

5 Planning for Mathematics Learning

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INTRODUCTION

Learning how to plan effective lessons is one of the most important skills you will acquire. Having a good lesson plan is important for a whole host of reasons, not least in hopefully ensuring that learning will take place during the lesson. Not only is this because good planning results in lessons that are interesting, challenging and motivating for pupils, but also because planning is closely linked to the equally demanding (but often more overt) issue of effective classroom management. A good lesson plan, one that actively involves the class, helps to boost your confidence in the classroom and provides you with a sound basis for managing the class successfully. A good lesson plan goes a long way towards *preventing* classroom problems.

Learning to plan good lessons needs work and effort, which takes time. This is because planning depends on your knowledge and understanding of a complex set of matters including: how pupils learn mathematics; the structure of the mathematics curriculum; the specific content, skills and concepts you are teaching; the prior knowledge of the pupils; ways of teaching mathematics; how lessons can be planned for maximum effectiveness. Devoting considerable time to planning is definitely worthwhile. It is a valuable investment for future years that, in the long term, reduces the demands of paperwork as planning becomes quicker and easier as experience grows.

This chapter addresses what it takes to plan a lesson, covering the setting of objectives and how to structure individual lessons. This leads into how to plan sequences of lessons, including how to take account of pupils' prior knowledge and varying needs, how to select and prepare resources (including ICT) and how to build in assessment opportunities. The chapter concludes by looking at the wider

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aspects of planning, including planning as part of a team and planning for out-of-school learning. The chapter opens by looking at why planning is important, how it links with other aspects of teaching and how your planning fits in with other levels of planning.

OBJECTIVES

By the end of this chapter, you should be able to:

- understand the relationship between the mathematics curriculum, a scheme of work, the choice of teaching strategies and your individual lesson plans;
- select appropriate teaching strategies and mathematical tasks and resources (including ICT);
- plan mathematics lessons and units of work, identifying clear objectives and content;
- set appropriate and demanding expectations for pupil learning;
- plan assessment opportunities;
- work as part of a team in your planning and plan for out-of-school learning.

TEACHERS PLANNING LESSONS

Teachers approach the task of planning for their lessons in various ways, but all teachers need to plan. Before you consider some of the approaches to planning that some experienced teachers use, you need to think about why planning matters so much and what is it that you are planning for.

Why planning is so important

The demands of lesson planning can add to your frustrations if you are not clear about why lesson planning is necessary and exactly how it can help you in your role as a teacher.

**Task 8.1 Analysing
K54 provision**

Write down five (or more) reasons for planning lessons.

You may have written down some or all of the following:

Planning:

- requires you to articulate what you think will happen in a lesson;
- helps you to ensure that your lessons begin interestingly, maintain a good pace throughout, and have a satisfying ending;
- enables you to rehearse various aspects;
- makes you more likely to be receptive to the ideas of others;
- provides a basis for negotiation, discussion and evaluation;
- creates a feeling of confidence for you, the teacher;
- provides a history of your thinking and development.

Or you might have written that lesson plans help you to:

- structure your lessons;
- build on previous lessons and learning;
- share the objectives of the lesson with pupils;
- assess pupil achievements so that you can take these into account in future lessons;
- develop effective 'assessment for learning', so pupils receive feedback that helps them to improve;
- make lessons more inclusive and address a range of needs;
- make better use of classroom support and learning assistants;
- make explicit the key teaching strategies you are using;
- address the key questions you need to ask;
- highlight key vocabulary;
- focus on targets for raising the standard of achievement in the class;
- set homework.

What is a lesson?

The conventional unit of teaching is the *lesson* (or *period*), although in any given school this might last anywhere from thirty to seventy minutes. In contrast, there is no conventional unit of learning. Learning can take place at any time, day or night, and does not necessarily occur only in the presence of the teacher. Breaking down learning into lesson-size chunks is necessary for teaching but this can result in a fragmentation of topics and ideas if teaching is solely thought of in terms of individual lessons. For example, without careful planning, pupils may never appreciate the connections between fractions, decimals and percentages, particularly if these are

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all treated separately. Another form of fragmentation can happen with investigative tasks when these are treated as comprising solely of distinct components such as “generating results”, “drawing a table” and “finding a formula”. Effective planning has to be in terms of individual lessons that work well, but it also has to look to the longer term.

