BOWLAND MATHS
Professional development

Tackling unstructured problems

'Do I stand back and watch, or intervene and tell them what to do?'

Module overview

In mathematics lessons, pupils are usually told which prerequisite information they need and which techniques to deploy. If, however, pupils are to learn to use their mathematics autonomously outside the classroom, they also need opportunities to work on unstructured problems that require the selection and use of a wide range of mathematical techniques. This module compares structured and unstructured versions of problems and considers the demands and challenges unstructured problems present to pupils and teachers.

This guide is intended for use alongside the *Bowland Maths DVD* or website, which include a short introductory video for each of the activities; longer videos of lessons and teacher discussions and links to all the handouts and ICT-based problems.

Introductory session — 1 hour

- Critique and revise structured problems
- Compare structured and unstructured problems
- Observe teachers using unstructured problems
- Discuss pedagogical implications
- Plan a lesson using one of the problems

Into the classroom — 1 hour

- Introduce the problem to the class
- Pupils work on the problem
- Pupils share different approaches
- Pupils continue with the problem

Follow-up session — 1 hour

- Report and reflect on the lesson
- Observe teacher interventions
- Consider strategies for offering help
- Discuss how you handle sensitive issues
- Plan some strategies for future lessons

Resources needed

Handout 1	Three structured problems
Software	Body Mass Index Calculator (optional)
Handout 2	Three unstructured versions of the problems
Handout 3	Notes on the unstructured problems
Handout 4	Practical advice for teaching problem solving
Handout 5	Suggested further reading

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Introductory session

Introduction What is an unstructured problem?

In mathematics lessons (and examinations), most of the 'problems' given to pupils are not really problems at all - they are highly structured exercises. Pupils are told which prerequisite information they need and which techniques to deploy. They are then led by a chain of short, closed, questions to the required, unique, solution. Alternative approaches are neither encouraged nor discussed. If, however, pupils are to learn to use their mathematics autonomously outside the classroom, they also need opportunities to work on unstructured problems that require the selection and use of a wide range of mathematical techniques.

In this module, we compare structured and unstructured versions of problems and consider the demands and challenges they present to pupils and teachers. We try out one or two unstructured problems with a Key Stage 3 class and then go on to consider the support pupils need to work on more 'open' problems of this type.

Activity 1 Critique and revise structured problems 10 minutes

Handout 1 presents three structured problems:

- *Organising a table tennis tournament*
- *Designing a box for 18 sweets*
- *Calculating Body Mass Index*

These problems are of the same type as those typically found in many of the Bowland Case Studies. These are, however, structured so that they lead pupils through the problems, guiding and making decisions for them.

Work through one of the structured problems carefully.

- List all the decisions that are being made for the pupils.
- Revise the problems so that some of these decisions are handed back to pupils. This will make them less structured.

For example, in *Organising a table tennis tournament*, pupils are told:

- how to code the players (A, B, C .. etc)
- to list all the matches that need to be played
- how to systematically organise these matches
- how to tabulate the order of play
- to remember that players cannot play on two tables at once.

Activity 2 — Compare structured and unstructured problems — 5 minutes

Compare the unstructured versions of the problems (Handout 2) with the structured versions.

- What are the essential differences?
- What pedagogical issues will arise when you start to use unstructured problems like this?

Some immediate issues with the less structured problems are:

- They are more difficult.
- Pupils may not even know how to get started on them.
- If we offer help too quickly, pupils will simply do what we say and not think for themselves.
- They will generate a greater variety of approaches and solutions.
- Pupils may need reassurance that it is OK to try a different approach or reach a different conclusion.

Handout 3 explains the links to the Case Studies and gives possible solution strategies to these problems.

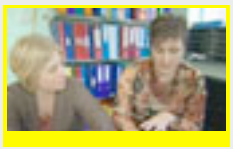
Activity 3 — Observe teachers using unstructured problems — 20 minutes

The three video clips show pupils working with the unstructured versions of the same problems you have worked on. The first time through, we suggest you watch Michelle using the *Organising a table tennis tournament* problem. You can return to the other clips another time.

As you watch the video, consider:

- How did the teacher organise the classroom?
  Why were pupils expected to work in pairs/ small groups?
- How did the teacher introduce the problem to pupils?
- What different approaches were being used by pupils?
- How did the teacher support the pupils that were struggling?
- How did the teacher encourage the sharing of approaches and strategies?
- What do you think these pupils were learning?

Activity 4 — Discuss pedagogical implications — 15 minutes



Watch the three teachers talking about how they will introduce the unstructured problems to their pupils.

- What culture are these teachers trying to create in the classroom?
- How did the teachers plan to make the problem more accessible to students?
- What do they plan for pupils that finish quickly?

Handout 4 offers general practical advice for teaching problem solving:

- Allow pupils time to understand and engage with the problem.
- Offer strategic hints, rather than technical guidance.
- Allow opportunities to compare alternative approaches.
- Place the focus on explaining methods, rather than on obtaining answers.
- Model thinking and powerful methods.

- What aspects of this advice were the teachers considering?
- Discuss the advice and consider the implications.
- Add your own ideas for advice to the bottom of the handout.

Activity 5 — Plan a lesson using one of the problems — 10 minutes

Choose one of the three problems that you feel would be appropriate for your class.

Discuss how you will:

- Organise the classroom and the resources needed.
- Introduce the problem to pupils.
- Explain to pupils how you want them to work together.
- Challenge/assist pupils that find the problem straightforward/ difficult.
- Help them share and learn from alternative problem-solving strategies.
- Conclude the lesson.

If you are working on this module with a group, it will be helpful if each participant chooses the same problem, as this will facilitate the follow-up discussion.

This is the end of the *Introductory session*. After you have tried out your lesson with your own pupils, return for the *Follow-up session*.

Resources to support the lessons, and suggested lesson plans, can be found in the *Into the classroom* session.