Co-op Academy Swinton

Numeracy Policy

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Raising Standards:

Raising standards in Numeracy across the school cannot be solely judged in increased test percentages. There is a need to evaluate the students' ability to transfer mathematical skills into other subject areas, applying techniques to problem solving.

Their confidence in attempting this is initially as important as achieving the correct solution.

The Senior Leadership Team also has a commitment to the implementation and evaluation of this work. They are aware of the need to create time for liaison to sustain the cross curricular links forged between subject areas. The effectiveness of these links will reduce the replication of work by teachers and students.

Consistency of Practice:

Teachers of Mathematics should:

1. Be aware of the mathematical techniques used in other subjects and provide assistance and advice to other departments so that a correct and consistent approach is used in all subjects.
2. Provide information to other subject teachers on appropriate expectations of students and difficulties likely to be experienced in various age and ability groups.
3. Through liaison with other teachers, attempt to ensure that students have appropriate numeracy skills by the time they are needed for work in other subject areas.
4. Seek opportunities to use topics and examination questions from other subjects in mathematical lessons.

Teachers of Other Subjects should:

1. Ensure that they are familiar with correct mathematical language, notation, conventions and techniques, relating to their own subject, and encourage students to use these correctly.
2. Be aware of appropriate expectations of students and difficulties that might be experienced with numeracy skills.
3. Provide information for mathematics teachers on the stage at which specific numeracy skills will be required for particular groups.
4. Provide resources for mathematics teachers to enable them to use examples of applications of numeracy relating to other subjects in mathematics lessons.

Areas of collaboration

Mental Arithmetic Techniques:

There is an acceptance that students are able to tackle the same questions with a variety of methods. These approaches rely on mixing skills, ideas and facts: this is done by students drawing on their personal preferences and the particular question. All departments should give every encouragement to students using mental techniques but must also ensure that they are guided towards efficient methods and do not attempt convoluted mental techniques when a written or calculator method is required.

Written Calculations:

Emphasis should be made of 'non-standard' methods, particularly for grid multiplication and division by 'bus stop'. Whilst the desire for students to progress to formal algorithms and the most efficient methods is acknowledged, it must not be at the expense of having only a method and not a cohesive and full understanding of what is required.

Vocabulary:

The following are all important aspects of helping students with the technical vocabulary of Mathematics.

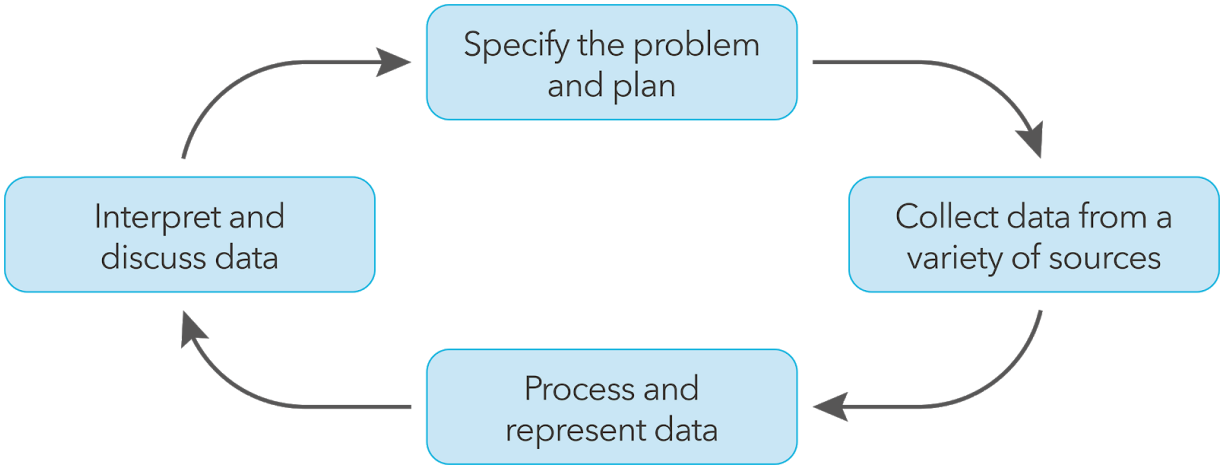
1. Use of display of key words.
2. Using a variety of words that have the same meaning e.g. add, plus, sum etc.
3. Encouraging students to be less dependent on simple words e.g. exposing them to the word multiply as a replacement for times
4. Discussions about words that have different meanings in Mathematics from everyday life e.g. take away, volume, product etc.
5. Highlighting word sources e.g. quad means four, lateral means side, so that students can use them to help remember meanings. This applies to both prefixes and suffixes to words.