Task 5.2: What are mathematics lessons like?

- 1 The mathematics lessons you observe are likely to differ in style and approach. From your observations of different teachers and different mathematics lessons, record as many different formats as you can. How might the lesson plan (and the lesson planning) be different for different forms of lesson?
- 2 Devise a way of categorising all the mathematics lessons that you have observed. How much variety in teaching approach is there? How does this variety vary over time and with different classes?
- 3 Talk to teachers who use a variety of teaching strategies about how they have come to use those particular strategies in the way they do. Can any piece of mathematics be introduced to pupils in any way you choose? Or can you detect influences that guide teachers' choices of teaching strategy?

There are a number of reasons why mathematics lessons you observe may differ in style and approach. Partly this may be due to individual teacher style, but there can be other underlying reasons. What you should notice is that effective lessons have a structure. Typically, a mathematics lesson might consist of: a starter task (perhaps an oral and mental starter) taking about five to ten minutes; a major segment of whole-class and/or paired or group work (about twenty-five to forty minutes), combining teaching input and pupil task; a final plenary (of from five to fifteen minutes) to round off the lesson (by summarising key facts and ideas, discussing the next steps, setting homework, etc).

Of course, other lessons structures are possible. Below are examples of the structures of mathematics lessons from a study of mathematics teaching in the USA and Japan on the topic of the area of triangles (Stigler, 1996).

Typical US lesson

- Teacher reviews concept of perimeter (1 minute).
- Teacher explains area of rectangle; pupils do practice examples (8 minutes).
- Teacher explains area of triangles; pupils do practice examples (25 minutes).
- Pupils work individually on an exercise (11 minutes).

Typical Japanese lesson

- Teacher presents a complex problem (4 minutes).
- Pupils attempt to solve the problem on their own or groups (15 minutes).
- Pupil presentations and class discussion of pupil solutions to the problem, combined with teacher explanations, leading to a general solution (21 minutes).
- Pupils work on practice problems (5 minutes).

Even though lesson structure is not the only influence on pupil achievement, it is worth noting that, in a recent large-scale international survey of mathematical achievement, Japanese pupils scored amongst the best in the world in mathematics, whereas the USA, Scotland and England and Wales scored considerably lower (see Jones, 1997). This suggests that what may influence how successful pupils are in mathematics is both how mathematics is taught (that is, the teaching strategies that are used) and what form of mathematical knowledge is taught.

Task 5.3: How are mathematics lessons structured?

From your observations of mathematics lessons, what different structures are used? Are the lessons you see more like the typical US lesson or more like the typical Japanese lesson?

How experienced teachers plan

Whenever you observe effective teachers of mathematics, you observe the result of their planning. Research suggests that, in constructing lessons, experienced teachers draw on a range of experiences and knowledge in an attempt to match the anticipated and observed needs of their pupils to a particular lesson or set of lessons (John, 1991, 1993; Wragg, 1995). In many instances, for experienced teachers lesson *outlines* consisting of phrases or illustrations, are entirely appropriate. While fully meaningful to the teacher concerned, they may not conjure up a complete lesson to someone looking at such an outline. Alternatively, experienced teachers may teach directly from the departmental scheme of work (see below), again making allowances for their particular classes. For a very experienced teacher there are times when a more detailed lesson plan may be appropriate (for instance, when a new or seldom taught topic is scheduled or as a useful basis for dialogue with a teacher colleague such as yourself) but such detailed plans are not always necessary.

This preference, by experienced teachers, for a more fluid mode of planning can appear to pose a difficulty for you. It can be that the more skilful the planning, or the more it happens at unscheduled times, the more difficult it is for you to under-

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stand how successful lesson planning is achieved. What is more, the requirement for you to produce detailed written plans may seem oddly at variance with the practice of established teachers. *Nothing could be further from the truth. All successful teachers carry out planning and it remains of critical importance.*

It is how you begin to plan, and how your planning changes as you develop professionally, that you should keep in mind. Likewise, you need to reflect on your lesson plans as you use them. Detailed written plans should be designed to give you the confidence to begin teaching well. As your confidence grows, and as you make progress with your classes, you might begin to negotiate the appropriate amount of detail to include in your plans.

