



Student SkillPack

Confidence with Numbers

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DEVELOPMENT LEVEL

Gower



CONFIDENCE WITH NUMBERS

Development Level

by John Routledge

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This SkillPack follows on from the Starter Pack, which looked at how to change the negative view many people about learning mathematics. Most people do not stop using mathematics when they finish GCSE. In fact, mathematics is all around us and many people are surprised at how much they can do simply due to their life experience.

This SkillPack will focus on the aspects of mathematics that you are likely to need on your course/programme. Being a user rather than a learner of mathematics can mean that you can/should adopt different strategies. You need to be aware of those possible strategies and to think about which ones will most help you and when to use them.

We suggest you use this SkillPack:

- whenever you have to do some work involving numbers and mathematics
- to reflect on how to solve numerical problems
- to identify your areas of concern about numbers and numeracy and begin to tackle these concerns confidently.

As you work through this SkillPack there are a number of points at which you are asked to write something down or respond to a question. This is done in self completion boxes which are aimed to help you to understand certain important points.

When you have completed it, you should be able to:

- 1 differentiate between numbers, facts, skills and concepts
- 2 identify your own needs in relation to a numerical problem
- 3 identify the numerical facts, skills and concepts needed for a problem you face
- 4 identify strategies to use to solve numerical problems
- 5 identify ways of acquiring facts and concepts and developing skills.

You should be able to use these elements of the skill for any numerical problem you face (written and mental numerical problems, mathematical equipment), with help from libraries, reference books and other students.

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I WHAT IS INVOLVED WITH WORKING WITH NUMBERS

Within any subject, there may be facts to be learned, skills to be practised and concepts to be understood.

Mathematics is no different.

The way in which you were introduced to the subject at school may not have made clear which of these elements you were being asked to consider. You may not have realised, therefore, that there are different ways of going forward. Being able to separate these different aspects of mathematics can be very useful in resolving misunderstandings, reducing anxiety and recognising that you can cope.

I.1 What are facts, skills and concepts?

Facts

In a report on mathematics, it says:

There are certainly some things in mathematics which need to be learned by heart but we do not believe that it should ever be necessary.... to commit things to memory without at the same time seeking to develop a proper understanding of the mathematics to which they relate.

(Cockcroft, 1982, para 238)

What facts do you, and should you, know?

The following are facts taken from time, number and measurement.

- There are 60 seconds in one minute...
- $3 \times 5 = 15$
- 10mm is the same as 1cm.

Write down THREE facts you know from the areas of	
Number 1 2 3	
Measurement 1 2 3	
Shape 1 2 3	

Discuss your facts with a friend.

- Do they know them?
- Did they dispute them as facts?
- Can they suggest some facts to you in these areas that you don't know?

Skills

Skills in mathematics, as in any subject, need to be practised.

Sometimes facts are related to skills, eg, *repeated practice in doing the multiplication $3 \times 5 = 15$ means that you can know it as a fact rather than having to work it out each time.*

Skills include drawing or using a piece of equipment like a protractor, a ruler, a calculator or a set of scales. It is useful to practice such skills if you wish to use that piece of equipment regularly.

Concepts

Concepts are a little more difficult to pin down.

Consider the question 'What is area?'

Some people might respond 'area is length times width' because they have a hazy memory of this rule at school. However this answer does NOT tell us what area is, only **how to find it**, and then only if we are dealing with certain **particular** shapes.

To say that area is an amount of space helps (but then so is volume). To say that it is related to two dimensions helps again.

You may need to **understand** what something is and then go further and develop skills or learn facts to develop a full understanding of the concept.

To summarise

Knowing facts - brings things to the level of immediate recall and can make it quicker to carry out certain calculations. If you have forgotten a fact, it can soon be looked up in a book.

Being able to perform a skill - makes you more accurate, makes things look better (eg, a graph), helps you to work faster. Any skill needs to be practised. Decide which skills you might need and would be worth practising now.