Students should become confident that they know what a word means so that they can follow the instructions in a given question or interpret a mathematical problem. For example a student reading a question including the word perimeter should immediately recall what that is and start to think about the concept rather than struggling with the word and then wondering what it means and losing confidence in their ability to answer the question. The instant recall of vocabulary and meanings can be improved through flash card activities in starters. Try to do this twice a half term with each group - this may be key vocabulary at the start of a unit of work or recalling vocabulary from previous mathematics.

Measures:

There is a potential for conflict between the Mathematics department and other departments with regard to units. For example in Design Technology they will use millimetres, whereas we will use centimetres and metres. We will need to ensure that we can help students to confidently convert between one set of units and another.

This also applies to converting between metric and imperial measures.



Students can use this four-stage cycle throughout Key Stages 3 and 4 in many subject areas. Similarly many subjects use graphical representation and we, therefore, need to be consistent in our messages to staff, students and parents.

Transfer of skills

The Mathematics Department will deliver the National Curriculum knowledge, skills and understanding through the Numeracy Framework using direct interactive teaching, predominantly in lessons consisting of several 'episodes'. They will make references to the applications of Mathematics in other subject areas and give contexts to many topics.

The transfer of skills is something that many students find difficult - especially if the approaches in other subjects differ significantly from those in the Mathematics Department.

Possible links with other departments could include:

Faculty	Content
Art	symmetry; paint mixtures as a ratio
Food Technology	recipes as a ratio; reading scales
Geography	representing data; use of spreadsheets
History	timelines; sequencing events
ICT	representing data
MFL	dates; counting in other languages
Music	sequencing
PE	collection of real data
RE	interpretation
Science	calculating with formulae; three-way relationships
Textiles	scale; practical equipment; proportion

Appendix : Mathematics across the curriculum

Introduction:

Numeracy is a proficiency that involves confidence and competence with numbers and measures. It requires an understanding of the number system, a repertoire of computational skills and an inclination and ability to solve number problems in a variety of contexts. Numeracy also demands practical understanding of the ways in which information is gathered by counting and measuring, and is presented in graphs, diagrams, charts and tables.

Mathematical skills can be consolidated and enhanced when students have opportunities to apply and develop them across the curriculum. Poor numeracy skills, in particular, hold back students' progress and can lower their self-esteem.

Need for a whole-school approach:

Improving numeracy skills is a whole-school matter. Each department should identify the contribution it can make towards the teaching of numeracy and other mathematical skills. So that students become confident in tackling mathematics in any context.

The teaching of numeracy is the responsibility of all staff and the school's approaches should be as consistent as possible across the curriculum.

All teachers should consider students' ability to cope with the numerical demands of everyday life and provide opportunities for students to:

- Handle number and measurement competently, mentally, orally and in writing;
- Use calculators accurately and appropriately;
- Interpret and use numerical and statistical data represented in a variety of forms.

Staff need to look for opportunities for drawing mathematical experience out of a wide range of children's activities. Mathematics contributes to many subjects of the curriculum, often in practical ways. Activities such as recording the growth of a plant or an animal, measuring temperature and rainfall, or investigating the cog wheels in a bicycle can provide data or starting points for discussion and the opportunities to apply and use mathematics in real contexts. The key to making the most of all these opportunities is to identify the mathematical possibilities in your subject at the planning stage.

Cross-curricular Guidance:

This document should provide information and guidelines to help produce consistency across the curriculum - it is not intended to be a prescription for teaching although some advice is given.

