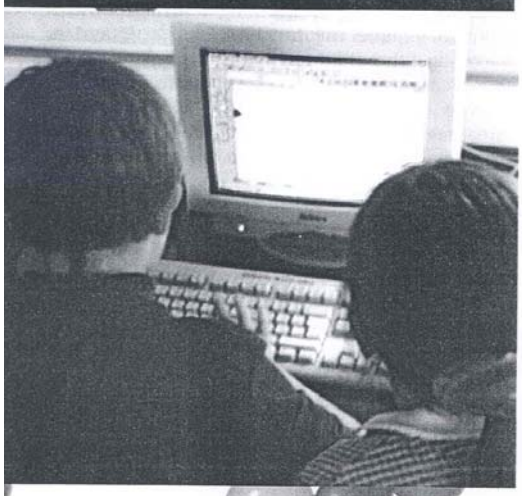


Who's a Smartie?

Using Microsoft Excel to support thinking together about graphs and charts in the primary numeracy hour.

Simon Mills

Introduction

This article stems from work with my year four class, during the Interactive Education Research Project, based at The University of Bristol's Graduate School of Education, and has evolved form ongoing course work for my Masters Degree and Best Practice Research Scholarship.

As a teacher I believe learning to be an emergent and ongoing social process and that the learning contexts we develop should be meaningful, relevant and purposeful, drawing on and building from the personal experiences our students bring to school with them. It is by making emotional and personal connections with their activity, that I believe children's learning becomes relevant, allowing them to evolve ownership over their outcomes and thereby to see purpose and meaning within the tasks they do. For me, integrating ICT into teaching and learning means engaging my students in learning to use a set of tools, which are constantly evolving, as users in the world around us find new ways of communicating, sharing and exploring ideas with them. If we are to make learning to use ICT relevant and meaningful, then we need to design situations, which enable students to see how this potential can be linked to the purpose of their activity and how ICT is used in real life contexts.

Why use ICT to support thinking together in Mathematics and Data Handling?

Ainley, Nardi and Pratt (2000, P.3), identified pictorial representation and data handling as areas which are frequently underdeveloped in primary school contexts. Their work suggests that, although graphical representation as a topic has a relatively high profile within the curriculum, the production of graphs is often seen as the end product of data handling activity. Indeed they suggest little attention is focussed on "interpretation (beyond rather superficial 'reading' of data), or on the use of graphs as problem solving tools."

Within the National Curriculum (DFES/QCA, 1999), data handling is presented very much as a tool for the representation and analysis of real data in a range of cross curricular situations. Review of curriculum documentation shows circumstances where children are required to use data handling and presentation skills beyond the mathematics classroom, e.g. logging change over time in science, exploring relationships between types of land use in geography or collecting evidence relating to preferences while identifying needs in design and technology. In these situations learners are not just required to draw charts or tables, but also to use information presented, to help solve problems, and develop understanding of relationships through interpretation of a range of graphical representations. In order to do this children must acquire understanding of how charts and graphs work in a range of situations, be able to access and use tools available to generate representations of data and have a common language base through which they can use and share their interpretations of data. Indeed they must develop understanding of how these systems of representation work.

McFarlane (2003) suggests that the potential impact of Information and Communication Technologies on learning may best be seen if we view them as a set of tools with various 'affordances' and 'constraints'. Where these tools are computer based she suggests that affordances may relate to the following categories.

- feedback
- representation of dynamic processes,
- multiple representations,
- ability to edit,
- automation
- sharing of a common communication space.

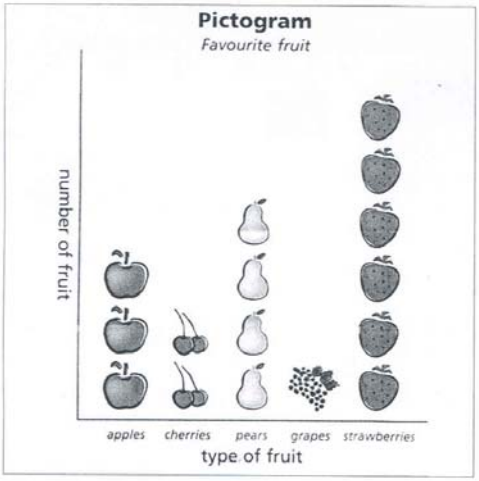
(McFarlane 2003 P.226)

