ENGAGING STUDENTS IN QUANTITATIVE METHODS: REAL QUESTIONS, REAL DATA

Mark Brown
University of Manchester
United Kingdom
Mark.brown@manchester.ac.uk

This paper sets out an approach to teaching 'statistical literacy' to social science students that is built around the need to first engage them with questions and data applications that excite them. It highlights the increasing range of accessible real world data which allow the teaching of statistics to be contextualized with data and questions that are topical, relevant and matched to the subject interests of the students being taught. The paper illustrates this approach with the example of a compulsory methods class taught by the author to Sociology undergraduates. The course is designed in a way that statistical concepts and techniques are encountered in-context and as part of a coherent research process in which the students are active participants – 'statistics' become the means to an end rather than an end in themselves. The approach has seen a transformation in student satisfaction scores and a new interest in developing data skills in final year options.

CONTEXT AND PURPOSE

The campaign for statistical literacy promotes the acquisition of a basic skill set that enables citizens to be informed and critical users of the data they will encounter in their studies, work and daily life. However, this notion of everyday and relevant statistics is at odds with the way statistics has traditionally been taught in the social sciences, siloed off into a quantitative methods module where learning numeric concepts and measures is abstracted from the substantive themes that give them relevance and meaning. It is in this context that so many students feel anxious and unmotivated about 'learning statistics' (Williams et al 2008; MacInnes, 2009; Williams & Sutton, 2011; Carey, S and Adeney, K, 2010). The challenge is to integrate the learning of those skills into the substantive curriculum so that they are normalized and seen by students as an integral and essential part of studying their degree subject.

APPROACH

Making course content relevant and engaging

Informed by our experiences at Manchester (Wathan et al, 2011; Brown, 2013; Carter et al,2014; Buckley et al, 2015) and the wider literature, the authors' approach to teaching 'statistics' to social science students is built around the need to first engage them with questions and data applications that excite them. An essential element of this approach is the choice of data. As methods teachers we are fortunate now in having a vast (and growing) supply of rich and accessible social data sets that enable our teaching of statistics to be contextualized with data and questions that are topical, relevant and matched to the subject interests of the students we are teaching. It is an approach that enables us to make explicit links between the substantive and methods curriculum. We can illustrate this approach by drawing on the author's experience of teaching an introductory module on quantitative survey research to second year sociology undergraduates at the University of Manchester.

The course is a compulsory component of our single and joint honours Sociology degree programmes. As a compulsory module there are no pre-requisites and consequently students display a huge range of prior experience with quantitative data, depending largely on what subjects they studied prior to University. Very few of our students have studied mathematics beyond the age of 16, a trait of humanities students in the UK more generally (Hodgen et al 2010). Extracts of the results from a short survey of student perceptions run at the start of the first lecture (Table 1) confirms a course facing all the well documented challenges of teaching students who are anxious, unmotivated, and in some cases resentful of the requirement for a 'quantitative methods' module.

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Sociology students shouldn't have to study quantitative methods	agree=14% disagree=62% neither agree nor disagree = 24%
The idea of analysing quantitative data on a computer makes me anxious	agree=58% disagree=16% neither agree nor disagree = 25%
If this course had been optional, would you still be taking it?	No= 68% Yes =9% Not sure =23%

Table 1: Results from a class survey on attitudes and preconceptions about quantitative methods (2015-16 cohort)

Against this backdrop, the driving philosophy in the design and delivery of this course is first and foremost about making its content relevant and engaging. That means making proper connections to the wider curriculum and the substantive themes that inspired them to take a degree in Sociology. While the course is in one sense a conventional quantitative methods module with learning objectives that include understanding a standard set of statistical concepts and measures, our approach is not to headline these as 'topics' in the way we structure the course but introduce them as part of a 'research process' that starts with a substantive research question or problem we wish to investigate. It is an approach that allows us to give proper emphasis to the importance of framing theoretically informed research questions and hypotheses to guide data analysis, and enables a more natural connection to the students' substantive courses by emphasizing that statistics are a tool with which to investigate and better understand the topics and theories they are studying as part of their training as Sociologists. Thus statistical concepts (like level of measurement, variation or inference) and techniques (like cross-tabulation, the use of a 'control variable' or running a chi square test) that students frequently find difficult to engage with in a formal lecture are encountered in-context and as part of a coherent research process *in which the students are active participants* – 'statistics' become the means to an end rather than an end in themselves.

