Statistics in Non-Mathematics Courses

Carol Butel - Christchurch, New Zealand

1. Introduction

Statistical concepts are more easily understood by children if their acquisition occurs through experimentation in all subjects across the curriculum and not just in the mathematics class. In fact the average school day has numerous opportunities to explore and extend children's understanding of statistics. No school day is complete without a chapter from a favourite book. The following extract from *The Phantom Tollbooth* (Norton Juster, 1988) is an excellent example of literature that explores a statistical concept.

> "Milo looked up, with his head still resting heavily in his hands; he was becoming quite accustomed to being addressed at the oddest times, in the oddest places, by the oddest people - and this time he was not at all disappointed. Standing next to him on the step was exactly one half of a small child who had been divided neatly from top to bottom.
>
> 'Pardon me for staring,' said Milo, after he had been staring for some time, 'but I've never seen half a child before.'
>
> 'It's .58 to be precise,' replied the child from the left side of his mouth (which happened to be the only side of his mouth).
>
> 'I beg your pardon?' said Milo.
>
> 'It's .58,' he repeated; 'it's a little bit *more* than a half.'
>
> 'Have you always been like that?' asked Milo impatiently, for he felt that that was a needlessly fine distinction.
>
> 'My goodness no,' the child assured him. 'A few years ago I was just .42 and, believe me, that was terribly inconvenient.'
>
> 'What is the rest of your family like?' said Milo, this time a bit more sympathetically.
>
> 'Oh we're just the average family,' he said thoughtfully; 'mother, father and 2.58 children - and, as I explained, I'm the .58.'
>
> 'It must be rather odd being only part of a person,' Milo remarked.
>
> 'Not at all,' said the child. 'Every average family has 2.58 children, so

> I always have someone to play with. Besides, each family also has an average of 1.3 automobiles, and since I'm the only one who can drive three tenths of a car, I can have the sole use of it.'
>
> 'But averages aren't real,' objected Milo; 'they're just imaginary.'
>
> 'That may be so,' he agreed, 'but they're also very useful at times. For instance, if you didn't have any money at all, but you happened to be with four other people who had ten dollars apiece, then you'd each have an average of eight dollars. Isn't that right?'
>
> 'I suppose so,' said Milo weakly." (from *The Phantom Tollbooth*)

The focus of the new Form I-IV Mathematics Syllabus in New Zealand stresses that mathematics activities have to be relevant and applied to our lives to be meaningful. Subjects such as reading, science, social studies, health, and physical education all provide opportunities for us to learn statistical concepts within a meaningful framework. At the same time, the statistical concepts themselves enable us to analyse and predict relationships between things and events, thus giving us added insight and deepening our understanding of the subject area studied. Both areas benefit - the subjects used as a vehicle to teach the skills are more thoroughly understood and statistics is seen to have meaning and relevance in our lives.

2. Language and statistics

Trends and interests in reading vary markedly over time and sometimes from one group of children to another. A successful reading teacher needs to be able to see clearly the changing interests of her class and to be aware of and use to her advantage the power of peer pressure. When you are 11 or 12 years of age a book recommended highly by your best friend is probably more likely to be read than one recommended by an adult.

One very effective way to highlight some of the most popular books in the class is to use a large pictograph on the wall. The names of 20 popular books are listed on a large pictograph and small book symbols are placed in a pocket at the base. As children read a book that is on the list they place a book symbol beside that title, perhaps colour-coded as to how much they enjoyed it. If several of the titles are not being read then they can be removed and others chosen by the children. This pictograph alows children to see what books are being read by others and which book is the most popular at a given time. It also gives children appropriate data to encourage the buying of additional copies by the school library if one book is in particular demand. It allows the teacher to see the changing interests of the class in a very visual way and could be a guide for new themes the class may be ready for.

An interesting language-based data collection activity involves finding out which letter of the alphabet is used most often. Each child can take a page of the book they are currently reading and tally up how often each letter occurs. Children can be encouraged to write down their expectation before the data collection begins. When all individual results are tallied the most popular letter can be found.

In spelling there are many words that are considered difficult to spell by the majority of people. If these are taken from a published list without relevance to the spelling acumen of the class they are possibly less motivated to learn to spell correctly. However, if challenging words are systematically recorded on a large chart as children are

doing other language work, then individual words can be ranked according to their difficulty level for that class. If these words are then specially highlighted in the spelling programme and status attached to spelling them correctly, it becomes a challenge for all. Children can also graph their weekly spelling results which gives the teacher an indication of their learning style.

