STATISTICAL LITERACY FOR LAW STUDENTS: SIX HOURS TO TEACH!

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Six hours to teach statistical literacy to Law students, six hours to prepare students for their professional lives. What comprises the quintessential curriculum? With a limited time span it was essential that students were empowered for lifelong statistical learning. Therefore the primary aim, of the program discussed in this paper, was to teach in a manner whereby students generated fundamental statistical ideas, and thereby, established within them the belief that they could understand and think statistically. They were to become aware that they could ask appropriate questions of a statistical kind, aware that they could and must establish meaning from the words of the statistics professional as they worked within their legal profession. This was tempered by the knowledge that the statistical thought gained in such a limited time was embryonic.

This paper examines: the context within which a statistical literacy unit for law students is taught; the curriculum aims; the teaching and learning environment created; the activities utilised; and learning outcomes.

CONTEXT: STATISTICAL LITERACY FOR LAW STUDENTS.

Recognised as valuable by professionals statistics is often seen as irrelevant by students. The Statistics component is compulsory. Many students believe they will never understand statistics, and if allowed will attempt to rote learn, when and where to do what. There is no point teaching statistical literacy if at the end of it students are less likely to entertain statistical ideas (the I hated it, learned nothing and it is not relevant review!). Changing negative attitudes requires an engaging and challenging curriculum and teaching and learning environment.

THE CURRICULUM: AIMS

The aims of the statistical literacy program for Law students were:

(1) to demonstrate how statistics may be to be of relevance to the legal and para-legal professions, and more broadly to thinking in everyday life;

(2) to provide students with an understanding of the nature of variability as it occurs throughout the statistical (or research) process; and

(3) given the limitation of ‘six hours to teach’, to provide students with a basis for continued statistical learning.

The approach taken in this statistical literacy program was to involve students in activities which could illuminate the most fundamental and embracing statistical ideas as

they relate to the law. The richness of the theme *Statistics is a study of variation throughout the statistical (or research) process* is best gained through an examination of the classroom activities used to engender it. These same activities were also selected so as to develop other competencies such as communication skills and teamwork.

THE TEACHING AND LEARNING ENVIRONMENT.

The Statistical Literacy for Law students as described in this paper was taught to four groups of approximately 25. Each group was taught over a period of three weeks in two hour sessions. Classroom activities are used to generate the statistical ideas which students are to become familiar with.

The activities were used to create a learning environment for both teacher and student wherein both teacher and students were involved in extensive communication and reflection. Ultimately the measure of success of the teaching is whether or not students left the classroom with a greater receptiveness to statistical ideas and ability to continue statistical learning. The experiential learning activities were designed to be revealing in ways that were important to the student (eg. about the primary discipline and about how they think, learn and solve problems). The intent was to enable students to develop positive beliefs about themselves and their ability to think statistically. Knowledge was not delivered to the students by the teacher, rather they created it. The teacher helped to extend, develop, modify and consolidate the knowledge created by the students. The teacher also was learning (about the students and often times about the statistics and law discipline).

The teaching role involved developing appropriate exercises (the most difficult component), the provision of a brief introduction to the exercises, linking it to previously met ideas and the current activity, and specifying what was expected from them. Students in groups completed the exercises and then reported their findings to the class. During and/or after the reporting, ideas omitted were raised, ideas commended, the findings summarised and a structure for ideas provided or further ideas alluded to. Students' expressed statistical ideas were reinforced, clarified and extended. The observing teacher and students commented upon teamwork and how decisions were made. The impact, (statistical or legal outcomes of the exercises) of student actions, domination, submission or other behaviour during the exercise was also commented upon. Video materials (*What is Statistics?* and *The Question of Causation* from

Decisions through Data) were also used to support and provide an alternative perspective on the ideas developed in class.

CLASS EXERCISES

The first two tasks discussed in this paper were designed to elicit the phases of the statistical (or research) process, the third alerted students to issues in measurement (for example, measurement is a source of variation or error in data) whilst the last involved students in the design, conduct and reporting in a mock court of an experiment.

