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Research and Teaching Functions in Undergraduate Projectwork: some integrating themes

LAURENCE MOORE & PAUL A. LONGLEY, *Department of Town Planning, University of Wales College of Cardiff (UWCC)*

ABSTRACT *This paper describes and evaluates an undergraduate project in which the interaction between teaching and research functions proved beneficial to both. The project initially involved undergraduate students in a major detailed questionnaire survey of shopping preferences in Cardiff. We found that we were able to extend the scope of the undergraduate project whilst simultaneously helping to fulfil a research function more effectively. We attempt to evaluate the pedagogic merits of this exercise, and seek to identify some broader prescriptions for integrating teaching and research.*

Introduction

This paper sets out to evaluate what we consider to be an innovative undergraduate project exercise, which brings together the teaching and the research activities of our department. We first describe the gulf that divides idealised project objectives from the staff resources which are practically necessary to bring them to fruition, and then we illustrate how the convergent interests of a staff member and a postgraduate student effectively doubled the resources available for teaching.

We begin by arguing the virtues of integrating teaching and research as a means of extending the scope of, and rejuvenating, undergraduate project work. Some generic considerations which we think should guide the design of this type of project are outlined. We then describe how our undergraduate students went about implementing the research design. A second strand to our argument is that teaching and research can be mutually supportive activities and that the former need not be regarded as a drain on the time available for the latter. We describe how a previous departmental research programme left us an 'interviewer-friendly' contact list which would enable us to pilot our project survey. This enabled the entire project to be structured such that students were able to retain individual responsibility for each of the successive tasks of data collection, analysis and evaluation. In the discussion we return to a pedagogic evaluation of the exercise, and an assessment of

the ethical status and the broader prescriptions for integrating teaching and research.

Integration of Research and Teaching Functions

The Department of Town Planning at UWCC is one of five university planning schools in the UK which has Royal Town Planning Institute (RTPI) recognition for its vocational undergraduate planning courses. The RTPI qualification is an essential requirement for entry to the planning profession and recognised courses are required to mount an extensive curriculum tailored to the needs of practising planners. This is inevitably at the expense of the flexibility of course structure more characteristic of geography departments (see Douglas, 1986). The department also accommodates a burgeoning postgraduate research school and all staff actively pursue research in their specialist fields.

Our research and teaching have been combined in order to execute a self-contained research project, the objectives of which were to give students practical experience of implementing a cogent, practicable research design; to give them experience of the way the UWCC computer network functions in practical research; and, without over-indulging the technical, to show how their statistical expertise could be extended to tackle a data analysis problem of a type which they had not previously encountered in lectures.

Pressure on Resources for the Undergraduate Analytical Methods Project

Our research project was scheduled for second year undergraduate BSc degree students and it was designed to bring together three streams within our course structure. The first is a component of our *Planning Techniques* course in which students learn the rudiments of survey definition, method, sampling, questionnaire design and implementation. Previous experience has shown our students to be reasonably adept at assimilating this material from lectures and texts, although their individual third year research projects suggest that many of them remain disappointingly inept at realising the practical potential of these tools. The second stream is the component of our *Analytical Methods* course which begins with a detailed and technical exposition of multiple regression analysis and concludes with an overview of some related statistical models which assimilate low order (categorical) data into quantitative analysis. Here again the students generally develop a very adequate understanding of the technical aspects of the espoused techniques, although some of them find it difficult to make the transition towards appropriate use of these tools in applied work. The third stream is our *Computing* course in which students begin by becoming conversant with the use of the MINITAB package (Ryan, Joiner & Ryan, 1985) for data manipulation in an interactive mainframe computer environment. They are then shown how to use the regional computer network in order to retrieve Small Area Census Statistics from the data archive at the South-West Universities Regional Computer Centre (SWURCC) in Bath, and are shown how to read these data into the MINITAB package and perform data manipulation.

Although two of these streams are assessed in their own right, the intention is that the students should gain as much expertise as possible in applying these skills in our second-year *Analytical Methods Project,* which currently accounts for 15% of

the year's overall assessment. However, timetabling and staffing restrictions are such that in 1986/87 the project was timetabled for a total of only 30 staff contact hours during the ten weeks in which it was to run.

However, as noted above, an implication of the scarceness of staff resources is an apparent breakdown in the students' ability to translate the techniques they have learnt to the analysis and solution of practical problems. There is thus a need for a self-contained start-to-finish project, but an incapacity to supply the staff resources needed to execute this.

