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‘I’m not a natural mathematician’: Inquiry-based learning, constructive alignment and introductory quantitative social science

Abstract

There is continuing concern at the paucity of social science graduates who have the quantitative skills required by academia and industry. Not only do students often lack the confidence to explore, and use, statistical techniques, the dominance of qualitative research in many disciplines has often constrained programme-level integration of more quantitative material. However, whilst the topic of statistical literacy is relatively well researched within the more general educational literature, the evidence-base with respect to the effectiveness of teaching and learning of quantitative research methods in the social science remains somewhat limited. This paper describes the development, integration, and evaluation of a series of student-led inquiry-based quantitative workbooks within a sociology/social policy undergraduate degree. It outlines how the workbooks were constructively aligned within a ‘methods spine’ and offers some insight into quantitative teaching and learning generally. The paper goes on to discusses some of the opportunities and challenges of taking both an aligned and IBL approach to the teaching of quantitative methods. In doing so it adds to growing evidence that ‘problem-based pedagogies’ tend to increase educational gain over and above more didactic approaches to learning and teaching. It highlights three key findings: programme-level approaches to curriculum design can be crucial in improving quantitative skills, particularly where they are tailored to student needs; a general indifference to quantitative methods is likely to be due to a process of disenfranchisement that happens before and during their engagement with university; and, meaningfully engaging students as partners in the process of designing, integrating, and evaluating curricula can help to overcome some of the barriers associated with

the learning and teaching of quantitative skills.

Keywords: constructive alignment, inquiry-based learning, quantitative methods, social sciences, student engagement

Introduction

Recent calls to establish an underlying pedagogy for the learning and teaching of quantitative techniques in the social sciences have highlighted the paucity of the evidence-base in the area, particularly with respect to the experiences of contemporary undergraduates themselves (MacInnes, 2012). Whilst the challenges of teaching quantitative methods in the social sciences are relatively well rehearsed (see Payne and Williams, 2011, for instance), evidencing effective solutions to these difficulties have proved much more elusive.

The topic of statistical literacy is, of course, very well developed within more mathematically-inclined arenas such as science and/or engineering. However, the entry requirements, the expectations of students, and the epistemological frameworks that shape the social sciences, are not necessarily the same as they are in disciplines such as physics and robotics. Simply transferring pedagogical techniques and experiences from one to the other is not necessarily a straight-forward task. Many students entering degree courses in the social sciences, and sociology and social policy in particular, have little knowledge of maths and statistics beyond the rudimentary requirements of GCSE level study (Byrne, 2012; Author). This is significant, as Parker et al. (2008: 11) note, "the lack of sustained and widespread mathematics training among secondary school students and their fear and suspicion of taking up maths or statistics

once in university creates a substantial impediment to quantitative methods training". Indeed, in our experience there is a general expectation amongst sociology/social policy students that there will be an emphasis on substantive ideas and issues. Furthermore, there is a tendency for qualitative approaches, including interviews and focus groups, to be favoured by social science entrants (Williams et al., 2008). It is these interests that attract them to study for their social science degree, not statistical equations.

This level of preparedness and interest can create a barrier between students and lecturers, with many 'stats' modules requiring substantial mathematical skill on one hand, and knowledge of dry technical literature on the other. This means that students are often anxious about undertaking quantitative methods modules, have a tendency to approach them with poor attitudes and misconceptions as to what it entails, and, fail to see their significance to the rest of their degree programme (see Earley et al., 2014). Not only do such barriers constrain the enthusiasm necessary to use quantitative data for sociological purpose, it can also lead to a (life-long) lack of interest in quantitative methods generally. The challenge for dedicated research methods lecturers is, therefore, to help to develop their students' confidence in using quantitative techniques in more engaging and meaningful ways.

The difficulties of teaching and learning these techniques are reflected in the apparent paucity of social science graduates who have the quantitative skills required by academia and industry (see, for example, Irvine et al., 1979; and Wiles et al., 2009). These concerns typically detail the relative shortage of quantitative research within a UK context "but also a shortage of the quantitative research skills required ... to understand, and critically review, quantitative research" (Gorard et al., 2003: 19). If quantitative data is to be useful, not only does it need to be used by skilled social scientists, any presentation of that data also needs to be understood

and interpreted with critical awareness.

Indeed, the need to promote statistical skills among social scientists is perhaps more prominent than ever. The commencement of the five-year Nuffield-funded Q-Step Centres in 2013 - a £19.5 million programme designed to promote a step-change in quantitative social science training - has once again underlined the need to establish quantitative skills as a cornerstone of the social science degree experience. Elsewhere, and as a part of their strategic plan for 2012-2016 to encourage 'reflection and innovation' in teaching, the challenges of teaching research methods have also been a key concern for the Higher Education Authority (HEA), with teaching research methods one of its three Social Science Strategic Priorities for 2013 – 14. Within the priority there is recognition of the need share good practice in the area and focus on "the use of open educational resources (OER) in research methods teaching" (HEA, 2014a).

