

Assessing statistics at postgraduate level: the Statistics Chapter assignment

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Statistics is perhaps one of the most challenging areas within the teaching and assessment of psychology. While a fair amount of attention has been given to this area within the context of undergraduate studies, rather less has been given to the ways in which these challenges may differ when teaching postgraduate students. This report describes an assignment that has now been used over a number of years within a postgraduate statistics module: the Statistics Chapter. For this assignment, students are required to write a statistics chapter aimed at second-year undergraduate psychology students. As part of this they must design their own data set, discuss the theoretical background behind their chosen method of analysis, explain how to run the analysis in SPSS and how to interpret and write up the results. The Statistics Chapter appears to provide an approachable method for assessing postgraduate statistical abilities.

INTRODUCTION

Research methods and statistical analysis form fundamental aspects of any psychology degree. However, statistics tends to be one of the biggest challenges when teaching a psychology degree. It is typically every psychology student's least favourite topic and it is often approached with a great deal of apprehension. Many of the current statistics teaching resources and teaching related publications are aimed at undergraduate teaching. However, statistics is also compulsory in all postgraduate degrees. Teaching statistics at a postgraduate level brings additional challenges.

One of the biggest challenges is that psychology postgraduate students come from a diverse range of backgrounds (see Zinkiewicz, 2004). Indeed, Zinkiewicz explicitly discusses the need to provide facilities, resources and support to 'nontraditional' students and to recognise that students will have a range of differing needs. Within the context of statistics, some will have a good and broad understanding of statistics (e.g., recent psychology graduates), whereas others may only be familiar with the basic concepts and methods of analysis (e.g., mature students returning to study after a break from education). A further challenge is that students will be developing their own research interests and beginning to specialise within a particular area. Depending on

which aspect they are focusing on, certain statistical methods may be more relevant and of more interest than others. Given these challenges, teaching statistics at a postgraduate level requires greater flexibility, both in the teaching of content and assessment of understanding.

This report describes an assignment which has been used on a postgraduate advanced statistics module: the Statistics Chapter assignment². The assignment was to write a chapter, suitable for inclusion in a statistics textbook aimed at second-year undergraduates. The topic of the chapter was not specified and students could select the statistical analysis that was of greatest relevance to their chosen speciality within psychology. To ensure that the statistic was appropriate (i.e., not too simplistic nor too complex) the chosen topic had to be approved by the lecturer before beginning the assignment.

The design of this assignment taps into the idea of 'learning by teaching', the suggestion that teaching a topic is a highly effective way of learning that topic (see Roscoe & Chi, 2008). The assignment attempts to encourage deep or active learning, rather than surface or passive learning. Deep learning strategies are seen as superior to surface learning strategies as they "do not simply rely on memorization of course material but focus instead on understanding it" (Felder & Brent, 2005, p. 63).

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²It is important to note that the Statistics Chapter only formed part of the course assessment. One of the main reasons for teaching statistics is so that students can appropriately analyse data and write up results sections in research reports, and hopefully for submission to journals. Throughout the semester-long course, students had to submit three 'mini-assignments', each worth 10% of the module assessment. Each of these required analysing a data set using a different and specified method of analysis (ANOVA, multiple regression and MANOVA or factor analysis) and writing it up in a style suitable for submission to a peer reviewed journal. The Statistics Chapter comprised the remaining 70% of the module assessment.

Benware and Deci (1984) asked students to learn materials under two different conditions: learning with the expectation of being tested on the material (surface learning) or learning with the expectation of teaching the material (deep learning). They found that students in the 'learning to teach' condition had learned the concepts more effectively and were more intrinsically motivated. The findings of this study provide strong support for the Statistics Chapter assignment. It was expected that a deep learning style would be adopted by students, which would consequently lead to an enhanced understanding of the statistical analysis covered.

