Numeracy across the Curriculum in Key Stages 3 and 4

Helpful advice and suggested resources from the Leicestershire Secondary Mathematics Team
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The Development of a Whole School Policy

N.B. The following information is not intended to be a definitive policy but to act as guidance and a source of ideas for you to use and apply in your own context.

However the whole school policy should:
- be agreed by members of the school
- clearly state how action to improve the delivery and development of Numeracy across the Curriculum (NAC) will be implemented.

When considering the development of a NAC Action Plan, the following points should be considered:

What does numeracy mean to our school?

Why is numeracy important?

How do we ensure involvement of all staff?

What action(s) will we take to develop Numeracy?

How will we support staff with Numeracy?

How can we incorporate future changes in the curriculum into the Numeracy plan?

How can we use ICT to improve Numeracy?

How can we involve parents and governors?

How will we address continuity and consistency with the other key stages?

How and when will we monitor and evaluate the impact of the Policy in the classroom.
The policy should be agreed by the schools' senior leadership team and by Heads of Department and/or the whole staff.

The policy statement should be short and to the point, avoiding unnecessary length and detail.

The following sections contain some examples of what may be included in a policy statement but they are not in any particular order.
A definition of numeracy

The development of the concept of "numeracy":

1959 - (Crowther report) - Numeracy is defined as a word to represent the mirror image of literacy.

1982 - (Cockcroft report) - A numerate pupil is one who has the ability to cope confidently with the mathematical needs of adult life. There should be an emphasis on the wider aspects of numeracy and not purely the skills of computation.

1995 (OED) – numerate means acquainted with the basic principles of mathematics

A current definition of numeracy:
Numeracy is a proficiency, which is developed mainly in mathematics but also in other subjects. It is more than an ability to do basic arithmetic. It involves developing confidence and competence with numbers and measures. It requires understanding of the number system, a repertoire of mathematical techniques, and an inclination and ability to solve quantitative or spatial problems in a range of contexts. Numeracy also demands understanding of the ways in which data are gathered by counting and measuring, and presented in graphs, diagrams, charts and tables.

(Framework for Teaching Mathematics - yrs 7 to 9 - DfES)

The document Definition of a Numerate Child, contains definitions of what a numerate child can do in years 6 and 9 are

The definition of what a ‘numerate child can do in Year 9’ can also be found in Handout 1.2 from The Secondary National Strategy, National Curriculum Materials.

The definition of what a ‘numerate child can do in Year 6’ can also be found on The Strategy website:-

www.standards.dfes.gov.uk
Mission Statement:

A mission statement is a broad statement of philosophy and commitment. School is committed to raising the standards of numeracy of all of its students; we want our pupils to be confident and capable in the use of numeracy to support their learning in all areas of the curriculum and to acquire the skills necessary to help achieve success in further education, employment and adult life.

Expected Numeracy Capabilities

The two lists of what a numerate child could be expected to do in years 6 and 9 could be incorporated into a single policy statement of what a school intends its pupil to be able to do. For example:

At XXXXX School, we intend that all of our pupils should:

- Have a sense of the size of a number and where it fits into the number system.
- Be able to use strategies successfully to solve number related problems mentally.
- Apply an appropriate method to help solve a problem, e.g. mental, oral and written methods.
- Make sense of number problems and identify and use the required operations to solve them.
- Restrict their reliance on using a calculator and use them only when it is appropriate to do so.
- Develop their skills in estimation and approximation and have strategies for checking the reasonableness of their answers.
- Be able to explain their methods and reasoning using consistent language and mathematical terminology.
- Be able to make and use sensible estimates of a range of measures in everyday situations.
- Be able to interpret, explain and make predictions from information given in graphs, charts and tables.
- Improve their general problem solving skills.
Cross-curricular development work.

The KS3 Mathematics Strategy has identified the following priorities for Cross Curricular Development work: -

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

The contribution of individual departments to the policy.

