Student Perceptions of the Undergraduate Statistics Unit ®

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Abstract

This paper describes an investigation into the long term benefits of service statistics units. Third year undergraduate university students doing minor research projects in science, human movement and psychology were surveyed about their perceptions of their first year statistics studies. Almost all saw the need for statistical skills in their current activities, and many had an increased perception of the relevance of statistics since the time when it was taught. On the other hand, few were confident in their ability to carry out more than the basic tasks of descriptive statistics and data presentation. There is a perceived need for either the initial teaching or a substantial revision of the statistics content to occur closer in time to when the skills are to be used in a practical context.

Introduction

Many university courses require their students to study a unit in statistics to prepare them for a research task or project in the later part of their course. The statistics unit is not intended to be theoretical, but to provide basic skills in applied statistics. Such uniuÁ±...❷•❺①¥¸①Ñ¡"①™¥ÉÍÐ①å•...È①1/2˜①Ñ¡"①❷1/2ÕÉÍ"°①Á...ÉÑ±ä①Í1/4①Ñ¡... the students will have been exposed to the statistics before they need them, but also because later years tend to be fully taken up with course specific material. Boland (1995, p.55) mentions the problems of "introducing statistics before students can appreciate its usefulness, and perhaps with the effect that they forget much of what they have learned by the time the applications arise."

According to several authors (Moore, 1988; Rosenthal, 1992; Taffe, 1991), many students come to these service statistics units with little motivation and sometimes with outright hostility. In the early stages of their course students cannot see the relevance of what they are supposed to learn. Students often have negative feelings about elementary statistics courses, particularly "if they cannot see the direct relevance of the course to their own real interests" (Wild, 1995, p.57). A survey of heads of biology departments in universities in the UK (A'Brook & Weyers, 1996) cited lack of motivation and an inability to see the relevance of statistics to biology as a factor limiting students' ability to learn statistics. In many universities, introductory statistics units are taught to a very large class from a range of discipline backgrounds, so examples cannot be made specific to an individual's subject area.

While many students perceive the elementary statistics unit as being difficult (Garfield, 1995; Garfield & Ahlgren, 1998; Watts, 1991), those who progress to later years of courses where statistics is a prerequisite study have achieved at least a passing grade in statistics. This does not, however, ensure that all the objectives of the unit have been met. In particular, it has not been demonstrated that passing the statistics course will provide any long lasting ability to apply statistical techniques outside the examination room. Williams (1993)

describes a study where students who had passed a statistics examination showed limited understanding of concepts and an inability to transfer their statistical knowledge to novel problems. Speed (1987) describes graduates who have completed a major in statistics yet are still unsure of how to deal with real world statistical problems. If one of the objectives of the service statistics unit is to facilitate a later year quantitative project, then students must retain the necessary skills beyond the final statistics exam, and be able to apply them in their own discipline area.

This article describes the results of a questionnaire survey of third year students at a small regional Australian university. The students were enrolled in science, psychology and human movement courses which all have a compulsory first year service statistics component. The aim was to find out whether students considered that they had benefited from their statistics studies, and to obtain a longer term perspective than can be achieved with the usual end of semester course evaluations. Students were asked about their perceptions of their statistics unit. Questions sought opinions on their enjoyment of the statistics class, and the relevance of statistics to their current studies. Participants in the study were asked about their ability to use various quantitative skills, and whether their knowledge came from the statistics unit or from some other source. Garfield (1995, p.27) thinks students should be "adequately prepared to use statistical thinking and reasoning, to collect and analyse data, to write up and communicate the results of solving real statistical problems". This study is an attempt to discover how confident students feel in their ability to achieve these goals.

Other researchers (Gordon, 1997; Gordon, Nichols & Crawford, 1996) have investigated students' approaches to learning statistics and their perceptions of the subject while they currently studying it. This investigation asks students to look back on their statistics units in the light of their further experiences in their own discipline studies. A retrospective view can provide new insights. We teach statistics not just for its own sake, but in order that students can apply their knowledge to wider applications. It is important to evaluate the outcomes of our teaching from this broader perspective

Methodology & Methods

The methodology adopted is that of a quantitative case study. Information is obtained from one particular tertiary institution, so the direct significance of the study is limited to that particular case. However there are universities worldwide where similar problems are encountered. Knowledge of the experiences of others in like situations can enlighten practice elsewhere.

