GIS AND TRAINING

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Abstract. This paper will discuss the development and integration of Geographical Information Systems within the School of Surveying. The paper will develop two themes; the development of educational programmes, and the underpinning of those programmes with the creation of a formalised research agenda.

1. INTRODUCTION

The Division of Land Surveying, within the School of Surveying, originated in 1948 when a course was introduced at the Southeast Essex Technical College to prepare students for the final examinations of the Land Survey branch of the Royal Institution of Chartered Surveyors. This was the first formal academic programme of Land Surveying to be offered in the United Kingdom. From these humble beginnings the Division has grown considerably, assuming its own identity in 1972. The original programme of study evolved from the preparation of students for external examinations, to a specialised Diploma in Land Surveying and eventually to the first degree programme in Land Surveying offered by any Institution of Higher Education in the UK.

At present the Division offers a wide range of courses, from day-release technician education programmes through to research degrees. The main bulk of the students, however, are registered on one of two programmes of study; the BTEC Higher National Diploma and the BSc (Hons) degree. In each programme of study, two broad subject areas are offered; Geographical Information Systems and Surveying and Mapping Sciences. Thus a total of four main courses are available to potential students. This range of courses is still unrivalled by any similar Department in the UK.

All courses are based upon a common core of subjects relating to Data Acquisition and the Management of Information. Those students electing to follow the Geographical Information pathway will cover in greater detail the Management, Application and Presentation of Geographical Information whilst those electing to follow the Surveying and Mapping Sciences pathway will consider the Theory, Science and Practice of Measurement. It can be seen, therefore, that the core subjects for all four programmes of study are Data Acquisition and Geographical Information.

The problems of introducing Geographical Information Systems into such a teaching programme are quite significant. The first year intake of students is normally in the region of between 60-80 and taken across the full range of the programmes of study, the Division is faced with the problem of coping with 200+ students of varying levels of ability. These problems are identified below and form the principal theme to this paper.

2. THE TEACHING PROGRAMME

The management and organisation of spatial and geographical information is organised initially through the general area of Data Acquisition with particular attention being given to the measurement process. As an introduction to this geographical information management the broad concepts of digital data, data structures and file formats are introduced through CAD packages such as Intergraph Microstations. Such a package allows students to import digital data files from a variety

of sources, such as photogrammetric data, field survey data and digitised map data, whilst appreciating the basic concepts of layering, data structure and data manipulation, modification and integration. At present the Division is operating in a networked PC environment each PC workstation having a dedicated digitising tablet.

Following on from these broad concepts, students are introduced to the concepts of Geographical Information Systems through another networked PC package - IDRISSI. This allows students to gain a better understanding of the nature, theory and application of more advanced Spatial and Geographical Information Systems.

The most advanced Geographical Information System available to students is ArcInfo operated on a network of dedicated UNIX workstations plus X-windows access on the PC network. It is at this stage that the full integration between measured spatial data and GIS is made.

3. THE TEACHING PHILOSOPHY

In common with many higher educational institutions, the Division follows the accepted pattern of combining theory (lectures) with practical experience (laboratory work and demonstrations) and case studies (tutorials and seminars). The major differences between the Higher National Diploma and BSc programmes lies in the ratio of practical:theory work, the BSc programme having a greater emphasis upon theory.

The practical demonstrations in GIS place considerable demands upon resources, both human and physical. It is therefore very important that they are carefully designed to demonstrate significant and particular features in the subjects. Experience has shown that the ideal practical/demonstration should be of about 2 hours duration, the student being guided through it - either singly or in pairs - using specially prepared documentation. This documentation should contain some means by which the student can demonstrate their understanding of the process, normally in the form of problem solving exercises. In the case of complex processes the practical/demonstration will consist of a series of exercises.

Throughout the process of practicals and demonstrations, use is constantly being made of data sets and exercises carried out by previous groups of students.

The main fulcrum of the teaching philosophy is centred around field schemes and these are the main providers of data for more advanced laboratory and project work.