Limited Time Resources in Collection of Social Survey Data for PhD Research

Increasing pressure is being applied to British PhD students to complete their research within the three years research training contract, or within four years as an absolute maximum. This has had wide-ranging effects on many aspects of post-graduate research, but of particular relevance is the increased need for the PhD topic to be investigated in sufficient depth within three years. The research project of one of the authors (Moore) centred on the development of a methodology to assess the optimal location of new stores, and involved the design and implementation of a stated preference choice experiment with subsequent analysis of the resulting data (see Moore, 1988). The efficient fulfilment of this research agenda necessitated the execution of at least 200 half-hour interviews which would have been very time-consuming for an individual research student, particularly when the data collection was only a small part of the research.

The research was instigated as a follow up to a city-wide study of shopping behaviour in Cardiff known as the Cardiff Consumer Panel (Guy, Wrigley, O'Brien & Hiscocks, 1983). This involved the collection of detailed panel data from 451 respondents relating to all shopping purchases over a 26-week period. There was a small amount of bias in the sample, exacerbated by an attrition rate of 21% over the 26 weeks. However, bias towards unwaged housewives and high social class was inevitable due to the onerous task of completing the diaries. The initial intention was to use this resource of proven interviewer-friendly respondents to pilot and respond to a related stated preference shopping questionnaire some four years after the original survey had been completed.

For this follow-up study, a letter was sent to each panellist address, asking them to take part in a half-hour interview. Of the 451 panellists invited to take part, 135 agreed. This represented an overall response rate of 30%, a low figure due to the (expected) migration of a major proportion of the sample over the four years since the original study. However, this sample was smaller than hoped for and also exhibited an accentuated bias towards retired persons. It was thus necessary to draw a second sample, with larger numbers of potential respondents and a lower level of bias. Recruiting and interviewing each member of any large sample would have been very time-consuming. As a result, extra manpower was needed, and it became apparent that a synthesis of research and teaching could be of considerable mutual advantage.

The Project Design

The project was thus designed to cater for the different, but complementary, requirements of the PhD researcher and the students. However, five common

problems were encountered in the administration of the undergraduate research project:

(i) *Survey purpose.* An omnipresent social survey problem which is particularly acute in student project work is the tension between defining problems which are non-trivial and yet remain 'researchable' using the available human resources. In this case, the desire to generate tangible substantive and methodological research findings provided no small motivation for both the students and staff involved. There was thus a very positive attitude shown to the project by both parties that is often lacking in the more tightly constrained projects.

(ii) *Survey method.* The objective of ensuring practical first-hand research experience often dictates that interviewing is the basic means of data acquisition. However, an obvious problem centres upon students' lack of experience of undertaking interviews. Interviewer briefing in formal small-group sessions is very time-consuming and is arguably no substitute for accompanied interviews in the field. A major problem thus emerges in adequately preparing students to collect detailed interview data of sufficient quality for reliable analysis to be performed.

(iii) *Sampling.* The method and limitations of the sampling frame were clearly described to the students. These abstract concepts were reinforced by the students' experiences in the fieldwork.

(iv) *Analysis.* The analysis should be closely related to the techniques taught in other course streams, as detailed above.

(v) *Assessment.* Ideally, collective responsibility for the successful execution of the survey should give way to some individual means of assessing student work. Normally, it is not feasible for each student to collect enough data for individual analysis. However, stated preference data are such that each respondent gives repeated measures of preference, and this provides data of sufficient richness to permit analysis of very small [sub]samples. It was thus considered possible to give each student a different data set to analyse, which pre-empts the possibility of gross collusion which we have detected in a small minority of reports from previous assignments. Each individual data set is based upon the student's own interviews.

The Administration of the Project

In an introductory lecture designed to relate the methodology of the project to a previous lecture course, attention was focused upon the axiomatic status of choice assumed in most geographical and planning survey work. The problems of attempting to understand and model shopping behaviour were then discussed with particular reference to the dependence of observed choice (revealed preference) data on situational factors and analytical assumptions. The students were then formally introduced to the stated preference methodology, which, for project purposes, involves the presentation of sets of hypothetical store alternatives to respondents who are asked to express a preference between them by ranking. Preference structures for shopping may then be estimated from these data, and can be related, for modelling purposes, to the respondents' socio-economic characteristics and actual shopping behaviour. The students were thus aware of the type of data they would be collecting, and the need for diligent recording of the respondents' preferences, socio-economic characteristics and actual shopping behaviour.