Concepts - *'make up the substance of mathematical knowledge stored in the long term memory..... They underpin the performance of skills and their presence is shown by the ability to remedy a memory failure or to adapt a procedure to a new situation.'*
 (Cockcroft, 1982, para 240).

You already have some understanding of the concept of number and how you might need to use it. You might need to calculate or to order numbers from smallest to largest or to note the smallest number taken from a large table of numbers. However, we all have different levels of understanding of number. For example, we might be able to work with whole numbers but feel less certain if the numbers are decimals or fractions.

In order to think about your own level of understanding, complete the following box, putting a tick for each entry listed in the first column, in the column which best describes your understanding.

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Topic	Understanding		
	None	Shaky	Good
<i>Operations on whole numbers</i>			
<i>Operations on decimals</i>			
<i>Operations on fractions</i>			
<i>Using percentages</i>			
<i>Measurement</i>			
<i>Area/Volume</i>			
<i>Converting units</i>			
<i>Graphs</i>			

The next section deals with the kind of maths that you think you need. Before moving on to it, write a sentence or two about whether you are concerned about any areas where you have said you have no understanding or where your understanding is shaky.

Handwritten signature

Date: _____



2 WHAT KIND OF MATHS DO I NEED?

2.1 Your needs

What facts, skills and concepts are you likely to meet on your course (and your everyday life)?

The following list expands the three elements a little further, notes things to help you structure your thinking and gives you some 'pegs' to hang things on.

When dealing with facts, you might need to remember:

- terms - eg, special vocabulary like 'isosceles triangle'
- notation - eg, % - per cent, or - is less than or equal to, \leq or $\sqrt{\text{square root}}$
- conventions - eg, you should always work out the numbers in brackets first.

The skills you might need, include:

- performing basic operations
- using a calculator
- using a computer
- using measuring devices (eg, rulers, protractor, weighing scales)
- drawing - freehand or with equipment
- talking about the maths you are doing (this is an important skill).

When considering concepts, you might need to understand:

- the concept itself
- the relationship between concepts
- the knowledge you already have that relates to a concept
- the skills you have that will contribute to a deeper understanding.

Example: If you need to work with the concept of 'area' you are:

- looking at the amount of space - in two dimensions - contained by a boundary
- able to relate it to length - a measurement in one dimension, and to volume - a measurement in three dimensions
- aware that any results are given in 'units squared'
- know, when dealing with a rectangle, that its area can be found by multiplying its length by its breadth.

2.2 Strategies

It will be important to have strategies to help.

'General strategies are procedures which guide the choice of which skills to use or what knowledge to draw upon at each stage in the course of solving a problem or carrying out an investigation. They enable a problem to be approached with confidence and with the expectation that a solution will be possible.'

(Cockcroft, 1982, para 240)

Some skills and strategies that are worth developing are those of:

Skills

- estimating
- approximating
- interpreting results
- selecting appropriate data

Strategies

- using trial and error
- trying to simplify a difficult task
- looking for a pattern
- making and testing hypotheses

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3 HOW DO I GAIN MY NEW KNOWLEDGE?

3.1 Is it really NEW knowledge?

You may be expected to know facts which:

- you can remember being taught in the past but have now forgotten eg, *What is the name given to the bottom number in a fraction?*
- You have no recollection of ever being taught eg, *What is the name of the units associated with electrical resistance?*
- you can remember learning in the past but which are now mixed up in your mind eg, *What the trigonometrical ratios are?*

Facts or knowledge can be found again in a variety of ways:

- look it up in a book
- ask a friend if they know it
- ask your lecturer to remind you.

3.2 So what's the problem?

If it is this easy, why do we have a problem? Often it is because of:

- how we think about ourselves
- what we think others expect
- how others make assumptions that everyone knows what they are talking about.

