Journal of Geography in Higher Education

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/cjgh20

Teaching GIS&T

Nicholas J. Tate [a] & David J. Unwin [b]

[a] Department of Geography, University of Leicester, UK

[b] School of Geography, Birkbeck, University of London, UK

Available online: 14 Oct 2009

To cite this article: Nicholas J. Tate & David J. Unwin (2009): Teaching GIS&T, Journal of Geography in Higher Education, 33:S1, S1-S6

To link to this article: http://dx.doi.org/10.1080/03098260903165964

Journal of Geography in Higher Education,
Vol. 33, Supplement 1, S1–S6, 2009

Routledge
Taylor & Francis Group

Teaching GIS&T

NICHOLAS J. TATE* & DAVID J. UNWIN**
*Department of Geography, University of Leicester, UK, **School of Geography, Birkbeck, University of London, UK

Introduction

This special issue contains a series of short papers on teaching with and about geographic information science and technology (GIS&T) in a variety of educational contexts, with contributors originating from both sides of the Atlantic.

Although geographical information systems (GIS) already has an edited volume that purports to outline its history (Foresman, 1998), we have yet to put the entire phenomenon into its proper perspective, even more so into its pedagogic context. Briefly, most authors cite the Canada system of the 1960s as the first 'GIS', but the term did not gain much currency until the mid-1970s, when the first academic, research-oriented meetings were held. The late 1980s and early 1990s saw a proliferation of programmes designed to teach the technology and, more importantly, what Goodchild (1992) called the 'geographic information science' (GISc) that underpins it. It seems to us that both the content of courses in 'GIS', with or without the 'c', and the ways by which they have been delivered, reflect an interplay between the available technology, the GIS industry and the academy. For better or worse the educational agenda has followed a technology-driven set of imperatives.

Sometimes it also pays to revisit things one did and wrote some time ago and in looking at these stages we revisit the chapter 'Enabling progress in GIS and education' that one of us co-authored a decade ago for the second edition of the 'big book of GIS' (Forer & Unwin, 1999). Although much of the content of that chapter now has a vaguely antique flavour and the perspective reflected that of two geographers working in the context of academic geography, five 'dilemmas' that at the time seemed important for educators were listed and described:

- Education vs. training? What is the purpose of the teaching? Is it the underlying science or the ability to drive a GIS that matters?

Correspondence Address: Nicholas J. Tate, Department of Geography, University of Leicester, Leicester LE1 7RH, UK. Email: njt9@le.ac.uk

ISSN 0309-8265 Print/1466-1845 Online/09/S10001-6 © 2009 Taylor & Francis
DOI: 10.1080/03098260903165964

- GIS or XIS? If it has a home, where should GIS&T be located on the academic disciplinary map?
- Breadth or depth? Students need depth to understand what goes on 'under the bonnet' of the GIS, but also need the breadth of vision to apply GIS properly and ethically.
- Hands on/off? Is the instruction to be built around hands-on laboratory classes, or can the intended learning outcomes be achieved in the lecture theatre?
- Option or integrator? Should programmes in GIS&T be treated as optional, or are they in some sense central to all programmes in academic geography?

It is convenient to recognize three moderately distinct stages in the development of GIS&T, driven by changes in technology but each with its own educational challenges and solutions to these dilemmas.

The 1980s: Workstation GIS

In both UK and USA, it was not until the 1980s that GIS entered into the consciousness of most academic geographers and their departments. Early GIS were difficult to use and demanded state of the art 'workstation' hardware. The number of people working in the field was low and ability to drive a GIS was hard won with both long and steep learning curves. The rise of GIS through the 1980s was benefited by 'Boosterism' from well-known individuals, some departments that decided to invest heavily in them, and the research funding agencies. In the UK the Economic and Social Research Council's Regional Research Laboratories (RRL) initiative and in the USA a consortium of universities that formed the National Center for Geographic Information and Analysis (NCGIA) were particularly influential. Importantly, in both cases, the funding had attached to it an imperative to preach, through educational activities, what was assumed to be the good word to others. In this technological and academic environment it was not surprising that almost all of this educational effort was at the one-year, taught Master's level. In terms of the dilemmas listed above, curricula struck an uneasy balance between providing an education in aspects of the science and providing what most of the students wanted, which was a training in their use that would provide them with a meal ticket for the future. With only a few exceptions, almost all this teaching was located in academic geography (see Unwin, 1991), with an emphasis on depth, rather than breadth, of knowledge. Whenever possible, instruction was 'hands on' and in the context of teaching programmes the science was regarded as essentially optional.

