Overview - University of Wollongong Teaching & Learning Journal

Volume 5 | Issue 1 Article 3

1998

Integrating generic skills into teaching

Anne Porter
University of Wollongong

Integrating generic skills into teaching

Abstract
In the Wollongong University policy document 'First Year Progress Report, Towards 2000' a number of competencies, attitudes and values felt desirable for graduates of the University of Wollongong are listed. Over the years the list has been modified and amended. Competencies as discussed in 1993 required that the graduate: 'is equipped for continued learning, intellectual development, critical analysis and creativity; has a coherent and extensive knowledge in a discipline; communicates clearly and fluently in writing; has a capacity for teamwork; is self-confident and orally articluate; is computer literate'; and, 'is statistically literate' (p 8). Amongst others desirable attitudes for graduates included: 'has the desire for continuing intellectual development and creativity' and 'values truth, accuracy, honesty and ethical standards in personal and professional life' (p 8). In August 1997 a generic skills workshop was convened by the Chair of the Generic Skills Working Party and at that meeting the view was put that the University considered that the generic skills which encompass these attributes should by integrated into teaching, not simply 'tacked on'.

Integrating generic skills into teaching

Anne Porter

In the Wollongong University policy document 'First Year Progress Report, Towards 2000' a number of competencies, attitudes and values felt desirable for graduates of the University of Wollongong are listed. Over the years the list has been modified and amended. Competencies as discussed in 1993 required that the graduate: 'is equipped for continued learning, intellectual development, critical analysis and creativity; has a coherent and extensive knowledge in a discipline; communicates clearly and fluently in writing; has a capacity for teamwork; is self-confident and orally articluate; is computer literate'; and, 'is statistically literate' (p 8). Amongst others desirable attitudes for graduates included: 'has the desire for continuing intellectual development and creativity' and 'values truth, accuracy, honesty and ethical standards in personal and professional life' (p 8). In August 1997 a generic skills workshop was convened by the Chair of the Generic Skills Working Party and at that meeting the view was put that the University considered that the generic skills which encompass these attributes should by integrated into teaching, not simply 'tacked on'.

One of the purposes of this article is to describe how the development of competencies, desired attributes or values of graduates is integrated within one specific teaching segment: Statistical Literacy for Law Students. The three week, six hour, statistical literacy module (as it was taught in 1997) forms an integral component of the 100 level Law program (although similar modules have been used with other students). There is another sense of the word integrated which implies that as students learn about, for example,the nature of legal evidence they may also learn about the principles governing evidence of a statistical kind. As a teacher of Statistics I like the initial deliberate focus on statistical principles and would hope that it is followed and reinforced through integrated teaching of the second kind.

A second purpose of this article is to provide insight into what a broad view of statistics and hence statistical literacy might entail through the examination of some aspects of the Statistical Literacy for Law Students module.

The teacher's task: statistical literacy

Six hours to teach Statistical Literacy to Law students, six hours to prepare students for their professional lives. One of the dilemmas when lecturers contemplate the teaching of generic skills and competencies in their subjects is that it often appears that this provides less time for

the delivery or teaching the discipline's material. On occasion I too have responded to this pressure. A second dilemma I always face as a teacher of Statistics is that rarely do my students actually want to to study Statistics. Statistics for virtually all beginners is compulsory. Recognised as valuable by professionals it is not seen as relevant by students. Students frequently believe that they will never understand statistics, although they might survive if they rote learn, aspects such as when and where to do what.

Given a limited teaching time span my foremost aim is to empower students for lifelong learning of statistics, an aim which is complicated by students' negative attitudes toward the discipline. To accomplish this requires an appropriate teaching and learning environment and a focus on what would be seen as fundamental concepts in statistics.This is particularly pertinent in a statistical literacy unit where there is not the time nor intent to focus in depth on the mathematics involved in the statistics discipline. In statistical literacy the intent is to convey an understanding of major statistical ideas so that students understand the processes involved in collecting good data and so that they can critically analyse information supplied to them.