It is as a result of these initiatives that greater interest is being directed toward the underlying pedagogy of the field. However, exploring how social science students understand statistics in practice is likely to be crucial in developing more effective pedagogies. This paper details the development and evaluation of a project funded under the HEA's Social Science Strategic Priorities for 2013 – 14. It aimed to enable sociology/social policy students who have no prior statistical knowledge to develop the confidence and skills necessary for quantitative research. More specifically, the project involved the design implementation and evaluation of a series of inquiry-based workbooks (see http://www.social-policy.org.uk/uncategorized/doing-quantitative-research-workbook-resources/ to access the workbooks) to provide undergraduate sociology and social policy students with 'hands on' experience of working with quantitative data extracted from the teaching datasets held by Economic and Social Data Service (ESDS). The paper outlines a rationale for the development of 'student-led' inquiry-based quantitative

workbooks, before describing how they were implemented within a whole curriculum approach that emphasised the constructive alignment of a 'methods spine'. Offering some student-led insight into quantitative teaching and learning generally - and the evaluation of these initiatives specifically - the paper goes on to discuss some of the opportunities and challenges of taking both an aligned inquiry-based learning approach to the teaching of quantitative methods.

Inquiry-Based Learning

Inquiry-based learning (IBL) - sometimes also referred to as 'active learning methods' - can come in a variety of forms and under many different headings. These include: 'collaborative learning', 'problem-based learning', 'performance learning' and even 'service-based learning'. What all these methods stress however, is a research-led and student-orientated approach to teaching and learning. IBL "describes a cluster of strongly student-centred approaches to learning and teaching that are driven by inquiry or research" (Levy et al., 2010). IBL promotes theoretically-informed practice-based learning. Often this means involving "students in discipline-based and interdisciplinary collaborative inquiries, develop[ing] students´ information literacy capabilities, and us[ing] information and communications technologies imaginatively to enhance the learning experience" (see Levy et al., 2010, for further discussion). Of course, didactic approaches to teaching and learning can be useful, particularly in terms of providing background information or instructions regarding assessments. However, there is a danger that an overreliance on such approaches can encourage a lack of engagement from students. Indeed, Barraket (2005) has noted how, when introducing student-centred teaching methods in a masters-level social research methods course, students emphasised the need for integration of IBL approaches with more didactic teaching practice (see also Petress, 2008).

It is evident that utilising IBL in teaching can have many benefits, particularly in respect to teaching and learning research methods. These include: a better understanding of the complexities and nuances of the research process; a better retention of skills; the development of higher levels of thinking, reasoning, critique, achievement, and motivation; developed levels of empowerment; better engagement with, and interest in, theory; and, higher evaluation scores and higher levels of satisfaction with their learning experience (Levy et al., 2010; Levy and Petrulis, 2012). Elsewhere Healey and Jenkins (2009) report that inquiry-based learning not only improved student grades, but helped students to develop a range of meta-cognitive and academic skills. These included: the ability to transfer skills across courses; improved engagement; changed understandings of what learning, teaching and research entails; and, improving the transition from secondary education to higher education in terms of retention.

Of course, the relationship between inquiry-based learning and research understanding was well recognised by the classical sociologists of the Chicago School who instructed their students to 'get the seat of their pants dirty in real research' (see McKinney, 1966). Indeed, as applied to research methods, IBL highlights the importance of both declarative and functional learning and involves doing research and reflecting on the process rather than just reading about it.

However, whilst research methods modules remain a core element of sociological programmes, and despite all that they could provide in terms of research-led and inquiry-based approaches, there are a number of challenges in employing IBL techniques. The increasing stranglehold of University ethical review boards on research and student projects often make it difficult to design inquiry-based courses that satisfy the various remits of the review process. Any project

needs to be achievable within the short turn-around times of semester long courses and not be overly draining on staff resources. Considerable innovation is often required to think of ways to develop IBL that either circumvents the need for ethical review, or can fast-track it. Large classes that are typical of research methods courses makes this even harder to achieve as the supervision and monitoring that is often required for students to do their own research can all-too-easily become over-whelming (see Mulryan-Kyne, 2010). Similarly, research methods teaching is often beset with a revolving door of convenors, many of whom have an interest in method as a subsidiary of their other substantive interests. As many early career researchers also find themselves required to teach research methods through necessity rather than choice, any long-term commitment to the development of innovative methods courses that promote inquiry-based learning is similarly constrained. In fact, quantitative methods teaching is often perceived as a necessary evil by those not involved in its teaching (Williams et al., 2004). This is all compounded yet further by the modularisation of degree programmes that often tacitly divorces research methods modules from other programme content. Research methods skills are often not embedded within other programme areas (Williams et al., 2016).