The study has not attempted to measure the students' current statistical knowledge and ability, but rather their perceptions of it. Students at this university, and many others, study the statistics unit in their first year, and are assessed then. All of the students in this study achieved a passing grade. That is the only formal assessment of their statistical ability in their course. What is needed in the third year is the ability to apply the statistical knowledge. This application could perhaps be judged by examining the project reports produced, but there are many other factors involved there. Students may choose a project where the level of statistics required reflects their perceived ability. They may (and frequently do) seek assistance from a statistical consultant, from their supervisor, or from their friends. The project reports then can not provide an objective measure of statistical ability. The students' perceptions of their own statistical ability can influence the way they go about their research project, and as such are of interest to statistics educators. Also of interest is the perceived relevance of particular statistical skills.

The three courses chosen for the study all involve substantial quantitative projects in the final year, for which the first year statistics unit is seen as a prerequisite study. Lecturers in

each area were asked for permission for the researcher to go into a class relevant to the final year project to explain the purpose of the study and to invite all students present to complete the questionnaire. It was made clear that this questionnaire had no connection with the assessment in the current course, that response was voluntary, and that names were not required.

The first part of the survey form asked for basic information on course and previous statistics studied. Perceptions were sought on the relevance of statistics at the time it was taught and now, as well as enjoyment of the statistics units. The central section dealt with skills. A list of nine basic skills which an ideal statistics unit should impart was compiled after discussions with a group of experienced lecturers. The skills were:

- collecting your own data,
- defining the variables that have been measured,
- entering data into the computer,
- descriptive statistics (mean, standard deviation, etc),
- graphical and/or tabular presentation of the data,
- knowing which statistical test or method to use,
- carrying out the test or procedure,
- interpreting the computer output,
- presenting the results of the statistical analysis in a report.

Students were asked if each of the skills was needed in their course, for an opinion on their ability with the skill, and for an indication of whether their knowledge came from their first year statistics unit and/or from some other source. Finally, open questions sought details of any quantitative research skills which they felt were needed and which had not been taught, and for any other comments on the teaching of service statistics units.

Results & Discussion

There were 138 respondents to the questionnaire, 64% of whom were female. Half were studying science, with the others evenly divided between psychology and human movement.

Replies to the questions on relevance and enjoyment were ranked from 1 "Not at all" to 4 "A lot". There was a distinct improvement in the relevance scores from "At the time" to "Now". Fifty-one per cent gave relevance ranks of 1 or 2 for "At the time", while 67% gave one of the top two rankings for "Now". A crosstabulation of scores for "Relevance at the time" and "Relevance now" shown in Table 1 showed that only 17% of all respondents thought that statistics was less relevant now than they did at the time they were studying it, while 46% saw an increased relevance for the subject. There were few differences between the three groups in these opinions. While science students saw the greatest current relevance for statistics, with 37% scoring it highly relevant, compared with 29% for Human Movement and 25% for psychology students, the difference was not statistically significant (c^2_6 =8.7, p=0.19).

Table 1: Relevance of Statistics Unit at the Time and Now

Tabulated values are counts

Relevance now						
		Not at all	A bit	Some	A lot	Total
Relevance	Not at all	5	4	7	5	21
at the	A bit	5	18	13	14	50
time	Some	2	12	24	20	58
	A lot			4	5	9
	Total	12	34	48	44	138

Only 32% of respondents claimed to have enjoyed their statistics more than "A bit". There was a significant correlation between opinion of relevance at the time and enjoyment (Spearman's rho =0.48, p =0.001), indicating that students enjoyed the unit more when they could see that it was relevant (see Table 2).

Table 2: Relevance of Statistics Unit at the Time and Enjoyment

Tabulated values are counts

Enjoyment of statistics						
		Not at all	A bit	Some	A lot	Total
Relevance	Not at all	16	4	1		21
at the	A bit	23	20	7		50
time	Some	17	13	24	4	58
	A lot	1		4	4	9
	Total	57	37	36	8	138

Most participants thought that all of the nine specific skills were needed in their course. The perceptions of ability provided reassuring feedback to statistics teachers. Over half of all respondents felt confident in their ability in collecting data, descriptive statistics and

graphical and tabular presentation. The worst result was for knowing which statistical test to use, where only 10% were confident, and almost 30% had no idea. These results were broken down into the three discipline areas, but there were no significant differences in the patterns of response.