The teaching and learning environment

The environment I seek to create is a learning one for both teacher and student. Irrespective of the size of class, teaching and learning should be fun. Learning needs to be revealing in ways that are important to the student (for example, about the primary discipline or ourselves). Students need to aquire positive beliefs about themselves and their ability to think statistically. In my classroom I do not deliver knowledge to students, they must create it and I help to extend, develop, modify and consolidate it, but I too am learning (about my students and often times my, or their, discipline). If my teaching is truly successful students will leave the learning environment with a greater receptiveness to ideas and continued learning. 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!).

The statistical literacy curriculum

Students need to aquire the building blocks for thinking statistically. The objectives of the statistical literacy program for Law students is to:

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

(2) provide students with an understanding of using a statistical or research process to build knowledge. The framework utilised was that the research and statistical process are synonomous each involving: ethics, expertise in elaborating the problem, identifying the hypothesis or research question, design, sampling, measurement, describing and analysing data, and making decisions. (Students are made aware that this is one perspective of the statistical and rsearch process); and

(3) to make students aware of variability as it occurs throughout the research or statistical process.

The theme *Statistics is a study of variability as it occurs thoughout the research process* characterises the unit. However just as experiential learning activities form the basis of the students learning, the responses by students to the various activities will be used to further elaborate the nature of variability and the statistical or research process. The intent in the unit has been to identify issues which confront users of data, not to fully define the scope and how to deal with the issues arising. Through the use of activity based or experiential learning it is possible to develop the students statistical understanding and at the same time to develop other competencies, attributes and values that our University considers desirable in graduates, such as communication skills, critical thinking or an awareness of ethical issues.

Organisation of the classroom

The most difficult task was to find activities that were manageable and which demonstrated the relevance of statistics to the law or to how students think about problems. The tasks were also to give rise to the statistical ideas the curriculum specified. Video materials were also used to support and provide an alternative perspective on the ideas developed in class. As teacher I provided a brief introduction to the exercises encapsulating what has gone before, linking it to the current activity and specifying what I expected from students. Students in groups completed the exercises and then reported their findings to the class. During or after the reporting, ideas ommitted were raised, ideas commended, the findings summarised, a structure for the ideas was provided and further ideas alluded to. The activity based approach created an environment in which students' statistical thinking could be rewarded, reinforced, clarified and extended. The observing teacher or student commented upon teamwork, and how decisions, actions, domination, submission or other behaviour during the exercise affected the statistical and subsequently legal conclusions drawn from the activities. The class activity was reinforced and extended by assessment which required students to present both orally and in writing a portfolio of annotated articles and clippings which illustrated the ideas students met in class as they pertained to the legal profession.

Class exercises

The Law Statistical Literacy module had four exercises entitled: Seashells on the seashore, The case for environmental damages, Variation in Measurement and Testing Advertisers claims. The first two tasks were designed to elicit the phases of the statistical (or research) process, the third to alert students to issues in measurement (principally, measurement is a source of variation or error in data) while the last involved students in the design, conduct and reporting of an experiment in a mock court.

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 other students with the same coloured handout as yourself (approximately 4-6 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, and the outcome of those changes and anything else of interest. This is to be reported to the larger group.

Outcomes: 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?; Has the evidence been tampered with?; Have the storage conditions (for example, heat, exposure) affected the shell collections?; Is there evidence other than the shells?; Can liability be ascertained from this report?; Who is liable or responsible for the accident?; Are there any other factors that could have caused the accident?; What effects did the accident have on the community?; What is the extent and area of the damage?; and, Were the effects short or longterm?

