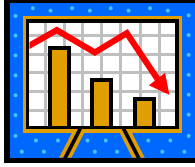


Statistical Literacy

Developing statistical literacy with Year 9 students.



Viney Shandil, Semisi Talakia'atu (Marcellin College)
Phil Doyle (Team Solutions - University of Auckland) and
Sashi Sharma (University of Waikato)



Why collaborative research?

- The relationship between educational research and teaching practice has typically been stormy (Groth, 2007)
- A partnership between schools and universities can help strengthen cyclic flow of information.



Research Questions

- How can we support students to develop statistical literacy within a data evaluation environment?
- How can we develop a classroom culture where students learn to make and support statistical arguments based on data?



Teaching and Learning Research initiative

Research Design

- Preparation Phase
- Teaching Experiment
- Analysis and Evaluation



Data Collection Techniques

- Survey to explore students initial ideas
- Audio and Digital recording of planning meetings
- Teacher and researcher journals
- Student work
- Student interviews
- Video and audio recordings of the classroom teaching



Why Statistical Literacy?

Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write' *attributed to H. G. Wells*

Most people will be consumers of statistics rather than producers.

(Iddo Gal, 2002)



Hans Rosling [video](#)



What is Statistical Literacy)

Statistical literacy is the ability to read and interpret data: the ability to use statistics as evidence in arguments. Statistical literacy is a competency: the ability to think critically about statistics.

Milo Schield (2004) Statistical literacy: Thinking critically about statistics



Level 3 Statistics

Statistical investigation

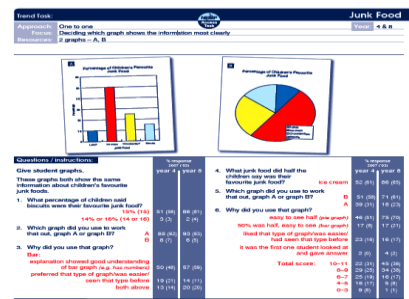
- Conduct investigations using the statistical enquiry cycle:
 - gathering, sorting, and displaying multivariate category and whole-number data and simple time-series data to answer questions
 - identifying patterns and trends in context, within and between data sets
 - communicating findings, using data displays.

Statistical literacy

- Evaluate the effectiveness of different displays in representing the findings of a statistical investigation or probability activity undertaken by others.

Probability

- Investigate simple situations that involve elements of chance by comparing experimental results with expectations from models of all the outcomes, acknowledging that samples vary.



Level 4 Statistics

Statistical investigation

- Plan and conduct investigations using the statistical enquiry cycle:
 - determining appropriate variables and data collection methods
 - gathering, sorting, and displaying multivariate category, measurement, and time-series data to detect patterns, variations, relationships, and trends
 - comparing distributions visually
 - communicating findings, using appropriate displays.

Statistical literacy

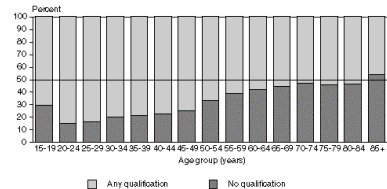
- Evaluate statements made by others about the findings of statistical investigations and probability activities.

Probability

- Investigate situations that involve elements of chance by comparing experimental distributions with expectations from models of the possible outcomes, acknowledging variation and independence.
- Use simple fractions and percentages to describe probabilities.



People With and Without Qualifications by Age Group, 2001



The strip graph shows that people aged 20-24 years are the biggest group with a qualification. People aged 85 plus are the biggest group with no qualification.

Source: 2001 Census: Education 2001



Level 5 Statistics

Statistical investigation

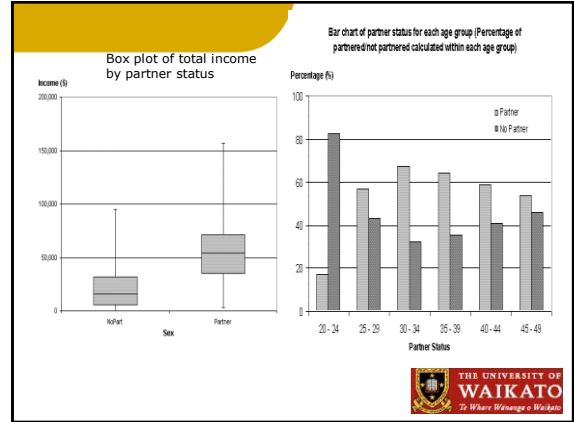
- Plan and conduct surveys and experiments using the statistical enquiry cycle:
 - determining appropriate variables and measures
 - considering sources of variation
 - gathering and cleaning data
 - using multiple displays, and re-categorising data to find patterns, variations, relationships, and trends in multivariate data sets
 - comparing sample distributions visually, using measures of centre, spread, and proportion
 - presenting a report of findings.

