HOW CAN STUDENTS BE ENCOURAGED TO READ STATISTICAL MATERIAL?

Stuart Young
Auckland University of Technology
New Zealand

This paper reports on the use of a system designed to encourage statistics students to read the course text as a primary source of information and ideas. Reading and limited assessment would precede classroom teaching. The system has been implemented for eight semesters. Summaries of data collected will be presented, as will qualitative feedback from students.

INTRODUCTION

Auckland University of Technology offers many single-semester introductory statistics courses, including Statistical Skills as a bridging course for first-year Applied Science students. The authors of the compulsory course text (Moore & McCabe, 1999) emphasise that they have concentrated on making the book more readable. The third edition of the text has been rewritten so that readability is enhanced without loss of conceptual richness. Increased attention to readability is also evident in another elementary statistics text (Wild & Seber, 2001) who state that they have endeavoured to write a book that is "expositional, chatty and friendly" to the reader.

It was with dismay that we realised many students were still not taking the trouble to read any material out of class. Too often suggested readings were not attempted. Students did not bother to purchase the textbook, but would share with others or wait for handouts. There was often a passive learning environment. Those few students who *had* read at home may not have been optimally engaged when the teacher repeated the material. These conscientious students may have been inclined to quit the habit of reading.

Anecdotal evidence suggested that while many students had acquired the skill of learning new material using reading, they were more familiar with using this technique at school for subjects such as business studies, science, social studies and languages. Projects at school had to be completed where teacher-provided information was minimal. Subjects such as mathematics and accounting placed more emphasis on practicing teacher-provided skills. Whether we, as teachers of statistics (often also maths teachers), made sufficient use of a student's ability to learn by reading, was open to question. Discussing this with students it appeared that many had not considered the simple idea that statistical skills can be learned through reading. The thought of reading about statistics as one would read a newspaper article (to acquire information) initially seemed strange to the students. At secondary school, many had not had this experience. Our aim was to show students that reading is a useful strategy for acquiring primary knowledge and ideas in statistics. The question of how to ensure their participation was discussed and a teaching approach proposed.

DESCRIPTION

Compulsory readings were given to students a week in advance. A section of work, usually from the text – for example Section 3.2 Sampling Design - was designated as required reading. This was to be read in conjunction with clearly stated learning objectives, as listed in the course descriptor. Readings were typically 10 – 20 pages long. Students were told from the outset that all questions would be non-arithmetical. A week later, the class was begun by handing out a single question typed on a sheet of paper to each student. This question would directly assess a learning objective associated with the topic, eg 'Explain how to select a stratified sample'. The students had not been taught this by the teacher and had five minutes to submit a written answer. The test was closed-book.

Once all answers had been collected, possible answers were discussed (with reference to the appropriate section). The material was not re-taught by the teacher who assumed that the students had learned the basic ideas through reading. Plenty of time was now available to develop and practice the basic ideas and skills of the student. Each student's answer was later assessed from 0 – 2% with half marks allowed. The basis for assessment is shown in Table 1.

Table 1
Allocation of Marks for Reading Questions

Mark	
0	Absent; Late; No evidence of reading
1	Evidence of reading, Limited scope/depth
2	Evidence of reading, Extended scope/depth

Answers were handed back at the start of the next class (usually a computer lab). The hand-back was used as a focus to start the class. Only the best ten of the weekly marks for each student were used, to give a total of 20% credit for the course. This allowed time for students to adapt to the expectation of learning at home and also the occasional sickness etc.

BENEFITS

Classes began promptly. The assessment lasted only a few minutes and provided an immediate focus to begin the lesson. Students were eager to refer to their books once the answers had been collected, that is, the course text was used as a reference. Questions often arose from students, which provided a natural and seamless start to the class. Tutors found that marking each assessment task for a class took less than 15 minutes, since there was only a single question from each student. A feel for class progress was facilitated.

FEEDBACK

Over the most recent eight semesters, a total of thirteen classes have used the system described above. Five tutors have been involved with the teaching of these classes. All of the tutors supported the general idea that students take some responsibility for their own learning by reading set material, however not all tutors were entirely comfortable with assessing material that had not been taught in class.