Task 5.4: How do experienced teachers plan?

- 1 Ask a class teacher if they can take you through the process involved in planning a particular lesson. What are the important aspects of this process? What aspects of the plan are recorded? How are they recorded?
- 2 See if you can observe or take part in the lesson and then discuss with the class teacher how the lesson went in practice. How and why may it have deviated from the lesson as planned?

How planning links to other areas of teacher knowledge and expertise

By now, it should be clear that planning is a key professional responsibility and that your planning is a key place in which you develop and show the high expectations you surely have of all the pupils you teach. Working with others in planning, and in learning from implementing your plans, is also central to developing and showing professional values of the highest level. In order to plan confidently and effectively, you need a high level of subject knowledge and understanding. This enables you to judge how ideas and concepts can be broken down and sequenced so they support pupils' learning, and how you might tackle likely pupil errors and misconceptions. Planning entails ensuring the purposeful use of a range of monitoring and assessment strategies, before subsequently using the information gathered to improve future planning and teaching.

Levels of planning

Planning can be thought of as operating at three levels.

- *Long-term planning* occurs at school and departmental level. Such long-term planning demonstrates, amongst other things, how the statutory components of the curriculum are to be covered. It also shows how coverage of the curriculum is structured within year groups and across key stages and how much time is allocated to mathematics.
- *Medium-term planning* might be half-termly or termly. Such planning is often specified within a “scheme of work”. In lower secondary school mathematics in England, the KS3 *Framework for Teaching Mathematics* usually plays a major role in a school’s medium-term planning. At KS4 and beyond, subject specifications (as laid down by the QCA, and the examination syllabuses that are approved in relation to these) play the major role.
- *Short-term planning* might include weekly, daily or individual lesson plans. The planning of individual lessons, and how it leads to planning sequences of lessons, is covered in detail below.

Task 5.5: What is a scheme of work?

Examine a scheme of work in your mathematics department and see to what extent it:

- provides the detailed framework for classroom practice;
- details the knowledge, skills and processes to be taught during a half-term or term;
- give clear guidance about the range of teaching approaches to be adopted.

Choose a topic or an area of work from the scheme of work in your school. Find out what the topic is designed to achieve, what the pupils were taught before, what length of time is devoted to it, what resources are suggested, how the work is assessed and what the pupils will do next.

There are two aspects of the structure of the mathematics National Curriculum, as currently specified, that are of central importance to your planning: *viz*, the programme of study, and the level descriptors for the Attainment Targets. One way to think about the relationship between the two is to consider the programme of study as indicating what you should plan to teach, while the level descriptors allow you to judge what your pupils have learned. What happens during your lessons provides the link between the two. Another important use for the level descriptors is to provide some indication of what you can expect from pupils. This can be especially helpful in planning your lessons. (There is a range of exemplary material available on-line at: www.ncaction.org.uk.)

Task 5.6: How can the mathematics curriculum aid lesson planning?

Choose some statements from the programme of study for Key Stages 3 and 4 mathematics and see how these are reflected in the level descriptors. How might the specification of the programmes of study and the level descriptors aid you in your planning? How do they link to the scheme of work in the mathematics department?

It is probably worth noting at this point that the current version of the National Curriculum for mathematics is only one vision of how the curriculum can be specified. Rather than arranging the curriculum in terms of content such as 'Number and algebra', another conception might be to arrange the curriculum around what are sometimes referred to as the 'big ideas' in mathematics. These 'big ideas' might include such notions as place value, variable, function, invariance, symmetry, proof, and so on. The resulting curriculum might well appear very different from the current model and, as a consequence, perhaps be taught in different ways. This illustrates the idea of the curricular shaping of teaching: that is, how the specification of the curriculum directly influences the teaching strategies used.

PLANNING A LESSON

Developing your confidence in planning and leading individual lessons takes time. It is a good idea initially to work alongside your class teacher, and to stage your first attempts, so that you do not try to undertake too much at once. As your confidence grows, you will be able to build on these early experiences.

First steps

A good place to begin your first steps in lesson planning is with a reasonably self-contained part of a lesson. This could be one or more of the following:

- going over a piece of homework;
- going over a test the class has taken;
- presenting an agreed segment of a lesson;
- concluding a particular lesson.