This section could contain for example:-

more specific detail of what numeracy skills might be expected in a particular subject
what all departments across the school agree to do

Possible actions include:-

reviewing Schemes of Work to ensure numeracy opportunities have been clearly identified
identifying how each dept will help to promote numeracy.

Further exemplification is included in the document Numeracy across the Curriculum Subject Prompts.
Calculation Policy.

The LEA suggested guidelines on calculation are available from this website.

A Policy on the Use of Calculators

All departments could be expected to have a policy on the use of calculators and display consistent practice on the use of calculators. Consideration of these 5 questions, and the points below, will help them with this.

a) What is the mathematics department policy on the use of calculators?
b) What is the mathematics department policy on mental and written calculation methods?
c) Does the practice in other departments support the development of pupils’ mental and written calculation skills?
d) Where in your subject do you expect pupils to be able to use a calculator?
e) Are the calculator skills required of pupils in other subject areas in line with expectations in the Maths Strategy Framework?

A policy statement on the use of calculators could include reference to the following points:

- Pupils should have the required skills to use the basic facilities of a calculator effectively, for example, the order in which keys are used the use of the constant and memory facilities etc.
- Pupils preferably become familiar with their own calculator, for example, how it handles the input of multi step calculations.
- The school expects each pupil to bring and use their own calculator (scientific / basic?).
- Pupils should be encouraged to estimate the approximate answer first and then use the calculator to check the reasonableness of their answer.
- Pupils need to interpret calculator answers sensibly.
- Calculators may be used when working with real data, possibly involving very large, small or decimal numbers, which might otherwise restrict their progress in a lesson.
- In all areas of the curriculum the use of calculators can be encouraged where they enhance the learning taking place, however, it is important that pupils do not develop a reliance on the use of a calculator to solve problems where mental and/or written methods can be used.
Vocabulary

A list of key vocabulary in Mathematics and words which have ambiguous meanings in Mathematics, together with suggested strategies for addressing the issues raised.

Key Vocab in other Subjects Glossary is a document detailing key vocabulary in mathematics and words with ambiguous meanings in other contexts.

Problem Solving

Problem solving is a generic skill which is applicable in mathematics and across the curriculum.

Problem Solving is a document, which gives details of ways of developing problem solving strategies.
Monitoring and Evaluation

Possible ways of doing this include:-

★ Using the policy to reflect on the implementation of Numeracy across Curriculum in the school.

★ Pupil Interviews aimed at identifying:-
  - their perception of numeracy/mathematics in other subjects,
  - their skills in reading and interpreting graphs and charts from other subject areas
  - their written calculation methods.
Interviews could be conducted at the start and end of the year to establish any changes in attitude, perceptions and skills. The document Pupil Interviews suggests a possible model.

★ Interviews with staff

★ Lesson observations

★ Work sampling. The document Pupil Work Analysis suggests a possible model.

★ Interviews/Evaluations completed by departments within the school

★ Students diaries. Students keep a diary for a week documenting when they have used Mathematics in other subjects

★ Identification of mathematical elements in subject areas' schemes of work.

★ Identification of mathematical elements in lesson plans

★ Analysis of performance in K S 2 Non-Calculator SAT paper for targeted support

★ Analysis of performance in K S 3 Non-Calculator SAT paper for targeted support
Conducting an Audit

Individual departments complete audits of their subject area, identifying the mathematical skills used by each year group.

Ways of doing this:-

• Provide departments with a list of mathematical skills and ask them which skills are needed for particular groups. Teachers could add any extra skills which they think are pertinent to their subject. The KS3 Strategy NAC Objectives could be used as prompts.

• Use an audit pro-forma, e.g. from The National Strategy or The Maths Association in Numeracy Across the Curriculum by M. Ledwick.