Approaches:

- It is recognised that not all students in a teaching group will have the same numerical skills and where unsure of an appropriate 'numerical level' teachers should consult with the Mathematics Department.
- All teachers should discourage students from writing down answers only and encourage students to show their numerical working out within the main body of their work.
- All teachers should encourage the use of estimation particularly for checking work.
- All teachers should encourage students to write mathematically correct statements.
- It is recognised that there is never only one correct method and students should be encouraged to develop their own correct methods, where appropriate, rather than be taught ‘set’ ways.

- All students should be helped to understand the methods they are using or being taught - students gain more and are likely to remember much more easily if they understand rather than are merely repeating by rote.

General Advice

Calculators:

In order to improve numeracy skills, it is essential that students should be encouraged to use non-calculator methods whenever possible. However departments should ensure students have access to calculators when they are necessary.

It is recognised that where calculators are to be used their correct use may have to be taught.

Methods and Presentation:

Where a student is gaining success with a particular method it is important that s/he is not confused by being given another method. This does not disallow the possibility of introducing alternatives in order to improve understanding or as part of a lesson deliberately designed to investigate alternative methods, provided students can manage this without confusion.

Working out:

In all arithmetic, the importance of place value and neat column keeping should be stressed.

In a line of workings an 'equals' sign should only appear once.

This is poor practice: £3.50 x 0.85 = 2.975 + 3.50 = 6.475 = £6.48

This is good practice: £3.50 x 0.85 = 2.975

2.98 + 3.50 = £6.48

Language:

- When referring to decimals, you should say 'three point one four' rather than 'three point fourteen'
- Read numbers out in full, so say three thousand four hundred rather than three, four, zero, zero
- It is important to use the correct mathematical term for the type of average being used, i.e. mean, median or mode.

Mean:	Total of values of sample ÷ sample size [The term average is commonly used when referring to the mean]
Median:	Middle value of sample when sample values are arranged in size order
Mode:	Sample values which occur most frequently

Checking:

Encourage students to check divisions by multiplication and subtractions by adding.

Specific Advice

Number:

Standard Form

Students need to be aware of how their calculators express standard form and what it means. e.g. on some calculators.

It should be noted that this should be recorded as 2.5 x 10-2 and that it is equivalent to 0.025

Multiples of ten

When multiplying by ten do not teach the 'rule' add a nought or move the decimal point along one but rather explain that the numbers move one place to the left relative to the decimal place.

So: 3.64 x 10

= 36.4

Measures:

Rough Conversions between Metric and Imperial

In the Maths Department we teach the following conversions:

1 inch = 2.5cm	1 yard = 1m	1 kg = 2.2lbs
2 pints = 1 litre	1 mile = 1.6 km	1 oz = 25g
5 miles = 8km		

Students should be expected to record the units they are using when answering a question.

Time

Students should never record 3 hours and 30 minutes as 3.30hrs but as 3.5hrs.

[When working with time it is possible to use the degrees/mins/secs key on many calculators.]

Data Handling:

Guidelines for constructing/using Graphs and Charts

Students should be encouraged to:

- use a sharp pencil.
- label both axes and give a title
- use an independent variable on x-axis, and a dependent variable on the y-axis, eg: if graphing temperature of a cooling liquid, time should go on the x-axis and temperature on the y-axis. [The temperature of the liquid is dependent on the time of the reading.]
- label lines not spaces, unless a bar-chart with discrete data
- use equally spaced intervals
- use convenient scales
- mark points by a small cross not a dot
- draw graphs on squared or graph paper
- to draw graphs of a sensible size (they tend to make them too small)

Students should be exposed to Bar Charts, Pie Charts, Pictograms, Line Graphs and Cumulative Frequency Curves. Histograms are only tackled by higher-level students.

If axes do not start from zero, a break represented by a zig-zag line should be shown on the axis.

Students need to be taught when each type of graph is appropriate. (This is very important as students will generally produce the type of graph they last met without much thought to appropriateness.)

Types of Data:

Discrete Data

Data is described as discrete if specific values only can be used, e.g. shoe size is discrete as sizes such as 4.8 and 5.77 cannot exist.

Continuous Data

Data is described as continuous if all values can exist, eg. height and weight are continuous data as potentially any value could be measured.