Each of these first steps needs to be negotiated and agreed with class teacher. All are designed to boost your confidence with speaking to a whole class and may help you to get to know their names. Planning for these first steps might well involve specifying precisely what you say, based on the class teacher's lesson outline (or scheme of work).

Task 5.7: Planning and presenting parts of lessons

Negotiate to take a reasonably self-contained part of a lesson. Discuss your plan for this lesson segment with the class teacher. What aspects of the lesson segment would you like feedback on? Discuss how the element went in practice. Which aspects of your presentation skills do you need to work on?

Planning a whole lesson

Planning a whole lesson entails specifying, as a minimum (and taking into account the teaching time for the lesson):

- the objectives and activities for the starter task (usually oral and mental mathematics);
- the objectives to be addressed in the main teaching tasks, with adjusted objectives as appropriate for higher and lower attainers;
- the key teaching points and activities for lessons, matched to the objectives, with suggestions for how the tasks can be developed (including extensions for the more able or simplifications for those pupils requiring additional support);
- the timing of each element of the lesson;
- key mathematical terms, notation and specialised vocabulary to be introduced/used;
- the resources needed, including ICT, with references to any departmental resources and relevant parts of textbooks;
- ideas to be drawn out in the plenary (or mini-plenary sessions), including some key questions and homework tasks;
- opportunities for assessing (usually formatively) how successfully pupils are learning the key ideas in the lesson.

As you become more experienced, your lesson plans can become more developed and might also include:

Task 5.8: Beginning planning whole lessons

- 1 Negotiate to plan a complete lesson *with* the class teacher that the teacher will take. During the lesson, make notes on the opening, middle and closing segments of the lesson, the timing of each segment and any deviations from the set plan. Discuss how each segment went and the reason the teacher decided to make some changes.
- 2 Negotiate to plan further lessons with the class teacher of which you will take agreed elements: for example, you could start the lesson or conclude it. Discuss the extent to which the learning outcomes were achieved. How can you build assessment opportunities into your plans and use the outcomes to inform your future planning?

- potential difficulties or misconceptions that pupils may have, and suggestions to pre-empt or rectify them;
- how best to deploy any available support staff;
- assessment strategies and what adjustments to future plans might be needed as a result;
- connections with other mathematical topics and other subjects.

One way to approach planning whole lessons is to use *pro forma*. These usually contain the following elements that were explored earlier in this chapter:

- practical details such as date, class, time, room;
- references to topic, module or scheme of work;
- aims, objectives or learning outcomes;
- teacher and pupil tasks;
- timings for elements of the lesson;
- homework.

An important aspect of successful lesson plans (and hence successful lessons) is careful consideration of the various stages in a lesson. It is certainly likely that some lesson segments will take longer than you expect, while others may take considerable less. Clearly, you need to adjust your plans to account for both. This involves working flexibly with your lesson plan and having more ideas at hand in case you need them. Always ensure you finish on time and avoid rushing things if they are taking longer than you expect. If the main task needs more time than you allocated in your plan, it is usually better to cut out part of it and have a proper finish than

Task 5.9: Using lesson planning pro forma

- 1 Review some of the lesson *pro forma* that you have seen or have been given. How suitable are they for the lessons you will teach? How might they aid the planning of your lessons? In what ways might they restrict what you do with your classes?
- 2 One alternative to using pre-printed *pro forma* is designing your own. Design some *pro forma* for your own use. How can these vary according to the format and/or learning intentions of the lesson?

to have the lesson end abruptly.

Your early experience with lesson planning will confirm that the most important consideration to take into account is what the pupils already know. As you take more lessons, your role in the lessons can increase with your confidence until you are taking responsibility for teaching the whole of your lessons.

Selecting objectives

As John (1993) claims:

Virtually all major guide books on curriculum and lesson planning begin with the importance of laying down, at an early stage, the educational and learning goals that will guide the lesson. (p. 30)

This reflects the view that the way to introduce new teachers to the complexities of lesson planning is to use a framework based around the 'rational planning model' first outlined by Tyler (1949). This model asserts that planning a lesson or a sequence of lessons involves:

- specifying objectives;
- selecting and sequencing learning tasks;
- evaluating the outcomes.

The advantages of clearly specifying objectives include that they:

- are measurable;
- are easily communicated;

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- help to clarify thinking and planning;
- make assessment and evaluation clearer.