As a result, research skills are all-too-easily taught in a manner that does not support long-term retention or promote the central concern of sociology: the analysis of the social world (see also Atkinson and Hunt, 2008). This typically involves a reliance on a limited range of 'cover all' textbooks and assessments that focus on essays and/or multiple choice questionnaires. Whilst these approaches have some value in that they promote declarative understanding, they struggle to provide meaningful functional experience of the research process (see Biggs, 1996). Indeed, many 'text-book' approaches to research methods are unable to respond to the reflexive principles of sociological research itself and instead focus on prescriptive definitions and the well-rehearsed advantages and disadvantages of particular techniques. Students are all-too-

often not required to actually ‘get the seat of their pants dirty’ or attempt to apply any knowledge gained in ‘real world’ settings. In short, methodological comprehension is divorced from practice-based experience.

It is, therefore, unsurprising that many students often report that they do not enjoy the courses (Scheel, 2002). Reciprocally, many staff will often try to avoid teaching research methods modules due to a recurring shortage of student engagement or a lack of their own interest (see Lorenz and Bruton, 1996 for some discussion). The irony of this with respect to quantitative skills specifically, however, is that for social scientists in particular, “a large number of high quality national surveys are readily available and that expertise in the analysis and data management of large surveys is in great demand by employers” (Arber, 2001: 270). These datasets have huge potential for social scientists as they have both representative samples and a very broad range of subjects. The challenge for dedicated research methods lecturers in the social sciences is, therefore, to help to develop their students’ confidence in using the diverse range of resources on offer.

Indeed, there are many practical advantages of using these datasets. They are free at the point of access; as a secondary source they negate the need for lengthy ethical review processes; and, they are diverse in scope meaning that they can be shaped around the programme and students’ interests meaning that there is the potential for students to take ownership over their learning experiences. There are also online tools such as the UK Data Service’s Nesstar Catalogue that promote ease of engagement. This is a visual data library that can be used to search, browse, download, and analyse a selected range of key social and economic data.

One of the difficulties of using these sources, however, is that there is relatively little accessible

material that is appropriate to introductory social research students. Although there are some very good introductory sources available for the more mathematically able social science students, for those who do not understand the technical language of maths and statistical thinking this resource can prove too difficult. Whilst not numerically illiterate, many students on methods courses do not understand or engage with the equation-led approaches offered in many standard texts and this often serves as a barrier to developing any interest in quantitative techniques (Author). Maths is, quite literally, a different language.

From the perspective of teaching, it is also not often clear how to integrate the material within course structures in a way that is meaningful from the perspective of students. Indeed, the principles of constructive alignment dictate that teaching and learning take place in a whole system - classroom, department, and institution (see Biggs, 1996). All components within that system - the curriculum, its intended outcomes, the teaching methods and the assessment tasks - should be aligned with each other. This principle of deep integration applies to both topic content and the level of understanding that is required. Therefore quantitative teaching provision needs to be seen as a part of a whole system of teaching and learning that is suitably embedded within the programme curriculum. Furthermore the relevance of the content needs to be clearly articulated for students with respect to this wider curricula (Parker, 2011). In turn, such approaches should aim to enable students to conduct robust, rigorous, and reflective sociological research.

Course structure and the 'methods spine'

Taking a student-led approach to curriculum development, methods provision at the Department of Sociological Studies, the University of Sheffield, has undergone substantial

changes over recent years. In 2008 it consisted of just two general modules: one 10 credit module at level one, and a 20 credit module at level two. These modules were primarily didactic in nature, and declarative in assessment. This was complemented by an empirical dissertation in the final year of study. In 2016, however, there are now: two 10 credit modules at level one - '*Introduction to social research'* and *'Doing sociological research'*; two twenty credit modules at level two - *'Doing quantitative sociological research'* and *'Doing qualitative sociological research'*; and, a dissertation module at level three.

There was, however, an intervening stage of programme development that saw a 'methods in theory' and 'methods in practice' split at level two (for an overview, see Clark et al., 2013). Following the success of the practice-based module, the decision was taken to develop the programme further by making both modules at level two largely inquiry-based. The development of 'the methods spine' that now underpins the programme is summarised in Table 1.

Table 1 Modules within 'the methods spine'

	2002-2009	**2010-2013**	**2014-Present**
LEVEL ONE	● Introduction to Social Research	● Introduction to Social Research ● Doing Sociological Research	● Introduction to Social Research ● Doing Sociological Research
LEVEL TWO	● Social Research Methods	● Social Research Methods ● Social Research Practice	● Doing quantitative sociological research ● Doing qualitative sociological research

LEVEL THREE	• Dissertation	• Dissertation	• Dissertation

Currently, all modules within the spine are predominantly inquiry-based in design and the development of research, communication, and wider skills are progressively sequenced in both scope and depth over the length of the course. The assessments for these modules currently include: project reports, research posters, dissemination websites, reflexive journals of the research process, oral presentations, and research proposals. Formative tasks also include literature searching tasks and submitting applications to ethical review boards. Working both individually and as part of a team, and culminating in a 15,000 word empirical dissertation, our single honours students will have completed a total of five research projects by the time they graduate.