The benefits of teaching as a method of effective learning have received a great deal of attention in assessing reciprocal peer tutoring, where students tutor one another (see Roscoe & Chi, 2008). It has been shown that students involved in reciprocal peer tutoring tend to achieve higher grades and also report less anxiety (e.g., Griffin & Griffin, 1998; Riggio, Fantuzzo, Connelly, & Dimeff, 1991). In the Statistics Chapter assignment it was hoped that these two benefits of peer tutoring would also be achieved, that the students completing this assignment would gain a strong understanding of the statistical analysis covered and that they would feel more comfortable with the assignment than alternative, more formal methods.

The use of such problem-based learning techniques is becoming more common within a number of disciplines, including psychology (Norton, 2004). According to Hmelo-Silver (2004), problem-based learning has five ways in which it improves students learning: by developing flexible knowledge, acquiring problem solving skills, encouraging self-directed learning, enabling collaborations and increasing intrinsic motivation. Therefore the development of an assignment that is problem-based may have many advantages. In particular, the flexibility of such an assignment is particularly advantageous given the diversity of postgraduate students (as discussed earlier).

On the basis of these distinct sources of evidence it seemed that there was theoretical support for designing an assignment that encourages deep learning, encourages the student to view a topic from the perspective of a teacher, and that is problem-based. The Statistics Chapter assignment was designed with these three factors in mind. Consequently, the assignment should not only have provided an accurate reflection of the student's statistical ability, but also should have been a more effective learning experience for the student. Further, by having each student select the topic of the Statistics Chapter according to their chosen specialist area within psychology, it was hoped that the assignment would also be of use in the student's own area of research.

THE STATISTICS CHAPTER

Within the Statistics Chapter assignment, there were a number of specified components that had to be completed.

Designing a data set

Students had to demonstrate how to run their chosen method of statistical analysis. In order to do this they had to first design an appropriate data set. By asking them to design a data set they needed to decide what the data set needed to illustrate and to understand how the data set related to the findings of the analysis. They were told to consider how they wanted their final analysis to 'look' before designing the data set. For example, did they want the assumptions of the analysis to be met or violated?

Background information and when to use the statistical test

The assignment specification required students to begin the chapter with a brief theoretical introduction to the statistical test. They also had to explain when it was appropriate to use that method of analysis.

Running the analysis in SPSS

It was specified that the analysis should be run using SPSS. The chapter had to describe how to run the analysis in SPSS, including screen shots and descriptions of why particular options should be selected.

Interpretation of the analysis

The interpretation aspect of the assignment had two parts. First, they had to explain how to interpret the SPSS output produced by the analysis and identify the most important parts of the output. They were also asked to describe how to write up the analysis and present the results graphically.

METHOD

This assignment has been used across three cohorts of postgraduate (MSc or PhD) students taking the Advanced Statistics module: 2005-06 ($n = 5$), 2006-07 ($n = 11$) and 2007-08 ($n = 9$). Feedback was collected at the end of the module for each of the three cohorts. The module was part of the MSc in Psychological Research Methods. All students needed a British Psychological Society-recognised undergraduate degree in psychology to gain entry to the course. First-year PhD students also had to take this module unless they already had completed an Economic and Social Research Council-recognised course with comparable content. The module was offered in the second semester of a year-long course and followed two other taught modules, Foundations of Psychological Research and Qualitative Research Methods.

The chapters were completed on a variety of analyses with a roughly even split between one-way ANOVA (emphasising either assumptions or planned and posthoc comparisons), factorial ANOVA, multiple regression and factor analysis (exact numbers for each analysis are not available).

All students were given a short questionnaire containing six open-ended questions about the Statistics Chapter assignment. This was given at the end of the module, after the piece of work had been submitted, but before marks were returned. Of the 25 students, 18 responded (72%). Some students did not respond to every question.

RESULTS

When asked whether they found that the Statistics Chapter assignment “enhanced their statistical understanding”, all students reported that it did. Many ($n = 10$ from 15) responded that they previously knew “how” to run and write up their chosen method of analysis, but that the assignment enhanced their understanding of “why”. It seems that the assignment was effective in making students move beyond the basic procedural processes involved in SPSS towards a deeper and more theoretical understanding of statistics.