At the end of each semester, written anonymous feedback was obtained from all the students. General comments were mainly positive, even from those who found the material difficult: “I think this is an excellent way to maintain student participation in the course”, “The 2% questions are excellent motivation to read the text”. There were also negative comments: “I prefer it when the teacher explains everything to us first”, “We should be given more notes”.

Many comments were pragmatic: “The good point about it is that they only ask one question”, “Because the questions are worth 20% you actually read the text (I found I did anyway)”, “I learn better by reading. A week gives sufficient time to read when you have a spare evening”. There were also a few inspirational comments such as “Very worthwhile. Understood the topic better than if explained by the teacher”. Whether or not this last statement was true is debatable; however the implication is that this student believed that they were able to learn some statistical ideas independently of a formal lesson.

DATA

Two hundred and eighty eight students who sat the final exam were included in the brief analysis that follows. The variables recorded were Tutor, Semester, Gender, Weekly Reading Scores, Computer Assignment (three computer based practical data analysis projects) and Final Exam Result (a 2 hour written formal exam). Unfortunately feedback was not collected from students who did not complete the course (probably a 10% dropout rate) and also it was not recorded whether English was a first language (many students in these classes were weak in English). These omissions will bias the summaries.

RESULTS

The mean Reading Score of each class did not show any trend as the semester progressed. Total Reading Scores for students are strongly positively correlated with their Final Course Results ($r = 0.76$, $p<0.01$) and also with Computer Assignment Totals ($r = 0.61$, $p<0.01$). The correlations were not gender dependent. An important question is whether increased reading

improved understanding of basic statistical ideas. This positive correlation does not demonstrate causality, but it may imply that better students do better at both of these activities.

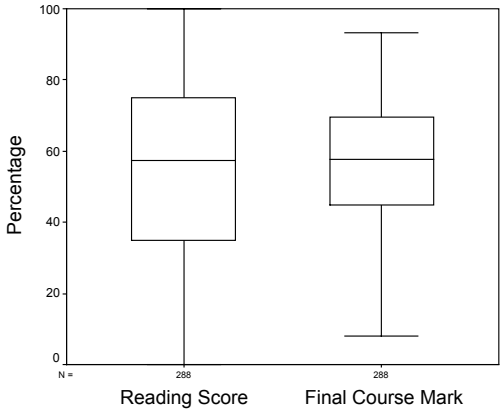

Figure 1. Reading Scores and Final Result for all Students.

When all students are examined as a group, figure 1 shows that marks awarded for the weekly tests appear to be similarly distributed to final course marks. Figures 2 and 3 show that the five tutors were reasonably consistent in their allocation of percentages.

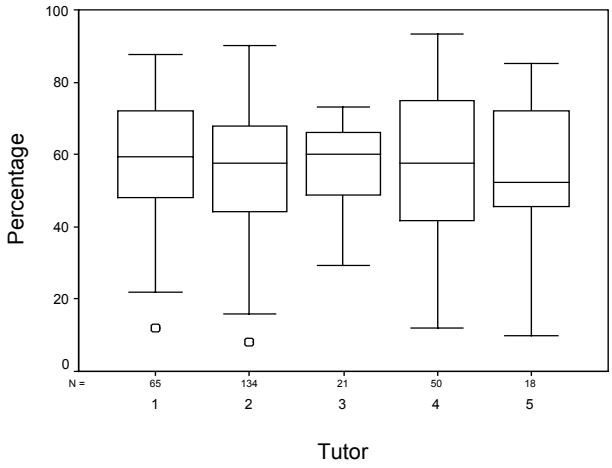

Figure 2. Final Result for Students by Tutor.

