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Statistics – worse than a poke in the eye?

Advertisement on board at MU:

"If you think statistics is worse than a fork in the eye, you need help!"

Introduction

- We have previously researched statistics majors' conceptions of statistics.
- More students take "service" course in statistics.
- Look at science students' views of statistics and its use in their studies and profession.
- Data from open-ended questionnaire analysed using previous theoretical framework.
- Implications for teaching and learning.

Stats major students' conceptions

- "Students' conceptions of statistics: a phenomenographic study" (2002) JSE 10(2) www.amstat.org/publications/jse/v10n2/reid.html
- Interviews with 20 students (1st and 3rd year):
  - "What is statistics?"
  - "What do you find interesting about statistics?"
  - "How will you use statistics in your future profession?"
- Phenomenographic analysis resulting in outcome space that shows range of variation.

Outcome space

Focus	Conception of Stats	Brief Description
Techniques	1. Numerical techniques	Limited, fragmentary understanding, statistics is a type of maths, uses 'boring calcs' 'numbers' or 'probability'
	2. Individual statistical techniques	Statistical rather than mathematical fragments, individual techniques to look at data, eg. graphing, regression
	3. Collection of statistical techniques	Collection or "stockpile" of range of techniques, accumulated and listed as a description
Data	4. Analysis and interpretation of data	Interpreting or making sense of a complete set of data, analysing it and drawing conclusions from it
	5. Understanding using statistical models	Way of understanding situations by examining statistical models, analysing data sets, testing conclusions
Meaning	6. Making sense of world, develop personal meaning	Statistical methods developed to understand and make sense of wider aspects of reality, develop critical thinking, create new interpretations of data and life

Extending the statistics investigation

- Further interviews with students in service courses (engineering, tourism, sports science) statistics as a professional component
- Open-ended questionnaire to other groups (122 students in dentistry, nutrition, sports science): *What is statistics? How will you use statistics in your further studies? … future professional work?*
- Investigation of statistics lecturers' ideas about statistics (with Sue Gordon)

Service students' conceptions

Focus	Conception of Stats	Example
Techniques	1. Numerical techniques (**14**)	A lot of numbers and graphs everywhere/ A form of maths/ Maths calculations/ The study of numbers
	2. Individual statistical techniques (**9**)	Displaying information in numerical format/ Studying relationships between values and data/ Measurement of specific phenomenon with a group of subjects (or objects)
	3. Collection of statistical techniques (**19**)	The study of probabilities and the significance of results/ Standard deviation, are the results statistically significant?/ ANOVA, Wilcoxon rank sum test, can't remember detail
Data	4. Analysis and interpretation of data (**66**)	Analysing numerical data and then putting them to some use/ Analysing data and making sense of it/ The collection of data, making sense of the collected data
	5. Understanding using statistical models (**5**)	Collection and organisation of data so that it can be understood and give meaning to a particular situation/ Analysing numbers to make sense of results of experiments
Meaning	6. Making sense of world, personal meaning (**0**)	

Questionnaire vs interview

- Joe (Honours, Sports Science): [Ok, can I start then by asking you, what you think statistics is?] I would think stats is about investigation of data. It can be any kind of data and it can be used for anything, but pretty much working to formulate anything they want really. /…/
  [What do you think the main things are from what you have learned here in stats that you take with you when you leave?] The whole way of thinking about things differently, you know, ideas of formulation that I would have never had come up with before that maybe I could lay things out a little bit differently so it works, that I may not have thought of previously. It will just make my life easier basically. /…/ I think differently now because I can see now that it's much wider and can be used for a much wider range of things, as previously I may have been a bit more closed minded, thinking it was just nerdy stuff that we don't need to know. But now it's like, oh this really applies to everything. You know I can work out this, and whack these things together. Just thinking differently, thinking more advanced.

Ideas about use of statistics

- Statistics major students had no doubt that they would use statistics in their professional work
- Service students less clear expectations
- Most common use: reading and understanding research articles, carrying out own research
- Many specific examples: sports coaching, nutritional status, developing better dental materials
- Some broader uses: understand the industry where I will work, derive conclusions from observations at clinic

Service students' ideas about use

Use of Statistics		Studies	Work
Unspecific:	• no role	3	3
	• unsure of role	9	12
	• some role	5	7
	• large role	12	9
Specific example:		17	33
Research use:	• organise and present data	2	4
	• analyse data and evaluate results	10	2
	• read and understand research	28	30
	• carry out own research	48	27
Professional use:	• explain to clients		1
	• understand the industry	1	
	• support professional judgement	2	3
	• further studies (PhD, Honours)	4	

Implications for pedagogy

- Help students become aware of variation in views of statistics (as well as views of science)
- Use learning activities and assessment that direct them to broader views (eg. explain an analysis)
- Development of "problem-based learning" materials
  - laboratory exercise on Rayleigh's data, quality management video , *Reading Statistics* book
  - UniServe Science "winners", Nightingale interview
- Support student learning rather than techniques

Perceptions of professional work

- Traditional approach to professional competencies via real-life problems, laboratory work
- Lecturers may have limited industry experience and prepare students from academic orientation
- Provide space for students to explore and challenge their own beliefs about professional work and the role of component tools such as statistics
- Connect institutional and professional learning

Conclusion

- Karin (Honours, Sports Science):
  [What do you think might be the main things you take away with you from your stats learning when you leave university?]
  More understanding of it, before I thought statistics was very dry and useless. Something for academics to keep them busy. But it actually has a purpose: I changed my mind.
  [Why?]
  Because I guess I realized I might use it in the future.