GIS education by another name? Geographical referencing for social scientists

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1. Introduction

This paper presents the work of an ESRC-funded project entitled *Geo-Refer: Geographical Referencing Resources for Social Scientists*. The underlying motivation for this work was to address the needs of social science researchers who have to work with geographically referenced information but who do not have any background in GIS, most of whom cannot realistically be expected to engage in formal GIS training ancillary to their primary research. The project arose from the authors' repeated experience of being approached by colleagues (and strangers!) with a range of spatial analysis needs, who were unfamiliar with the key concepts, reference datasets and software tools which are often seen as central to GIS education. We thus devised a series of online learning resources and associated workshops intended to address these learning objectives, delivered through an adaptive learning interface which permits the user to profile their own requirements and obtain a customised online tutorial. Design and implementation of this project has required a careful deconstruction of spatial concepts and skills, resulting in an extensible series of highly granular learning resources. This paper provides an overview of social scientists' needs for geographical referencing skills and describes our learning design and implementation.

2. Social science and the need for geographical referencing

Geographical location provides a key mechanism for linking data between sources, and Jones and Elias (2007) identify a need for social scientists to be better equipped with geographical linkage skills. This is apparent in the case of linkage between individual-level data such as survey responses or health records and existing secondary data such as that provided by the census of population. Similar situations arise when researchers have access to area-based data for two different sets of geographical areas which are not directly comparable – for example 1991 and 2001 census data or 2001 census data and contemporary health service areas. A third instance arises when the researcher is engaged in primary data collection, leading to questions such as 'should addresses be recorded in some standard format?' or 'Which is better: postcodes or placenames?' These questions are usually prompted by a desire to produce maps or to link data in preparation for subsequent analyses.

Public bodies have invested significantly in datasets and services which allow social science users to access geographically referenced datasets. Key data products such as census datasets include geographical codes and products such as the All Fields Postcode Directory relate many alternative geographical systems. The various UK statistical organizations have each developed neighbourhood statistics services which provide geographically referenced data, primarily in support of the neighbourhood renewal agenda (Martin, 2004).

A sound understanding of geographical referencing underpins the ability to properly conduct advanced methods such as multilevel modelling, geographically weighted regression and statistical

methods for the integration of many individual and aggregate datasets. Knowledge and practice regarding these issues are frequently derived from the GIS community, but the majority of social science researchers will have neither the time nor desire to attend GIS courses. Researchers will often be experts in their own disciplines and research methods, but have highly focused and time-limited requirements for GIS use.

3. Presenting geographical referencing through adaptive online learning

We have developed a set of online learning objects (Hawley Orrill, 2001) from which customised training sequences can be assembled for individual researchers. They are designed for individual online use but can also support face-to-face courses. In addition, we are now developing alternative interfaces for specialist researcher fields (e.g. public health). Based on our conceptualization of teaching geographical referencing, four types of learning objects have been developed to meet learners' particular requirements: concepts, datasets, methods and examples, illustrated in Table 1.

Table 1. Examples of four types of Geo-Refer learning objects.

Concepts	*Datasets*	*Methods*	*Examples*
The spatial nature of social science data	National Statistics Postcode Directory	Creating a choropleth map in ArcGIS	Mapping Index of Deprivation for the Isle of Wight
Creating a choropleth map	Census Geography: England 2001	Adding data layers to ArcGIS	Relating GP QOF scores to census Super Output Areas
How to match two lists together	Census Geography: Northern Ireland 2001	How to match two lists together using Access	Mapping Devon patient data to rural/urban areas

'Concepts' objects explain fundamental georeferencing principles such as the spatial nature of social science data; map scale; how to match two lists together. Without a firm understanding of such issues, researchers may apply unsuitable techniques or derive inappropriate conclusions (Martin, 1999). Concepts objects are as far as possible context-independent and do not explicitly cite datasets or methods. 'Datasets' objects describe the characteristics and availability of specific spatial datasets (currently limited to the UK) which are used in social science research, such as census and postcode boundaries and directories. The differences between (for example) 1991 and 2001 census geographies or 2001 geographies in England and Scotland are a frequent source of confusion to research users. The independent nature of the learning objects makes it possible to incorporate new datasets within this overall resource framework. 'Methods' objects describe techniques for georeferencing, manipulating and transforming spatial data. Examples include generic and software-specific methods for accessing datasets or carrying out the tasks explained in the concepts objects, such as linking data by list-matching or spatial joins in GIS software. The focus is not only on describing the techniques themselves but also in generating an understanding of the complex issues involved and an appreciation of the potential impacts on resultant maps and analyses. The final type of object, 'Examples', provides exemplars of the use of spatial data in a range of social science applications, including some drawn from our workshop participants.

