Unit 1

The importance of numeracy across the curriculum

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Objectives

- To consider the need to raise standards in numeracy
- To consider current images of mathematics and mathematicians
- To introduce the definition of numeracy
- To consider the need for improving numeracy skills across the curriculum

Suggested use and organisation

- All schools except those which have already established policies on numeracy across the curriculum; whole-staff meeting.
- This is an introductory session for a whole-school training day. It could also be useful as the first in a series of staff meetings.
- Staff should sit around tables in departmental groups; where possible there should be a member of the mathematics department with each group.

Resources

- OHTs 1.0–1.7
- Handouts 1.1–1.4 (one set for each participant)
- *Framework for teaching mathematics: Years 7, 8 and 9* (one copy per group)
- Video sequence 1, 'Consulting with the pupils' **or** copies of your own pupils' web diagrams showing how they use mathematics in other subjects (one for each participant)
- Appendix 1, *Images of mathematicians and mathematics* (one copy per group; optional)

Session outline — 75 minutes

Introduction Considering the need to raise standards in numeracy	Talk, group discussion	20 minutes
Defining numeracy Introducing and discussing the Strategy's definition of numeracy	Talk, group discussion	25 minutes
Mathematics in other subjects Considering the pupils' views and Ofsted's expectations of the use of mathematics in other subjects	Video (optional), group discussion	25 minutes
Conclusion Identifying points for action	Talk, discussion	5 minutes

Introduction 20 minutes

Show **OHT 1.0** and outline the objectives of the session.

OHT 1.0

Objectives

- To consider the need to raise standards in numeracy
- To consider current images of mathematics and mathematicians
- To introduce the definition of numeracy
- To consider the need for improving numeracy skills across the curriculum

Does numeracy matter?

This section could be delivered by a member of the senior management team.

Distribute copies of **handout 1.1** which lists quotes from *Does numeracy matter? Evidence from the National Child Development Study on the impact of poor numeracy on adult life* (Basic Skills Agency, 1997).

Invite participants to read the handout, then ask the group:

- What is your reaction to the information?
- What are the implications for pupils?
- What are the implications for the school?

Take brief feedback.

Point out that numeracy is recognised as a key skill that is important for the employment opportunities of pupils at all levels of attainment.

Emphasise that the evidence shows that poor numeracy skills are a greater impediment to life chances than poor literacy skills. If all members of staff support the drive to raise standards of numeracy the career prospects of pupils will be improved.

The image of mathematics and mathematicians

Next, mention that the public image of mathematics and mathematicians is often rather negative. As an example, you may want to distribute copies of **appendix 1**, *Images of mathematicians and mathematics*.

Show **OHT 1.1** which lists some common views about mathematics.

OHT 1.1

Views of mathematics

Mathematics is …

- an important subject
- nothing to do with real life
- a boys' subject
- something you can either do or you can't
- about learning rules
- about right and wrong answers

Adults often boast that they were 'never any good at mathematics' when they were at school, reinforcing the generally accepted view that it is OK to be innumerate.

Ask colleagues to consider why adults might have a negative view of the subject and to suggest ways of avoiding such attitudes developing in their pupils. Allow a few minutes for discussion in groups before taking feedback.

Mention the following points:

- Negativity is frequently connected to adult insecurity in the subject, poor learning experiences and fear of getting the 'wrong' answer. Problems can be created if these views are passed on to pupils.
- Some teachers, in mathematics or in other subjects, may put pupils under pressure in their lessons to perform mathematical routines that are insufficiently developed or unfamiliar; this can reinforce negative feelings which pupils may already have.
- Some teachers may avoid the mathematical elements of their subject, thereby losing opportunities to demonstrate the necessity of mathematics.

Defining numeracy — 25 minutes

Introduce the definition of numeracy taken from the *Framework for teaching mathematics: Years 7, 8 and 9*. Distribute copies of **handout 1.2**, 'A definition of numeracy', and ask teachers to read through it. Point out the range of mathematics covered by the definition, stressing that it is not restricted to arithmetic.

Allow participants, working in departmental groups, about 15 minutes to consider the definition, using **OHT 1.2** to guide their discussion.