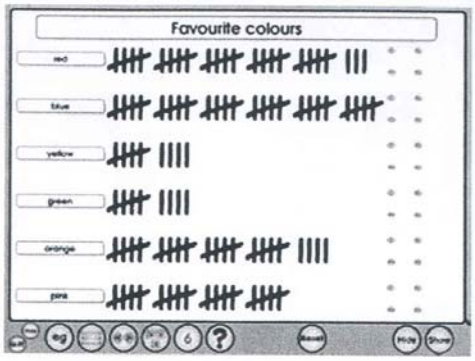
This article seeks to demonstrate how identifying the affordances of software environments and matching these to specific teaching and learning objectives helped me to structure and support my student's engagement in an active graphing process. I shall discuss how I drew on the affordances of Microsoft Excel and interactive teaching and learning resources to develop situations where my students and I could work collaboratively to develop shared understanding of how graphs and charts work. The affordances of the Excel environment enabled us to move beyond representation towards discussions and interpretation, using and applying data we had collected to help discuss and evaluate the validity of a real dilemma.

Establishing a Starting Point

The teaching sequence began with a series of whole class and group discussions. In pairs the children explored a collection of "real" charts presenting data in different formats. Not all the chart types were familiar to the children, this was important, in light of my long term aims which were to explore the function of charts, and to encourage the children to think together about those features which make them useful in real life. During their exploration the children were encouraged to view the materials as they might a diagram or piece of text from a book, and consider 5 main questions

- What was the chart about?
- Who might have made the chart and why?
- Who might find it useful?
- How useful was the chart?
- And what features of the charts enabled them to make these decisions?





Above: Screen shot from Tally chart, an interactive teaching program by Mark Cogan. www.interactive-resources.co.uk
Left: Screen shot from PowerPoint presentation.

As they worked together I supported their discussion helping to identify chart features that enabled us to make sense of them. Children were encouraged to discard charts they found problematic, but asked to present their reasons for discarding them.

When reviewing this lesson a Microsoft PowerPoint presentation, including charts we had discussed, was used to focus class discussion and help gather together the children's views about "what makes a good chart?" This type of process is common in the context of literacy sessions. Teachers often work with students to evaluate and record the features of texts, which are later used as prompts in guided or shared writing sessions. Children use the features of say, a "good instructional text" as a model to help organise and structure their own writing and as a checklist for evaluating their completed outcomes. In this context I used a similar process to support discussions and record their outcomes, encouraging the children to use and apply language conventions associated with charts and graphs. In the process we identified the types of charts presented, discussed and recorded possible uses they might have and identified and named features which enabled them to fulfil their purpose. This introductory activity elicited invaluable formative assessment data. The children had a very clear understanding of simple frequency tables, tally charts, Carroll and Venn Diagrams and how they worked. They had some understanding of bar and line charts which used discrete data and were able to visually interpret pie charts by comparing the relative sizes of their segments. The group were very critical of pictograms as representational devices and raised a number of issues which led to wider discussion about the importance of how we present data to an audience if it is to be meaningful. When I later considered the charts discarded by children, they were as I'd predicted: those which presented continuous data, for example time and change graphs. Discussion revealed that these chart types were completely unfamiliar to the group.

Building on prior learning

For the sessions that followed, I used an interactive whiteboard and a range of both commercially and freely available Interactive Teaching Programs (ITPs), to explore methods for data collection, and presentation. Here we referred to the features of "good charts" identified earlier. We also spent time "thinking together" about chart titles and axis labels, which would help our readers understand what our data was about. This allowed us to further expand and consolidate our vocabulary as we carried out surveys and used different ways of presenting our results. The use of the computer and interactive whiteboard allowed us to present the same data in different formats quickly and to discuss which method of presentation was best for our purpose. We were also able to observe the effects of changing axis scales on the way our data looked and to focus on the importance of the value of scale divisions in interpreting certain chart types.

The speed of representing data and the ability to view our representations as a large group allowed us to use this "real" data to solve number problems in the context of data handling for example:

- calculating the difference between frequencies
- finding and comparing totals.

These then raised issues about the validity of the data we present, and problems we might encounter in the organisation of data collection and surveys, for example, how to make sure the whole sample is represented.

- How would we know everyone is included?
- What would happen to members of a sample who did not fit into any of the categories we had used in our survey?