Exercise 1

Scenario: Seashells on the seashore. A maritime disaster has occurred on a beach near a town on the southern coast of Australia. The local community may seek compensation for damages to the sea life. It is intended to use seashells collected from the seashore as a measure of sea life. An avid collector of shells makes available shells collected prior to the accident. Another collection of shells is to be gathered and used as a measure of sea life after the accident.

Task: Your task is to generate all the questions that you would need to ask and have answered before you would accept any report concluding that there was or was not damage to the sea life due to the disaster? Identify also any legal issues or questions that you think pertinent. Join with 4-6 other students and complete the task. Prepare your questions on overhead for presentation to the class.

Exercise 2

Scenario: The case for environmental damages. On the first table are the seashells collected before the maritime accident and on the second table the seashells collected after the accident. Assume that you have a collection that is well selected and representative of the sea life before and after the accident.

Task 1 (for up to 10 students in each of two teams). Your task is to decide if there has been damage to the sea life due to the maritime accident. You will have access to both the before and after sets of shells. Organise your case for seeking damages and present it in the mock court.

Task 2 (for 2-3 students attached to each team). You are to remain as independent observers of your team. Your task is to record the behaviour or dynamics of

the group, the decisions made, what prompted the changes in direction, the outcome of those changes and anything else of interest. This is to be reported to the larger group.

OUTCOMES EXERCISES 1 and 2: STATISTICAL AND LEGAL PERSPECTIVES.

Some of the legal considerations raised and discussed were: What was the nature of the accident?; Was the evidence kept securely?; Was the evidence tampered with?; Were the storage conditions eg heat or exposure likely to have affected the shell collections?; Was there evidence other than the shells?; Could liability be ascertained from this report?; Who was liable or responsible for the accident?; Were there any other factors that could have caused the accident?; What effects did the accident have on the community?; What was the extent and area of the damage?; and, Were the effects short or long term?

The questions of a statistical kind were classified into what has been designated to be the statistical (or research) process; ethics, researching the problem, identifying the hypothesis, design, sampling, measurement, describing and analysing data, and making decisions. The questions included amongst others:

- Ethics. Who collected the shells? That is, were there issues regarding ethics, integrity or bias. What were they looking for? Were they appropriately qualified?
- Researching the problem. Were there historical studies in the area examining pollution levels, marine life, global warming, introduced species from ballast water, which might allow comparisons? What was the nature of the accident?
- Hypothesis. What is the task or real issue/question?
- Design. Were the shells collected at the same time or season? How soon after the maritime accident were they collected? What were the relevant seasonal influences, for example, different tides, warm currents? Were the shells collected from the same place?
- Sampling Issues. How were the samples collected? Were the shells randomly collected? Which area were the shells collected from? What was the sample size? Was the sample big enough to fairly represent the entire population?
- Measurement. Did the shells represent all sealife? Was the effect on the sealife the same as the effect on the shells? Are seashells indicative of more of less sealife? What attributes of the shells should be measured for example, size colour, apparent health. How should they be classified? Should they be counted?

- Description, Reporting and Analysis of Data. Shells were classified according to species or type or shape (a biologist was needed), some counted each category, size of shells were measured or rated according to size giving rise to different ways of presenting or summarising data. Tables, graphs and verbal summaries were used to describe nature of differences.
- Making decisions about data. Students presenting their case in the mock court were required to make decisions as to whether or not given the data damage had been caused. Unexpectedly for students different teams drew different conclusions about the same set of data.

