TEACHING STATISTICS AND RESEARCH METHODS TO HETEROGENEOUS GROUPS: THE WESTMINSTER EXPERIENCE.

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Teachers of statistics are often faced with the task of teaching their subject to heterogeneous groups of students. At the University of Westminster we are faced with groups of students who are all studying psychology but have very different academic and social backgrounds. To teach statistics and research methods successfully to such heterogeneous groups we have developed teaching and learning strategies to enhance student experience of the course. These strategies encompass curriculum design and student support and include interventions using blended learning, study groups, reflective learning journals and the management of statistics anxiety.

INTRODUCTION

When we teach statistics and research methods to BSc Psychology students at the University of Westminster we are faced with groups of students who include some who have not been in a classroom for 20 years, others who have entered university straight from school. Some of our students have previously studied statistics and research methods whilst others have not completed a basic mathematics course. In addition, some students are keen to study psychology but arrive with little idea that statistics and research methods are so central to the psychology curriculum.

HETEROGENEOUS GROUPS

One of the key issues when dealing with teaching heterogeneous groups is to decide whether or not to treat diversity as a burden or resource. We know that our students differ widely in their attitudes, beliefs and previous knowledge. One strategy is to manage this diversity by grouping together students who share similar characteristics and providing material suitable for their particular knowledge base. We could, for example, split students into "advanced" and "remedial" seminar groups for statistics and research methods. We have rejected this deficit model and prefer to maintain the diversity within our groups. In part this is due to the practical difficulties of screening students; a test at the beginning of the semester would be unpopular with students and would require increased staff resources. It is also the case that the important differences between our students are, not so much, the result of differences in their knowledge base but in their attitudes and beliefs about learning and the external pressures they experience. Very few students lack the basic ability to pass our first level statistics and research methods course and most students who can overcome their early difficulties go on to progress successfully.

INSTITUTIONAL CONTEXT

Current UK government higher education policy is to widen participation in higher education. The aim is to increase student numbers so that by 2010 50% of 18-30 year olds attend university. As part of this widening participation agenda universities have been given financial incentives and targets to recruit and retain students who come from groups that have traditionally been under-represented in higher education.

The University of Westminster is a good example of a university that has succeeded in attracting students from under-represented groups. The Department of Psychology reflects the diversity found throughout the whole University. We have, over the last 5 years, taught over 600 undergraduates on the BSc.Psychology course. Forty-five percent of these students are the first members of their family to attend university (a key indicator used by the Higher Education Funding Council for England, HEFCE, to identify students from under-represented groups), 73% are categorised as non-white British and 16% are foreign. These foreign students were made up of the nationals of 41 different countries. 43% of our students come to us with non-traditional entry qualifications (mature students, students with vocational qualifications, students who have completed access to university courses and so forth.).

STATISTICS AND RESEARCH METHODS

The teaching and learning of statistics and research methods hold key places in undergraduate Psychology education. Statistics and research methods underpin the understanding of psychology theory and research at all levels. At the University of Westminster statistics and research methods are taught in tandem and are compulsory taught modules at the first and second year levels. At the third year level statistics and research methods are assessed on the basis of the completion of an individual empirical project. By the start of their third year students should have basic competence in multiple regression and analysis of variance. Failure to progress through statistics and research methods results in students being forced to withdraw from the BSc Psychology course. Failure to complete the third year level empirical project results in the award of an ordinary rather than an honours degree.

The format for teaching statistics and research methods at the University of Westminster is that of lecture and seminar. One hour lectures are followed by two hour seminars where students are split up in to groups of about twenty. The seminars are split into two one hour sessions. One session is devoted to data collection or group practical work and the other to the analysis of the data students have collected using *SPSS*. Assessment is by in-class test, coursework and submission of a learning journal. Students must also complete three hours research participation time. Research participation time is "earned" by taking part in the research of staff and postgraduate students. There is no final examination.

THE PROBLEM

Overall the teaching of statistics and research methods to BSc Psychology students at the University of Westminster is successful. Progression rates are similar or better to those of other courses throughout the rest of the university. However as teachers of statistics and research methods our "failures" are more salient than our "successes." Of particular concern are those students who do well on other psychology modules and struggle only in statistics and research methods. These students often appear to disengage from their learning. This may take the form of non attendance or "cognitive shutdown" within seminar sessions. Students who are experiencing difficulties often fail to take up the opportunities for further help which are readily available. This results in students failing to progress or experiencing statistics and research methods modules as more difficult and stressful than is necessary. To understand and alleviate these phenomena the Department of Psychology Learning and Teaching Group (LTRG) and the Statistics Anxiety Management Group (SAM) have been conducted a programme of pedagogic research. The main goals of this research are to identify particular student needs and to identify points in the student cycle where interventions can have maximum benefit.