While it is undoubtedly important to be clear about what pupils are to learn during a lesson, there are disadvantages to *starting* the process of lesson planning with the objectives. Amongst the disadvantages are:

- planning becomes more rigid;
- opportunist learning is inhibited;
- learning is trivialised;
- a 'technicist' rather than a creative view of teaching is encouraged.

When thinking about lessons, and especially when using lesson *pro forma* whether pre-printed or designed by you, you will certainly need to learn how to work creatively with objectives. Unless you do so, the research evidence suggests there is a real risk that planning will become overly rigid and thereby inhibit learning opportunities than can arise. Working creatively with objectives means, among other things, looking for interesting tasks and deciding how they match with what you are teaching (rather than always starting with the objective and trying to find tasks that match).

Task 5.10: What is involved in specifying objectives?

Review some of the successful lessons you have seen. How easy is it to specify the objectives for each one? Are some sorts of objectives easier to specify than others? How can you tell to what extent objectives have been met?

Specifying objectives concentrates attention on what is to be taught *and* how pupil learning will be judged. What may not be addressed is the important issue of *how* pupils will be provided with learning opportunities. What matters is that there should be some criteria for how success – or degrees of success – might be evaluated: this is where objectives are important.

Where possible, objectives should be precise, assessable and achievable and, as such, be a statement of learning *outcomes* in terms of pupil learning, not what the pupils will be doing as they complete a task. In this way, objectives should help to frame the lesson or sequence of lessons and aid the articulation of 'key' questions to inform the structure an introduction or conclusion. Learning outcomes can also be used as assessment criteria and provide different learning outcomes for different groups of pupils.

Useful 'stems' when writing objectives include the following.

By the end of the lesson, pupils will:

- know that ... (*knowledge*: factual information, for example symbols, formulae, ..);
- develop/be able to ... (*skills*: using knowledge, applying techniques, analysing information, etc.);
- understand how/why ... (*understanding*: concepts, reasons, effects, principles, processes, etc.);
- develop/be aware of ... (*attitudes and values*: empathy, caring, sensitivity towards social issues, feelings, moral issues, etc.).

Working with existing lesson plans

Another way to approach planning whole lessons is to work with existing lesson plans, such as the one below, and to modify them in light of the particular circumstances of the class you are working with.

Table ???

Year 8 (middle set)		Topic: Fractions National Curriculum reference: Ma2, 2c (KS3 PoS) Reference: KS3 Framework pages 66, 67
Starter	Objectives	Develop mental methods to find fractions of amounts
10-15 min.	Task	Use whiteboards or digit cards Ask questions such as: $18 \div 3$, $20 \div 5$. $1/4$ of 80, $1/10$ of 70, $2/3$ of 24, $4/5$ of 40 Discuss methods
Main part of lesson	Objectives	Find fractions of quantities Recognise equivalent fractions
	Key vocabulary	Numerator denominator equivalent fractions proper fraction
5 min.	Introduction and task	Model the activity they are to do in pairs using a 60 cm line on the board. Throw 2 dice. Make a proper fraction. Plot the fraction on the line. Repeat several times.

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15 min.	Pupils work in pairs or small groups. On large paper, draw lines 60 cm long. Using 2 dice pupils create random proper fractions and mark them underneath their number line.
15 min.	Ask pairs to put in any other fractions with denominators 2, 3, 4, 5, 6 (without rolling the dice) (<i>Key Question</i> : How many will there be altogether?), then to add tenths and eighths.
Extension	Plot sevenths and ninths as well on the line or change the fractions plotted into percentages
Equipment	Large sheets of paper with 60 cm line drawn Dice Whiteboards or digit cards
Plenary 5 -10 min.	Did you find any equivalent fractions? Look at results: <i>Key Questions</i> : Which is larger, $\frac{2}{5}$ or $\frac{1}{3}$? $\frac{3}{4}$ or $\frac{4}{5}$? $\frac{2}{3}$ or $\frac{7}{10}$? Which pair of fractions has the bigger difference: $\frac{3}{5}$ and $\frac{4}{6}$, or $\frac{4}{5}$ and $\frac{5}{6}$?

