

BIRTHING BIG IDEAS IN THE MINDS OF BABES

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Do students leave high school with a sufficient appreciation of the big ideas of statistics? If not what do they leave with? It is often said that *the devil is in the detail*. Historically, teaching statistics amounted to starting with the individual details. Perhaps the hope was that one day the many intricate links between the details would form, and the big ideas would somehow materialise in the minds of the students.

Electronic technology has had a significant effect on the way that statisticians carry out their work. Has it had an effect on the way teachers teach and students learn statistics? Consider the big statistical idea of variation. Prior to students having ready access to electronic calculators, their formal introduction to variation consisted of learning how to calculate the measures of variation, most commonly the range, followed by the inter-quartile range and then the rather more mystical standard deviation. Prior to this they learned how to calculate the measures of centre (mean, median and mode!) without ever having the chance to appreciate the important role they can play in describing variation. Prior to this they had learned how to manage and display data using methods that require the students to learn and remember pre-defined processes for different types of data. This largely ensured that viewing and reasoning about variation was unlikely to be the central purpose of the tasks provided.

Since the early 1980s Australian students have had ready access to electronic calculators. These tools trivialised the calculation processes that formed a large part of the heart of the curriculum until then. The mid to late 1990s and into the 2000s saw access to spreadsheets and graphing calculators increase. These tools simplified the process of managing and displaying data, the remaining part of the traditional heart. What changed in the classroom as a result of these developments? Personal observation since 1984 reveals the following:

- For quite a few years not a thing changed, the technology capabilities were simply ignored or outlawed.
- By the mid to late 1990s some movement towards the use of real data, larger data sets and some expectation of interpretation was starting to be seen, but the core pedagogical approach bore a strong resemblance to the pre-1980 era, meaning the extras, were just that.
- The 2000s have seen attempts by some to move towards the inclusion of statistical investigations. However, the core pedagogical approach still bears a strong resemblance to the pre-1980 era.

So the result of ready access to electronic technology has largely been an increase in what there is to do with the meagre time allowance devoted to the chance and data curriculum without any real change to the teaching approaches employed. And so the big ideas of statistics remain either poorly formed or not formed in the minds of those leaving high school. Why? Because both teacher attitude and text-book fare were formulated in the pre-1980 era, and until recently, the readily available electronic technologies have done little more than take the labour out of the calculation processes. So even though many teachers now employ the use of some form of electronic technology in the classroom, little has really changed. The big ideas remain largely unexplored and poorly understood by most.

At the Sixth International Conference of the Teaching of Statistics (ICOTS6) in 2002 I met TinkerPlots. Two things are immediately obvious about TinkerPlots:

1. It simplifies the process of data management and display to a point where the student does not have to learn and remember pre-defined processes for different types of data to make meaningful and powerful displays. Such displays can be made quickly and then the time taken to reason about what the display illustrates. Most interestingly, it does not trivialise the process.
2. The processes of data management and display used in TinkerPlots are fundamentally different from those that students are currently expected to learn and that form the foundation on which they are expected to build other, more complex knowledge.

The existence of such a dramatically different environment might prompt one of two questions from an educator:

1. Can I make TinkerPlots do what I am used to doing, so I do not need to change the teaching approach I currently use?
2. Does TinkerPlots offer the opportunity to alter the teaching approach I use in such a way that the big ideas are more accessible to the students?

It is the latter question that struck me. So what is a natural way to birth a big idea in the mind of a child? I suggest that one way is to involve them in an activity that is structurally similar to a process that could possibly have first given birth to the idea. Such activities will be referred to as *simulations of simplified realities (SSRs)*. They provide a setting for the student to be primarily involved in thinking about the big idea and then working towards the need for the detail. In doing so they have the opportunity to form the critical links between the big idea and the detail and the links between the details.

We will look at one example in which students behave as manufacturers and need to consider ways of quantifying and controlling the variation that they themselves produce.