How often have you sat in a lecture theatre thinking 'I don't know that?' Because nobody else says anything you think you are the only one who doesn't know, only to find out afterwards that others didn't either.

Write a brief account below of when this happened to you recently.

One problem with numeracy and mathematics is that there is so much that we could have met, that we might know, that others may assume that we know, that it is difficult not to feel defensive when we don't know or remember something.

4 HOW DO I DEVELOP MY SKILLS?

There is one short answer - **practise them**. There are a number of things that you can do to help with this.

Example: If you need to use a piece of equipment - say a protractor to draw an angle of 70° :

- are you able to draw freehand what you think the angle will look like?
- are you familiar with the protractor? There are different kinds (eg, 180° and 360° protractors)
- are there two sets of numbers around the edge of the protractor and you are unsure as to which one to read?

The first question is important as it shows you **understand** the concept of angle, that you **know** that 90° is a **right angle** and you have the **skill** to estimate that 70° will look something like... The second is important because familiarity helps - that's why you should have your own calculator, why many people get 'jumpy' when driving a strange car. It is unlikely that you will carry out a **skill** to a high level if you are using unfamiliar equipment. The third is about knowledge, knowing which number to read. It is related to the first question, because if you understand what the angle should look like, the problem of which number to read disappears.



What next?	Do you think one of these options is preferable? If so, Why?
<p><i>You could: either ask a friend to watch as you draw the angle - perhaps talking all the time about what you are doing...</i></p>	
<p><i>...or ask a friend to draw the angle - again talking all the time about what they are doing.</i></p>	

Since you may want to draw angles again, at some point you will need to practice - not just deal with this 'one off'.

Perhaps at this point you could **discuss** with a friend whether **measuring** a drawn angle is the same skill as **drawing** an angle? There are many closely related skills required of you when working with mathematics, but equally that there are differences between them.

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5 HOW DO I DEVELOP UNDERSTANDING OF CONCEPTS?

The following example shows how we can have different levels of understanding which also involve facts and skills.

When we meet something new we bring to it our experience and previous learning and try to accommodate the new alongside the old.

Example - measuring

Concepts

- you understand what it means 'to measure' something
- you understand that more sophisticated devices allow us to measure more accurately
- you understand what is the most appropriate unit of measurement in a certain case, eg Km rather than mm.

Facts

- you know that you use different units to measure time, length, mass or volume
- you know that there are different systems of measurement for, say, length (imperial or metric) or temperature (Celsius or Fahrenheit)
- you know that there are 10mm in 1cm.

Skills

- you can use a ruler or tape measure accurately (but not perhaps a thermometer)
- you can calculate the area of a rectangle (but not the area of any other shape)
- you can use both the 12 and 24 hour clocks with confidence.

To develop your understanding about measuring you need to experience different situations in which measurement is involved, practice using different measurement devices and measure different kinds of quantities. You may recognise that some quantities are easier to measure than others, realise that you need to develop your accuracy when measuring, etc. All these experiences will add to your deeper understanding of the concept of measurement.



6 WORKING FROM CONTEXT

In this section, you will be asked to consider the situations in which you meet numerical or mathematical problems.

6.1 Word problems

You may meet numerical information in a word problem.

This is an example only which you do not need to answer. It suggests the type of questions you can ask whenever you meet a problem.

Example: A race of 2000 metres starts from a point a little distance round the first lap and ends at the end of the last lap. As the winner is breaking the tape at the end of lap four, one competitor is only three quarters of the way round this lap, and another is two thirds of the way round.

- a) *If the distance between these other competitors is 42.5 metres, what is the length of the lap?*
b) *How far is the starting point round the first lap?*

- Do you understand the situation?
- Do you know what the numbers represent - eg numbers of people, length, money?
- Do you know whether the numbers are exact or approximate?
- Do you know whether you are expected to combine the numbers in some way - eg add some, divide one by another?
- Can you carry out the operation required? How? In your head, with a paper and pencil, with a calculator?
- Do you understand what the answer is telling you?
- Did you have a feel for what the 'size' of the answer should be before you made the calculation? (So you have a rough idea of whether the answer looks right.)
- Do you understand what you have to do with the answer?