• Use pupils to gather information based on their own experiences of Numeracy in their subjects over a short period per year group, recording the evidence in a diary or planner.
Promoting and developing Numeracy across the Curriculum

Once the audit is completed, areas for development need to be agreed by the SLT and the maths department to ensure consistency in the delivery/presentation/language used in for example:-

- calculations
- estimating and checking answers
- reasoning & problem solving,
- measurement,
- algebra
- data handling

Graphically, possible areas of development might be:-
- the presentation of work or
devolving pupils ability to tell the story behind a graph

Attention may also need to be given to vocabulary and the raising awareness of the mathematical meaning of common words and phrases

- e.g. take-away is nothing to do with fast food.
Models of working to develop Numeracy across the Curriculum

- Forming a working party consisting of representatives from each department

- Linking a mathematics teacher to each department in the school

- Targeting key departments e.g. Science, Technology. Possible model to support the cross-curricular link between maths and science and possible model to support the cross-curricular link between maths and technology are examples of ways of working with science and technology.

- Select two or three NAC subject prompts from the 'Subject handouts' (KS3 Strategy NAC folder Numeracy across the curriculum, Notes for school based training, Ref:- DfES 0697/2001). The prompts could be discussed as an agenda item at a department meeting. The outcomes of this discussion could then be sent to the Numeracy Co-ordinator/Head of Department for recording and identification of further support.

- Identifying mathematics opportunities in the SOW in each subject area

- Identifying mathematics opportunities in lesson plans
Raising the profile of Numeracy across the Curriculum:-

Activities to consider:-

- Maths teachers leading inset on teaching particular mathematical topics.
- Developing liaison with feeder schools
- Numeracy focus posters in each tutor room. Illustrating the importance of, for example:-
  - pupils being able to make sense of information in chart/graphical form and be able to describe the 'story' behind the graph.
  - pupils being able to make sense of calculation answers, check the reasonableness of an answer and select the most appropriate method of solution.
- Key word posters e.g. the language of operations, pre-fixes
- Posters produced in other subjects displayed in maths rooms e.g. pupils work in D.T. illustrating the use of mm in measurement.
- Sign posts around school giving the distance to other places e.g. the hall, specific classrooms, the post office etc
- Stickers giving measurements of doors, windows, desks etc in imperial & metric units
- Laminated cards made available in non-Mathematics lessons to help students with key maths skills e.g. drawing a pie chart
- School intranet to provide online support for students with numeracy problems in other subjects
- Examples and exercises used in Mathematics lessons based on examples and the schemes of work of other subjects.
- Key Vocabulary/key facts to be provided in student planners.

Cont:
★ Glossary of maths terms to be available in all teaching rooms

★ Numeracy week, e.g. all subject areas to teach some maths
  A Leicestershire school has had a numeracy day using the Count On materials (available from www.counton.org).

★ Maths problem for the week for use in tutor periods
  A Leicestershire school has a box of maths materials available for use in tutor periods

★ Key maths word for the week in bulletin/for tutor period

★ An evening for parents explaining calculation methods
Sources of Support for developing NAC can be found from:-

The Secondary National Strategy

Contact:- DfES Publications 0845 60 222 60
www.standards.dfes.gov.uk/keystage3

Available Strategy Resources are:-

Numeracy across the curriculum
Notes for school based training
This folder is designed to help schools plan and run training matched to their needs. It contains 9 modules.
Ref:- DfES 0697/2001

Numeracy across the Curriculum
Support materials
This pack includes posters, Numeracy across the Curriculum objectives for Key stage 3, CD-Rom with PowerPoint slides for the school based training units and video for use with the school based training units.
Ref :- DfES 0699/2001

The notes for school based training can also be downloaded from the Key Stage 3 website

The Numeracy across the Curriculum resources can be found at:-
http://www.standards.dfes.gov.uk/keystage3/respub/numxc

Also worth a look is:-
http://www.standards.dfes.gov.uk/keystage3/respub/num_xc_webresources

Commercial publications

The Mathematics Association have published a useful reference book:-
Numeracy across the Curriculum in Secondary Schools by Mary Ledwick
The Mathematical Association ISBN 0 906588 47 2