4. FIELD SCHEMES

Although most educational institutions in the UK are under financial pressure to reduce or eliminate field schemes, the Division of Land Surveying believes implicitly in the necessity and value of field schemes (both local and residential) as a means of improving and extending the educational experience of students. Field schemes give students a realistic experience of gathering geographical and spatial information under a variety of conditions and under differing circumstances. It allows them to interact with the public and be faced with decisions that have to be made in the field often without the assistance and prompting of teaching staff.

During the last 5 years, field schemes have evolved as the principal methods of demonstrating the interaction between spatial data measurement and Geographical Information Systems.

The Division concentrates its residential field schemes in two locations; Somerset, in the western part of England, and the Lake District - a region of northern England. Both areas have been carefully chosen in that they are primarily of a rural nature and consist essentially of permanent grassland and 'natural' vegetation. In addition they contain a variety of small farms (useful for Land Surveying exercises) and a scattering of small towns.

Data acquisition in the field will include the use of several forms of analogue data; typically aerial photography, large/medium scale topographic maps, geological maps and planning and policy information. The purposes of the exercises are two-fold; to gain experience of using different types of data on the ground and being aware of their relative merits, and to relate the geographical attributes visible on the ground to the existing data sets.

Students are, in addition, set problem solving exercises. Examples are given below of two such exercises set on field schemes.

Example 1

In the Somerset area the land of the individual farms is often widely dispersed. The students need to map the extent of the land holdings and also assess the 'quality' of the land. This data is used as part of a land re-apportionment exercise in which the holdings are consolidated as more contained blocks yet retaining the original area and land quality. Another element of the field scheme is to monitor traffic movements and occupancy of Glastonbury and Wells, two towns which are being bypassed in the near future, thus any changes in traffic flow and occupancy can be assessed and recorded.

Example 2

A scheme has been set up in the Lake District to assist the Lake District National Park Authority to up-date their maps of bracken, a natural vegetation that spreads into fallow land at an alarming rate. The ground data is gathered to map the bracken within a defined area. At the same time, the location of suitable ground control points are identified and their positions recorded. The ground data and maps produced by the students are subsequently used under laboratory conditions as training data to both classify the satellite image and to test the accuracy of the classified image.

This data is subsequently transferred to a GIS and compared with the data held by the National Park Authority. The exercise has an additional twist in that the Authority is using a TYDAC SPANS GIS whilst the Department is using ArcInfo GIS. This gives students the valuable experience of transferring and handling data files in different formats. The results of this exercise are passed to the National Parks Authority.

On the GIS side of the field schemes, one such example is the co-operation established between the Department and the South Lakeland District Council. This field scheme involved an occupancy survey and an indication of the age and state of preservation of the properties of the small seaside resort, Grange-over-Sands. The students also conducted a traffic census. The problems they have been set is to add the attributable data Ordnance Survey map data at 1:2,500. In addition, by using the querying commands and specific criteria, they have to indicate a preferred route to bypass the town centre and to advise on the location of suitable car parks. The resulting information is being passed to the District Council who are simultaneously examining the same problems.

During the second year of both courses, the students utilise the data gathered on the field schemes

in more advanced units.

The advantages of students working together with outside bodies brings mutual advantages. For the part of the outside bodies, they are often exposed to technology and techniques not normally available to them. For the part of the students, they have an opportunity to communicate with experts in other fields, to prepare reports and maps under 'realistic' conditions and also to 'sell' themselves and their ideas to potential employers.

5. Problems in Course Design and Content

5.1 Educational

This is essentially a function of time and of forecasting changes likely to take place in the near to medium future. The design of any course takes about one year to plan, and, if we take the example of a 3 year BSc programme, will run for a minimum of 5 years. Great care must be exercised in the planning stages especially when dealing with subjects as technologically dynamic as Data Acquisition and Geographical Information Systems. For example, we have to anticipate the demands of the employer and relate those to the intended educational experience of the student. What changes are likely to occur to the technology and the software (normally determined by the technology): will costs rise in real terms or will they continue to fall? Should we take into consideration changes in teaching staff and staff development.