The students were then briefed on survey implementation. This consisted of a

discussion of every question in the survey, how it should be asked, and how the answers should be recorded. These briefings took place in small groups, and concluded with pairs of students interviewing each other in turn. This was an essential exercise both to practice technique, and also to experience the respondents' viewpoint. The survey itself was structured around three quite laborious ranking exercises. In each, respondents were presented with nine cards which in turn described a hypothetical shopping store in terms of four attributes. Respondents were required to rank these store alternatives in descending order of preference. A number of factual questions were asked of the respondents between completing these three exercises.

Our major problem centred upon finding the most effective means of developing our students' ability in practical survey implementation, given that the survey design was complicated and yet the resource implications of taking each of them on accompanied interviews were clearly unrealistic. The solution to this central problem lay in the use of some of the 135 respondents to the 1982 Cardiff Consumer Panel survey who had expressed willingness to participate in the follow-up survey. It was clear that the demands of completing a detailed shopping diary for 26 weeks and agreeing to the associated interviews had left these respondents with both a strong familiarity with the often eccentric questions of academic surveys and a quite benign willingness to subject themselves to further interrogation along similar lines. Our knowledge of their characteristics in 1982 also suggested that there was likely to be a very high preponderence of unwaged housewives and retired persons with sufficient time on their hands to respond to our survey. In short, they were likely to comprise an almost uniquely 'interviewer-friendly' sample of respondents who, despite not being entirely representative of Cardiff shoppers as a whole, were likely to be ideal fodder for our apprentice interviewers. Each student was therefore given the names and addresses of three panellists, and was allowed two weeks to arrange and carry out the interviews at mutually convenient times.

The results of this exercise were highly successful. The students reacted very well to the responsibility of having three interviews to arrange and execute, and showed considerable resourcefulness in locating the panellists and travelling to their homes (each set of three addresses was clustered for each student as closely together as was practicable). Student feedback suggested that the interviews themselves went very well, with the interviewer-friendly panellists answering the questions patiently and building up the confidence of the students, who were initially unsure as to how they would be received in other peoples' homes.

During this two-week interview period, the formal timetabled sessions were used to discuss the bias in our sample due to the time lapse between surveys and the compounded effects of non-response. We then discussed the design of the second, main sample.

It was clear that within the resources of the research project, it would be impossible to initiate a prior recruitment procedure, such as postal or personal invitations. It was therefore decided that the second survey should be carried out on one day, and that we would employ a 'foot-in-the-door' recruitment procedure. Reference to the literature (e.g. Hôinville, Jowell & Associates, 1978) suggested that the response rate would probably not be improved by prior warning of potential respondents. The day chosen for the interviews was a Saturday so as to minimise any response bias that would be encountered in a door-to-door survey carried out on a weekday. On the Saturday, each student was allocated a small area

in Cardiff, and given a list of 30 addresses. They were driven to their area and given five hours to work their way through the list of addresses and to interview as many willing respondents as they could. Some small prizes were offered in order to sustain motivation.

The areas in Cardiff chosen for the second sample were selected using a stratified multi-stage sampling frame. The areas were chosen randomly from the strata of four indicator variables (see Moore, 1987 for a rationale): car ownership, average household size, the number of households with wives working full time, and accessibility to supermarkets. The level of each of the first three variables was calculated for each enumeration district in Cardiff from data obtained from the 1981 Small Area Census Statistics. The students had been taught the procedure for automated census data retrieval using SASPAC as part of the computer stream of the BSc course. Each enumeration district was allotted to one of 24 groups defined by the indicator variables and one was chosen from each group, with two being chosen from the four largest groups to give 28 areas. Thirty households were then randomly chosen in each area. They were selected using the 'firsting' procedure advocated by Hoinville, Jowell & Associates (1978), which uses the electoral register to draw a sample of households independent of their size.

The fieldwork day was successful with 142 interviews completed, an average of five interviews per student. The main problem encountered was the low response rate, exacerbated by the fact that many of the selected sample were not at home on the Saturday afternoon, and a number of students thus exhausted their list of 30 addresses. This eventuality had been foreseen, and (if their allocation had been exhausted) the students were instructed systematically to continue to approach residents in their study area. The sample achieved proved to be highly representative of the Cardiff population with respect to household characteristics such as car ownership and economic activity rates.