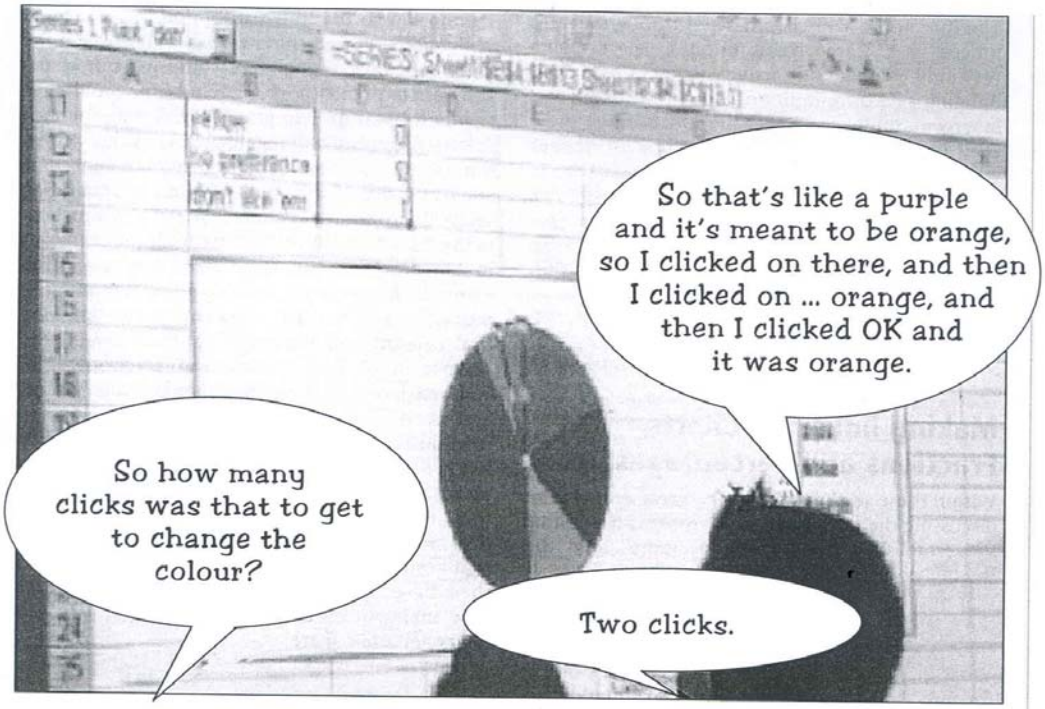
If I had used traditional paper based presentation methods, as described by Ainley et al (op. cit) it is likely that these issues would have been lost due to time constraints, and the limitations of the media.

Becoming Chart Wise: Using and applying emergent learning through guided investigational work.

These classroom based activities were followed by a guided investigational task, based on an idea presented by Janet Ainley (1996 p.28). For this series of activities we moved to the ICT suite. The children were each given a tube of Smarties. I told them my favourite sweets were Smarties, particularly the orange ones. I had noticed though, that there never seemed to be a fair share of these in any of the tubes I bought. The children were asked to work in pairs and to help me investigate whether this was true. They were introduced to Microsoft Excel and asked to construct a frequency table to represent the number of each colour Smartie in their tube. It was interesting observing the children as they sorted and counted their sweets.

Some grouped their beans by colour and counted these entering the results into the spreadsheet. Others arranged their beans into columns, similar in form to bar charts and pictograms, comparing them before counting them.

Some children began exploring the software environment unprompted. The children had used several other Microsoft applications in the past, and were familiar with the use of "Wizards" as tools and templates. They were also aware that usually they needed to highlight by using "drag and drop" in order to use features within these applications. I noticed that one pair of students had begun using the chart wizard feature to explore independently the different types of chart they could present using Excel. I decided to draw on this opportunity and the following day encouraged one child to present what he had learned to the rest of the class. Internet sources for some of the ITPs used during these sessions are presented at the end of this article.



Using the Interactive whiteboard the child opened the next session. He demonstrated to the others how to use the chart wizard to present the data in their frequency tables as a pie chart and how to edit the default colours of each chart segment so they were the same as the beans they represented. This he thought was a good idea as it would allow readers to see easily which segments represented each colour Smartie, the class agreed.