Statistical literacy

- Evaluate statistical investigations or probability activities undertaken by others, including data collection methods, choice of measures, and validity of findings.

Probability

- Compare and describe the variation between theoretical and experimental distributions in situations that involve elements of chance.
- Calculate probabilities, using fractions, percentages, and ratios.



Level 6 Statistics

Statistical investigation

- Plan and conduct investigations using the statistical enquiry cycle:
 - justifying the variables and measures used;
 - managing sources of variation, including through the use of random sampling;
 - identifying and communicating features in context (trends, relationships between variables, and differences within and between distributions), using multiple displays;
 - making informal inferences about populations from sample data;
 - justifying findings, using displays and measures.

Statistical literacy

- Evaluate statistical reports in the media by relating the displays, statistics, processes, and probabilities used, to the claims made.
- Investigate situations that involve elements of chance:
 - comparing discrete theoretical distributions and experimental distributions, appreciating the role of sample size;
 - calculating probabilities in discrete situations.



Does drinking soda affect your health?

Figure This! Math Challenges for Families

Figure This! For this study, researchers questioned ninth- and tenth-grade girls at a Boston-area high school. Do the data support the headline?

Hint? Data organized in tables help people understand how different categories or groups are related. Tables are used by researchers, businesses, media, and the government to display information about study results, profit and loss, news stories, and census data.

	Fractures	No Fractures
Drank Cola	38	69
Did Not Drink Cola	5	52

Source: USA Today, Thursday, June 15, 2006.



LEVEL		What?	Source?	Criteria?
3	E V A L U A T E			
4				
5				
6				



LEVEL		What?	Source?	Criteria?
3	E V A L U A T E	Effectiveness of different displays	Undertaken by others	Representing the findings of a statistical investigation or probability activity
4		Statements	Made by others	Findings
5		Statistical Investigations or Probability Activities	Undertaken by others	Data collection methods Choice of measures Validity of findings
6		Statistical Reports	In the media	Displays Statistics Processes



Components of Statistical literacy

According to Gal (2002) there are five interrelated knowledge bases that must be used to exhibit statistical literacy

- mathematical knowledge
 - statistical knowledge
 - knowledge of the context
 - literacy skills
 - critical questions
- as well as dispositional elements that include
- beliefs and attitudes
 - a critical stance

Gal, I. (2002). Adults' statistical literacy: Meanings, components, responsibilities. *International Statistical Review*, 70(1) 1-51



Statistical literacy has been positioned as an important skill for citizens and a desired outcome of statistics education. However, while the knowledge bases and beliefs and attitudes that underlie statistically literate behavior have been outlined in some detail, it is less clear *how* to develop them

Iddo Gal



Assessing statistical literacy

Levels of Statistical Literacy (Watson & Callingham, 2003)

1. Idiosyncratic.
2. Informal Intuitive - ability to read data cell entries.
3. Inconsistent - limited appreciation of content and context without justification.
4. Consistent Non-critical - straight-forward engagement with context; statistics, simple probabilities and graphs.
5. Critical Questioning engagement; appreciation of variation; qualitative interpretation of chance.
6. Critical Mathematical - questioning critical engagement with context; proportional reasoning; subtle language.



Key findings so far

Statistical literacy is more than the ability to make calculations and read tables and graphs

Students need to be exposed to good statistics

Literacy is critical to statistical literacy

Contextual knowledge is a barrier for many students.

Developing a critical statistical literacy can be a challenge to community and school practices

All students can be exposed to critical thinking in statistics

Assessment and progressions



Literacy or "You want me to read all this?"

When students are asked to read text and interpret data displays it is likely to be difficult for many students due to **language and literacy issues**.

Statistical and probabilistic meanings are very subtle.

We were explicit about language.

We need to take advantage of language/literacy support and professional development



A critical stance or "Is that true?"

Developing a critical statistical literacy can be a challenge to some community and school practices.

Our attempt to foster critical thinkers caused tension around who was speaking and what was said in the classroom.

Attempting to make statistics more accessible and applicable to students by using meaningful real-life contexts was a challenge to some.