Perhaps as a consequence of the magnitude of the various educational challenges posed by GIS&T, and what is unusual in academic geography in higher education (see Jenkins, 1992), is that its practitioners took pedagogy seriously and collaboration in an informal 'community of practice' became the norm. The result was a series of educational meetings and projects, and the emergence of shared teaching resources of which perhaps the best known was the original NCGIA core curriculum (Kemp & Goodchild, 1992). Other early education projects in the UK included GISTutor, a pioneer computer tutorial system (Raper & Green, 1992), which, although not used by many, developed a variety of important concepts. Similarly, the ASSIST (Academic Support for Spatial Information Systems) project to develop resources for training GIS users was funded by the UK Universities' Joint Information Systems Committee (JISC) and reflected the relative ease of

obtaining support for software and teaching resource development associated with almost any new technology. That not much of the substantive materials developed by these projects remain should not surprise, or necessarily be of concern. Technology was evolving more rapidly than the ability of the education system to produce quality materials that were both academically and technologically 'portable' between institutions, disciplines and systems.

The 1990s: GIS on the Desktop

Although various 'microcomputers' had been around for a few years and the original IBM 'Personal Computer' was introduced in 1981, it was not until the 1990s that 'desktop' hardware became powerful enough to run standard GIS software, but this change triggered an immediate and massive increase in the use and usefulness of GIS as what had been expensive to acquire and difficult to use year-on-year became cheaper and acquired point and click interfaces that made them easier to use. In curriculum design, as was noted in Forer and Unwin (1999), concentration on education *or* training became much clearer (see also Kemp & Unwin, 1998). At the same time GIS&T began to emerge from the ghetto of academic geography, with an increasing number of disciplines taking it up as an enabling technology. As might be expected in this environment, learning outcomes associated with breadth gradually took over from those associated with depth. The interested reader should contrast the text by Wise (2002) which, despite its date of publication, is very much in the 1980s tradition of teaching the depth with the '1990s' materials presented by Reeve and Petch (1999) that emphasize management issues. Similarly, the collection of essays edited by John Pickles under the title *Ground Truth* (Pickles, 1995) and works such as *Digital Places* (Curry, 1998) encouraged introspection on the part of GIS&T practitioners that led to attempts to address even broader educational and societal objectives. In this 'machine on every desk' environment, instruction could be hands on or hands off, according to taste, and there were some attempts to use the technology as a basic workhorse in integrated curricula, what Forer and Unwin (1999) referred to as teaching *with*, rather than *about* GIS&T. Based on the foundations laid in the 1980s, throughout the 1990s collaborative educational projects in GIS multiplied but development continued to be hindered by the absence of standards that would facilitate the reuse of educational resources and their transfer into disciplines other than geography. A good example is the enormous effort in the UK associated with the *Teaching and Learning Technology Project* (TLTP), which was tasked to develop teaching resources for undergraduate programmes making use of geographic information science concepts. Initially, these resources were developed in a proprietary system but at the end of the decade this was overtaken by the World Wide Web and the efforts seem to have been more or less wasted.

The 2000s: GIS is Everywhere and Nowhere

Future historians of science and society will note the commercialization of the Internet/World Wide Web from around the turn of the millennium as marking a major step change in computer use over all of the developed world, but the implications for both academic geography and GIS&T have been especially profound. In the academy, virtually all disciplines that have any spatial component whatsoever have embraced the technology and its associated science, drawing from it whatever concepts and theory seem appropriate

in their own contexts and developing spatial analytical methods and theory that are appropriate to these concepts. The impression that we have is that, although in the early days these disciplines cited and used methods drawn from the spatial analytical tradition in academic geography, nowadays they pay little attention to this material. For the vast majority of GIS&T practitioners in the real world the concerns of contemporary academic geography are more or less irrelevant.

The same is true of everyday life, where the list of relevant location technologies that have been developed and used is very long. We now have so-called Web 2.0 in which 'do it yourself' user-generated Volunteered Geographical Information (VGI) (Goodchild, 2007, 2008) is being used to develop new mapping applications such as Open Street Map. Virtual globes have provided new learning opportunities (see Rakshit & Ogneva-Himmelberger, 2008; Tuttle *et al.*, 2008) and 'mash ups' onto virtual maps have made geographical knowledge available to all. At the same time the GNNS Global Positioning System has made location-aware devices commonplace and revolutionized numerous activities that depend on location, as well as 'sports' such as *GPS drawing* and *geocaching*. All of this has been called *neogeography* (Turner, 2006) and the surprising thing is how little its practitioners owe allegiance to what most readers of this journal will think of as geography. The view seems to be reciprocated, such that, at the time of writing, very few academic geographers have paid much attention to neogeography, which might well have developed on a totally different planet (Unwin, 2005, but for an exception see http://www.wun.ac.uk/ggisa/seminars/archive/autumn08_program/index.html).