Building on declarative and functioning knowledge of research design and research process at level one (see Biggs, 1996), the specific techniques of quantitative provision are developed at level two in the module Doing quantitative sociological research. The main aim of this module is to provide students with a theoretical and practical foundation for conducting independent quantitative social research. Assessment consists of a group-based research poster that uses student-generated survey data to respond to a specific research brief, and an individual project report based on the analysis of secondary data provided by the ESDS. Teaching material consists of a variety of student-directed lectures, seminars, workshops, multiple-choice questionnaires, and a series of bespoke inquiry-based workbooks to support the development of quantitative skills. It is these workbooks that are the main focus of this paper.

The workbooks integrate a number of worked 'by-hand' examples drawn from the datasets provided by the ESDS, whilst also providing a 'step-by-step' guide to analysing the data using PASW (IBM SPSS), a computer programme utilised to analyse quantitative datasets. They are designed to be 'narrative', rather than mathematical, and aim to ensure that students understand the principles of specific quantitative methods, before developing the ability of students to use them for research purposes. The five workbooks cover a range of techniques that novice researchers need in order to develop and carry out introductory quantitative projects. These include: 'Research Rationales, Research Questions and Research Hypothesis'; 'Designing Variables and Understanding Levels of Measurement'; 'Describing Data'; 'Using Chi-Square, Phi and Cramer's V'; and, 'A guide to analysing data using PASW (IBM SPSS)'. They have been designed to provide a comprehensive introduction to the key skills necessary to undertake quantitative work, and many of the ideas that underpin more advanced analysis. Indeed, with the knowledge that many undergraduate students need to develop confidence in handling quantitative data, we specifically chose to integrate non-parametric tests into the workbooks because of their verisimilitude with respect to introducing statistical ideas and interpretation.

Innovatively, these workbooks have been developed in two stages, and alongside two groups of students who were encountering social statistics for the first time. Indeed, engaging students in the design, integration, and development processes of embedding the workbooks within an aligned methods curriculum has been especially helpful in developing an inquiry-based approach to the development of quantitative skills. The cycle of evaluation and development are detailed below.

Methodology

Evaluation within any module or programme can take many forms. Whilst both informal conversations with students, attendance, assessment outcomes, and critical reflection are a staple of the reflexive practitioner, the analysis presented below specifically highlights the use of two methods of formal evaluation that have been used in the development and integration of the workbooks within the methods spine. Firstly, two focus groups were used to explore students' experience of the quantitative workbooks and opinions about quantitative research methods more generally. Secondly, we analysed student evaluation data prior to and following the changes to the sociological methods spine at the University of Sheffield. Adopting a pragmatic approach to methodological choice and combining the use of both qualitative and quantitative methods means that the strengths of one method essentially assist in compensating for the weaknesses of another (Denzin, 1978).

The first focus group was conducted early in 2010 with six level 1 undergraduate sociology and social policy students. These students were asked about their experiences and expectations of quantitative research and the quantitative workbooks which were being developed to ultimately be introduced into the curriculum. They were also asked to provide written thoughts on quantitative methods before reading the workbooks. Written feedback from the students, in addition to the comments in the focus group, enabled us to refine the workbooks in accordance with their experiences. The first four workbooks were then utilised in the core sociological studies research methods module 'Social Research Principles' which took place in the first semester of level two in 2010-11. The final workbook - that detailed how to use PASW/SPSS - was delivered in the module 'Social Research Practice'.

The original workbooks were subsequently redesigned in 2013-14 and their content updated with the assistance of Higher Education Academy funding. They were also expanded to include

new sections and further tasks for students. In addition, another workbook was developed focusing on the use of secondary datasets and incorporating ESDS datasets. Once again five students were recruited to participate in the project. These were level one students with limited previous research methods experience, and no experience of working with PASW/SPSS. They were asked to work through the newly redeveloped workbooks and provide feedback on both content and the tasks. A subsequent focus group was conducted where they were asked about their opinions about quantitative research and the value of the workbooks themselves. Following some amendments, the redesigned workbooks were introduced into the curriculum in 2014-15.

The focus groups enabled the students to express their own views and interpretations of the workbooks in detail, and their views on quantitative research methods more generally. They are especially useful in providing a detailed, contextual and multi-layered interpretation of a particular social problem or social group (Mason, 2002). They lasted approximately one and a half hours, and participants were selected as a result of recommendations by graduate teaching assistants regarding their reliability in terms of attendance. As evidenced by their student record, the student collaborators covered a range of abilities (relative to the institution). The students were recruited through the use of a personal email asking them if they were willing to take part in the research. Participants received payment for testing the workbooks and attendance at the focus group. The focus groups were recorded, transcribed and pseudonyms employed.