THEORETICAL ORIENTATION

To conceptualise and integrate our pedagogic research we have adopted the Person-Process-Context-Time (PPCT) model put forward by Bronfenbrenner (1979) and adapted by Renn (2003) for use in Higher Education. The PPCT model conceptualizes the student as situated at the centre of a series of ecological subsystems. These subsystems are the microsystem, mesosystem, exosystem and macrosystem. The student's microsystems include all the "activities, roles, and interpersonal relations experienced by the developing person [student] in a given setting with particular physical and material characteristics" (Bronfenbrenner, 1979). The macrosystem refers to more distal environmental influences that impinge on the student (Government policy and so forth). The mesosytem comprises the interactions between the relatively discrete microsystems and the exosystem is made up of the indirect effects of the microsystems of others. The value of this terminology is that helps us to think about our students in terms of their relationships and the importance these relationships have for teaching and learning.

PREVIOUS EXPERIENCE

A distinctive feature of Psychology courses in the UK is that the broad curriculum is set by the British Psychological Society (BPS) rather than the university faculty. This is because a UK degree in Psychology is not just an academic qualification but also a pre-requisite for professional qualification as an accredited Psychologist. The BPS Psychology curriculum presupposes no previous knowledge of Psychology and results in all students beginning their studies from the same starting point.

Over the past decade there has been an increasingly popularity of Psychology as a subject at secondary school (post-16 education). Of the 57% of our students who come to us with traditional (A-level) qualifications over half of those students have an A-level Psychology qualification. This has lead to a polarization in terms of student's previous knowledge. Those students with A-level Psychology have already learnt about, for example, *t*-tests, correlation and the rudiments of experimental design.

In a survey of our students approaches to studying using the Approaches and Study Skills Inventory for Students (ASSIST, Entwistle, 1997) we found that students with A-level Psychology performed significantly better in assessments but had significantly "worse" attitudes towards their studies being less deep and more surface in their approach to the curriculum (Porter, 2003).

EXPECTATIONS

Our students also differ in their expectations of the Psychology curriculum. In annual surveys of student expectations (Dewart *et al*., 2005) we have found that for over half our students believe that studying Psychology is a question of personal development and is related to skills related to counseling and psychotherapy. The emphasis on statistics and research methods these students encounter when they begin their studies can be daunting and unexpected. An example of student unrealistic expectations of the curriculum is that when asked to name three psychologists over 70% of our students chose Sigmund Freud, Carl Jung and other psychoanalytically informed psychologists. In fact the UK Psychology curriculum has little coverage of psychoanalytically informed psychology. In contrast no students over a six year period mentioned Charles Spearman or Karl Pearson who are both more representative of the kind of psychology found on UK courses.

ANXIETY

Those students with non-traditional qualifications have either little or no experience of formal education or it may be that their experiences of formal education were entirely negative. Often these negative experiences are related to the study of mathematics and have resulted in a lack of confidence in their ability to cope with statistics and research methods. Such students report that they do not want to study statistics and research methods and that they are very anxious. This anxiety is exacerbated when they see students who along side them who are familiar with the material and already understand the major concepts. The extensive literature on statistics anxiety (Onwuegbuzie and Wilson, 2003) suggests that anxiety is a factor in early dropout and failure to progress. Using Hong and Karstenssen (2002) methodology, we have carried out a survey measuring the cognitive and emotionality components of trait test anxiety, statistics course anxiety, and perceived statistics course difficulty. Results for the first cohort show that state anxiety was correlated with marks on various types of assessment, whereas trait anxiety was correlated with very few assessments. If this finding is valid, it indicates that interventions can assist students since anxiety is related to particular tests rather general personality characteristics (Snelgar *et al*., 2005). We are currently assessing the validity of these findings and have collected samples of saliva that have been tested for levels of salivary cortisol in an attempt to examine the biological correlates of test anxiety.

ACADEMIC AND SOCIAL INTEGRATION

Another consequence of the widening participation agenda and changes in the funding of Higher education in the UK is that students that come straight from school cannot afford to live in student accommodation in central London. These students live with their parents, commute to

university and finance their studies with part-time work. Hixenbaugh (2005) found that over a third of University of Westminster students were engaged in virtually full-time work and that increased part-time work was associated with lower satisfaction with the university and poorer health outcomes. These students have limited opportunity to engage in social activities with staff and other students. They tend arrive at university immediately before a lecture or seminar and leave immediately afterwards. Our mature students with their family commitments and financial constraints face similar problems. Previous research has shown (Kuh, 1993) that student who miss out on the informal aspects of university life have increased difficulties in progressing through the course.

INTERVENTION STRATEGIES

Using Bronfenbrenner's terminology we have targeted the microsystems of students and have tried to support interaction and communication between students and staff so that they can develop richer mesosystems to support their learning. By providing support in formats that students can access in their own time, we aim to reduce potential conflict between students' potentially competing mesosystems, for example, between the demands of studying and the demands of child care or part-time work. Interventions or changes we have made include:

- Changes to curriculum and assessment design
- Increased use of Virtual Learning Environments to provide blended learning,
- Supporting and encouraging the formation of study groups
- Increased support outside of scheduled staff contact time.