What of GIS in a neogeographical world? When thinking about these new directions and possibly even enthusing about them (Hudson-Smith & Crooks, 2008), it is easy to forget that standard 'GIS' on the desktop and workstations is still being carried out routinely in applications such as the utilities, emergency services and local government. Indeed, Goodchild (2007, p. 213) considers that the various developments outlined above have led to a 'democratization of GIS'. However, many of the new geographers live in what we might call a 'post-GIS&T' world that owes very little or nothing to the history of the science or the concepts that those of us who teach them have thought of as important. Writing in 2009 it is evident that the decoupling of GIS&T from academic geography is almost complete, at least in the UK. In the world of neogeography, basic web-oriented computer skills are much more important than any understanding of the science of geographic information and you do not need to use any GIS software to participate. The ubiquity of locational knowledge post-GIS&T means that all of the world that has access to Internet uses that 10 years ago would have been thought of as a 'cutting-edge' GIS. Andrew Hudson-Smith's short booklet (Hudson-Smith, 2008) shows just how easy this can be in a 'post-GIS&T' world. A case can be made that this is GIS&T, but 'not as we know it', but what is clear is that there are some new challenges here that the academic system may well struggle to meet. In this post-GIS&T world our five dilemmas have become more or less irrelevant, replaced by concerns such as those about *geosurveillance* (Fisher & Dobson, 2003) and even *geoslavery* (Dobson & Fisher, 2003).

For educators, a corollary of these changes is the need to isolate just what it is to be 'geographic', to think spatially, and to find ways by which these qualities can best be addressed in facilitating student learning. Various publications and international initiatives are beginning to explore these issues (for example, the US National Research Council's 'Learning to Think Spatially' publication and the HEFCE-funded SPLINT CETL initiative

in the UK; see http://www.splint-cetl.ac.uk/). Emphasis on spatial thinking along with trends in neogeography/VGI would suggest a challenging future for GIS&T education.

The Papers

This collection attempts to benchmark the state of play in GI higher education and it takes up some of the themes we have tried to put into a historical context in our preamble. First, Diana Sinton (Redlands, USA) introduces the topic with reference to outward diffusion of GIS&T into higher education in the USA. One of the more puzzling things that future historians of academic geography will struggle to understand is why the GIS&T-fuelled boom in academic geography in the USA that she documents is not being replicated in the UK. Two papers then take up the theme of outreach from academic geography into other disciplines. That by Stacey Hespanha *et al.* (UCSB) looks at the use of GIS&T to introduce a much-needed spatial perspective into social sciences, with illustrations mostly from archaeology, whereas Ifan Shepherd (Middlesex), a geographer teaching in a business studies school, looks at strategies and curriculum design for delivering GIS&T into that environment.

As we noted earlier, a feature of early GIS&T education has been willingness to collaborate on curriculum developments in what have been called communities of practice. The most recent of these is the so-called GIS&T Body of Knowledge (BoK), an attempt by a large international group of educators to define what might be included in specific curricula on a sort of 'pick and mix' basis (DiBiase *et al.*, 2006). The result is a resource that has numerous uses. Steve Prager (Wyoming) and Brandon Plewe (Brigham Young) employ an interesting visual approach to identify course content and benchmark it against the BoK. They conclude that it is possible to use the BoK to benchmark different programmes in a way useful to those involved in curriculum development and more broadly. Of general interest to all educators is that in defining the required knowledge the authors of the BoK decided to do this by way of specific intended learning outcomes (ILOs). This provides Michael DeMers (New Mexico) with an opportunity to compare the verbs used in the BoK's articulation of objectives with those associated with Bloom's well-known taxonomy. Perhaps unsurprisingly, he suggests that there is a gap between the stated aims of sections of the BoK, which are at a relatively high level in the taxonomy, and the listed ILOs which are at a generally lower level. Intended revision of the BoK may well need to articulate objectives that in some way narrow this gap.

