# Graphicacy in the Primary Curriculum

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## 1. Introduction

Literacy and numeracy are bywords in educational systems the world over. We concentrate very hard on teaching children how to communicate using the written word and to manipulate numbers; yet the art of combining these two skills is often sadly neglected. Graphicacy, which could be defined as the ability to communicate numerical information visually, is I believe a greatly underestimated skill. Yet we live in a world where graphs abound. They can be magnificent tools of communication or blatant misrepresentations of the truth. They are very often badly produced by artists who are concerned only with making them look attractive, with little or no concern for accuracy. This lack of concern for graphical accuracy extends beyond the popular press, even statistics textbooks are prone to it, for example confusing bar charts and histograms.

## 2. Problems

Graphwork is in fact taught quite extensively in our schools, but there is rarely more than a superficial attempt to rationalise what is taught, when, and how. It appears in many subjects, not only in mathematics but across the entire school curriculum. There is even an instance of pupils being required to interpret a graph as part of an oral examination in French! (Hampson, 1985). Traditionally, mathematics classes have concentrated on the skills necessary for drawing graphs, whilst in the other science subjects pupils may be expected to draw their own graphs and then interpret them. In arts subjects the emphasis is almost entirely upon interpretation. When one considers that graphs are a communication tool, it is perhaps not so surprising, after all, that they appear in language classes.

The result of all this is that whilst graphs are encountered frequently by pupils there is very little coordination between work in the various subjects. It is a problem which applies to much of statistics and led the Cockcroft Committee to recommend that a Statistics Coordinator be designated in each school with the remit to ensure cooperation and coordination between the teachers of statistics in all the subject areas (Cockcroft, 1982). This has happened in only a very few schools, but a major boost to its inception must be the training pack for Statistics Coordinators produced by the Centre for Statistical Education (Holmes and Rouncefield, 1990).

So, where does this leave the pupils? In many places, unfortunately, very confused. A large-scale survey of 11 and 15-year-old pupils found for example that only 20 to 60% of 11-year-olds could read pie charts and the success rate rose to only 40 to 70% for 15-year-olds (APU, 1982). It is notoriously difficult to transfer learning from one subject to another, so how much more difficult it must be for pupils when notation, terminology, and even technique, may be taught differently in, say, geography and mathematics. It is not surprising that some pupils actually think they are being taught about different types of graphs when in fact they are the same. Even more disturbing is the tendency for teachers in the "applications" subjects to assume that the pupils will have learnt all about a particular graph in mathematics and so expect the pupils to be able to use it without any help or tuition.

The difficulty is compounded by the experience of graphs which these pupils will have had in the early years of schooling. The problem here is not one of separate subjects, for in English schools most children are taught all subjects by the same teacher until they are about eleven years of age. In fact, there has been an increasing trend towards topic work in our primary schools. So, for example, under the heading of "water", pupils may consider the water cycle, the natural history of streams and ponds, capacity, flotation, etc. Clearly this provides an ideal opportunity for realistic and useful graphwork. When used well this can be an excellent way of developing graphicacy, but it is not without pitfalls.

Working in primary schools over many years I have become increasingly concerned about the rather haphazard way in which graphwork is covered. It is all too easy to use graphs as a way of simply brightening up a display of work. I have met a lot of pupils who are convinced that the criteria for a good graph is that it is carefully drawn and neatly coloured in, presumably their teachers would agree. The drawing of the graphs seems to be an end in itself with no discussion of what the graph is "saying".

In particular, there seems to be very little thought given to the order in which various aspects of graphwork are taught. It is not unusual to see eleven-year-olds drawing graphs of exactly the same type as five-year-olds. In all other aspects of mathematics very careful consideration has been given to the order in which techniques are taught. In our post-Piaget classrooms great emphasis has been placed on the gradual transition from the concrete to the abstract, but very rarely is this applied to graphs.

## 3. Solutions

Once alerted to this neglected area teachers are quick to develop a progression, but initially raising awareness is a slow process. Textbooks and resource books for teachers have, so far, been of very little help. They seem to fall into much the same trap as teachers, showing very little development between the various stages. The end result is usually a plethora of block graphs and bar charts with the occasional pictogram for a change.

We take great care to provide our youngest pupils with concrete materials to handle and manipulate when they take their first steps in mathematics. We use structured materials such as Dienes blocks in number, three-dimensional shapes, objects to weigh and measure, and then expect them to display their results as a very abstract diagram such as a block graph. Is it then surprising that at a later date they have difficulty with graphs?