While the course includes a conventional series of weekly lectures, the real learning goes on in the lab classes, where students gain understanding and confidence through experimentation and practice. In terms of lecture content, for this introductory course we make a conscious decision to teach statistics without use of formal statistical notation or an emphasis on formula. The focus is on what purpose a measure serves in the research process and how it is interpreted. The limitations of the exploratory techniques covered are highlighted and the value of more sophisticated methods like regressions discussed and flagged as the focus for more specialist options in year 3.

The approach can be illustrated best with specific examples used in the course. In the first we use British Social Attitudes (BSA) as an evidence base with which to explore public perceptions around poverty and welfare in the context of UK economic recession and austerity policies. Many of our students have chosen to study Sociology because they have an active interest in themes of inequality and thus have a degree of engagement and a willingness to take up theoretical and ideological positions that are an ideal starting point to build research questions and hypotheses. While students may struggle to relate to the formal conditions of hypothesis testing, they have no problem in putting forward ideas about how attitudes towards the poor and the benefits system are likely to differ across the population along lines of class, political ideology and demography. Immediately we can bring in the concept of variation and the challenge of how to measure it as a pre-condition for testing out our theories and hypotheses with evidence. The BSA is then introduced as an ideal evidence base to explore attitudes on this topic, and is the subject of a linked computer workshop.

While the course involves a training in survey micro-data (using SPSS), for this opening workshop we use a more immediately accessible on-line interface to the BSA data (http://www.britsocat.com/) provided by the Centre for Comparative European Survey Data (CCESD). This has the advantage of allowing students with no-prior experience to get working hands on very quickly with the data – pulling off frequency distributions within 20 minutes of starting the first practical workshop.

Making Students Part of the Dataset

At this point it is useful to introduce a second plank of our teaching strategy which is to make direct connections between the data and the students own lived experience (we coin the phrase 'making students part of the data set'). Prior to the first workshop, six related attitudinal questions on the themes of inequality and welfare were selected from the BSA, and set up as a mini-survey to be completed on the Course VLW site. The results from the survey were then collated into a handout showing the frequencies for the class. The students were then invited to source the results from the national sample and enter them into the handout as a basis for a comparative exercise. The incorporation of the students into the dataset in this way serves a number of purposes. First and foremost it encourages engagement – students are now part of the evidence base and there is a natural curiosity about their own views and the way they compare. Secondly it provides a perfect context to engage in some of the key ideas behind statistical analysis, including the challenges of describing differences and making meaningful comparisons. For a class more naturally inclined to qualitative methodologies, the advantages of a standardized measurement enabling comparison between groups (them and the national sample) and across time (different years of the BSA, before and after recession in this case) are made apparent. Another theme introduced in this exercise is the concept of populations and samples – in particular the nature of the approximately 3,000 individuals in the national sample, with questions on how they were selected and in what sense can they be considered representative (this sets up a later session where the theory and practice of random sampling is considered in much more detail). Then we have the core business of making comparisons. For a class where many students lack confidence in even basic numeracy (including calculating percentages) the challenge of comparing class survey results with the national sample provides an ideal illustration of the problem of making meaningful comparisons between different size groups, and the importance of working with percentages.

Another highly valuable aspect of the exercise is that by subjecting students to play the role of research subjects in generating the data, they gain a particular insight into the challenges of measurement. The questions included a range of answer types including Likert scales and students were asked to reflect on the process by which they came to their answers (including the sense of pressure to give socially desirable answers). It makes transparent and demystifies the process by which social concepts are operationalized and transformed into the numeric data that appears in datasets (especially important when we move to working with the microdata in SPSS). It also demonstrates the seriousness of a problem inherent in observational studies (overlooked in courses that work only with prepared datasets) namely the reality of non-response. Students were surprised that only 61% of them had responded to the initial survey, and more so when it was explained that this actually represented a fairly good response rate for an on-line survey.