Have you met a word problem during the last month which caused you difficulty? Write about it in the box below, trying to identify answers to some of the questions above, where appropriate.

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6.2 How to deal with your problem

In overcoming difficulties it helps to break down the problem into a series of steps related to the ideas talked about earlier.

Gather the facts

- What numbers or other facts are you given?
- Are there some that you feel less happy about than others? Why?
- Is it because some are whole numbers while others are decimals, fractions, percentages?
- Is it because some are measurements whose units you do not know?
- Is it because some notation (eg a symbol) has been used which you do not understand?

Decide on a strategy

- Are there any other facts that you need to look up, ask other people about, check on?
- Do you know what calculations you need to make?
- What else do you have to do - eg make a table of values, draw a graph or other diagram?

Carry out the strategy

- Find the extra information you need - from a book, a friend, your tutor.
- Make the calculations required. How? In what order?
- Get the right equipment, eg to draw a graph or diagram.

As you do each step think about what outcomes you expect - *eg the size of any answer to a calculation, the shape of a graph.*

Performing the skills

Once you have decided on your strategy, you need to carry it out and this involves skills.

With calculations, if it is an addition, subtraction, multiplication or division and if the numbers are in a form you are happy about (eg whole numbers, simple decimals), then performing the calculation can be relatively pain free. You could use pencil and paper or a calculator.

If it is more complicated, such as calculating a percentage of something, then decide whether you know the rules, whether there is only one way to do it or a number of ways.

The following examples are worth considering in detail as they should help your understanding.

Example 1 Find 20% of £34

How many ways can you find to answer this? Do you think there is only one way? Are you struggling to remember how to set it out the way you were shown in school?

What do you know about 20%

What is the same as?			Which is easiest?		
20 out of 100	0.2	1/5 (one fifth)	$\frac{20}{100} \times \frac{34}{1}$	0.2×34	$34 \div 5$

Can you carry each of these out on a calculator? What do you get for each one? Does each one give you the same answer? What does the answer mean - how would you write it?

Example 2 Draw a graph which allows you to convert from £ Sterling to French Francs. From it work out the equivalent value of

- a) £24 in francs
- b) Ff150 in pounds and pence.

With this example in your mind, follow the steps made below. Each step indicates what is needed to draw a graph and extract information from it.

The steps can be described as:

- A gathering the information in advance
- B entering the information
- C completing the graph
- D taking new information from the graph (if required).

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A Gathering the information

Question	Answer
What axes do you need?	Two
What will go on each axis in terms of quantities?	The horizontal one to show the number of £ Sterling and the vertical one to show the number of French Francs.
Does it matter which way round the axes go (which goes across and which goes up and down)?	Here you are going from £ to Ff. So the horizontal axis shows £ and the vertical Axis shows Ff.
What range of numbers do you need on each axis, eg, do you have to begin at 0?	Although you are not told the range of values to use, you can see from the question that you should go to at least £24 and at least Ff150. As there are about 9Ff to each £ (check your newspaper) this means that £25 is equivalent to about Ff225 and so £25 and Ff225 should be all right. In this case it is sensible to start both at 0.
How should each axis be calibrated, eg, in ones, fives, tens, hundreds, 0.1's, something else?	I suggest counting in 5's for the horizontal axis and 20's for the vertical axis.
Is it OK to use a different scale on each axis?	Yes.

You should now be able to draw and label the axes and be ready to move to step B.

B Entering the information

This example uses the simple approximate conversation rate mentioned above where £1 = Ff9.

You have to:

- know that each point depends on two quantities, eg (3, 27)
- know which number relates to each quantity, eg 3 means £3 and 27 means Ff27
- know that the first number shows how far to go across while the second shows how far to go up
- be able to enter each point accurately by reading the scales you have chosen
- decide how many points to plot in order to have a useful graph.