It is not difficult, in fact, to find ways of beginning graphwork with real, concrete materials and then gradually move towards more abstract representations. It is possible to begin with graphs made up of actual objects, for example the children's shoes can be arranged on the floor in rows according to size, and from that conclusions can be drawn about the "popularity" of various sizes. "Toys" is a favourite theme for young children and I often see graphs of "our favourite toys" on classroom walls; why not allow children to bring their favourite toys to school on a specified day and make a graph of the real thing?

From the real thing it is possible to move on to either smaller scale versions or pictures of them. For example, toy cars to represent real cars in a graph of "The Colours of Cars in our Car Park", or if that is not possible pictograms using either pictures cut from magazines or the children's own drawings.

Later this can be made slightly more abstract by replacing the real objects by others which do not necessarily resemble the real thing. There are plenty of three-dimensional building materials available which can be used to build three-dimensional graphs. To make this transition even smoother the building blocks can be labelled so that there is still an obvious one-to-one relationship between the graph and the real thing.

At the same time there are plenty of opportunities for using graphs which arise naturally. An obvious example is to be found in plant growth. In the early stages seeds can be planted at one day (or one week) intervals and the heights of the resulting plants will provide a real live graph of growth rates. Later just one seed can be planted and it's height marked on a chart at regular intervals.

In all these early graphs there is unlikely to be uniformity of size, a scale, axes, or even labels. These should actually arise naturally, for example when using towers of toy building bricks the floor provides a natural base line and the use of a vertical scale saves counting every time.

The important thing to note is that the transition from concrete to abstract should be both gradual and logical, giving a sensible progression through the subject. Over the years I have tried, with the help of colleagues and many teachers, to develop such a progression for primary schools. The progression itself has been modified many times over the years and the current version can be seen in Figure 1. I make no claims for it being the definitive answer, in fact everybody who looks at it tends to want to refine it in some way. What I do hope is that it will provide a stimulus for others to go away and think about a progression in primary graphwork. Above all I hope that it will make teachers (and teacher trainers) more aware of the need for careful consideration of the way in which graphs are taught.

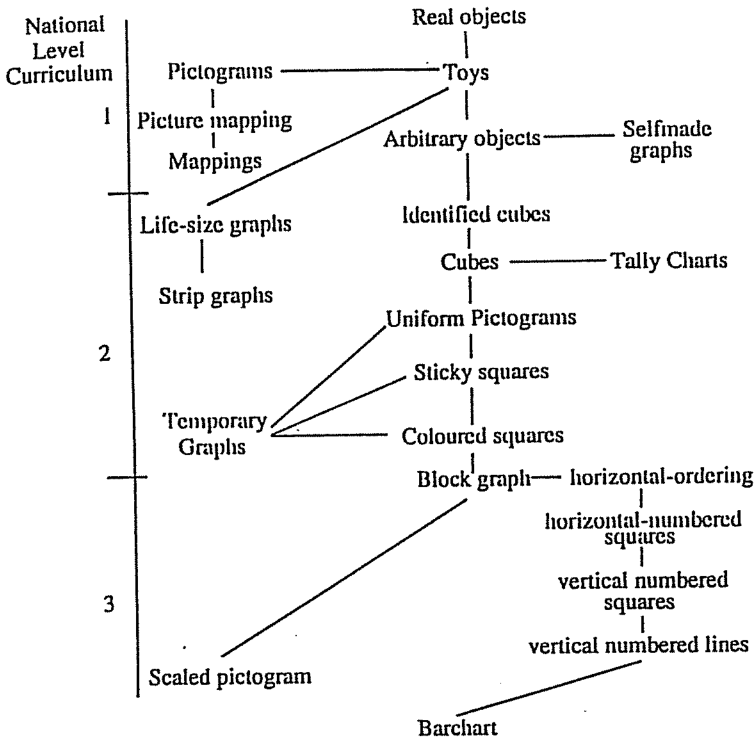


FIGURE 1
A progression for graphical work in primary schools

## 4. Conclusions

Graphs are a wonderful tool and we should be helping our pupils to use them to the greatest advantage. Much can be done to improve the development of graphicacy in older pupils, particularly through the coordination of work in the various subject areas, but this will be to no avail if these pupils have developed only a very superficial understanding of the basics in their primary schools.

Graphicacy is beginning to be treated seriously in primary schools in England and hopefully future generations will not only be literate and numerate, but also "graphicate".

## References

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