In summary this relatively simple but highly engaging exercise introduces some of the key concepts and challenges that lie at the heart of any training in statistical literacy (including measurement, non-response, populations and samples, bias, variation, distributions, making comparisons, standardization)

One of the challenges of using real world survey data to teach statistics is the fact that the vast majority of variables in social datasets are categorical. Applying the principle that data should be matched to the themes and interests of the class group, finding good interval level measures to teach concepts and measures like correlation and simple regression is difficult. One exception we have found is the Health Survey for England. Health and health related behaviour are popular topics among our students and we have used the HSE to study obesity, drinking behaviour, smoking and blood pressure. As with the BSA example, the media and policy debates around a UK 'obesity crisis' provides an ideal hook to engage students into thinking about theory and evidence. As a class (and again drawing on their learning in related substantive modules) we can quickly develop research questions and hypotheses about the trend in obesity and how it varies across the population. Obesity is an ideal topic to discuss challenges of measurement. A set of anthropometric measures provides the basis for alternative measures of BMI and waste-hip ratio. Aside from providing some excellent 'real' examples of normal distributions (with which to explore associated properties), the applied task of operationalizing a measure of obesity from these continuous measures provides a nice illustration of the subjectivity and (where informed by public

health guidelines) the political nature of many quantified measures – opening up a more philosophical discussion about the extent to which social statistics are in some senses 'created' rather than 'collected' and the importance of thinking critically about the politics of data. Similar scenarios are presented when looking at the measurement of 'problem drinking' or 'high' blood pressure.

In summary we are pursuing an approach that enables us to make clear connections between the learning of theory and the evaluation of evidence with which to test and critique that theory – accompanied by the right data, the critical skills of statistical literacy can be introduced as part of an enquiry led and hands on student learning experience which is substantively driven.

LESSONS LEARNED

The notion that social science students will reject quantitative methods because they 'can't do maths' is exposed as a red herring – the real barriers are about motivation and perceived relevance and related (lack of) engagement. When students are engaged through meaningful substantive questions, and involved as active participants in a research process, statistical concepts and techniques immediately become more accessible and meaningful as they are encountered naturally and in context. While we lack the data to directly assess the extent to which our teaching approach results in better understanding of statistics and their application, the indirect evidence is positive. First we have observed a striking improvement in student satisfaction based on the formal Unit Evaluation Questionnaire (UEQ) used annually on all Manchester credit bearing courses. While the course is continually evolving, it was first introduced in its current format in 2008 as a replacement to an earlier quantitative methods course which had been experiencing high levels of student fails and low UEQ scores. In a measure of the departments commitment to the emerging agenda for more rigorous quantitative methods training in Sociology, the credit rating and contact time of the revised version was doubled (from 10 to 20 credits). Despite some prior concerns over the student reception of this change, the overall course UEQ Score for teaching excellence went from 0.38 for the old course to 1.60 in the first year of running the newly designed module (with a School mean in that year of 1.20), a high score that has been maintained in all subsequent years. While it is acknowledged that student satisfaction measured in this way is not a direct measure of either engagement with, or understanding of, statistics, it has been accompanied by a decline in the overall fail rate (in the most recent year of data, just two out of a cohort of 96 failed the course on a first sit). While recognizing that attaining the pass mark (40%) represents only a very basic measure of statistical understanding, we see the minimal fail rate (and a median mark of around 65%) on this compulsory course as evidence that we have successfully 'carried' the student body with us in our redesign of the quantitative methods curriculum, with a teaching approach that has proved inclusive of students with varying leaning styles and prior experience.

Moreover, from a situation where students tended to view the compulsory quantitative methods module as a course to be endured and passed, we have seen an increase in the number of students electing to build on their quantitative skills in final year options and in dissertations. By way of illustration, a new quantitative final year option launched in 2015/16 'changing social attitudes' (with regression modelling appearing for the first time in one of our sociology modules) immediately filled to capacity (with a long waiting list) - this is a significant development for a degree programme that previously saw very little application of quantitative methods beyond the compulsory year 2 methods course.

Looking forward we are keen to develop a more rigorous evaluation of our teaching methods. As part of the current Q-Step funding (see below) we are looking at ways of collecting more longitudinal data (and even exploring ways of incorporating some quasi-experimental approaches) to evaluate the impact of a range of innovations including taught courses like the one discussed here, as well as major initiative to develop linked internships, where students are given opportunities to work with one of a range of organizations for 8 weeks in the Summer on a project involving use of quantitative data.