The process of data analysis that is presented below focused on identifying themes employing an open, axial and selective coding process advocated by Strauss and Corbin (1990). Open coding entails the initial coding of sentences or paragraphs using ‘analytic memos’. Axial

coding was then employed to collapse categories with similar semantic meaning derived from open coding (Taylor-Gooby, 2005). The selective phase of coding involved a return to the data to clarify at a higher level of abstraction the significance and scope of the themes emerging during axial coding. These key themes were used to assist in the organisation of the findings. Due to the limited sample size and strategy, theoretical saturation cannot be assumed. The study is therefore illustrative rather than extensive, with quotes and examples utilized to indicate the themes identified. The strength of this approach, however, is in developing a rich "understanding of processes, motivations, beliefs and attitudes than can be gained from quantitative research" (Rowlingson, 2002: 632). 'Moderatum' generalisations can be drawn from the data which resemble modest, pragmatic generalisations drawn from personal experience which bring a "semblance of order and consistency to social interaction" (Payne and Williams, 2005: 297). They can provide powerful illustrations of the kinds of trends which emerge from the data and are particularly useful when placed within the context of previous research findings.

The quantitative elements of the evaluation entailed the use of student evaluation feedback. This involved exploring the student evaluation scores prior to and following the introduction of IBL methods, including the workbooks in the methods teaching, in sociological studies (pre and post 2010-11). The analysis is limited by the fact that student evaluation data was not available for all of the years, either because the information had not been collected or the data has simply been lost. The number of respondents was not always available, but figures were only collected when there were at least 25 respondents. Furthermore, the fact that the questions asked in the surveys changed at certain points presented a challenge. However, two questions did remain broadly the same and we present these as a point of comparison. The first is associated with enjoyment/interest in the methods module. The second was concerned with

satisfaction with the course.

Findings

The findings presented below offer insight into both developing resources that help to enable inquiry-based approaches to quantitative research and students' understandings of quantitative research more generally. Indeed, in the process of exploring the impact of developing and evaluating quantitative provision, a number of themes were developed that are presented and discussed below. These include: expectations of quantitative research; usefulness of quantitative techniques in sociology and social policy; the value of making 'quants' accessible; statistics, stereotypes, and structural impediments; learning through doing and IBL; and, students as partners. Results extracted from student evaluation forms are then presented and discussed.

Expectations of quantitative research

The information we received from the students prior to engaging with the material is revealing with respect to their expectations of learning quantitative methods. For instance, Fran's initial comments (2013) about her involvement in the project are particularly indicative of a student's attempt to understand statistics for the first time:

"My current level of ability in the area of quantitative research is relatively low and in a *formative stage. I feel that the literature surrounding 'doing quantitative research' is often* quite inaccessible and dry, and I am not a natural mathematician."

This notion of not being very competent at mathematics was a common theme. For instance, Ellie (2013) also stated "I think that most students who do sociology that I know struggle with thinking mathematically, which puts them off wanting to do anything with statistics because it *seems a bit complicated"*. Across both focus groups there was a general consensus - and concern - that learning and teaching should be targeted accordingly and provided at a suitable level: "I feel that in order to consider conducting a quantitative social research it would be *essential for students to learn the basics in the simplest form"* (Sarah, 2013). It was this disjunction between perceived ability and level of expectation required that caused some anxiety for students - as Kay (2010) pointed out: "quantitative methods was something I was *worried about"*. Fran elaborated that this anxiety can quickly turn to indifference:

"… from speaking to my peers, I know that many people feel intimidated by certain quantitative methods unless they come from a mathematical background. Often that lack of confidence leads *to indifference and a loss of interest in the subject matter … The literature surrounding so*cial research methods are not always easy to read and understand - especially when numbers become involved - meaning people are often averse to learning about quantitative methods (Fran, 2013)."

Indeed, where material is not presented in an appropriate manner, or where it is not linked to the students' discipline, many students are likely to agree with Linda's (2010) assertion that "*quantitative research is a bit boring"*. Indeed, this lack of interest in quantitative methods has been commonly cited in the social sciences (Irvine et al., 1979; MacInnes, 2012).

The usefulness of quantitative techniques in sociology and social policy

Despite the tendency for students to worry about undertaking quantitative methods, especially as a result of a lack of previous positive exposure, there was certainly evidence of students' awareness of the importance of quantitative methods in their own studies, and in their overall understanding of sociology more generally. Prior to completing the workbooks, our focus group students felt that they lacked the skills to conduct their open independent quantitative research. However, they clearly thought that developing these skills would be a good idea as it would enhance their functioning knowledge and experience:

"I think I would find it difficult to conduct a project from start to finish, because I have a lack of experience in conducting a project independently. I would like to learn more about the *processes required, as I think it would be useful for conducting my own research"* (Al, 2013).

