

Teaching geographical information handling skills for lower-income countries

1. Dr Christine E. Dunn
Department of Geography
University of Durham
South Road
DURHAM DH1 3LE
Tel: 0191 374 2491
Fax: 0191 374 2456
e-mail: C.E.Dunn@durham.ac.uk
(author for correspondence)

2. Dr Peter J. Atkins
address as for Christine Dunn
e-mail: P.J.Atkins@durham.ac.uk

3. Professor Michael J. Blakemore
NOMIS
Unit 1L
Mountjoy Research Centre
University of Durham
DURHAM DH1 3SW
e-mail: Michael.Blakemore@durham.ac.uk

4. Dr Janet G. Townsend
address as for Christine Dunn
e-mail: Janet.Townsend@durham.ac.uk

This is an early draft. For the published paper, please see:

Transactions in GIS 3 (1999), 319-332

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Abstract:

Geographical Information Systems are seen by many as a quick ‘fix’ for the problems of lower-income countries and people in those countries have been encouraged to adopt this perception, along with the technology. As teachers of students from LICs, we seek to avoid reproducing a contextless transfer of technical skills and rather aim to promote an education based on the limitations of the technology and on the nature and construction of information. While identifying GIS as one of many components of ‘geographical information’, we emphasise the importance of including ‘non-GIS’ staff in the education process. We advocate a ‘problem-posing’ approach to the teaching of ‘Geographical Information for Development’ and discuss some of the challenges which this raises, both for teachers and students.

Teaching geographical information handling skills for lower-income countries

Christine E. Dunn, Peter J. Atkins, Michael J. Blakemore and Janet G. Townsend

1 Introduction¹

The export of skills and technologies from higher to lower-income countries (LICs) is a process deeply influenced by culture, politics and finance. At the global level, institutions such as the World Bank and International Monetary Fund have been criticised for imposing capitalist-focused, finance-orientated strategies on LICs. Such perceived new economic 'colonisation' can extend into strategies for distributing foreign aid within individual LICs, such as the tying of aid to the purchase of Information Technology (IT) from the donor nations. Similarly, at the corporate level, most major IT businesses operating in LICs also promote the adoption of 'western' hardware and software, and Geographical Information Systems (GIS) are a significant element of this sales thrust. The biases do not end here,

however. Where higher education in the United Kingdom has been involved in training and education strategies in association with LICs, the main emphasis has so far been on technical courses with a relatively narrow and specific practical skill outcome. The focus has been on a market demand for deterministic analytical tools that require sophisticated levels of understanding by skilled users, rather than addressing the broader questions which social scientists are increasingly asking of GIS.

In this paper the present authors wish to share their own doubts and questioning of the relationship between GIS training and 'development'. Consider first the mode of educational delivery. The eminent Brazilian educator Paulo Freire (1972) made a distinction between what he called a 'banking type of curriculum' and a 'problem-posing type of curriculum'. A banking curriculum is one where teacher and text books are the sources of knowledge, and where the purpose is the acquisition of technical skills and qualifications. In a banking educational system the main currency is certificates, and status for both the teachers and the students follows from successful graduation. This type of system is common in information-rich countries and is increasingly being subjected to quality monitoring so that, in theory, all aspects of the structure are clearly defined and running as efficiently as possible in terms of market forces².

¹ The authors wish to acknowledge the detailed and constructive comments of two anonymous referees on an earlier draft of this paper.

² Some would rather argue that the performance indicators (PIs) now required throughout the UK public sector, have been introduced *whether or not they indicate important aspects of performance*. In the British National Health Service, PIs are dubbed Perverse Incentives (Toynbee, 1998) while in development economics Gore (1998) argues that "performativity" turns attention from the important to the measurable.

The problem-posing curriculum, on the other hand, has less emphasis upon a hierarchy of teachers and learners. The knowledge and skills acquired are related to the practical world of the students rather than to the ‘diploma disease’ (Dore 1976) of passing examinations and gaining certificates. The educational ethos is one of empowerment, seeking both to enable ordinary people to employ new skills in their everyday lives and to help them think more critically about the economic, social and political context in which they live. It is different from the banking curriculum and so avoids the worst excesses of a top-down power structure by placing more emphasis upon the real needs of the pupils.