IMPLICATIONS FOR PRACTICE

When quantitative methods teaching becomes separated from the substantive curriculum, the learning of statistics can be a dispiriting and alienating experience for many social science

students who come to university without a strong background in mathematics. At Manchester, supported by a series of funded teaching projects, and culminating in our successful application to become a Q-Step Centre (www.manchester.ac.uk/q-step), we are developing strategies to tackle this disconnection. In this paper we have focused on our approach to rethinking the design and delivery of a traditional quantitative methods module. We have shown that when students with little prior maths experience are engaged with relevant and meaningful social applications, they will more readily embrace the learning of statistical concepts and techniques that underpin a critical statistical literacy. With a degree curriculum that gives heavy emphasis to the importance of learning and critiquing theory, many students actively enjoy the chance to engage more with an evidence base, which for many of them helps bring that theory alive.

In that context, alongside the development of the methods module we have at Manchester been embarking on a programme of 'quantitative embedding'. In an approach that mirrors bringing substantive themes to the methods module, we have sought to identify ways to bring more data and quantitative learning into substantive courses. This has ranged from the very light touch (a use of more quantitative examples in lecture slides) to more interactive tutorial exercises. Our approach has been written up in a recent paper (Buckley et al, 2015) and there are case study exemplars from our project website (www.socialsciences.manchester.ac.uk/research/research-centres-and-networks/essted). Again the initiative has been positively received by students, as illustrated by the following student observation during a focus group run to evaluate one of the case studies

"The quants activity we did in the workshop really helped when we were discussing the theories with each other. I know some people find looking at tables really daunting but I think it really helps to back up some sociological arguments with stats. For me personally I always feel like I understand the theory better when I can use quants to argue around it."
(Sociology Undergraduate)

Through this complementary approach we are tackling 'the problem' from both sides, our goal being a more integrated curriculum that ensures students encounter and engage with number alongside other types of data as a natural and integral part of learning their substantive discipline.

CONCLUSION

By integrating the learning of statistics into the core curriculum we can ensure the campaign for greater statistical literacy is fully inclusive, raising the training bar for all students. This avoids the potentially divisive effect of building quantitative capacity through the development of 'Quantitative pathways', where the message that statistics are just for statisticians is easily perpetuated. Rather it helps students to see the acquisition of a basic competence and confidence working with social data (of all descriptions, quantitative and qualitative) as an integral part of becoming a good sociologist or political scientist – and after graduation, an informed and engaged citizen.

REFERENCES

Brown, M (2013). Engaging Students in Quantitative Methods: it's all about the data, *The Sociology Teacher,* (Journal of BSA Teacher Group), Vol 3. (1), WINTER 2013: 15-17

Buckley, J, Brown, M, Thomson, S, Olsen, J and Carter, J (2015). Embedding quantitative skills into the Social Science curriculum: case studies from Manchester. *International Journal of Social Research Methodology*. 18(5): 495-510 [Taylor & Francis Online]

Carey, S and Adeney, K (2010). How to Teach the Reluctant and Terrified to Love Statistics: The Importance of context in Teaching Quantitative Methods in the Social Sciences. In: G. Payne & M. Williams (Eds), *Teaching quantitative methods: Getting the basics right*, London: Sage.

Carter, J Brown, M & Morgan, B (2014). C*reative Teaching in Health and Social Care using the UK Data Service' in Health and Social Care Education, Vo 3, 2014 - Issue 1*: 16-22[Taylor & Francis Online]

Hodgen, J, Pepper, D, Sturman, L and Ruddock, G (2010). *Is the UK an outlier? An international comparison of upper secondary mathematics education.* Nuffield Foundation.

Howery, C. B., & Havidan, R. (2006). Integrating Data Analysis (IDA): Working with Sociology Departments to Address the Quantitative Literacy Gap. *Teaching Sociology*, 34(1): 23–38.

Wathan J, Williamson L and Brown M (2012). Increasing Secondary Analysis in Undergraduate Dissertations. In: G. Payne & M. Williams (Eds), Teaching quantitative methods: Getting the basics right, London: Sage.

Williams, M., Payne, G., Hodgkinson, L. & Poole, F. (2008). Does British Sociology Count? Sociology Students' Attitudes toward Quantitative Methods, *Sociology* 42(5): 1003 - 1021