Project Analysis

The analysis focused upon two broad issues arising from a previous techniques course centred upon the multiple regression model. First, we highlighted the issue of functional form by inviting the students to explore the relationship between the ranking of a store alternative and its specified attribute level for price, quality, range of goods, distance and car parking. Secondly, we built upon the students' knowledge of the extension of regression-type models to the analysis of categorical data. Awareness and utility of these techniques has increased considerably in recent years (Wrigley, 1979, 1985) although their dissemination into undergraduate courses has been hampered by the inability of most user-friendly statistical packages (notably MINITAB) to tackle this class of problem. However, it has become increasingly apparent that a transformation of a categorical dependent variable into an intervally scaled response variable will allow relatively robust estimation of logit models using multiple linear regression (Hensher & Louviere, 1983). Thus, the rankings were transformed into choice probabilities, and the students were able to develop their knowledge of MINITAB in the construction of models relating store choice to the five attributes of stores outlined above, and also to the consumer-related attribute of car ownership. In the spirit of the project, the students were given only a general class of problem to solve, and were left to explore the software capabilities in MINITAB for themselves.

The final project assignment involved an essay evaluation of the survey design and implementation and an assessment of the empirical results annotated with appropriate computer output.

Project Evaluation

The design and implementation of the survey and its subsequent analysis involved the students in a wide range of tasks and procedures. This diversity makes evaluation of the complete exercise a complex task. Additionally, the project fulfilled a secondary role, in so far as it made a major input into a current postgraduate research project. A cynical observer might accuse us of using unpaid labour in order to stretch the resources available to research functions, or of using a full-time researcher in a teaching role. Such views are founded upon the belief that the design represented a purely pragmatic compromise in response to resource constraints. Our own view is that our approach created a solution mutually beneficial to both teaching and research, and that our project demonstrated the strengths of carrying them out in close proximity.

The success of the project owed much to the student commitment which was consequent upon their realisation that they were engaged in a genuine research project. The project was perceived as being of wider use than a more sterile teaching exercise, and this more than compensated for any feeling amongst the students that they were being 'used' as a convenient means of furthering a related research programme. Clearly this also provided much of the motivation of the staff co-ordinators, and both parties benefitted from the dialogue generated during the survey design and implementation process.

Our experience leads us to advocate the greater integration of teaching and research within higher education and to anticipate that this might lead to a fuller grasp by students of the complexities of survey implementation. The most objective indicators of the success of this strategy are provided by the 94% interview success rate in the first part of the survey, and by the quality of the data. Preliminary analysis has not only shown that all of the expected relationships within the data are present, but it has also shown only minimal variability in the results obtained by different interviewers. Testimony to the general level of student commitment is apparent in that no penalties had to be administered for late submission of either results or reports—although this must also be in part due to the rigid timetable of the real-world survey research.

Pedagogic Implications

Two generalisations about the analysis of the survey are worth recording. The first is quite specific and technical: stated preference research designs provide a viable means of collecting quantities of reliable survey data sufficient for each student to analyse an individually-allocated data set. The second is more general and qualitative: we have previously noted that our students find it difficult to relate technical expositions of social statistics to real-world problems and, in particular, find it difficult fully to grasp how statistical signals penetrate the sources of noise (e.g. indifference, uncertainty, etc.) inherent in social survey research. In their essay-based critiques of the survey design and implementation, many of the students had clear reservations about the ability of their interviewees to perform

the stated preference ranking experiment: in their analyses based upon their own data almost all of them nevertheless found that expected relationships were identified and that these results remained directly comparable with those of most of their colleagues. Even those with only a limited technical grasp of quantitative techniques were thus able to see this as an affirmation that they did have a clear and valuable place in applied survey research.

A final and even more general point relates to the ethics of combining teaching with research. In many cases there will be little opportunity for such a synthesis, where postgraduate research topics and undergraduate courses do not coincide. However, this opportunity is likely to increase following the implementation of the recommendations of the Winfield Committee (ESRC, 1987), which proposes methods to ensure the closer matching of research topics and supervisor interests. Although in some cases the supervisor may not have related teaching duties and research interests, where the opportunity does exist we contend that it is ethical to supplement the available manpower for time-consuming tasks. The crucial stages of social survey research remain the design of the questionnaire, the selection of sampling technique and the execution and interpretation of the results of the analysis. We therefore suggest that supplementation of research resources in a manner which is clearly complementary to the teaching function constitutes an ethical, worthwhile and attractive proposition.

Correspondence: Lawrence Moore, Department of Town Planning, University of Wales College of Cardiff, P.O. Box 906, Cardiff CF1 3YN, United Kingdom.

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