The recent boom in demand for courses in geographical information has been focused on GIS, particularly in its technical aspects. The Department of Geography at the University of Durham, like other institutions, responded to this demand in the late 1980s, at the undergraduate level, in the traditional banking mould, and we were concerned to transmit technical skills, such as spatial analysis and modelling, to a high standard. Issues of politics, information and society, as elsewhere, were at that time left to other courses. In the early 1990s, however, we designed a new taught postgraduate programme in ‘Geographical Information for Development³’. We sought to avoid a highly technical approach which would merely serve to ‘export’ training to students in the same way that much of the technology itself has been exported, as a ‘blind’ transfer. This was in 1992/3, when software and hardware costs were still very high and many students were returning to LICs after having earned a higher degree in the UK with little prospect of ever again seeing the software

³ As we shall see, even in 1992, when the course was first designed, ‘Development’ was a problematic word, implying some attractive form of change but often denoting changes for the worse, but it was and is still the word in widest use in LICs.

they had been trained to use. Given this, we set out to design a programme to educate students in 'appropriate' uses of geographical information through a problem-posing curriculum.

Both the socio-cultural, political and organisational issues surrounding knowledge and the very nature and construction of information are particularly pertinent to teaching the principles of geographical information to students from LICs. There seem to be relatively few courses which seek to explore the specific challenges of this context. Exceptions that we know of include formal postgraduate programmes in, for example, the ITC in the Netherlands; a masters programme in GIS and International Development at Clark University, U.S.A.; and the University of Durham's postgraduate certificate/diploma/ masters course in Geographical Information for Development. Some individual educators have advocated appropriate uses of GIS, and in this context we particularly welcome Tracey Morton's approach to teaching the politics of GIS to students in Soweto, South Africa (Morton 1998). In this paper we seek to highlight from our experience at Durham the need for appropriate education and training in geographical information, in the same way that GIS has been explored as a potentially 'appropriate technology' (Yapa 1991). We argue that the need in information-poor countries is for a problem-solving curriculum where students become professionals in the use of geographical information, of which GIS are one, albeit very powerful, component. At the same time we worry that the continuing fascination with GIS technology in LICs has some potentially negative aspects. The paper will begin by discussing the formulation of our activities in Durham. It will then place these activities within a wider theoretical and practical context.

2 Teaching and research in appropriate geographical information: our experience

The training programme at Durham came out of discussions between two of our formal departmental research groups: on the one hand, specialists in GIS, remote sensing and the politics of geographical information, and, on the other hand, specialists with experience of data-construction, policy-making and planning in LICs. Together, we explored the possibilities of mounting modular postgraduate programmes in ‘Geographical Information for Development’ (GID) and ‘Spatial Information Technology’ (SIT)⁴. These built on a GIS focus which concerns itself not solely with algorithmic or computational research, but also with complementary research to develop ‘appropriate’ strategies for handling geographical information.

Demand for GID has primarily been from LICs, although there has also been some interest from UK and other EU countries.⁵ Funding has been from DFID⁶ via the British Council, from national governments, students’ own resources, students’ employers, the Ruth First Educational Trust and the World Bank. Successful British Council link programmes with Bangladesh, Brazil, India and Mexico have not merely brought us students but have also led to several associated information-resource projects.

⁴ As demand for the SIT programme, which concentrates more on technical skills, has been mainly from the UK and other European Union countries we will not discuss it further here.

⁵ Employability of students on graduation is high, even when not counting those on leave from a job that they return to, and some students have subsequently joined our doctoral programme.

⁶ The UK Department for International Development, previously the ODA.