Elsewhere Ellie (2013) pointed out that whilst she recognised that *"the whole maths thing puts me off a little bit"*, this was balanced by a healthy curiosity that led her to believe that "it would *be good to learn more about quantitative research"*. Following completion of undertaking the workbooks Mick (2010) similarly stated that "...having knowledge of how to do quantitative research is quite good and really *useful"*, with Fran (2013) also eloquently recognising the overarching value of quantitative skills to her own arguments and research:

"I would like to learn more about quantitative research as quite often interesting and/or relevant facts within sociology that support points both in my own essays and within general reading are of a quantitative statistical nature. Whilst I often feel more drawn to learning about and carrying out qualitative research in sociological sense, it seems sensible to use mixed methods research techniques to fully support ideas or theories. Sometimes quantitative methods are the key way to investigate certain phenomena."

However, she went further to articulate the value of understanding quantitative material more generally (c.f Gorrard, 2013):

"*...analysing 'easy to digest' statistics and quantitative findings is vital to breaking down* common misconceptions which is integral to sociology ... learning more about quantitative research would be essential to being successful within this course and learning more about sociology and society in general."

Against the popular stereotype, what is important to recognise here is that the students did not identify themselves as particularly 'anti-quantitative research'. Whilst they did acknowledge that they were generally more qualitatively oriented, they also recognised that quantitative research is important and they understood the need to engage with it – if it is presented in a manner that is appropriate to their ability, confidence, and interest. Of course, the sample of students presented here is limited and there is little doubt that militant 'anti-quants' students do exist. However, resistance and relative indifference is not the same thing. Indeed, current understanding of the processes by which students make decisions about methodological interests and/or how and why they become disenfranchised with the idea of quantitative research is not particularly well articulated within the literature.

Statistics, stereotypes and structural impediments

That said, the focus group data does offer some hints at how statistical stereotypes are structurally reinforced. Indeed, whilst we have already highlighted the lack of widespread mathematics training and a fear of statistics among students in the social sciences, some

interesting observations regarding the (purely didactic) teaching of quantitative research methods at A Level were explored within the interviews. Ellie (2013) for example noted how "at A Level they put quite a negative spin on quantitative data ... at A Level we just did pluses *and minuses of using quantitative methods but nothing practical"*. In spite of the fact that the data provided by the UK Data Service is incredibly robust, the problems of 'official statistics' were often presented as being so problematic they were not really worth bothering with at all. Other participants also felt that the emphasis on quantitative research in A Level Sociology was largely about emphasising the negative elements of social statistics rather than their possibilities. Al (2013), for instance, stated that this often involved teachers developing lists of the "pros and cons" of quantitative methods - with the "cons" list often appearing far weightier than the "pros". This kind of purely didactic approach has obvious implications for student's level of engagement (Petress, 2008). Furthermore, the A level syllabi places very little emphasis on quantitative methods and it is possible for students to mostly avoid assessment in this area (Williams et al., 2016).

This is certainly an area which needs further attention. Indeed, for our sociological students it would appear that the process of disenfranchisement is already well formed before they arrive at university, yet alone industry. Policies that are designed to support the development of quantitative knowledge, such as Nuffield's Q-Step programme and the HEA's strategic priority on teaching research methods, are likely to be constrained by particular realisations of the A level syllabus that are derisory toward quantitative appreciation generally, and near non-existent in terms of skill-development specifically. Conforming to wider popular stereotypes of maths and statistics, this means that those sociological students entering university are already someway predisposed to be critical of such methods. This is likely to lead to lower levels of engagement with quantitative research methods at university (Earley et al., 2014).

The value of making 'quants' accessible

Following the completion of the workbooks, however, the students in both of the focus groups were generally very positive about the workbooks and the contribution they had made to their knowledge, experience, and confidence. Using written and verbal feedback from them we found that all of the students involved in the project felt using the workbooks had substantially enhanced their quantitative knowledge and their ability to undertake a quantitative research project. Sarah (2013), for instance, suggested:

"...[the] books definitely enhanced my knowledge of quantitative social research and demonstrated new aspects of it and how it can be used in practice ... I was very pleasantly surprised with how student friendly these workbooks were and they definitely changed my attitude towards quantitative research and statistics."

Al (2013) similarly emphasised the importance of the sociological content of the workbooks:

"I found it interesting because it was put into a sociological context, so there was some sort of relevance to it, and the sort of topics I am interested in were integrated into the statistics."

The relevance of the examples was also highlighted as an important factor by, Fran (2013) amongst others:

"The information is rich and detailed without being over complicated. Examples that are *relative to student's current life experience are used which creates interest and also gives*

inspiration for topics of research relevant to students' lives."

Indeed, the importance of relating the techniques of quantitative methods to areas of both student and disciplinary interest was clearly valued by all members of the focus groups. Not only did it make the material meaningful, it also enabled them to take ownership of the ideas that they chose to develop. Accessibility and relevance helped to facilitate the creativity needed to develop their own ideas and learning experiences.