Students were also asked whether they felt that the Statistics Chapter enabled them to demonstrate their “statistical understanding and ability”. Of the 12 students who responded to this question, only two noted some reservations. Both reported feeling that they had to work hard to not simply reproduce either textbooks or lecture notes (all pieces of work were submitted via Safe Assignment, an online plagiarism checker). However, the majority ($n = 10$) responded positively and made a variety of comments. The most frequently occurring remark was that the nature of the assignment forced understanding of all aspects, from the theory through to the writing up of the analysis. Consequently, it was necessary to have a full understanding of the analysis of choice to successfully complete the assignment.

Given that the Statistics Chapter was a slightly unconventional method of analysis, students were asked if they would have preferred a different type of assignment. All students reported that they felt the Statistics Chapter should be kept as the primary assignment. However, four respondents did suggest that other methods of assessment (e.g., short essays, presentations, critiques of published results sections) might be beneficial in addition to the Statistics Chapter, to give a broader coverage of both skills and types of analyses. Students were also asked if they would make any changes to the Statistics Chapter. Only one suggestion was given, which was that a short reflective

element be added. This is a very interesting possibility and could easily be integrated into the assignment.

Students were asked what they thought the best and worst aspects of the assignment were. A wide variety of responses were given, and those that were raised by more than one student are discussed here. Many students ($n = 7$) thought that the all encompassing nature of the assignment was the best aspect and that it provided them with a far deeper understanding of an analysis, rather than simply knowing which buttons to click in SPSS and which bits of output are important. A number ($n = 4$) commented that the assignment was “fun” and “approachable”. Some of the students ($n = 3$), who are either already involved in teaching undergraduates or considering a career in academia, also said that they found the assignment very useful for developing their own teaching techniques. The most frequently reported ($n = 4$) worst aspect was that preparing the figures and screen shots for the assignment was time consuming, although preparing these was also raised as one of the best aspects by three students. Whether this is a “good” or a “bad” aspect is possibly a result of how much experience they have previously had with image manipulation and creating figures in Word.

DISCUSSION

The aim of the Statistics Chapter assignment is to provide an alternative and approachable method for assessing postgraduate statistical ability. There are two main aims when using the Statistics Chapter assignment. First, to enable students to select the statistical test that is most appropriate to their chosen area of research. This seems to have been achieved. The range of statistics chosen was varied and the statistics covered were clearly appropriate for each student’s chosen area of expertise. Second, to provide an approachable learning experience for students with varying levels of statistical ability and an effective way of assessing students. On the basis of the student feedback given it is clear that the assignment was well received, however further work is necessary to really determine the effectiveness of this method (e.g., by direct comparison to performance with more traditional assignments).

It was noted in the introduction of this report that postgraduate psychology students tend to come from a diverse range of backgrounds (see Zinkiewicz, 2004). One possible advantage of this assignment is that it can benefit students at any level of statistical understanding and ability. Students across the whole range of abilities, determined by a mixture of self-report and their performance throughout the module (in class and assignments), seem to feel that the assignment enabled them to further their understanding of statistics and to successfully demonstrate this.

It is interesting that students at different levels of understanding seemed to further their understanding in quite distinct ways. For example, students with less statistical experience/confidence tended to report that the assignment helped them to understand and run the statistical analysis. In contrast, the more experienced/confident students reported additional benefits, such as understanding the maths behind the statistic or a greater understanding of the basic elements that underlie all statistical analyses. This aspect provides particular support for the Statistics Chapter assignment, as all students reported enhanced understanding following completion of the assignment, albeit in different ways. Statistics is often extremely anxiety provoking for students, and this can be most evident in the assessment of statistical knowledge and understanding. It is very reassuring that even students who reported being "statistics phobic" gave very positive feedback about the assignment and reported that it aided their understanding a great deal.

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