OHT 1.2

Points for discussion

Consider the definition of numeracy (handout 1.2).

- Are there any areas of mathematics useful to your subject which you feel are not covered by the definition?
- Which aspects of the definition are most relevant to the work of your department?
- Identify the two most important aspects of numeracy you require for each of the Years 7, 8 and 9.

Take feedback from each subject group, using **OHTs 1.3–1.5** as prompts (which repeat the text on handout 1.2), identifying any common needs.

OHT 1.3

A definition of numeracy 1

By Year 9, pupils should:

- have a sense of the size of a number and where it fits into the number system
- recall mathematical facts confidently
- calculate accurately and efficiently, both mentally and with pencil and paper, drawing on a range of calculation strategies
- use proportional reasoning to simplify and solve problems
- use calculators and other ICT resources appropriately and efficiently to solve mathematical problems, and select from the display the number of figures appropriate to the context of a calculation

OHT 1.4

A definition of numeracy 2

By Year 9, pupils should:

- use simple formulae and substitute numbers in them
- measure and estimate measurements, choosing suitable units, and reading numbers correctly from a range of meters, dials and scales
- calculate simple perimeters, areas and volumes, recognising the degree of accuracy that can be achieved
- understand and use measures of time and speed, and rates such as £ per hour or miles per litre
- draw plane figures to given specifications and appreciate the concept of scale in geometrical drawings and maps

OHT 1.5

A definition of numeracy 3

By Year 9, pupils should:

- understand the difference between the mean, median and mode and the purpose for which each is used
- collect data, discrete and continuous, and draw, interpret and predict from graphs, diagrams, charts and tables
- have some understanding of the measurement of probability and risk
- explain methods and justify reasoning and conclusions, using correct mathematical terms
- judge the reasonableness of solutions and check them when necessary
- give results to a degree of accuracy appropriate to the context

Teachers of other subjects often see mathematics as a service subject and ask for certain mathematical topics to be taught to fit in with the requirements of their scheme of work. However, there are often ways in which these same teachers could use the context of their own subject to support the teaching of mathematics. For example, a geography teacher may be able to enhance the teaching of data handling by providing real data collected as part of a geographical survey, or a PE teacher could link timing in athletics with work on levels of accuracy in a mathematics lesson.

Having discussed the definition of numeracy, it is likely there will be some agreement on the areas of mathematics most useful in other subjects. However, needs will be diverse and there is a danger, in trying to tackle everything at once, that little will actually be achieved. It will be useful to agree some priorities. The priorities suggested on **OHT 1.6** probably cover most departments' needs, and will be the focus for this course.

OHT 1.6

Priorities for cross-curricular numeracy

- To improve accuracy, particularly in calculation, measurement and graphical work
- To improve interpretation and presentation of graphs, charts and diagrams
- To improve reasoning and problem solving

Mathematics in other subjects 25 minutes

Introduce this section using either option A or B.

A A group of pupils from Years 8 to 10 at John Masefield School, Ledbury, were asked to discuss their use of mathematics in other subjects. Show **video sequence 1**, 'Consulting with the pupils', in which the group constructs a web diagram to support their discussion. The video sequence lasts 5 minutes.

B Distribute the copies of web diagrams drawn by your own pupils, showing how they use mathematics in other subjects.

Ask teachers to spend a few minutes in small groups discussing the points raised.

- Are there any surprises?
- Do pupils' perceptions agree with your own?

Emphasise that many pupils will not see the links between mathematics and other subjects unless they are pointed out.

Next, remind teachers of the Ofsted approach to inspecting numeracy.

When reporting on standards in mathematics, inspectors are expected to give attention to numeracy and pupils' competence in using their knowledge, skills and understanding of numbers not only in mathematics but also in other subjects. Use **OHT 1.7** to illustrate this.