The questions of a statistical kind were classified according to whether or not they corresponded to the phases of the statistical (research) process. The purpose was not to tightly define the phases, but rather to use the questions raised to provide a structure for looking at statistics. Further discussion allowed each of the phases to be further elaborated, however each of the phases represents specialities in their own right and students were made aware of this. For example the discussion of ethics extended beyond the concept of deliberate bias to the ethical issues surrounding the release of new drugs or treatments (the value of which must be ascertained in statistically controlled experiments). The requirement upon researchers to meet the standards of ethics committees when researching was also discussed.

The students' questions as classified were:

- **Ethics**. Who collected the shells? that is, were there issues regarding ethics, integrity or bias.What were they looking for? Who conducted the tests ie were they qualified?
- **Researching the problem**. Have there been historical studies in the area examining pollution levels, marine life, global warming, introduced species from ballast water, 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 tides, warmth? Were the shells collected from the same place? Were there other influencing environmental factors ?
- **Sampling Issues**. How were the samples collected? Were the shells randomly collected? Which area were the shells collected from? What was the sample size? Is the sample big enough to to fairly represent the entire population?
- **Measurement.** Do the shells represent all sea life? Is the effect on the sea life the same as the effect on the shells? Are seashells indicative of more of less sea life? 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's expertise was identified as being 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 decribe 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.

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. I now had a role again as both statistician and educator. Where was the statistics in these exercises? If students are to develop their statistical thinking they need to understand the reasons why each of these questions was important. As an educator (or student observers) I also had a role in communicating what happened during the activity. How the teams selected or discarded ideas (perhaps because of one student's expressed logic or perhaps because of their dominating approach) had implications for how they solved problems and hence the outcomes.

Where is the statistics in these exercises? Behind each question asked there is a need to understand, control or manipulate variation. Statistics in this unit is defined as a study of variation throughout the research process. Why each question was important was scrutinised. The design questions eminated 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 or at different tides. They also 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 sea life. If there were a big discrepancy in the number of a species for example, if the beach yielded 2000 pippie 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 dicrepancy in shell numbers. Yet, until the daily variation in shells is known, we do not know how big a difference in the numbers is unusual and suggestive of some event such as the maritime accident. It may be that a difference of 5 abalone shells (a rare and protected species) is 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. While the students used terms they did not always have the appropriate meaning. For example, many students used the term random sampling to mean haphazardly collecting the shells. This manner of teaching allowed the students' conceptions to be identified and when erroneous to be clarified.

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.

Teaching methods that are inclusive of generic skills

Understanding the nature of the statistical process and the need to understand and manage variation at each phase provides a framework for the critical analysis of research? It provides a means of critiquing scientific methods. In this instance students became more aware of the discipline of law and the role of statistics within it. The statistical process began with notions of bias, of truthful representation of data and ethics. 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 there

had been damage to the sea life. 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 as 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. For example the decision to classify the abalone shell with another species hid the decline in abalone shells and was thus ommitted as evidence of a decline in a species.

Student assessment further promulgated the development of generic skills in addition to extending students' statistical thinking. In teams of up to six students they searched newspapers, the internet and journals and other publications for recent articles which could demonstrate the relationship between law and the statistical ideas they encountered in class. To their peers they presented selected summaries and commentaries from the portfolio they provided to myself as teacher. Oral and written communication, team work, computing skills (wordprocessing, graphing and using the internet), making connections between statistics and the law and the demonstration of statistical thinking and skills were all required by the assessment task.

Fulfillment of aims

That I have chosen to write is a reflection of students' positive response to the statistical literacy strand as measured by independent assessors and my own evaluations. Students completing the modules were more open to continued statistical learning than when starting. Much of the success of this course I attribute to the teaching and learning environment created. This environment where students were required to think and create much of their own knowledge was one which was imbued with teamwork, activity and communication (or the practise of generic skills).

Examination of the student portfolios suggestes that the aim to prepare students for continued learning of statistics as it relates to law also appeared to have been fulfilled. All too often users of Statistics think of Statistics as only of the analysis of 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 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 (for example, 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 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.