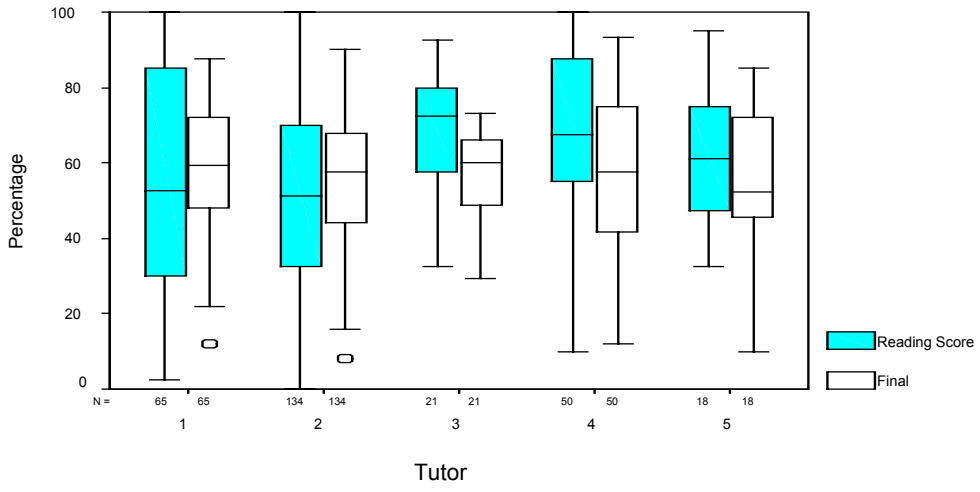

Figure 3. Comparison of Reading Scores and Final Marks by Tutors.

Tutor 4 used the system described above with a class in semester one, but in semester two reverted to a more conventional approach. The material was delivered via a lecture. Following this a required reading was given; a week later a one-question test on the reading material was administered. The course material, notes and questions were very similar to those of semester one. Figure 4 shows the two classes were of similar ability as represented by final mark. The group of students who were required to read material as learners were awarded typically slightly higher and less variable scores than the group who read material as a supplement to a lecture.

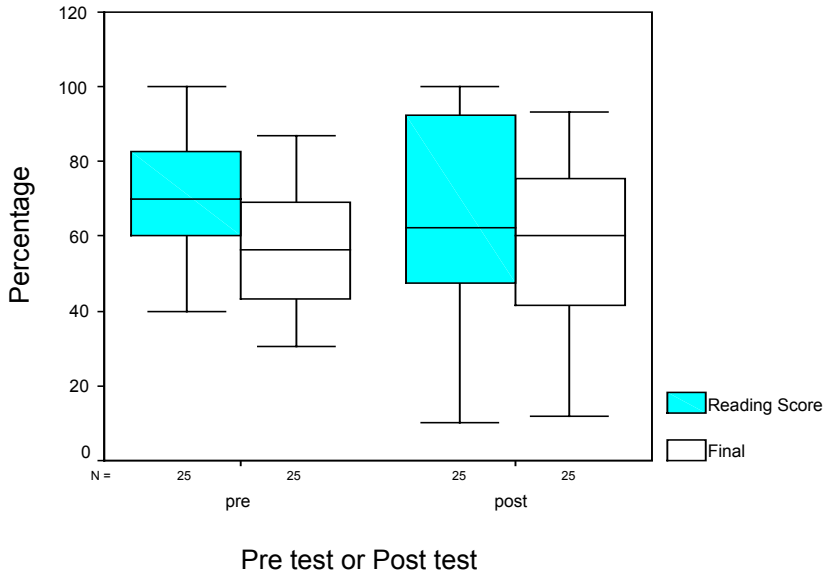

Figure 4. Comparison of results for two classes: one receiving test after reading, the other a test after teaching.

DISCUSSION

There is some evidence to suggest that this approach has encouraged some students to learn statistical ideas and techniques through increased reading. The qualitative feedback is encouraging, and for many students at least some time has been spent in private contemplation of well-written statistical material. There is little evidence to suggest that pre-testing material before formal instruction has disadvantaged students.

Encouraging students to read statistical material takes patience and perseverance. In addition, a carefully planned teaching approach may also need to be devised. This approach should include linking those students with language difficulties to other learning support facilities provided by the school/academic institution. In the longer term, this reading approach may help prepare students for post-graduate work when a large proportion of new statistical ideas will be learned from journals, articles and books.

REFERENCES

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences*. Hilsdale, NJ:Erlbaum

Moore, D.S., & McCabe, G.P. (1999). *Introduction to the practice of statistics* (3rd edn). New York: W H Freeman and Company

Wild, C.J., & Seber, G.A. (2000). *Chance encounters: A first course in data analysis and inference*. New York John Wiley and Sons