At year 4 in the programme it is the norm that changes will begin to take place and be implemented in Year 6 of the cycle. Those changes must be anticipated. Will the changes be made in the correct direction with the correct emphasis to ensure that our students can survive in a changing job market.

5.2 Ambition

Any Institution of Higher Education must strike a balance between what is ideally possible and what is realistically possible. When we design and advertise a programme of study, we are under a contractual obligation to the student to satisfy and deliver.

This Division has always made a commitment to work with Industry Standard equipment and to work with industry to provide students of a recognised calibre. We must, however, take very great care not to be driven by industry since ideally, most employers would prefer to take-on students who have been trained rather than educated. Our role is quite simply to provide students with the best possible learning experience using the best possible equipment and resources so that they will be adaptable to their changing roles throughout their careers.

5.3 Equipment/Software

It is essential that any teaching organisation involved in a technologically dynamic subject area has a realistic programme of equipment maintenance and replacement. Certainly in the UK some of the funding of this programme is expected to be self-financing with income being generated by running short courses and/or consultancy contracts.

We are aided in the UK by the bulk purchasing powers of the CHEST agreement, set up between Institutions of Higher Education, hardware manufacturers and software houses to provide equipment, software and data very cheaply **for educational use.** It certainly allows UK Universities access, particularly, to software they could otherwise not afford to purchase in sufficient numbers to satisfy

an undergraduate teaching programme.

A further problem relating particularly to hardware and data, is finance. It is unlikely that the University of East London is not unique in differentiating between capital expenditure and consumables. The problem we are encountering at present is determining what fits into which category. For example, we are faced with the problem that PCs, Workstations, Software etc are classed as capital items, yet they become obsolete and are 'written-off' after about 3 years (often less in the case of software). On the other hand data is classed as a consumable and **good data** can have a life expectancy far in excess of a PC or an item of software!

There is also a degree of financial disparity. A 486DX PC can cost in the order of £2,000: the annual CHEST licensing agreement for an item of software approximately £100, yet a single set of data can cost £3,000.

It is now becoming possible to purchase digital data more cheaply for educational purposes. For example, Ordnance Survey and Bartholomew Digital Map Data, Landsat TM and SPOT imagery of the UK may be purchased for a nominal outlay through the CHEST agreement.

6. THE GEOGRAPHICAL RESEARCH UNIT

The link between measurement and the management of spatial information is fundamental to an appreciation of data quality and underpins the formation of the School of Surveying in which the Geographical Information Research Unit (GIRU) has its home. Within the commercial sector, there is much data and experience but little of this is accessible to educational establishments. The principal role of the Research Unit is to concentrate research into geographical information in such a way that it forges links between the University and outside organisations. As a result of this partnership with industry, GIRU has research and consultancy experience of land, property and personal information management. GIRU's partnership with industry also gives access to dat and other resources, such as finance. GIRU's work includes projects for a Trust Hospital, several local authorities, and a number of regional infrastructure development projects.

GIRU is formed from, and builds upon, the reputation of the Doomsday 2000 Research Group (DRG) from which many of its members are drawn. The DRG is the research group supporting the development of the National Land Information Service for Great Britain. These individuals already have a high profile within the UK GIS community for their contribution to the development of a National Land Information Service.

The Research Unit directs its work into areas that will bring experience to the teaching base of the subject area. This knowledge enriches the academic provision of the School and GIRU has an explicit policy and staffing resource aimed at translating academic and commercial research into the academic programme. In addition, GIRU aims to develop new methods of delivery, particularly the development of self-taught exercises and the use of multi-media in teaching delivery. In this way, the academic life of the University will be enriched and staff time released. The development of GIRU will help to keep the delivery of geographical information knowledge ahead of the changes in the commercial sector.