Modifying existing plans is an important skill. It entails matching the lesson to what you know of the pupils you are teaching. Will they find it engaging and motivating? Does the context need adjusting? Is the timing of the various segments suitable? These are the sorts of questions to ask yourself when you are modifying existing lesson plans.

Task 5.11: Modifying existing lesson plans

Find some existing lesson plans that are suitable for a topic you are planning and try modifying these for the pupils you are teaching. What aspects of the existing plan can you keep? What needs adjusting to match the needs of your pupils? The Teacher Resource Exchange (tre.ngfl.gov.uk/) is a useful database of resources and tasks where teachers can share ideas for lessons.

Reflecting on lessons

Reflection on all the points raised in this section will provide you with the basis for sound evaluation of your work and of your progress as a developing teacher. For individual lessons, you will probably concentrate on the following.

- What was the best thing about the lesson?
- What did I enjoy most? What did the pupils enjoy most?
- How did the pupils react to the lesson? Why?
- What would I change about the lesson if I did it again?
- At what points in the lesson could I have engaged the students more? How?
- Were the pupils able to do what I wanted them to do? Why/why not?
- What did the pupils learn?
- Did the pupils reach the learning objective for the lesson? Why/why not?

PLANNING SEQUENCES OF LESSONS

Being confident about planning and leading individual lessons is a good start. Building on this so that you can plan and teach a coherent series of lessons allows you to tackle some of the problems associated with having to divide learning into lesson-sized chunks (where the danger is that mathematics can seem fragmented and incoherent for your pupils). This section looks at how you can ensure the continuity and progression of pupil learning in your classes, so that learning does indeed happen over time.

In this context, a topic of work is a coherent series of lessons on a mathematical topic (such as fractions or solving equations), a 'big idea' in mathematics (such as invariance or symmetry) or a piece of project work (such as an investigation or a substantial problem). The scheme of work in your department may well specify quite precisely what each lesson contains. On the other hand, it may provide no more than a title and a list of resources. No matter what you have in your current circumstances, there are inevitably going to be times when you want to plan or review a topic of work.

Given that mathematics is not a group of isolated learning objectives, but an interconnected web of ideas, it is the connections between these ideas that may not be all obvious to your pupils. Good planning means trying to ensure that mathematical ideas are presented in an interrelated way. This means planning, as far as possible, to:

- present each topic as a whole: for example, by showing pupils that decimals and percentages are particular forms of fractions;

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- bring together related ideas across strands: for example, by linking ratio and proportion (in number) to rates of change (in algebra), to enlargement and similarity (in geometry) and to proportional thinking in statistics and probability;
- help pupils to appreciate that important mathematical ideas permeate different aspects of the subject: for example, linking the concepts of inverse and order in the four number operations to the transformation of algebraic expressions and the geometrical transformations of reflection, rotation and translation;
- use opportunities for generalisation, proof and problem solving to help pupils to appreciate mathematics as a unified subject.

Your plan for a topic should include:

- at least one key aim for the topic as a whole;
- an indication of what topics should come before and what might come after the topic being considered, as well as links to other topics and other subjects (often detailed in the scheme of work);
- lesson plans for each lesson, detailing objectives for each individual lesson, outline starter tasks, how the work is to be developed in the main part of the lessons through teaching input and pupil tasks, how each lesson is to be rounded off and suggestions of what homework should be set;
- details of relevant resources, such as textbooks, worksheets and ICT applications.

When selecting learning tasks it is a good idea to reflect on what makes an interesting, motivating and challenging task for your pupils. Consideration here includes deciding about:

- context ('real-life', 'pure', 'fantastic', ...);
- single outcome/many possible outcomes;
- ways of working:
 - exposition;
 - discussion (small groups, whole-class, paired);
 - solving problems;
 - investigating.

In terms of aims and objectives, it is probably wise to determine *an aim for the topic* and, subsequently, to devise *objectives for each lesson*. Selecting these objectives involves separating a topic into distinct elements (or aspects) and designing a sequence through these elements. *Research suggests that this is the most demanding aspect for a beginning teacher*. Deciding how to select objectives in a way that satisfactorily meets

the pupils' needs demands good subject knowledge, skill at separating and sequencing the elements of a topic and awareness of pupil needs.