It was during this time we also learned how to edit charts, discussed titling and axis labelling as ways to help engage our readers.

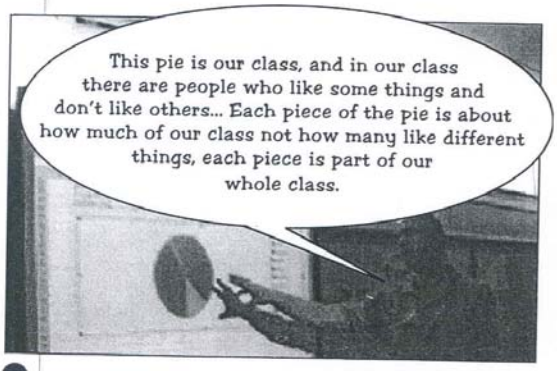
Amid this the children worked to develop their own charts in pairs. Each group presented their data in a variety of forms, quickly using the chart wizard to help them present the same information in different formats.

The interactive whiteboard acted throughout this process as a shared communication space where we could evaluate our activity together as a class, building as a community of enquiry a shared and emergent understanding about real charts, how they work and which would be best to present what we wanted to show. This approach I really felt helped the children gain not only an understanding of how charts worked, but also engaged them fully in developing an understanding that different charts were used for very specific purposes.

Making links: Pie Charts, Fractions and Percentages

Within these sessions we spent a great deal of time discussing the purpose of pie charts and bar charts. We established that bar charts represented the frequency of colours of Smarties, whilst pie charts represented the proportion of colours in a whole tube. We were able to establish the idea that pie chart segments represented these proportions as parts of a whole; that these were fractions of the content of a whole tube and ultimately to concretely relate these to percentages by turning on Excel's percentage function within the pie charts displayed. Through discussion we began to approximate what fraction different percentages represented, e.g. 24% was about one quarter, 47% was about a half and so on.

The visual representations afforded by these charts provided a rich context for exploring and comparing concretely the properties of fractions and percentages. These discussions later proved invaluable as the investigation proceeded.



Having shown that the distribution of the colours of Smarties in each tube was uneven, I asked the children if they thought we could use our charts and data to predict how many tubes I would have to buy if I was ever to get an equal share of each colour. After thinking together it was suggested by one of the children that she could combine data she had collected with that of other children. She could then redraw her pie charts and count how many sets of data it took to make all the segments in her pie chart the same size. This suggestion evolved from her understanding about the properties of Pie Charts and the groups growing understanding of the relationships between the properties of percentages and fractions. The children agreed to share their data between groups and then used Excel to redraw pie charts to investigate this idea. The children noted as they worked that adding additional data did bring about a degree of convergence in some sets. But they eventually concluded that although some data sets seemed to equalise, some sets had significantly more Smarties than others. From their data, they concluded that it didn't matter how many tubes of Smarties I bought, I would never get a fair share.

Making it real: Reporting our findings

We concluded our investigation by writing to Nestle to inform them of our findings and asking about the process of packaging which may have lead to our results. The children were highly motivated by the process we had engaged in and also suggested we should make a book to share their findings. Using the charts they had developed and their desk top publishing skills we produced a floor book.

In conclusion

This project took eight Numeracy Hours in total to complete, using unit 4d of the QCA scheme of work for ICT as a vehicle to develop objectives from Attainment targets 1 and 4 of the National Curriculum for Mathematics, and 1 and 3 of the National Curriculum for English.

This teaching and learning sequence clearly demonstrates the richness of learning outcome which can be achieved through using ICTs as mediating tools within primary data handling.

However, it was also clear as the sequence developed that the way in which tools were selected and used were of equal, if not more importance, than their availability. Simply having and using these tools was not sufficient to ensure my desired learning outcomes were achieved. I needed to be familiar with the "affordances and "constraints" of the software and hardware available and be clear about how best to use them in order to achieve the desired learning outcomes I had planned for. Teachers have central roles to play in the successful development and use of computer mediated learning situations. We are key instrument in the classrooms, creating the contexts in which what has to be taught can best be learned. The computer and its associated software environments can clearly support and enhance this process, but act alongside many other tools we use to facilitate teaching and learning as it evolves on a day to day basis in our classrooms.

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Interactive Teaching Programs available on the Web

www.interactive-resources.co.uk
http://www.standards.dfes.gov.uk/numeracy