Learning through doing: inquiry-based learning

Consolidation exercises are a constant pedagogical feature within the workbooks. Generally, these tasks encourage students to use the information they are learning about to develop their own interests and/or skills. They might be asked to construct a rationale for a particular topic, for instance, or analyse a table and compare their findings with an account offered in the book. These exercises were designed to both enable students to develop their own research interests and give them experience of the process of 'doing research'. Indeed, the examples used within the book are often aligned in that particular themes are repeated. So, for example, workbook two introduces the problem of measuring ethnicity, with workbook three exploring the relationship between ethnicity and 'hours worked', and workbook four exploring how ethnicity and 'fear of crime' might be associated. This enables students to imagine the research as a 'process', something that was highlighted by the students. Linda (2010), for example, noted that "*it was good to learn about how to do research"*, with Mick (2010) adding, "the idea of understanding why and where i*t comes from is relevant rather than just exercises"*. At the same time, he emphasised the value of inquiry based learning more generally: "I like to have *the opportunity to work things out. I learn best that way"*. As such, it was apparent that the

student-centred approach to learning and teaching advocated by Levy et al. (2010) had a positive impact on student engagement.

Indeed, the opportunity to 'practice' was deemed to be a useful way of developing quantitative skills. For instance, Fran (2013) stated:

"...in terms of experience of quantitative methods within sociological research these workbooks are effective as they provide simple exercises in order to practise methods that are previously *only abstract to the student"*.

Ruth (2010) similarly acknowledged that she "would feel confident in undertaking a *quantitative project now"*. By providing students with opportunities to use quantitative methods in a manner which allowed them to focus upon their own areas research interest appeared to enhance their confidence. This was enhanced yet further by being able to follow a particular line of inquiry from start to finish.

Students as partners

Another feature of the development of the workbooks that was highlighted as beneficial by students in both sets of focus groups was the fact that they were able to make a difference in developing teaching resources. Indeed, the benefits of involving students as partners in the design and delivery of curricula are well recognised within the pedagogical literature (see Healey et al, 2014 for a review). Not only can it increase engagement and success, it has also been shown to: develop the knowledge and skills to support employability; foster a greater sense of belonging and community; change how teachers think about practice; and generate a

deeper appreciation of contributing to an academic community (see Trowler, 2010 and HEA, 2014b). These benefits were reflected across the focus groups with particular emphasis given to the fact that they were able to indicate which tasks and explanations were likely to work best and which needed alterations. For instance, Ruth (2010) noted, "I wish we could have this kind of *involvement in the development of other modules",* with Mick (2010) elaborating: "first years usually just hand their work in, turn up to seminars and not say anything. People on my course were interested in what I was doing with the workbooks. It is nice to be involved in stuff *like this"*. Kay (2010) similarly highlighted how it elevated her learning experiences beyond being a passive recipient of knowledge: "it's nice to not feel like we are just being told what to *learn and have a say"*.

Student evaluation data

Beyond the specifics of the focus group data, it is also evident that the workbooks were positively received when rolled out into 'the methods spine'. Prior to the introduction of the workbooks, module evaluation feedback for the level two module 'Social Research Methods' indicated that some students felt that on completion of the module they still "lack[ed] confidence in the practical application of quantitative skills".

Indeed, the figures presented in Table 2 show the average score out of 4 (1 = strongly disagree to 4 = strongly agree) in relation to enjoyment/interest in the module and module satisfaction for several years prior to 2010-11 and post 2010-11.

Table 2 Research methods module engagement and satisfaction (average mark out of 4) from 2002-3 to 2013-14

Year	Enjoyment/interest	Quality/overall satisfaction
2002-3	1.64	2.1
2004-5	1.44	1.92
2005-6	1.2	1.76
2006-7	2.16	1.52
2010-11	3.4	3.7
2011-12	3.7	3.7
2012-13	3.4	3.3
2013-14	3.3	3.3

Source: Module evaluation data 2002-3 to 2013-14

Whilst we failed to locate the evaluation data for the periods 2007-2008, 2008-2009, and 2009-2010, as detailed earlier, 2010-11 saw research methods provision within the programme increased from 20 to 40 credits in level 2, with an additional emphasis on inquiry based learning. This was also the time that the quantitative workbooks were introduced.

It is evident from the table that the average scores in relation to the module feedback in relation to enjoyment/interest and module satisfaction increased considerably after the changes were implemented. For instance, in 2002-3 the average level of enjoyment/interest/engagement out of 4 was 1.64 compared with 3.4 in 2010-11. In fact, following the introduction of the workbooks, the average score has always been above 3 whereas it was only above 2 once in 4

years prior to the introduction of the changes. The overall quality/satisfaction with the module showed similar trends improving from 2.1 in 2002-3 to 3.7 in 2010-11. Once again, following the changes to the teaching in 2010-11, the quality/overall satisfaction has not dropped below 3. Before the changes, overall satisfaction was not higher than 2.1.