Table 3: Ability with Statistical Skills

Tabulated values are row percentages

Skill	Needed in course	No idea	Some knowledge	Confident in ability	Total valid responses
Collecting own data	97	2	48	50	138
Defining measured variables	94	8	58	34	136
Entering data in computer	94	7	52	42	136
Descriptive statistics	95	1	48	52	137
Graphic & tabular presentation	97	4	43	54	138
Which statistical test to use	89	27	63	10	133
Carrying out the test	94	16	64	20	134
Interpreting computer output	93	15	61	24	135
Presenting results in report	96	12	55	34	137

Interestingly just over 20% of the responses to the question about source of knowledge specified that all of their knowledge about a particular skill came from sources other than the statistics class. Collecting data, graphical and tabular presentation and presenting the results in a report were the skills which rated highest for "other source of knowledge only", while knowledge of which statistical test to use came from the statistics course only for 69% of those who claimed some ability with that skill. This perhaps reflects the emphasis in most statistics courses on statistical techniques and procedures ahead of the possibly more difficult concepts of planning a study and presenting the results to a non statistical audience.

Over a quarter of respondents gained their knowledge from a combination of the statistics course and other sources, indicating a pleasing ability of students to make use of a variety of knowledge resources. Unfortunately no further information as to the specific source of this outside knowledge was sought. This might provide an area for further research.

Written comments at the end of the questionnaire form provided some valuable insights. Participants were asked for any specific skills they had not been taught, and for any general comments. By far the most common was a plea to make the statistics more relevant to the student's particular course. Other themes were the need for more practical applications rather than theory, and the need for the statistics to be taught or at least revised in later years of the course, when it was needed for research projects. Several students complained that there was too much material in the statistics course, that it was too difficult or taught too fast. In contrast, there were two complaints that the statistics taught was too easy! Practical requests were for a wider range of computer packages to be used, and for more guidance on which statistical test to use in a given situation. Opinions of the subject ranged from "I'm sorry but it was very very boring" to "Well worth the effort" and "Tutorials were great". One student summed up well with "We didn't understand the relevance at the time. A quick look-see at what we have to do in the third year for major project would have made a great difference. The idea of stats as part of any scientific report needs to be emphasised as much as possible".

Conclusion

This study has investigated the perceptions held by third year undergraduate students of their service statistics unit. Participants were doing minor research projects in science, human movement and psychology courses. It differs from other similar studies in that instead of surveying the students during or immediately following their statistics class, it takes a longer term perspective. Participants were questioned a year or more after completing their statistics, and asked if certain specific quantitative skills are needed in their current studies, and how confident they feel in their ability with those skills.

The results give a strong message to statistics educators. Much of what we do is valued. Most students now see the need for statistical skills, even though they did not enjoy studying the subject at the time. Many have improved their view of the relevance of statistics with experience.

The service statistics units studied by these students had given them confidence in their ability at descriptive statistics, collecting and presenting data. They were much less confident at more advanced skills such as knowing which statistical procedure to use in a given situation. The students had gained their knowledge in these areas from a variety of sources. While many claimed to have learnt from both the statistics class and elsewhere, a disappointing minority gained all of their knowledge of statistics from sources other than the statistics class.

The overwhelming view about statistics expressed by these students was that the subject must be made relevant to their particular discipline area, must have a practical rather than a theoretical emphasis, and should be taught or at least revised later in the overall course. Most service statistics in universities is taught to large mixed groups in the first year of an undergraduate degree, as university administrators see this as the simplest and most efficient way to do it. The message to statistics educators from this study is that we must work within these administrative constraints to show the students how statistics will be used later in their courses. Statisticians often consult with researchers from many disciplines. They should endeavor to incorporate the flavor of these consultations into the undergraduate curriculum. While formal course structures may preclude it, the revision of the statistics material closer in time to when the skills are to be used in a practical context would be of benefit to the students. Greater collaboration between statistics educators and academics in the end user departments might lead to the introductory statistics course being seen as a springboard to be followed up by directly applicable discipline specific modules.

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