Queensland University of Technology

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The Statistics Voyager: vehicle for learning enquiry and problem-solving

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This presentation showcases three enquiry learning "compartments" of *Statistics Voyager*

- A. Problem-solving in data investigations (first/service course)
- B. Problem-solving & constructivism in real probability (first/semi-service course)
- C. History, motivations & mathematics in stochastic modelling (second/advanced course)

Comments on student engagement, enquiry and research: 1

Generic skills/capabilities for research include

Enquiry
Persistence
Problem-solving
Systematic
Operational knowledge
Initiative
Communication
Teamwork

= Generic skills/capabilities for workplace

Comments on student engagement, enquiry and research: 2.

Student engagement requires student ownership and internalisation of their learning

Students are not yet what they are going to become

Contexts for learning need to be { familiar to / chosen by } students

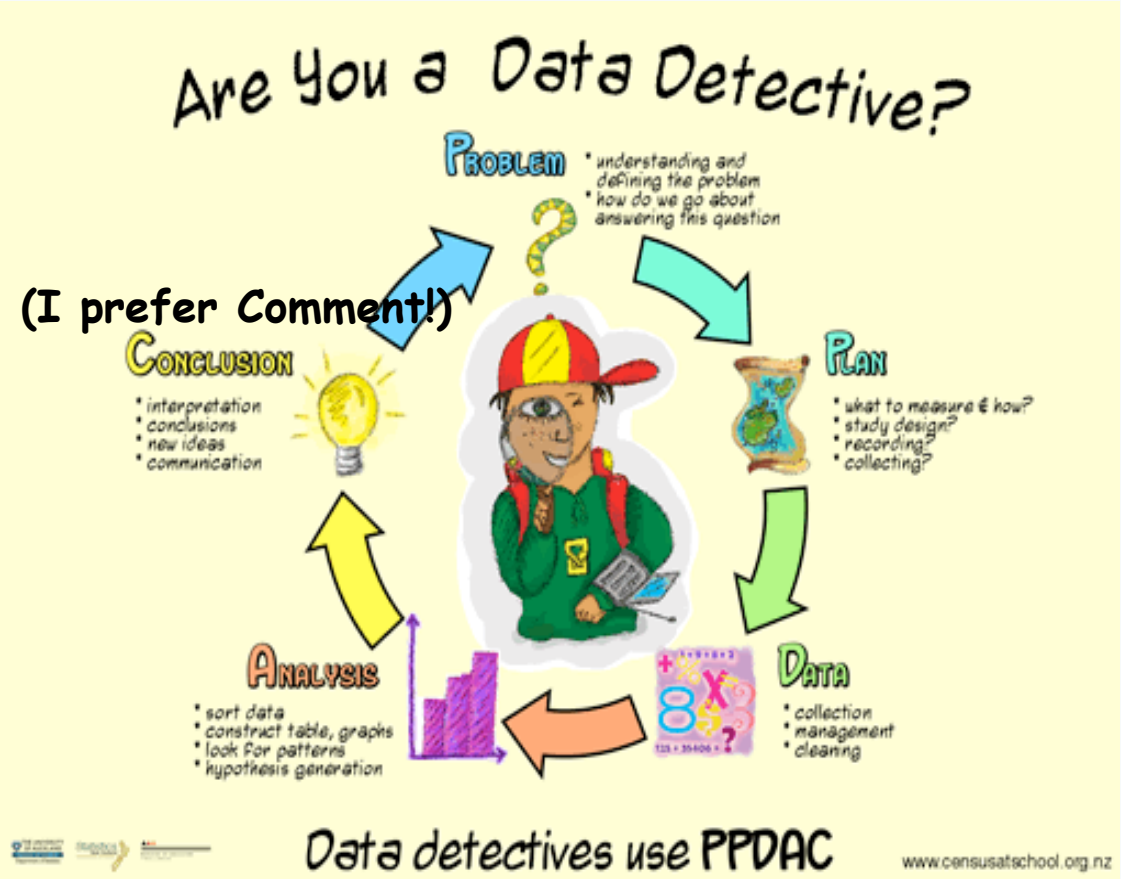
In statistics:

- context & data essential for learning statistical thinking
- transferability of operational knowledge & skills essential
- need structure & system in parallel with contexts and enquiry

Context-learning occurring at same time as statistical-learning can increase student difficulties and inhibit learning and transferability of statistical thinking

A. Problem-solving and enquiry in data investigations

Planning, collecting, analysing & reporting data investigation in context of free-choice



Data investigation cycle heart of statistical problem-solving

Can be extended to include higher-order statistical research

(MacGillivray, 2009)

Background and Motivation

- Ready-made data and contexts, no matter how real, can't provide experience of *setting up and investigating a problem*
- *Reporting* how, what, when
- *Ownership* of data and context ⇒ engagement