One way to begin planning topics is to rely on established practice (for example, the scheme of work or a textbook scheme or equivalent). But remember that an objective is *not* about which exercise the class are to do, nor what they are going to draw, nor even that they are going to have a class discussion. These are the means used to promote learning. *Objectives say what is to be learnt. A major pitfall in planning a topic is to neglect objectives and to see planning as simply organising tasks.* There is much more to it than that. For lower school classes in England, referring to the Key Stage 3 Framework for Teaching Mathematics can help.

Working with the Key Stage 3 Framework for Teaching Mathematics

The *Framework for Teaching Mathematics: Years 7, 8 and 9* provides guidance on meeting English National Curriculum requirements for mathematics for pupils aged 11–14. It sets out yearly teaching programmes, showing how objectives for teaching mathematics can be planned. Sample medium-term plans are available, designed to continue the progression and expectations established in the yearly teaching programmes for the primary years. These sample plans are based on the examples of planning charts in the Framework and identify core objectives that define a minimum expectation for the majority of pupils in a particular year group. The plans show:

- progression in the teaching objectives for each strand of the curriculum;
- links between the teaching objectives, bringing together related ideas across the strands;
- opportunities to revisit topics during the year (the pitch of the second and subsequent units of a topic needs careful adjusting in the light of teacher assessment of pupil progress);
- how objectives for using and applying mathematics can be incorporated into units.

For each term, suggested objectives for oral and mental mathematics are also identified, designed to both support the main teaching activity as well as provide a means of regularly revisiting important elements.

Planning for assessment

In terms of monitoring and assessing pupil progress, it is worth asking yourself if this is to be formal (say, through a test) or informal, or a mixture? It certainly requires you to be *active and purposeful in the classroom* (not just waiting for hands to go up) and involves you observing, probing, questioning, checking, assessing, and so on.

Task 5.12: Planning a topic

For a topic you are beginning to plan, look at how the topic links to other topics and other subject areas, as well as how pupil learning develops in this area. What prior skills do they need to be able to do the work in this topic? What similar topics will they have studied in previous years? What do they need to learn now to prepare them for later topics? Look for suitable resources. How can you plan to include a range of tasks (including open-ended, group and individual work)? What tasks do you think your pupils will find interesting? How can you use a range of teaching and learning styles? Consider how the tasks you have selected need modifying to meet the range of attainment in your class. How will you stretch the most able? How will you ensure that materials support those who are less able or who might find this topic more difficult? Will you need to create some of your own resources? What misconceptions may pupils have about this topic and how you will overcome these? What assessment opportunities can you build in to your lesson plans and how you will record pupil achievements and progress in this topic?

Planning for assessment means using assessment for learning to help pupils reflect on what they already know, reinforce the learning being developed and set targets for the future.

Planning for Inclusion, Equity and Differentiation

The promotion and realisation of equity of opportunity for your pupils to learn mathematics needs to be integral to your planning. This entails taking care to promote pupil experiences by means of resources and content that do not reinforce, and wherever possible positively counteract, stereotypical thinking. It means ensuring that you provide the best for *every* pupil, irrespective of gender, social class or ethnicity.

Differentiation is not solely about helping slow pupils nor stretching the bright ones. Differentiation is about all children. In this context, *diversity* refers to the range of individual aptitudes, while *differentiation* is the planned process of intervention in the classroom to maximise potential based on individual abilities and aptitudes (Stradling, 1991; Dickinson and Wright, 1993). Individual aptitudes can vary in terms of attainment, motivation, interest, skills, and so on. Take these into account in how you differentiate.

For example, you can *differentiate* in a number of ways, including the following.

- In *planning*, by:
 - employing an appropriate variety of tasks;
 - identifying outcomes of tasks;
 - ensuring elements of pupil choice.
- in *task design*, through:
 - type and design (text, worksheet, poster, tape, video, computer, etc);
 - ease of use (for example, reading level).
- in *providing support*:
 - from you as teacher;
 - from other adults and/or pupils;
 - in terms of materials or technology
- in *expected response*:
 - having accessible aims and objectives;
 - making assessment criteria explicit.

**Task 5.13: Planning
for inclusion**

Review some of the successful lessons you have seen. How has the variety of pupils in the classes been included in the classroom activity? How does the teacher differentiate their teaching to ensure all pupils are achieving their best?