With an eye to their careers, most students have chosen high-tech topics for their master's dissertations, usually the strengths and limitations of a specific GIS application in a particular context. Several have been first-class, on topics such as wilderness mapping from existing datasets for Venezuela, vegetation mapping on the ground in North-East Brazil and the planning of new urban development in the Seychelles from existing data. One GIS graduate from 1994 has recently completed a multimethod doctorate, using remote sensing, oral histories, focus groups and group transects in western Kenya (Mahiri 1998) and another doctoral student is working in GIS and sustainable development for peasants in central Mexico.

Apart from the GIS programme in Durham, we have also taught short courses in appropriate geographical information in Bangladesh, Brazil, Mexico and Nigeria. Some of our graduates now teach appropriate uses of GIS at Jahangirnagar University in Bangladesh (Atkins and Alam 1996). Our departmental skills in handling large volumes of geographical information for UK and EU statistical offices have also resulted in work with the University of Gezira in the Sudan on local and regional information networks, and with the ILO and State Institute of Statistics in Turkey on dissemination strategies for labour market data.⁷

For the Department, the collaboration between the two research groups has proved enabling for research on both environmental and socio-economic topics using geographical information. Two recent examples are DFID-funded participatory research in sustainable

⁷ Nomis is an online service, based at Durham, for UK labour market statistics run under contract to the Office for National Statistics. The Resource Centre for Access to Data on Europe (see <http://www-rcade.dur.ac.uk>) disseminates international statistical data.

development in coastal Ghana (Porter *et al* 1998), and our *Atlas of Women and Men in India* (Raju *et al* 1999). Again, our applied, non-technical strengths have complemented our skills and understanding in information technology (IT) and this was the basis for a recent DFID-funded workshop on participatory GIS in Durham. Robert Chambers, a pioneering proponent of Participatory Rural Appraisal (PRA) but a sceptic about GIS, participated at the workshop with Dan Weiner and Trevor Harris, who have explored the possibilities for participatory GIS in South Africa and in the U.S.A. (Harris and Weiner 1998; Weiner *et al* 1995; Harris *et al* 1995; Weiner *et al* 1996). PRA is a leading field source of geographical information today in LICs (Chambers 1997), while maps drawn through participatory resource mapping (PRM) and those derived using GIS both provide visual spatial information. Potential for GIS and PRA to complement each other arises if each, previously independent source of geographical information, can be integrated and used in meaningful ways. One avenue for this is the use of GIS as a vehicle through which local scale, PRA-derived information is scaled up to district, regional or national levels. This is particularly appropriate under decentralised administrations, such as that in Ghana, where the government is committed to popular participation in planning and where local agendas and priorities can be integrated into regional plans (Abbot *et al* 1998).

Not surprisingly, matching the harder, technical GIS with broader approaches to geographical information is problematic. Planners, policy-makers and professionals in geographical information all need a professional grasp of appropriate methods for specific tasks, and today that means calling upon an epistemological range from ethnography and oral histories, at the qualitative end of the spectrum, to GIS and satellite remote sensing at the

quantitative/technical end. But few have the experience, expertise or even inclination to exploit the full range of possibilities. Our own collaboration between IT and ‘development’ specialists proved unexpectedly difficult but, by integrating our technical and our applied, non-technical strengths, it has been very rewarding.

3 GIS: some problems

In practice, the politics of geographical information have always made painful reading, ever since maps were first used as instruments of power (Harley 1990; Edney 1991). In recent decades the political issues have been made more alarming by the potential uses of both remote sensing and GIS in surveillance and control, and by their sometimes inappropriate actual uses in information-poor societies. Some geographers have expressed great hostility to our teaching of GIS for use in LICs (Dunn *et al* 1997), seeing IT as necessarily corrupting in such a context.

On the demand side, we have also met some student resistance. Many of our overseas candidates come with the very clear objective of acquiring generic skills in the ‘latest’ high technology. They frequently seek training *after* their employing organisation has committed itself to purchasing a specific commercial package, and so their training needs are post-hoc rather than part of a strategy to build geographical information handling skills. Those sent by employers in LIC government service have often been instructed to acquire specific skills and are told that their promotion will depend on their ability to pass these skills on to others.

In the light of such mechanistic objectives, non-technical parts of the curriculum may seem marginal and perhaps even counter-productive.