Part 2

Questioning the data detective



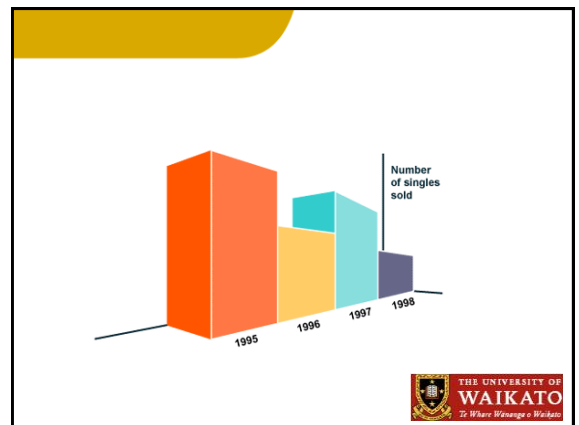
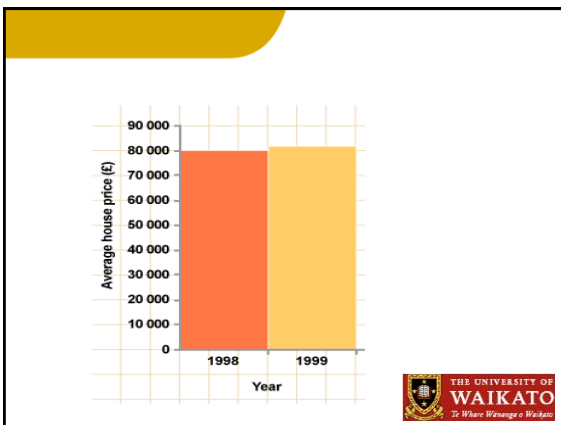
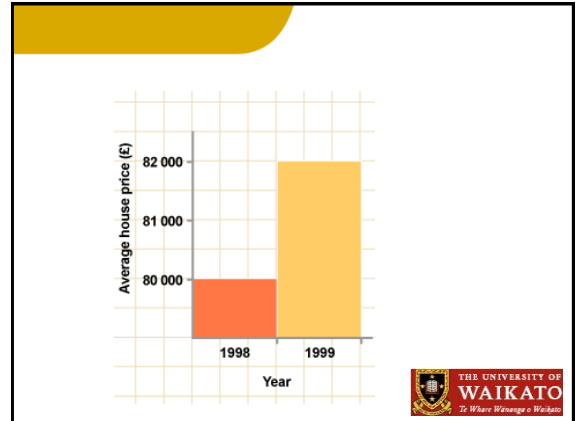
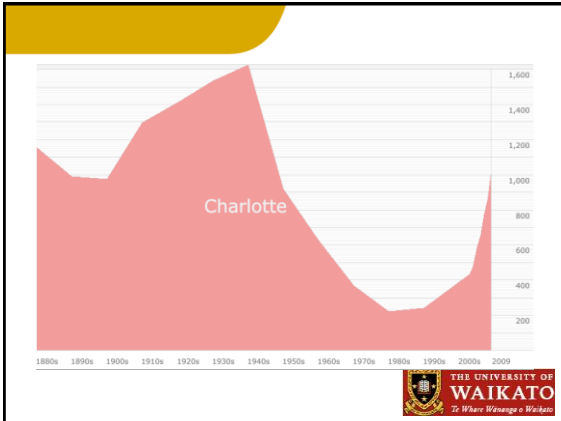
<http://www.stats.govt.nz/>



<http://www.babynamewizard.com/>

GAPMINDER unveiling the beauty of statistics for a fact based world view

<http://www.gapminder.org/>



"Four out of five dentists use Bubbles toothbrushes"

Figure It Out – Statistics in the Media Level 4+

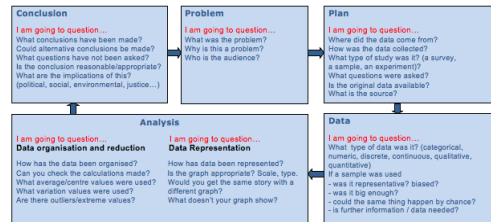


"Toddlers who Attend Pre-school Exhibit Aggressive Behaviour"

<http://www.bbc.co.uk/dna/h2g2/A1091350>



Questioning the Data Detective



Things to Look Out For :

47.3% of all statistics are made up on the spot.
- Steven Wright

- Where did the data come from? Who ran the survey? Do they have an ulterior motive for having the result go one way?
- How was the data collected? What questions were asked? How did they ask them? Who was asked?