OHT 1.7

Numeracy in Ofsted inspections

In relation to numeracy, inspectors should establish:

- whether there is clear understanding and consistent practice among staff in the development of pupils' mental skills, written methods of calculation and use of calculators
- if pupils can identify and use an efficient strategy for the calculations they need to do
- if pupils cope well with the mathematical demands made in different subjects, or are held back through lack of mathematical knowledge or poor basic skills in numeracy
- how well numeracy and, where appropriate, other mathematical skills are taught, developed or practised in other subjects

Distribute copies of **handout 1.3**, 'Evidence of mathematics in other subjects', that summarises the range of evidence that may be available. Teachers may need to return to this handout later (perhaps in a department meeting) and consider their department's contribution.

Conclusion 5 minutes

Distribute copies of **handout 1.4**, 'Priorities for cross-curricular numeracy', and ask participants to list any points for action. Explain that they will need to keep this handout for future use. Their notes will help to inform departmental developments in unit 9.

Conclude the session by explaining that while the main purpose of developing numeracy across the curriculum is to improve standards across all subjects, it is also helpful to try to improve the image of mathematics amongst pupils, teachers and the community at large as many have a fear of mathematics.

OHT 1.0

Objectives

- To consider the need to raise standards in numeracy
- To consider current images of mathematics and mathematicians
- To introduce the definition of numeracy
- To consider the need for improving numeracy skills across the curriculum

Key Stage 3 *National Strategy*

OHT 1.1

Views of mathematics

Mathematics is …

- an important subject
- nothing to do with real life
- a boys' subject
- something you can either do or you can't
- about learning rules
- about right and wrong answers

Key Stage 3 *National Strategy*

OHT 1.2

Points for discussion

Consider the definition of numeracy (handout 1.2).

- Are there any areas of mathematics useful to your subject which you feel are not covered by the definition?
- Which aspects of the definition are most relevant to the work of your department?
- Identify the two most important aspects of numeracy you require for each of the Years 7, 8 and 9.

OHT 1.3

A definition of numeracy 1

By Year 9, pupils should:

- have a sense of the size of a number and where it fits into the number system
- recall mathematical facts confidently
- calculate accurately and efficiently, both mentally and with pencil and paper, drawing on a range of calculation strategies
- use proportional reasoning to simplify and solve problems
- use calculators and other ICT resources appropriately and efficiently to solve mathematical problems, and select from the display the number of figures appropriate to the context of a calculation

Key Stage 3 *National Strategy*

OHT 1.4

A definition of numeracy 2

By Year 9, pupils should:

- use simple formulae and substitute numbers in them
- measure and estimate measurements, choosing suitable units, and reading numbers correctly from a range of meters, dials and scales
- calculate simple perimeters, areas and volumes, recognising the degree of accuracy that can be achieved
- understand and use measures of time and speed, and rates such as £ per hour or miles per litre
- draw plane figures to given specifications and appreciate the concept of scale in geometrical drawings and maps

Key Stage 3 *National Strategy*

OHT 1.5

A definition of numeracy 3

By Year 9, pupils should:

- understand the difference between the mean, median and mode and the purpose for which each is used
- collect data, discrete and continuous, and draw, interpret and predict from graphs, diagrams, charts and tables
- have some understanding of the measurement of probability and risk
- explain methods and justify reasoning and conclusions, using correct mathematical terms
- judge the reasonableness of solutions and check them when necessary
- give results to a degree of accuracy appropriate to the context

Key Stage 3 *National Strategy*

OHT 1.6

Priorities for cross-curricular numeracy

- To improve accuracy, particularly in calculation, measurement and graphical work
- To improve interpretation and presentation of graphs, charts and diagrams
- To improve reasoning and problem solving

Key Stage 3 *National Strategy*

OHT 1.7

Numeracy in Ofsted inspections

In relation to numeracy, inspectors should establish:

- whether there is clear understanding and consistent practice among staff in the development of pupils' mental skills, written methods of calculation and use of calculators
- if pupils can identify and use an efficient strategy for the calculations they need to do
- if pupils cope well with the mathematical demands made in different subjects, or are held back through lack of mathematical knowledge or poor basic skills in numeracy
- how well numeracy and, where appropriate, other mathematical skills are taught, developed or practised in other subjects

Handout 1.1

Is numeracy a problem?

In 1997, the Basic Skills Agency published *Does numeracy matter?*; the following notes are taken from that report.