On the supply side, European and North American universities increasingly see masters and shorter courses as means of earning additional income, and winning candidates is a matter of having programmes which potential students find attractive. A discursive, critical, social science content is usually seen as incompatible with the objectives of both teachers and learners. There is little point in ignoring this inertia within course demands, so our approach is to ensure that the critical issues of information resources, relevance, and appropriate technologies are given a high profile within courses which also provide the technological meal-ticket.

As the student demand is highly focused on GIS skills, we teach GID around GIS, with compulsory modules in GIS and in geographical information, its acquisition and analysis⁸, and optional courses (of which students must qualify in one) in geographical information and public policy, in remote sensing, and in rural development (Table 1). A pattern has evolved: students attend two or even three options, with the politics of information being very popular, but many choose to *qualify* in remote sensing, 'for their cvs'. Dissertations may take students to non-IT advisers, from geomorphologists to planners, who specialize in information-poor societies, and students gain immensely from their own efforts to integrate IT with a real and relevant application at this point. Many students also express appreciation for our 'softly

⁸ Taught largely by 'non-IT' staff, as are Research Methods and Development. We call on specialists in geomorphology, soils, climate, development, survey methods and qualitative methods to explore data-construction in their field and the strengths of GIS in their field.

softly' approach to teaching the technical aspects of GIS, in what, otherwise, has come to be regarded as a rather macho computer culture (Hall 1996).

We seek to train professionals skilled not only in GIS, but also in its strengths and limitations in terms of both capacities and costs vis-à-vis other methods. We teach that the optimum solution to any problem in geographical information handling depends on the specific conditions in which the techniques are to be embedded. The 'best' solution will require an institutional as well as a technical evaluation. Consideration must be given to the institutions within which the information will be produced and used, as well as the users' needs, data availability, data costs, costs of hardware, software and maintenance and technical capacities. Harris and Weiner (1998) argue that the nature of GIS 'cannot be

divorced from the politics and social relations associated with its use', and Warren (1995) considers that these relations are complex and often contradictory. The main challenge for GIS implementation is seen by Innes and Simpson (1993: 233) as achieving compatibility with the 'culture, language, skills, practices, understandings, and organizational and social structures of the community that is to use it'. They encourage the adoption of innovative approaches to GIS in planning applications including participation of the public in policy discussions.

A significant obstacle to our teaching programme is the specific culture around IT, which has been transferred to poor countries along with the technology itself. There are several issues here. The first point concerns the perfectly legal, and some would say admirable,

profit motive of transnational IT businesses. GIS companies are naturally interested in making sales and the evidence suggests that they and the small army of GIS consultants working in LICs would rarely advise a government agency that GIS is not relevant to its needs if that meant the loss of a lucrative contract. In any case there is an underpinning strategy of software discounts, gifts and demonstrator projects which has already provided apparent cost-benefit justifications for GIS procurement.

Second, GIS course leaders in high-income countries (HICs) may take it for granted that, on graduation, students will have access to a high quality of both data and technical and institutional support. These expectations are often exported to LICs but they tend to conceal both the basic limitations of all GIS, and the specific difficulties faced in societies which are information-poor and which may not have much depth of information culture (defined by Bell 1996 as an acceptance that to process data and be informed is a beneficial condition).

Both of these issues are articulated in Pickles (1995) and in the special issue of *Cartography and Geographical Information Systems* (1995: 22). In our own experience, there is a third problem which is exemplified by a difficulty we faced in writing the *Atlas of Women and Men in India* (Raju et al 1998). This was the problem of explaining to a popular Indian audience the limitations of our computer-generated maps, which look authoritative but which were compiled after many technical difficulties (Kumar et al 1997). This is the well-known problem of GIS flattering to deceive with the superficially impressive quality of its outputs.