Some features

- Engagement, ownership, synthesis, learning vehicle for statistics and enquiry
- Turn research questions into statistical questions
- Group because task needs a group – real world
- Guidelines & descriptors of criteria with standards given (MacGillivray, 2005)
- They propose – we advise
- Use of student datasets in demonstrations and practicals
- Access to past projects and model reports
- Each group receives a written assessment report with comments & marks for the criteria

Evolution of free-choice group discovery project in data analysis

- Initially (1994) on practical challenges of data planning, collection/observation and exploration.
- Key concept was that the group chose their own context, identifying what was of interest to them, what data was accessible, how to collect it; explored & reported on features.
- Because students "owned" it, they wanted to try the statistical tools as they met them.
- Grew to include analysis, interpretation & reporting
- Developed in engineering statistics 1994-2009
- In 1st year science & maths course
  - developed 1993-1995
  - retained but by 2002 was optional
  - from 2003, full data investigation as in engineering

Student choices: > 4000 projects!

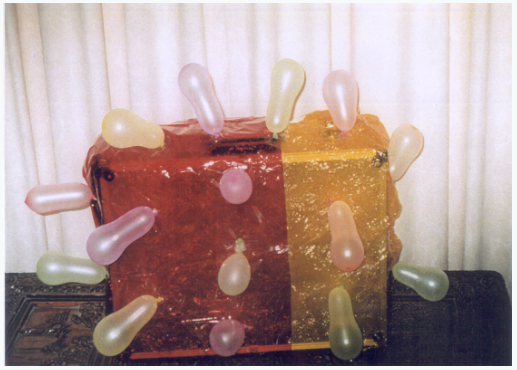
MacGillivray, H.L. (2002) "One thousand projects" MSOR Connections

Just a few!

- The three minute pop song
- Length of corporate employee phone calls
- 24 hours in a service station
- Undie-lemma
- Aircraft noise levels
- Go go go!
- Human curiosity
- Death by statistics
- Holding breath
- Where are all the single people?

Crash testing stubbies

Egg strengths



Human curiosity

Many effects on learning and teaching

- Choices of topics illustrate types of examples in which students want to see how statistical thinking and techniques can help
- Increased coverage of topics
- Improved overall results
- Past students remember their projects - as do staff
- Peer adoption - despite initial concerns of workload
- Curriculum development better reflects
  - learning needs
  - real statistical problems
  - modern statistics
  - statistical research

Available but under ongoing construction!

Data2Teach https://teaching.sci.qut.edu.au/data2teach/

B. Problem-solving and constructivism in real probability

- Course aims to
  - help students unpack, analyse and extend their existing knowledge and understanding of probability and its many roles in statistics, mathematics, other disciplines and the real world
  - develop skills in problem-solving and identification and building of models involving probability and random variables

- Learning experiences emphasize problem-solving in environments geared to ‘having a go’, collaborative work and links with everyday situations and real data (MacGillivray, 2007).

Some features

- Group project
  - Each group chooses two everyday processes
  - Plan, collect data, analyse, report
  - Criteria & standards & marks/comments against criteria

- Special tutorial group exercises
  - structured for immediate "hands-on" learning in problem-tackling environment
  - *"an emotionally and cognitively supportive atmosphere where students feel safe to explore, comfortable with temporary confusion, belief in their ability and motivation to navigate stages."* Gal et al (1997)

- Each topic has preliminary experiences or exercises or discussion points
  - perceive, unpack, analyse, extend

"Using what we already knew to learn other stuff was really good and helped us learn other stuff" *A student definition of constructivism perhaps?*

Some examples from group projects in this course

- Australian Rules (football) grand final
- Time spent on phone
- Occurrences of “Harry” per page in a Harry Potter book
- Traffic on a pedestrian bridge
- Number of lecturer’s “ums” per minute
- Time between arrival of emails
- Time between the arrival of feral utes at the front gate of a rally (“feral” was defined)
- Number of arrivals at a pub per minute
- Distribution of leaves on tiles
- Behaviour of ants
- Service in “fast” supermarket checkout
- Time between customers wearing high heels.
- Time between changes of a baby’s nappy

C. A second course in modelling with probability and distributions

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Some features:

- dual development of models and applications
- separate & combine statistical & mathematical thinking & problem-solving
- variety of real contexts
- environments that emphasize value of trying, working individually and collegiately with peers and teachers

Enquiry & research links:

What can we use in this problem?

What do we need that we don't have yet?

Why did researchers develop this?

QUT

Problem-tackling & enquiry: foundations for research, workplace, lifelong learning

- Necessary to have enquiry context accessible to students at each level
- Not necessarily a research context
- Learning and assessment environments for learning problem-tackling
  - *"an emotionally and cognitively supportive atmosphere where students feel safe to explore, comfortable with temporary confusion, belief in their ability and motivation to navigate stages*." Gal et al (1997)
- Statistics ideal vehicle
  - Data investigation cycle essence of real investigations
  - Pervasiveness of chance & data in everyday
  - Plurality of motivations for research
    - modelling & structural
    - problems in other disciplines
    - real & everyday

Thank you & here's to statistics!