Planning as part of a team

As the teacher of the class, *you* have overall responsibility for pupil learning. The role of another adult in the classroom, such as a teaching assistant, can be open to some negotiation or can be quite clearly prescribed – the latter is often particularly true for those who work with pupils with identified “special educational needs” (SEN), especially if they are statemented. It is good practice to liaise with the other adults in advance to ensure lesson planning is consistent.

Task 5.14: Planning as part of a team

Find out about the best ways of planning when you have other adults in a class you are teaching. How might you involve them in or brief them about your planning? How can your planning make sure that they are clear about their role in the lesson? How might you learn from their expertise?

PLANNING FOR OUT-OF-SCHOOL LEARNING

When pupils are expected to continue working outside school, they have opportunities to develop important life skills such as independent study and time management. Teachers play a vital part by setting the expectations and by planning the work to support what takes place in school.

Planning for Homework

When planned well, homework experiences provide a valuable supplement to classroom activities. For example, you can use homework to reinforce and consolidate classroom learning or to gather information that you will then use in classroom activity. Homework is one way in which parents come to know about what their child does in your lessons. Amongst the things you can investigate are the use of home-school contracts and how mathematics departments in particular, but schools more generally, involve parents in supporting pupil learning.

One particular issue to consider in your planning is whether you can use homework as an opportunity to practice skills or for widening the perceptions of mathematics. Or perhaps you can aim to do both over time.

Planning for other out-of-school learning

Valuable pupil learning can take place in a wide range of out-of-school contexts. Such opportunities are known to have positive effects on the achievement of low-achieving students in mathematics. Such out-of-school learning can involve liaising with pupil mentors and the involvement of various partners such as museums, galleries, libraries, sports clubs, theatres, etc.

Task 5.15: Planning for out-of-school learning

Find out about how to plan for out-of-school learning. What are some good ways of using homework, either to consolidate classroom learning, or to gather information that you will then use in the classroom? What are some benefits of home-school contracts and how might you involve parents in supporting pupil learning. What are some other ways in which you can plan for pupils to learn in out-of-school contexts?

SUMMARY

Your success in teaching depends crucially on the effectiveness of your planning and how well you put your plans into action. Your planning needs to be explicit and detailed, particularly in the early stages of taking over classes. This takes both good organisation and time. Developing a range of lesson structures and matching these to what you want to achieve in your lessons is vital. Spend time getting to know the structure of the curriculum and the departmental scheme of work, so that you can begin to work creatively within the statutory framework. Practice your presentation skills, both verbal and non-verbal. Get to know what your classes can do and what motivates them. Build up a collection of classroom tasks that you are confident will engage the attention of pupils. Review and evaluate your work and both seek and act on advice. Always expect a high standard of work.

Successful planning entails preparing a rich mathematical diet for your pupils. Your efforts will be rewarded with the quality of pupil learning you are able to engender.

ESSENTIAL DOCUMENTS

DfES (1999) *Framework for Teaching Mathematics: Years 7, 8 and 9*.

DfES (2001) *Sample Medium-Term Plans for Mathematics* (Ref: 0504/2001)

FURTHER READING

ATM (1993) *In Our Classrooms: Strategies for the Teaching of Mathematics*, Derby: Association of Teachers of Mathematics.

A thoughtful collection of accounts of teachers working in their classrooms to develop their pupils' mathematics.

90 LEARNING TO TEACH MATHEMATICS IN THE SECONDARY SCHOOL

Gammon, A. (2002) *Key Stage 3 Mathematics: a Guide for Teachers*, London: BEAM.

A useful guide to teaching at lower secondary school level, especially Chapter 4 on 'Planning'.

Harris, J. (1995) *Presentation Skills for Teachers*, London: Kogan Page.

A helpful guide to many of the skills involved in developing a good presentation style in the classroom.

John, P. (1993) *Lesson Planning for Teachers*, London: Cassell.

A practical guide to many of the general issues involved in planning lessons; include a range of useful lesson-planning pro forma that can be photocopied.

Neill, S. and Caswell, C. (1993) *Body Language for Competent Teachers*, London: Routledge.

Despite having a rather odd-sounding title, this useful book shows how to use non-verbal skills such as gesture, posture and facial expression to establish good relationships with classes. Contains many illustrations of classroom situations.