A table of values can be useful here and one is drawn up below.

Number of £	Number of Ff
0	0
5	45
10	90
15	135
20	180
25	225

Enter these points on to your axes.

C Completing the graph

Once you have plotted the points, decide what to do next.

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Question	Answer
Should you join the points up? If so, how?	Here, the answer is yes because the points in between all show equivalent values as well. You should also see (and might have expected) that you will get a straight line.
Do you need to read anything off the graph? If so, what?	You want to know the equivalent value for £24 and Ff150.
Do you need to extend the graph any further? Why? Is it OK to use a different scale on each axis?	No. You thought about how far the axes had to go before you began.

D Taking new information off the graph

From the graph you should now be able to see that:

- £24 is equivalent to Ff216 (in this case because of the simple relationship of $£1 = Ff9$ used. You could perhaps have calculated this without the help of graph but if the relationship were more complex, the graph would have been important).
- Ff150 is equivalent to about £17. You might be able to put a slightly better estimate on this but it will depend on the scale you have used.

What have I learned from this example?

Graphs are used in many situations to display data and provide answers to questions. A particular example has been used here but there are more questions that you could consider about graphs in general, such as:

- what does the graph tell you?
- did you expect the points to fit some kind of pattern? Why?
- what information can you extract from it?
- does it help you - and others - to understand the behaviour of something?
- how difficult is it to interpret graphs?
- how much practice do you need in drawing and interpreting graphs?
- how much has careful consideration of this example clarified your understanding of graphs?

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7 WHAT HAPPENS NEXT

The examples above show how you can break down a problem and deal with its separate parts. In working through the Pack you have been asked to think through problems you have met in the recent past.


It is now important to look forward to the future.

When you are asked to answer a question which involves numbers, shapes and numerical information of any sort, you can return to this Pack.

You can begin to analyse the facts, skills and concepts that you need, matching them to those that you already have. You will have the general skills to search out the additional facts you require, the confidence to develop further the mathematical skills needed and, with each new experience, you will have a greater appreciation of the way in which mathematical concepts are interrelated.

Perhaps the greatest help to you in the future would be the keeping of a reflective diary in which you enter details of problems met, difficulties overcome and solutions found.

8 ACTION PLANNING

What actions can you take to improve your ability to deal with numbers? 

Action	By (Date)
	<p>Handwritten notes in the right column, including the word "planning" and other illegible text.</p>

9 REFERENCES AND BIBLIOGRAPHY

NOTES

Libraries will have a great deal of material on aspects of numeracy and mathematics. If you feel you need to work on a particular topic area, then look for that within the index of a general text.

However, since much of this skill pack is concerned with your developing confidence in tackling mathematical questions and problems, the following readers might help you.

- Burton, L. (1986) *Girls into Mathematics Can Go*. London: Holt Educational.
Buxton, L. (1981) *Do You Panic About Mathematics?* London: Heinemann Educational.
Cockcroft, W (ch.) (1982) *Mathematics Counts*. London: HMSO
Frankenstein, M. (1989) *Relearning Mathematics: A Different Third R - Radical Maths*. London: Free Association Books.
Tobias, S. (1978) *Overcoming Math Anxiety*. New York: Norton.

9.1 Student skills product list

Having worked through this Skillpack might like to know that similar structured, straightforward guidance is also available on the following topics:

- Identifying Strengths and Improving Skills
- Organising Yourself and Your Time
- Note Taking
- Gathering and Using Information
- Essay Writing
- Report Writing
- Oral Presentation
- Group Work
- Solving Problems
- Negotiating and Assertiveness
- Coping with Pressure
- Revising and Examination Techniques
- Reflecting on Your Experience

The Student Skills Guide

All of the SkillsPacks listed above are gathered together and are available as a paperback workbook.

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