CHANGES TO CURRICULUM AND ASSESSMENT DESIGN

To take into account the varying mathematical backgrounds of our students we have designed the practical and seminar activities with the focus on principles rather than calculation. On only two occasions (the calculation of standard deviation and *z*-scores) are students expected to do calculations by hand. Other calculations are all carried out using *SPSS* software and are supported by the *SPSS* textbook, Brace, Kemp and Snelgar (2003) that was developed for our Psychology students. Deliberately we have chosen to assess often and for low stakes rather than use a final exam. The rationale for this is to maximize feed back to students and to minimize anxiety.

As part of the assessment we have recently introduced a learning journal. The goal of this learning journal is to encourage students to reflect on their learning and to think about not just what they learn but also on how they learn (Dart, 1998). As part of this process of reflection students are encouraged to make use of material developed for the Cognitive Learning Strategies for Students Project (Smith *et al*., 2004) which provides a means for students to identify their approaches to learning and to see examples of other approaches to studying which they may not have encountered before.

INCREASED USE OF VIRTUAL LEARNING ENVIRONMENTS

Whilst the course team feel strongly that we do not wish to produce a distance learning course we have made increased use of Information Communication Technology (ICT). Using a propriety Virtual Learning Environment (VLE) we have provided students with an on-line repository for course material. We have provided supporting material that students can use to fill in gaps in their knowledge or use to practice what they have learned. For example, we provide tutorial material on basic mathematics such as understanding decimals since every year we encounter students who are not confident in judging whether or not 0.05 is smaller or larger than 0.005. We also provide annotated films taking students through the steps of data entry and analysis using *SPSS*. Formative assessments are also available so that students can judge their progress. Perhaps our most successful use of ICT is the use of a discussion board that is monitored by the course team. This discussion board generated over 1000 messages during the 2003/4 period.

SUPPORTING AND ENCOURAGING THE FORMATION OF STUDY GROUPS

To address the issue of academic integration we provided the infrastructure and support for the development of study groups. Material was created explaining the functions and benefits of peer learning. A room was obtained for the use of study groups and additional staffing was obtained to offer help and advice.

INCREASED SUPPORT OUTSIDE OF SCHEDULED STAFF CONTACT TIME.

Our first year modules are arranged to run on Monday, Tuesday and Wednesday morning leaving the other two and a half days of the working week free for students to pursue private study or engage in their part-time work or family activities. First year students do not need to come to the University for Timetabled Events on these days. This has obvious advantages for students but also disadvantages because they may feel cut off from staff and each other. To provide contact outside of the timetabled sessions students are encouraged to use the telephone, e-mail, staff office hours and so forth. As an addition to conventional modes of communication we have experimented with an on-line chat facility so that a member of the course team will be available twice a week to answer questions in real time.

CONCLUSION

The aim of our intervention strategies has been to offer students the support to extend their micro and mesosytems. In less theoretical language to extend students support outside of the University by means of a VLE and to give the opportunity so make social contacts more easily. We have evaluated the various changes we have made to the way in which we teach statistics and research methods using centrally collected University qualitative and quantitative feedback as well as through the examination of VLE usage. This feedback has been very positive. Students use the facilities we have offered them and do not wish to have them removed. However, there are dangers in taking these evaluations at face value. We have not been able to use experimental designs to examine the effects of specific changes because of ethical and practical considerations. (See Kember, 2003, for a discussion of the use of experimental methods in educational research.) Examining repeated cross-sectional data is also problematic because of the rapid changes that have occurred in the last five years in UK higher education. Our students are changing rapidly and are continuing to change (from 2006 students will have to pay increased tuition fees and the shift to students as consumers may be accelerated). There are also unintended consequences which result from our changes. For example, a danger we have identified, that arises from our studies of statistics and research methods anxiety, is that we are over-sensitizing our students to the difficulties that some of them will experience during the course

A second unintended consequence is that student support may be perceived as adding to the students work load. For example, the extensive use of the discussion board to ask questions and discuss issues, was seen by some students as yet more work for them to do. The use of the discussion board also generated on at least one occasion increased anxiety. After a session on correlation and the use of scatter-grams, one student identified a data point that was more extreme than the other data points. The student initiated a discussion of whether to exclude or include outliers in analysis. This had not been covered in the curriculum at that stage and messages appeared from students worried that they didn't understand the discussion and that this would adversely affect their coursework marks.

The use of technology also has its dangers. The on-line chat facility was removed by the central computing administration and resulted in complaints from students. What the course team perceived as additions and supplements to teaching and learning may well be perceived by students as essential and overall, there is a danger or raising student expectations to unrealistic levels.

In conclusion, the University of Westminster experience is of increased student diversity. To address this diversity requires constant monitoring and innovation. Of crucial importance is the recognition that students belong to different ecological subsystems and that these subsystems impinge on their experience of teaching and learning.

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