Manuel Castells (1996-1998), in his influential trilogy on *The Information Age*, characterises Sub-Saharan Africa as a whole region excluded from the global informational economy. Castells draws a disconcerting picture of ‘the disinformation of Africa at the dawn of the Information Age’:⁹ an Africa which is not only by far the least computerised region of the world, but is also lacking the minimum physical infrastructure and skills required to make use of computers.¹⁰ ‘The limited computerisation of Africa has become another source of money-making for bureaucrats, without linkage to the needs of the economy or public service.’¹¹ For Ouma-Onyango (1997), inefficient institutions are also the great obstacle to the proper use of information in Africa: ‘[Improved] information management in development is the way to the future. It is the avenue of hope into the next millennium.’¹²

It is such understanding, not technical skills alone, which is essential in the use of geographical information for policy, planning or action. In the Durham GID programme students grasp this point most in the problem-solving work of their dissertation, often under the direction of ‘non-IT’ staff.

Despite our advertising, most of our students arrive expecting not a professional training but a high-technology fix centred on a specific manufacturer’s GIS. While we do teach ARC/INFO, we also teach Idrisi because it can be very useful in LIC situations where

⁹ Vol. 3 *End of Millennium* p. 95.

¹⁰ *Ibid.*, p. 92.

¹¹ *Ibid.* p. 95.

resources are limited. At our course evaluations, particularly early in the year, many students (from both LICs and HICs) would prefer not to spend time on Idrisi because they see it as second-best, low-grade and cheap¹³. They state that their skills in Idrisi will not enhance their own status and they would rather spend more time on ARC/INFO. Equally, some see themselves as technicians: it is the ministers and senior bureaucrats who will buy the hardware and software and decide what work is required. In their view the technician's job is to carry out this work, right or wrong, to the highest *technical* standards, and not to have opinions, however professional. Their dilemma is understandable.

Applications for admission to the course can generate some difficult ethical decisions: whether to offer a place to an applicant working for the military in an oppressive regime; whether to provide extra dissertation support for those willing to pay for supervisory visits to home countries; and how to respond to offers of scholarships from organisations whose own ethics we might wish to question. We aim, ideally, to attract overseas students who, on returning home, are themselves able to teach others. This process has been most successful where we have had funded link programmes, as, for example, in Bangladesh, and where there is a well-established resource of hardware and software. Success (in our terms, a self-sustained GIS programme in the LIC) is most likely where there is a critical mass of staff with GIS expertise and a social-science awareness.

¹² P. 205.

¹³ Emmanuel (1982) argues that appropriate technology is merely second-rate. Many people in lower-income countries share his opinion, from peasants to presidents.

The licence restrictions on GIS manufactured in the USA pose a political dilemma. Licences are constrained by the US State Department not to allow access to people in states labelled as 'terrorist' or 'enemy'. We did once fax a vendor to ask whether this required us to refuse access to a Sudanese student, and to say that if they so insisted we would have to ask the UK Foreign Office for advice as to whether all of that vendor's GIS installations would have to be removed in the UK. Not surprisingly they recognised this 'Catch-22' and failed to respond at all, but this is yet another layer of western technological hegemony.

Our main obstacle in teaching LIC students stems from attitudes exported in the past from the HICs. In the 1960s and 1970s, disciplines such as geography or planning sought scientific legitimacy in quantitative methods. Many overseas students who studied in HICs during this era are now senior professors or civil servants at home. Because of their training, they may be impressed by the techno-scientific aura of GIS and some are in the position of budget holders who decide upon investments in new initiatives. In India, Nigeria, Brazil and Mexico, we have found doctoral students in the 1990s employing statistical methods on inappropriate as well as appropriate subjects; where appropriate, the techniques may be sufficiently wrong in detail as to invalidate the results. We are facing a potential corruption of information culture which is rarely mentioned on grounds of political correctness. Statistics imply 'objectivity' and confer status, and quantity rather than quality has come to rule. Experience suggests that doctoral students returning to countries such as Kenya or Bangladesh must use statistical methods or their thesis may not be taken seriously at home. In Nigeria in 1990, the last census of population to yield

results approved by the government had been in 1961. At the University of Jos (Plateau State, Nigeria) in 1990, postgraduate students were required for their theses to multiply the 1961 data for each settlement by the estimated national increase since then. As a method for arriving at current populations, given the highly differentiated growth of these settlements, this was grossly inferior to riding round on the bus and guessing, let alone walking the settlements and estimating. But it was regarded as more 'scientific' to manipulate numbers than to employ observation, which was felt to be 'subjective'.