Types of Charts:

Bar Charts

The bars should be of equal width and equally spaced. The bars do not have to touch for discrete data frequency should be on the y (vertical) axis.

Pie Charts

Sectors should be labelled (e.g. Car, Blue.) or there should be a key. Do not be surprised if the total of all the angles is 360° plus or minus one or two degrees. This will almost certainly be due to the rounding that may be necessary. In these cases either add or take the one or two degrees from the largest angle.

Histograms

Do not use the term Histogram unless the bar widths are unequal and relative frequency is plotted along the y axis. This is only taught to those in the top set in Years 10 and 11. Students need to appreciate the connection between the area and the frequency.

Algebra:

Equations

The terms 'cross-multiply' and 'swap sides-swap signs' can lead to misunderstandings, as part of any explanation of how to solve equations and so should be avoided.

To teach solution of linear equations the mathematics department staff use the 'balancing method' or a flow diagram

To solve: $3x - 7 = 5$

Balance Method

$3x - 7 = 5$ (add 7 to both sides)

$3x - 7 + 7 = 5 + 7$

$3x = 12$ (divide both sides by 3)

$3x \div 3 = 12 \div 3$

$x = 4$

Flowchart Method

START: x → [x3] → [-7] → 3x - 7 (you now UNDO)

END: 4 ← [÷3] ← +7 ← 5

x = 4

Specific Mathematical links with other subjects

Science:

Almost every scientific investigation or experiment is likely to require one or more of the mathematical skills of classifying, counting, measuring, calculating, estimating, and recording in tables and graphs.

In Science students will :-

- order numbers, including decimals
- calculate means and percentages
- use negative numbers when taking temperatures
- substitute values into formulae
- rearrange equations
- decide which graph is the most appropriate to represent data and plot, interpret and make predictions from graphs.

Art, Design and Technology:

Measurements are often needed in Art and Design and Technology. Many patterns and constructions are based on spatial ideas and properties of shapes, including symmetry. Designs may need enlarging or reducing, introducing ideas of scaling and ratio.

In Food Technology:

- a great deal of measurement occurs, including working out times
- there are opportunities to calculate the quantity of ingredients required when a recipe is adapted to feed different numbers of people
- costs may need to be calculated

ICT:

Children will apply and use mathematics in a variety of ways when they solve problems using ICT.

For example:

- they will collect and classify data
- enter it into data handling software
- produce graphs and tables and interpret and explain their results.

Their work in control includes:

- the measurement of distance and angle
- using uniform non-standard and then standard measures.

When they use computer models and simulations they will:

- draw on their abilities to manipulate numbers
- identify patterns and relationships.

Spreadsheet work can also involve the use of formulae.

Geography:

In Geography, students have opportunities to collect, present and interpret data. It is important that there is consistency in the way that data handling is taught in Mathematics and Geography. In addition, map work involves the use of coordinates (6 figure grid references), map scales and compass bearings.

History:

Although there would appear to be fewer opportunities for developing numeracy in History lessons, historical data can be analysed and presented in graphical form. Timelines can also be used to calculate the passage of time between historical events.

Physical Education:

Athletic activities require measurement of height, distance, time and speed.

There is an opportunity to calculate averages and use graphs to, for example, chart improvements in performance.

Ideas of time, symmetry, movement. Position and direction are used extensively in dance, gymnastics and ball games.

Religious Education, PSHE and Citizenship:

Belief and likelihood in Religious Education, or risk assessment in PSHE, relate well to work in mathematics. The discussion of moral and social issues is likely to lead to the use of primary and secondary data and the interpretation of graphs, charts and tables. Students should be encouraged to make reasoned and informed decisions, based on facts and to recognize biased data and misleading representations.

By applying mathematics to problems set in financial and other real-life contexts students will develop their financial capability and awareness of the applications of Mathematics in the workplace.

Music:

In Music there are opportunities to explore

- time (time signatures and rhythm)
- the relationship between mathematics and the musical scale (using the idea of ratio)

English:

Members of the English department can help students improve their achievement in Mathematics by teaching them to identify important information from texts. This will help them to better understand mathematical examination questions.

MFL:

Aspects of Mathematics such as counting, calculations, money, the time and the date can be explored in MFL lessons.