3. Physical education and statistics

In the area of physical education and health there are a number of exciting activities that can be used to teach the skills of statistics while being actively involved. One particularly successful fitness circuit is to make ten stations around the hall or open space and challenge the children to see how many of each exercise they can do in one minute. Each exercise can be graphed separately and data collected over several weeks. The children can see very clearly the changes in their fitness level. A trundle wheel can also be used to find out how far they can skip, hop, run, and walk in one minute.

Pulse rates can be taken at rest, then after a 100 metre sprint and following relaxation, or at regular intervals following vigorous exercise, to look at the time taken for heart rate to return to normal. Pulse rates can then be recorded on a graph before a fitness programme begins, then recorded weekly over an eight-week period. This clearly shows children the physiological effects of their daily fitness programme.

Swimming statistics from the New Zealand Water Safety Council can be used as an excellent introduction to the topic of water safety. The children can be asked to guess which age group they think would have the highest incidence of death by drowning. Statistical data can then be shown and graphed by the children. Possible reasons as to why an age group would have a high incidence of drowning could be discussed then skills taught to prevent such a high incidence in future.

Cycling statistics also can provide insights into potential risks. The children can be encouraged to find patterns from the data given then take appropriate action such as organising cycling safety posters or showing cycle safety videos to increase others' awareness. Injuries resulting from non-helmet accidents could be compared with those where the children were wearing helmets.

The skill of interpreting graphs can be taught using graphs that have relevance and interest to children. A major fitness test of New Zealand school children was conducted recently and the results published looked at average height, weight, flexibility, and strength. These graphs show national averages for New Zealand and children can be compared with average height in one particular class. Is the average height or level of fitness greater or less than the national average?

4. Science and statistics

In science there are many activities which rely on accurate graphs in order to draw appropriate conclusions. A simple activity such as boiling water can become a challenging exercise by looking at changing a number of variables and seeing how the time taken for the water to boil varies. You can vary the size of the container, the shape, the volume of water, the amount of heat applied, and the type of solution.

Possible solutions are: sugar and water, salt and water, and ice. Children can work in groups to collect their data. This lesson teaches a number of important statistical ideas such as: when comparing different solutions the temperature readings should be taken at the same interval by each group. The different graphs on which information is recorded should have the same x and y axis.

Search for insects in a wasteland area or sea life at the rocky shore provide an ideal opportunity to teach the skills of tally tables and appropriate graphing. The tidal patterns can also be graphed after monitoring water levels using a stick placed in the sand in the intertidal zone.

Conservation issues also provide suitable data to analyse. Present levels of species this year compared with those of five years ago, pre- and post-whaling statistics, tuna populations before and after the introduction of drift netting, average life spans of wild animals, appropriate food weight for weight of animals, are all suitable topics to explore. Weather patterns in other areas of the world can also be graphed while the society living in that area is studied. Such topics allow children to study scientific and social issues using statistics as the method to raise awareness.

5. Social studies and statistics

Social studies provides many activities which develop statistical skills while increasing awareness of others. These can be people-oriented lessons. Examples are: What social distance is acceptable? Can you get closer to birds than you can to people? Do you blink more frequently when you are being watched? What environmental stimulus evokes mood changes in you? Which type of mathematics is used most often by 20 different occupations? Which advertising strategies affect peoples' buying patterns the most?

A litter survey can be conducted to find out what type of litter is dropped, where it is dropped, and why. Then an appropriate problem-solving approach can be used to attempt to solve the litter problem in their school. Violence on television can be a challenging topic for a Form II class to investigate and involves forming a hypothesis, collecting data, checking consistency of methods, generalising from a small sample, and possible follow-up action. There are statistics available showing the average life-span of people in different countries and the availability of fresh water in that country, from which comparative studies can begin. One very exciting classroom activity especially suitable for 1991 is to take a class, or even school, census around the same time as the national census is being taken. This gives the children the chance to explore a number of the social issues associated with collecting data such as confidentiality, interpersonal skills, unambiguous survey questions, and care when extrapolating from data collected.

6. Conclusion

There are many activities that can be used to enhance the teaching of statistical concepts. Statistics can act as the vehicle to raise awareness and act as a catalyst for a problem-solving venture. It enables us to see trends and changes, whether it is in our reading or buying habits, fitness level, or learning style. If statistics is to be seen as

relevant and purposeful it must be taught in an integrated and natural way. This paper gives suggestions on how that can be achieved.

References

Brooker, B, Butel, C and Carson, P (1990) *Maths Matters 2.* Caxton Educational Ltd, Christchurch, New Zealand.

Burns, M (1987) *I Hate Maths.* Cambridge University Press.

Juster, N (1988) *The Phantom Tollbooth.* William Collins & Sons & Co Ltd, Glasgow.

Scott (ed) (1984) *Environmental Education.* Commission for the Environment, Wellington, New Zealand.

Stanmark, Thompson and Cossey (1986) *Family Maths.* University of California.