Most GIS students take our modular course in remote sensing, and revel in their new powers to extract masses of detailed information from images. They find it disappointing and frustrating that there are no equivalent techniques other than costly surveys which are able to raise social and economic data to a similar standard. The natural reaction seems to be either, first, to overemphasise the physical, visible and measurable at the expense of fuzzy and slippery human data, or, second, to stretch whatever human data is available beyond its innate capacity and to assume that it has the characteristics of consistency, reliability and comprehensiveness that are required for much statistical and spatial pattern analysis. It is even harder for some students to believe that GIS, so admirable for deriving patterns, is weak on processes or relationships, and that much of the associated software is based on societal and behavioural assumptions which may apply in the western United States but not in Europe, let alone in Africa (Obermeyer 1995).

GIS is high-technology and therefore 'should' in the eyes of many students and their employers be able to overcome the limitations of poor data. Seminars at which students

outline the history, strengths and weaknesses of GIS in their country produce horrifying tales, but many students prefer to keep the tales separate from their professional thinking. They insist that we do not publish the names of countries of which they speak, because they believe that they could be identified and become unemployable. In certain cases such conflicts have meant that the material relating to 'uncomfortable' political and ethical issues, has had to be excluded from student dissertations which would be accessible to an employer. The irony of this situation is not lost on the students since it is precisely these issues which we wish students to be able to incorporate into their writing.

In a sense it is understandable that students prefer not to evaluate the quality of data, for, if they recognise or admit its limitations there is so much less they can do with it. A further point is that, for most of our LIC students, information is not a free good. Their experience is that information held by one ministry is not always freely available to another.¹⁴ Jealousy between ministries is common, and can be an insuperable barrier to data-sharing. There is even one country (not communist) where access to information depends on production of a party card. GIS outputs, even in universities, very often become the private property of those who produce them.

Our course on the politics and sociology of information shows that all is not well in HICs either. Harris and Weiner (1997) set demanding conditions for a truly 'community-integrated GIS', even in the information-rich United States. In Britain, local government can use a GIS to display planning issues to councillors and to members of the public

willing to attend either meetings or the planning office but there is of course no guarantee that those people are either numerate or computer-literate. According to the Minister for Local Government (Hilary Armstrong M.P. 1998), a half of all councillors are now retired, and such an age bias seems likely to undermine an appreciation of the value of IT and of its constraints. In much of local government in Britain there has anyway been a tendency to use GIS merely as a map store, although other applications are expanding, especially in planning (RTPI 1995). Overall, there seems to be a general feeling that the institutions are not using GIS to the best advantage in local planning for either professional or democratic purposes, both in LICs and HICs.

An unstable information culture, anywhere in the world, which seeks to use GIS without study of the limitations, is a problem. Thajchayapong *et al* (1997: 266-67) have a fascinating discussion of the need to incorporate information technology into society in Thailand in such a way as ‘to reduce the substantial gap between the information “haves” and “have nots”, not to further widen it’. They do not itemise the need to be aware of the strengths and limitations of specific technologies, but we hope that they include it under the fundamental prerequisite of a ‘Well-educated populace and adequate IT human resources’.

4 What would a problem-posing GIS curriculum look like and how could it be justified?

¹⁴ A problem not exclusive to low-income countries.

A move away from the banking type of curriculum at one end of the GIS education spectrum to a purely problem-posing curriculum at the other end, may at first sight appear to be unviable, particularly in view of the need for students to be able to demonstrate 'marketable skills' after completion of the course. Our own course still has banking as well as problem-solving characteristics. Warren (1995) however, argues that, far from detracting from learning important technical skills, a curriculum which regards GIS as a socially constructed technology is likely to produce students with a 'unique edge' and a more balanced set of skills in preparation for the job market. Such a GIS curriculum would use computer-based exercises to expose the socially constructed nature of data and, through role play and follow-up discussions, students would discover for themselves the social, cultural, institutional and political challenges inherent in managing geographical information.