- Against expectation, the groups showing the lowest levels of full-time labour market participation among men and women were those with poor *numeracy* rather than poor literacy (p. 10).
- We see signs here of an unexpected significance attached to numeracy in holding onto jobs (p. 11).
- As we might expect, those people in the poor numeracy + poor literacy group were most likely to be found in manual occupations. [But] … they were followed closely, not [by those] with poor literacy + competent numeracy, but [by those] with competent literacy + poor numeracy (p. 13).
- The differences between the numeracy and literacy groups demonstrate again the importance of poor numeracy in restricting access to job opportunities – this time within work itself (p. 15).
- People without numeracy skills suffered worse disadvantage in employment than those with poor literacy skills alone. They left school early, frequently without qualifications, and had more difficulty in getting and maintaining full-time employment (p. 27).
- One feature of the modern labour market is the relentless decline in unskilled and partly skilled occupations. Our case studies showed that people with poor numeracy were in exactly these kinds of jobs. As the number of such occupations declines further, then the people in them face increasing risk of unemployment. To improve their opportunities to get the kinds of jobs that are available, their numeracy skills have to be enhanced. This makes the case for viewing numeracy as just as important a target for educational intervention … as literacy (p. 28).

Taken from *Does numeracy matter? Evidence from the National Child Development Study on the impact of poor numeracy on adult life* (Basic Skills Agency, 1997)

Handout 1.2

A definition of numeracy

By Year 9, pupils should:

- have a sense of the size of a number and where it fits into the number system;
- recall mathematical facts confidently;
- calculate accurately and efficiently, both mentally and with pencil and paper, drawing on a range of calculation strategies;
- use proportional reasoning to simplify and solve problems;
- use calculators and other ICT resources appropriately and efficiently to solve mathematical problems, and select from the display the number of figures appropriate to the context of a calculation;
- use simple formulae and substitute numbers in them;
- measure and estimate measurements, choosing suitable units, and reading numbers correctly from a range of meters, dials and scales;
- calculate simple perimeters, areas and volumes, recognising the degree of accuracy that can be achieved;
- understand and use measures of time and speed, and rates such as £ per hour or miles per litre;
- draw plane figures to given specifications and appreciate the concept of scale in geometrical drawings and maps;
- understand the difference between the mean, median and mode and the purpose for which each is used;
- collect data, discrete and continuous, and draw, interpret and predict from graphs, diagrams, charts and tables;
- have some understanding of the measurement of probability and risk;
- explain methods and justify reasoning and conclusions, using correct mathematical terms;
- judge the reasonableness of solutions and check them when necessary;
- give results to a degree of accuracy appropriate to the context.

Taken from the *Framework for teaching mathematics: Years 7, 8 and 9*, section 1, page 9 (DfEE, 2001)

Handout 1.3

Evidence of mathematics in other subjects

When reporting on standards in mathematics, inspectors are expected to give due attention to numeracy and pupils' competence in using their knowledge, skills and understanding of number, not only in mathematics, but also in other subjects.

They are to gather evidence *from other subjects* of the extent to which pupils can:

- recall number facts and manipulate whole numbers (positive and negative), fractions, decimals and percentages;
- use the methods of calculation they have been taught in mathematics lessons in different curricular contexts;
- use calculators and ICT efficiently, and recognise when these are inappropriate tools;
- estimate and judge the reasonableness of their solutions, check their methods and answers and give results to a required degree of accuracy;
- solve problems where they need to identify the calculations required, and interpret and check their results in the context of the original problem;
- substitute numbers into formulae; and use and make sense of information presented in tables, charts and diagrams, and graphically;
- collect both discrete and continuous data, represent data pictorially and graphically, analyse data and make predictions; and
- explain their strategies and methods and use correct mathematical vocabulary.

Adapted from *Inspecting mathematics 11–16 with guidance on self-evaluation* (Ofsted, 2001, p. 25)

Handout 1.4

Priorities for cross-curricular numeracy

	To improve accuracy, particularly in calculation, measurement and graphical work	To improve interpretation and presentation of graphs, charts and diagrams	To improve reasoning and problem solving
Year 7			
Year 8			
Year 9			
Other points for action			