Brusilovsky and Maybury (2002) point out that many learning websites are far too static to meet the heterogeneous needs of users. The disjointed nature of web resources also means that users have to go through many iterations and undertake careful filtering before extracting the results of a search. Brusilovsky (2001) advocates the alternative use of adaptive hypermedia. Central to the Geo-Refer adaptive learning design is the principle that a user's specific geographical referencing requirements

can be met by a selected subset of the resources. A profiling web form elicits user needs in terms relevant to their research and generates a unique user profile. Each of the Geo-Refer learning objects is tagged with metadata describing its content and a script searches the object database, identifying those objects most relevant to the researcher's needs and sequencing these to form a personalised tutorial. The design is summarised in Figure 1:

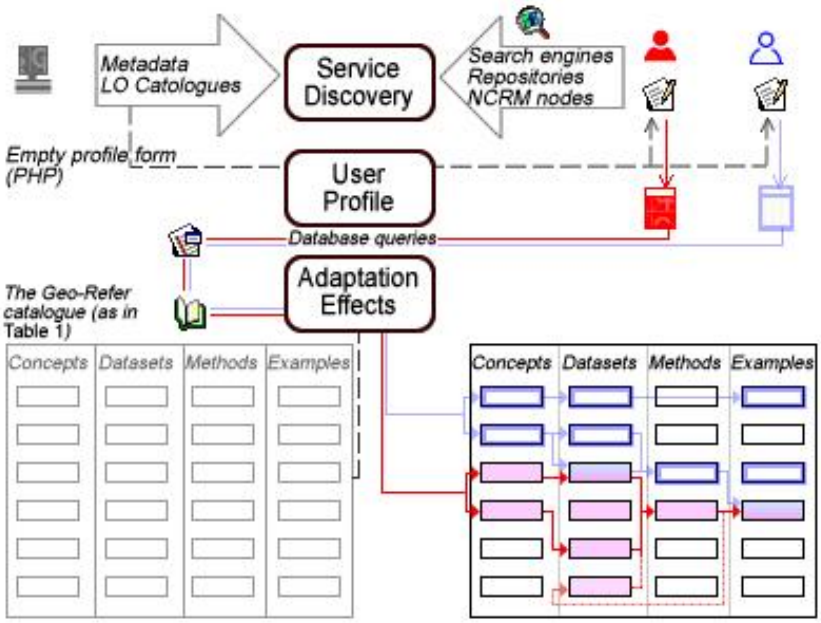

Figure 1. User profiling and Geo-Refer object selection: an example of an adaptive learning interface (after Brusilovsky and Maybury, 2002).

4. Conclusion

We have identified an important GIS learning need not met by conventional taught programmes but with significant research impacts. In response we have developed a set of extensible, adaptive learning materials for online use – either directly or through incorporation within others' teaching. We have developed a four-way classification of learning objects which allows delivery of customised sequences of essential conceptual and practical guidance in response to online profiling of learners' needs. GIS researchers approached by social science colleagues with geographical referencing questions are invited to make use of Geo-Refer at http://www.geog.soton.ac.uk/geo-refer/. We welcome feedback from GISRUK delegates.

5. Acknowledgements

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Biography

David Martin is a Professor of Geography at the University of Southampton. His research interests are focused on social science applications of geographical information systems. He is director of the ESRC/JISC Census Programme and a co-director of the ESRC National Centre for Research Methods.

Samantha Cockings is a lecturer in Geography at the University of Southampton. She has extensive experience in teaching geographical information systems and in research particularly with geographically referenced health data.

Samuel Leung is a learning technologist with expertise in the development of online learning resources in geography. He is a surveyor by background and prior to the Geo-Refer project worked on the JISC/NSF funded DialogPLUS project.