Direct and unquestioning adoption of a GIS cannot allow students to explore the potential in LICs of 'non-traditional' types of geographical information, such as that derived from PRA, oral histories, in-depth interviews and other qualitative methods. Recent work has begun to demonstrate clear possibilities for integrating information from these sources into a conventional GIS framework (Weiner et al 1995; Harris and Weiner 1998). This 'participatory' or 'community-integrated' GIS integrates local spatial knowledge with conventional 'official' digital information and aims to portray 'multiple realities' rather than a single, 'objective' view. This 'alternative GIS constructed with community participation and incorporating non-conventional knowledge types' (Harris and Weiner 1997: 13) has been developed in an attempt actively to involve local communities in conflict identification and decision-making. It has been regarded as such an important development as to be

provisionally labelled by some as ‘GIS2’ (Harris and Weiner 1997). The real test of whether this label is deserved will perhaps arise in terms of its ability to inform processes rather than simply extract patterns.

Other channels of communication are becoming important for reproducing contested geographical representations, notably the Internet¹⁵, for example in disseminating information relating to local struggles for indigenous rights in southern Mexico (Froehling 1996). Froehling argues that participatory-based GIS, by contrast, remains constrained by the need for a gatekeeper (usually the GIS analyst) and by the technology itself. Clark (1998) recognises that although participatory approaches to GIS do not implicitly provide access to GIS, they do act as a useful surrogate. He suggests that denial of access is related to organisational structures rather than to GIS *per se*.

In order to make a problem-posing curriculum work, it is essential first to challenge the authority claims of GIS and its image of a hard-edged and clinical spatial science, which uses a technology that is ‘objective’ and unsullied by qualitative considerations. As observed by Latour and Woolgar (1986), scientists systematically conceal the social nature of the activities that lead to their statements, and in this sense GIS is just as much of a sociological phenomenon and a craft activity as any of the humanities and social sciences. In social constructivist terms (Law 1987), GIS has acquired its aura of invincibility because critics from outside GIS have dismissed it loftily as an epistemological dinosaur without really

¹⁵ In March, 1998, a moderated electronic discussion conference began, using email for critical health, education, disaster and other matters of direct concern to people in predominantly rural LICs. This is

attempting much engagement to make the methodologies and software more suitable for the real needs of LICs, indigenous groups (Rundstrom 1995) or, indeed, popular users in HICs. In return, the criticisms coming from social science have risked an excessively polarised debate, where those for and against GIS trade epistemological insults rather than working together to improve practice. At present, such heated arguments remain thoroughly disconcerting to students but we have found that the experience of setting up a “GIS for water-planning in a desert known to you” for your dissertation does elicit many of the problems. Learning by doing draws on tacit knowledge, the knowledge that is accumulated but not systematised (Polanyi 1944). Problem-solving teaches abstractions as well as skills.

5 What kind of future for GIS education?

Academic courses in GIS will continue to flourish for the reasons expressed above, although the economic downturn in the most rapidly growing market in 1997-1998, South-East Asia, may affect recruitment. Programmes will all have a substantial component of technical training, although there is some evidence that student-centred learning through Computer Assisted Learning packages may reduce pressure upon the staff/student-ratio in practical sessions. We repeat that we hope that GIS will be taught increasingly as a component of geographical information rather than of IT, with the involvement of relevant, non-IT staff. We also look forward to developments in the type of GIS which allow room for qualitative

organised from VITALink@vita.org. Email and the WWW have the potential to reduce some problems of inaccessibility to information, although the cost still excludes most of humanity.

information as well as conventional spatial data. Present efforts are, to some extent, frustrated by the conceptualisation of current GIS software in terms of raster and vector representations of space into which spatially ‘accurate’ data will fit. It is possible, however, to represent certain types of indigenous knowledge by using these existing data models; for example, local knowledge about geographical boundaries as derived from participatory resource mapping (PRM) exercises. There will also be increasing opportunities for improved representations of indigenous spatial knowledge both through recent developments in ‘fuzzy’ logic (Openshaw 1996) and by incorporating other information sources (photographs, sound, sketches and moving images) through multimedia GIS (Weiner et al 1996). Software developers should be aware that much indigenous knowledge, however, remains ‘tacit’ (Polanyi 1944) and cannot be geo-referenced in this way or, indeed, be represented at all by the confines of IT.

