Transforming the teaching of data
Is your experience of teaching data less than exciting? Do you think there is more to teaching data than making bar charts of children’s favourite colours? And pictograms of modes of transport to school? Surely trend graphs can be used for reasons other than illustrating monthly rainfall? In this article we outline the latest exciting trends in teaching data handling.

Recent approaches to teaching data handling involve children carrying out real investigations with data using the PPDAC cycle.

What? The PPDAC cycle (Problem, Plan, Data, Analysis, Conclusion) is used in many countries to guide classroom-based statistical investigations.

How long? For 4-6 days, children take on the role of data detectives as they move through the PPDAC cycle.

Step 1: Problem (formulating a question)
The success of the PPDAC cycle in your classroom is largely dependent upon identification of a driving question that generates curiosity and motivates children to want to collect data. Arrange children into groups, and help each group identify a problem of interest and develop a statistical question arising from the problem. Younger children need more help; older children can generate their own questions.

When constructing graphs try to focus less on the techniques of graph construction (computers do them now for most of us!) and more on graphical sense/literacy by focusing on:
1. **Describing the shape of the data.** Younger students might describe the shape of the ‘missing teeth’ data as a bump or clump (or even as rabbits ears in figure 2). Use a mixture of language e.g. ‘Where is the bump? What does that mean?’ while slowly changing the language to more sophisticated statistical language ‘Where does most of the data lie?’ ‘Is the mode falling inside the bump/cluster?’
2. **Using statistical language** to describe features of the data e.g. in the missing teeth data there is a large spread/variability, data are skewed to the left and there is one outlier.

Step 2: Plan (planning the procedures used to collect the data)
Once the research question is identified, introduce children to common data collection methods and help each group identify the method that is best suited to their investigation. Younger children need more support in selecting an appropriate collection method. This step may take approximately 10-15 minutes of your class time.

The most commonly used methods are:
- Surveys (Question 2 above)
- Experiment / Measurement (Questions 1, 3 and 4 above)

Step 3: Data (the data collection process)
Prior to collecting data, help children decide on a way to record their data. Tally charts and tables are complementary representations that can be introduced as early as 1st class. Tally charts can easily transform into tables (see figure 1). Most data can be collected during the school day or as homework. Remember that internet searches are also useful tools for data collection in the senior classes (e.g. to answer the question ‘Are most children’s book authors male or female?’). Data collection time will vary (from 0-3 maths classes) depending on the questions children have written.

Some interesting questions that primary children have investigated:
1. How many baby teeth have children in our class lost? (Senior infants)
2. What is our favourite superhero – invisibility, flying, telepathy, super strength? (2nd class)
3. Are rugby and soccer players different in size? (5th class)
4. Is the length of your forearm the same as the length of your foot? (5th class)

Step 4: Analysis (the summaries and analyses of the data)
This step is where most of the active teaching takes place and constitutes a large proportion of the teaching time (from 2-4 maths classes). Teaching focuses on:

- Introducing different types of **graphs**
- Introducing children to **statistical measures**

Introducing different types of graphs
Different graphs present different ‘pictures’ of the data. Encourage each group to create many different graphs for their same set of data. One of the most versatile graphs is the line plot (see figure 2). It is easy to construct and is a natural precursor to the bar chart. Image 2 shows two line plots made by 5th class children being used to compare the heights of soccer and rugby players on the Irish teams.

![Image 1: The PPDAC cycle (PDF version available on website)](image1)

**Figure 1:** Tally-chart and table of children’s favourite superpowers

| What is your favourite superhero? | 7 |
| Invisibility | 10 |
| Fly | 10 |
| Telepathy | 1 |
| Super strength | 3 |

![Image 2: Children and teachers using line plots to compare data](image2)

**Figure 2:** Number of baby teeth lost by senior infant children

When constructing graphs try to focus less on the techniques of graph construction (computers do them now for most of us!) and more on graphical sense/literacy by focusing on:
1. **Describing the shape of the data.** Younger students might describe the shape of the ‘missing teeth’ data as a bump or clump (or even as rabbits ears in figure 2). Use a mixture of language e.g. ‘Where is the bump? What does that mean?’ while slowly changing the language to more sophisticated statistical language ‘Where does most of the data lie?’ ‘Is the mode falling inside the bump/cluster?’
2. **Using statistical language** to describe features of the data e.g. in the missing teeth data there is a large spread/variability, data are skewed to the left and there is one outlier.
3. Reasoning about which graphs are appropriate to display the data e.g. a pie chart might not be suitable for the missing teeth data as it will hide the gap of 6 and 7 missing teeth.

4. In the middle classes, focus on landmarks (see figure 3) in the data e.g. Clusters, gaps, outliers.

5. In the senior classes, identify statistical measures on graphs e.g. where is the mode, median, mean? Also focus on what these measures indicate about the data e.g. what does the mean tell us about the data?

Step 5: Conclusion (the conclusions about what has been learned)

Student’s conclusions should relate back to their original question. They should ask ‘Was our original hypothesis correct?’ The conclusion should restate the questions, outline the data collection method, and describe the outcomes from the analysis. Consider having each group make a mini-presentation to the rest of their class, placing posters of children’s work on display in the classroom/school or having children write a report (perhaps using computers) of the process and outcome of their investigation. Our experience in classrooms indicated that children enjoyed sharing their results and taking on the role of ‘experts’ (see image 3). At the same time, other class members were genuinely interested in asking questions about the work of other groups. Finally, encourage students to use some statistical language in their conclusion. Useful phrases include: Outlier, gaps, skew, these data suggest, probably, most, spread, shape, expected, unexpected, middle etc.

Aisling Leavy, Mairéad Hourigan and Áine McMahon lecture in mathematics education at Mary Immaculate College.

Acknowledgement: Sincere thanks to the co-operating pupils and staff in Scoil Mhathair Dé (Limerick) and St. Michael’s N.S. (Limerick) for their contribution to Lesson Study.