The general consensus of improvement is similarly reflected in the 'open comments' section of the evaluation forms that were made by students after the introduction of the workbooks. Not only did students comment on the helpfulness of the workbooks generally, they also highlighted that: "lectures were broken up by exercises/discussions which makes them much more interesting and useful instead of being lectured at for 2 hours"; "good interactive learning in lectures", "interactive aspects, activities - made lectures more engaging"; "I found the examples given to explain things helpful; "the mathematics aspect was explained very clearly"; "the lecturer was very enthusiastic and simplified matters by giving very good examples and handbooks"; "workbooks = good idea". Some students have also sought to specifically draw attention to the type of learning that the workbooks encourage: "the workbooks/exercises helped – practical based learning", "inquiry based learning = very effective, better than lecture based learning. Workbooks very useful!!!" (see Author, for further analyses of the effectiveness of the workbooks).

Conclusion

This paper describes the development, integration, and evaluation of a series of 'student-led' inquiry-based quantitative workbooks within the methods spine of a sociology/social policy undergraduate degree. It outlines how the workbooks were constructively aligned within the curriculum and offers some student-led insight into quantitative teaching and learning

generally. In doing so, it demonstrates how an 'holistic curriculum design' approach can enable the development of a more coherent, and less fragmented, programme (Rust, 2000). The evidence presented within the paper highlights some of the benefits of using IBL approaches with respect to the learning of introductory quantitative methods, and offers some discussion of the barriers to learning. It also provides some insight into how students might be better engaged so they are in a position to respond to wider policy initiatives.

There are, of course, some limitations of the evidence presented within the paper and the conclusions we can draw from it. Firstly, the size of the sample with respect to both the focus groups and student evaluations are limited. The extent to which both the ideas and the data presented will transfer elsewhere are likely to be constrained as a result. However, we would highlight that although the formal presentation of the data here is restricted, it does not contradict our own informal experiences of using the workbooks - either directly or indirectly - or the overall impression of their usefulness within the methods spine. Secondly, our approach to teaching research methods generally, and quantitative techniques specifically are also located within one department in one very particular institution. As a result, any conclusions drawn are not likely to be exhaustive of all student opinion about the learning and teaching of quantitative across the gamut of sociology/social policy programmes, yet alone the social sciences more generally. Further work needs to be done to more fully assess the barriers to quantitative social science specifically, and the processes by which students become disenfranchised with 'quants' more generally.

Thirdly, the methods by which we have evaluated the workbooks, and the programme more generally, has been emergent rather than specifically planned. This is, perhaps, an inevitable result of the limitations of both the relatively slow moving nature of higher education

institutions and the time it takes to develop and integrate material into a three-year long degree. Similarly, we recognise the limitations of relying on student feedback. However, we would suggest that any approach to teaching and learning needs to be tempered with the continuous development of knowledge, experience, and feedback. The practical requirements of teaching within a higher education context rarely affords the opportunity of experimental approaches to evaluation, and the speed at which opportunities for pedagogical development occur often mean that more rigorous designs are difficult to anticipate. Equally, we keep in mind Williams' et al. (2016) suggestion that the pursuit of student feedback is not the 'be and end all' of evaluating quantitative provision. After all, feedback can always be made better by telling students what they want to know, or giving them the assessments they can already do. However, whilst students do not necessarily recognise, or listen to our 'connected' narratives of tasks and assessments within the context of the methods spine, we would again seek to highlight informal feedback that suggests our students do, when they receive their dissertation mark and beyond, acknowledge the usefulness of the curriculum they have studied within. This is not an exhortation to 'trust us'. It is, however, a recognition that both curriculum delivery and evaluation is a situated practice that requires continuous reflection with respect to practitioner experience, student feedback, and the pedagogical literature. It is also to add to growing evidence that 'problem-based pedagogies' - of which IBL is a part - increase educational gain over and above purely didactic approaches to learning and teaching.

Indeed, this paper is important for a number of reasons. Firstly, it highlights that understanding the perspective of students does matter with respect to teaching introductory quantitative statistics. This means communicating with them in a manner that is familiar to them, and giving them the opportunity to shape the curriculum to their own interests so they can take ownership over their learning choices. This is also a recognition that one size is unlikely to fit all. There

are many subtle differences within student cohorts and between departments, universities, and disciplines. This is not the same as downplaying the importance of inquiry-based learning, active-learning strategies, or problem-based pedagogies. It is, however, to note that the realisation of these approaches, need to be tailored to the particular audience in question. Secondly, the paper also highlights that whilst the popular stereotype of students who are 'resistant' to quantitative methods might hold some weight, it is not a natural state of being, nor is it inevitable. Instead, general indifference is likely to be due to a process of disenfranchisement that happens before and during their engagement with university. As a result, we need to be careful that we are not simply treating the symptoms and instead begin to look beyond, and engage with, those factors that influence the processes by which students encounter research methods generally, and quantitative research specifically. Finally, we would seek to highlight the importance of meaningfully engaging with students as partners in the process - and it is a process - of designing, integrating, and evaluating material relating to the learning and teaching of introductory quantitative social science.

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