At the local level, on the ground, a people’s GIS should in our view be a fundamental aim of education. This may have some participatory elements, and probably will have if it is to be successful in practical terms of data gathering and mining upon the crucial seam of indigenous technical knowledge. But, most important of all, it must be a community-based GIS in which ownership of the data and their analyses must be vested in the people collectively. This is hardly the trend of GIS in the UK, the Netherlands or Australia (Masser 1998) but there is some movement in the right direction in the United States (Shiffer 1998).¹⁶

¹⁶ We are grateful to one referee for informing us of the work in the USA of Helga Leitner, Will Craig, Michael Barndt and Kheir al Kodmony.

6 Conclusion

Writers such as Habermas (1972) and Barnes (1977) argue that knowledge is constitutive of the interests it serves. GIS has to date served the interests of the ‘upper circuit’ of knowledge, which is dominated by urban-based, formally educated, instrumentally-orientated élites, with the ability to make capital-intensive investments to reproduce and further enhance their initial advantage. GIS courses have provided highly trained ‘experts’ who are well placed to exploit this knowledge circuit to their own advantage, especially by using their certificates as entry tickets into a profession which has all the characteristics of élitism and exclusion that liken it to a medieval ‘mystery’ or guild. This matters, because students from information-poor societies will themselves influence national policies as information cultures and national information policies develop. We are already training the technical trainers.

In teaching Geographical Information for Development we are to some extent isolated. We compete with other GIS-related courses for students who, for the most part, prefer to learn about the macro language of ARC/INFO than to acknowledge the limitations of the data sources on which such software relies, let alone study alternative and supplementary approaches. Attitudes in HICs play an important part; recent reactions to the idea of teaching GIS in LICs include disinterest or even hostility and we may speculate as to whether courses which integrate socio-cultural and political issues will become anything more than a minority interest. At the GIS in Higher Education Conference in Chantilly, Virginia in 1997, from which this special issue of *Transactions in GIS* partly arose, the notable lack of attendance by North American and West European delegates at the sessions on ‘GIS education in

developing countries' was at the same time both disappointing and enlightening. Three years earlier when one of us (Dunn 1994) presented a conference paper to the annual conference of the Institute of British Geographers on teaching GIS to students from LICs, the audience response was openly negative.

Despite this gloomy scenario, GIS has the potential to empower as well as to exploit and oppress. Locked within it is a capability to give access to information to the lower circuit: the rural and urban poor. Robert Chambers (1997) has shown that their visual imagination is as well developed as the best educated and that simple mapping and diagramming may not only establish simple databases but may also stir an interest in how the current situation has evolved. If PRA can achieve this with basic graphical techniques, then GIS can surely enhance its capability and create a series of outputs that cannot fail to impress and perhaps move the decision-makers and planners.

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Table 1 Geographical Information for Development: Course Outline

| Qualification | Timescale | Module Title | Compulsory or Optional | Module Category |
|----------------------------|------------------|---------------------------------|-------------------------------|------------------------|
| Postgraduate Certificate | October-January | GIS for Development | Compulsory | Single |
| | | Data for Development | Compulsory | Single |
| | | Research Design | Compulsory | Single |
| | | Research Practice | Compulsory | Single |
| Postgraduate Diploma | January-May | Advanced GIS and Remote Sensing | Compulsory | Double |
| | | Information & Society | Optional | Double |
| | | Development | Optional | Double |
| | | Environmental Remote Sensing | Optional | Double |
| Masters Degree (MA or MSc) | June-September | Dissertation (15,000 words) | Compulsory | Quadruple |