Arguably, collaboration of the kind demonstrated by the BoK has been less evident in the UK than in the USA, but an exception is that between GIS&T educators at Leeds and Southampton with their World-Wide Universities Network colleagues at Pennsylvania State in the USA. The paper by Jim Wright *et al.* (Southampton) outlines the basis for this work, focusing on important issues concerning reuse of the same learning materials in different educational contexts. Collaboration in one form or another is also evident in the final two papers. Don Janelle *et al.* (UCSB) report on the Spatial Perspectives on Analysis for Curriculum Enhancement (SPACE) workshop programme to disseminate geographic analysis in which over 800 young scholars in a variety of disciplines received training in GIS&T approaches. All of the above essentially concerns teaching *about* GIS&T. The final paper in this selection, Gary Priestnall (Nottingham) describes his work exploring how GIS&T can be used in student fieldwork to help students visualize both the present-day landscape of part of the English Lake District and its equivalent during the last Ice Age.

References

Curry, M. R. (1998) *Digital Places: Living with Geographic Information Technologies* (London and New York: Routledge).

DiBiase, D., DeMers, M., Johnson, A., Kemp, K., Taylor Luck, A., Plewe, B. & Wentz, E. (Eds) (2006) *Geographic Information Science and Technology: Body of Knowledge* (Washington DC: University Consortium for Geographic Information Science & Association of American Geographers).

Dobson, J. & Fisher, P. F. (2003) Geoslavery, *IEEE Society and Technology*, 22(1), pp. 47–52.

Fisher, P. F. & Dobson, J. (2003) Who knows where you are, and who should in the era of mobile geographies? *Geography*, 88(4), pp. 331–337.

Forer, P. & Unwin, D. J. (1999) Enabling progress in GIS and education, in: P. Longley, M. F. Goodchild, D. J. Maguire & D. W. Rhind (Eds) *Geographical Information Systems,* Volume 2: *Management Issues and Applications*, pp. 747–756 (New York: Wiley).

Foresman, T. W. (Ed.) (1998) *The History of Geographic Information Systems: Perspectives from the Pioneers* (Upper Saddle River, NJ: Prentice Hall).

Goodchild, M. F. (1992) Geographical information science, *International Journal of Geographical Information Systems*, 6(1), pp. 31–45.

Goodchild, M. F. (2007) Citizens as sensors: the world of volunteered geography, *GeoJournal*, 69, pp. 211–221.

Goodchild, M. F. (2008) Commentary: Whither VGI? *GeoJournal*, 72, pp. 239–244.

Hudson-Smith, A. (2008) *Digital Geography: Geographic Visualization for Urban Environments* (London: UCL Centre for Advanced Spatial Analysis).

Hudson-Smith, A. & Crooks, A. (2008) *The Renaissance of Geographic Information: Neogeography, Gaming and Second Life*, Working Papers, Centre for Advanced Spatial Analysis, University College London, 142, 16 pages. Available at http://www.casa.ucl.ac.uk.

Jenkins, A. (1992) Through a model darkly: an educational postscript, *Cartographica*, 28(3), pp. 103–108.

Kemp, K. K. & Goodchild, M. F. (1992) Evaluating a major innovation in higher education: the NCGIA Core Curriculum in GIS, *Journal of Geography in Higher Education*, 16, pp. 21–36.

Kemp, K. K. & Unwin, D. J. (1998) Guest editorial: From geographic information systems to geographic information studies: a teaching agenda for educators, *Transactions in GIS*, 2, pp. 2–8.

National Research Council (2005) *Learning to Think Spatially: GIS as a Support System in the K–12 Curriculum* (Washington, DC: National Academies Press).

Pickles, J. (Ed.) (1995) *Ground Truth: The Social Implications of Geographic Information Systems* (New York: Guilford Press).

Rakshit, R. & Ogneva-Himmelberger, Y. (2008) Application of virtual globes in education, *Geography Compass*, 2(6), pp. 1995–2010.

Raper, J. & Green, N. (1992) Teaching the principles: lessons from the GISTutor project, *International Journal of Geographical Information Systems*, 6, pp. 279–290.

Reeve, D. & Petch, J. (1999) *GIS Organisations and People: A Socio-technical Approach* (London: Taylor & Francis).

Turner, A. (2006) *Introduction to Neogeography* (Sebastopol, CA: O'Reilly Media).

Tuttle, B. T., Anderson, S. & Huff, R. (2008) Virtual globes: an overview of their history, uses, and future challenges, *Geography Compass*, 2, pp. 1478–1505.

Unwin, D. J. (1991) The academic setting of GIS, in: P. Longley, M. F. Goodchild, D. J. Maguire & D. W. Rhind (Eds) *Geographical Information Systems: Principles and Applications*, pp. 81–90 (New York: Wiley).

Unwin, D. J. (2005) Fiddling on a different planet, *Geoforum*, 36(5), pp. 681–684.

Wise, S. (2002) *GIS Basics* (Boca Raton, FL: CRC Press).