

Name:

Please return this form to your trainer before leaving.

Teacher's evaluation form: Workshop 1 as a whole

For completion by teachers by the end of Day 5

Please grade the workshop overall according to how useful it was.

| Grade: please ring | | | | | |
|--------------------|---|---|---|---|-----------|
| Very good | A | B | C | D | Very poor |

What was most helpful?

What changes would you suggest if the workshop were repeated?

Further comment (optional)

School:

Name:

Please return this form to your trainer before leaving.