Students at this stage had begun to realise that evidence of a statistical kind presented in court is only as good as the process from which it has come and that each phase of the statistical process needs scrutiny. At this stage there was a role for the teacher as both statistician and educator. Where was the statistics in these exercises? Behind each question asked there was a need to understand, control or manipulate variation. The why of each question was challenged. The design questions emanated from a need to control the collection of shells, they did not want variation in the numbers of shells because they were collected in different seasons. They wanted to control the variation that could occur from sampling by keeping the sampling in the same place and manner before and after the accident. How the shells were classified or measured introduced variation (alias error) due to measurement. Students made decisions about whether or not there had been damage to the sealife. If there was a big discrepancy in the number of a species collected, for example, (2000 pippies shells before and 100 after) they were likely to conclude that there was a difference, but if it were 120 pippies before and 100 after then they were likely to conclude no difference. Students drew their conclusions based on the size of the discrepancy in shell numbers. Yet, they needed to know the daily variation in shells in order to assess how big a difference in the number of shells were unusual and suggestive of some event such as the maritime accident. A difference of 5 abalone shells, a rare and protected species, might be important, it may be that a difference of 10,000 pippie shells is not unusual on a daily basis. They had a sense of this, the shells on the beach did not have to be exactly the same but the role of variation in decision making needed to be refined. The clarification of meaning continued exposing what students meant by certain ideas (eg random sampling) and establishing a need to develop ideas further (eg how do we measure variation and use it to make

decisions). As an educator along with the student observers there was also a role in commenting upon what happened during the activity. How the teams selected or discarded ideas (perhaps by logic or dominance) had implications for how they solved problems and hence the outcomes.

After the initial exercises students were receptive to the development and refinement of their statistical skills. Issues of variation due to measurement, controlling and manipulating variation through experimental design and the distinction between causation and association (or correlation) were examined through subsequent classroom activities and video clips and assessment. Student assessment was designed not only to extend students' statistical thinking but to develop other skills important for legal practitioners. Teams of students searched newspapers, the internet, journals and other publications for recent articles which could demonstrate the relationship between law and the statistical ideas they had encountered. To their peers they presented selected summaries and commentaries from the portfolio. Many forms of communication were required and at times led to the modification of subsequent behaviour. (For example, at the end of the second exercise students who had counted measured and drawn up tables almost invariably set these aside and made a general statement to the mock court as to whether or not their had been damage to the sealife. As they uttered their conclusions they realised they had left out their evidence and in subsequent exercises they ensured that they had meaningful numbers, graphs and tables as well commentary). Students were required to work in teams and the impact of the teams' decisions or actions, of having ideas dismissed or taken, was examined in terms statistical and hence legal outcomes.

AIMS FULFILLED?

Students provided positive responses to the statistical literacy strand as measured by independent assessors and the teacher's own evaluations. Furthermore, students completing the modules appeared to have a basis for continued statistical learning as it relates to the law. All too often users of Statistics think of Statistics as only the analysis of data, without questioning the value of the data. For the Statistician, however, data come from a process and the data are only as good as the process involved in collecting them. It is through looking at the processes in terms of managing and understanding

variation that we can determine if the data are indeed useful. Students were able to capture this in their assessment portfolios.

Portfolios tapped into legal/statistical issues that went beyond the classroom teaching (examples including: the questioning of whether or not scientific or statistical studies equate to the truth; whether or not statistics can make good a deficiency of evidence involving a particular defendant; the appropriateness of using Bayesian statistical methods in legal evidence). They identified problems associated with the jargon of statistics and the need to deal with these matters in litigation (they need to make meaning from the statistics as do jurors). They began to identify the breadth of usage of statistics in their discipline (in employment discrimination, product liability, capital punishment, criminal prosecution, jury selection, advertising claims and toxic torts). They identified questions asked in the legal literature such as, “is the source reliable?”, “do the statistics cover a sufficiently long period of time?”, “are the units of measure comparable?” They identified Statistics as a positive influence with the potential to bring about reform within the legal system (eg the Welfare Reform Bill in the US) and at times where the statistics were ignored or misused. They began to develop deeper themes in relation to the various stages of the process some, for example, examining sampling in the context of the composition and representativeness of juries. Others defined and then attempted to collect studies which would provide evidence regarding, for example, possible health damage caused by using mobile telephones. They had begun their journey. It is a journey that is long, a journey that will hopefully be aided by further integration of statistics into their law course.

REFERENCES

Decisions through Data. Consortium for Mathematics and its Applications (COMPAC) Inc. Australasian Distributer: Australian Association of Mathematics Teachers Inc. GPO Box 1729, Adelaide, SA 5001, Australia.