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A personal journey through the world of GIS, teaching and development of students' core knowledge

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Abstract

School geography in the United Kingdom (UK) is under pressure to justify its place in the country's National Curriculum. It has experienced a general decline in the number of students taking it at GCSE, A-Level and University, in the face of growing competition from subjects seen as being more "trendy". Thus, it has had to look within itself and find ways to appeal to, or reposition within, the student "marketplace". One way has been to "jump on the bandwagon" of the digital revolution, and as a result the use of Geographical Information Systems (GIS) is becoming more common in the secondary Geography classroom. However, to get the most out of GIS a number of fundamental questions need to be addressed, for example: How can teachers harness, and get the most out of the many GIS programmes on the market? Should they simply teach about GIS? Or is there a wider and deeper approach? Can GIS be seen as part of the wider toolkit which a teacher uses to communicate geographical concepts and stimulate students to think geographically? This paper will establish the purpose, as I see it from the perspective of an experienced educator, for the inclusion of GIS as part of everyday classroom activity. I will discuss how I have gone about creating series of lessons and resources to teach students key geographical skills, knowledge and understanding through their direct interaction and manipulation of GIS resources.

Keywords: GIS, Lessons, Geography, Education, Resources, Materials, Knowledge, Understanding

1. Introduction

Geography in UK secondary schools is at a cross-road, and under pressure to justify its place in the National Curriculum as never before. It has also experienced great turbulence in recent years what with the introduction of the English Baccalaureate (EBacc), fluctuations in the number of students taking it at GCSE, A-Level and University, and growing competition from subjects seen as being more modern or easier. Some secondary schools, in fact the secondary school I went to as a pupil, have experienced such a decline in student interest in the subject that it is no longer offered as a GCSE examination subject.

What's more, the UK government's curriculum review in 2011 proposed several significant changes to the English education

system/curriculum; most significant of all is that all learning should aim to increase a student's "core knowledge". As such the entire range and scope of the country's National Curriculum was up for grabs, each subject having to demonstrate it's "worth" and "relevance" to children's learning in the 21st century and an increasingly globalised education marketplace.

Although, from challenge comes new opportunity. For instance, Geography is perhaps "the" subject uniquely placed to best respond to the "core knowledge" agenda, and GIS could hold the key to this… after all, what other subject deals with factual knowledge, data handling skills, and complex inter-spatial analysis all in the space of a one hour lesson?

Therefore, perhaps rather than Geography being marginalised in the curriculum, the curriculum is in fact moving closer to Geography's core values. So, the UK National Curriculum is clearly once again undergoing great change and this time the emphasis is clearly on the "core knowledge" agenda. However, there is considerable ambiguity as to what "core knowledge" actually means, what it looks like, what it incudes, and indeed how it should be taught, delivered and learnt in the 21st century classroom. This is, undoubtedly, a very important question.

2. What is knowledge?

It is, in my view, reassuring that the UK Government does not address what core knowledge is or how it is to be taught or learned in minutia detail as one can argue whither such delicate and intricate issues are best addressed by educational professions or by politicians? – I personally favour the former. However, while these issues abound we are not moving the debate forward and nor does it secure Geography's rightful place at the centre of the curriculum – for it should surely be easy for geography to excel in this world of core knowledge given the kind of topics and issues with which it deals on a daily basis.

However, the danger is that "information does not equal knowledge in the deeper sense… and so for the school curriculum 'knowledge' has to be more than a mere collection of information and facts – that is, more than a 'pub quiz' view of knowledge" (Martin and Owens, 2011, p. 89). Thus, and as I fully support, there needs to be a much more in depth view, because "knowledge [is] a complex and contested set of ideas" (Morgan, 2011, p. 89).

Yet even with this notion there is a danger that "real place contexts can often become a backdrop to studying problems, and that places become typecast in the geography curriculum because of what they exemplify rather than their ever-changing realities" (Hopkin, 2011, p. 89). This is a good metaphor and rationale indicating the need for more spatially-based learning in the Geography curriculum and the intrinsic thinking which needs to go into creating GIS materials to facilitate this.

3. What should core knowledge look like?

Therefore, this leads to a consideration of what core knowledge should look like within the context of Geography teaching and learning. Yet this is surprisingly difficult to establish because in the past for some seemingly innate reason educators have been ever so keen to opt for simple opposing choices – knowledge or skills? – knowledge or understanding? – teaching or learning? However these are unhelpful when we need, as now, to look at the whole picture. So, in order to begin to see what core knowledge might look like one needs to start by thinking about geographical knowledge within which it is useful to make distinctions between different forms of knowledge, and so is born there being fundamentally three knowledges[1] to all geographical education.

The Geographical Association (the association representing geography teachers in England and Wales) has proposed these three broad areas of knowledge, with each building on and interrelating with the others. The first of these knowledges is core knowledge and

[1] For more information regarding the three knowledges concept see "The Geography National Curriculum GA Curriculum Proposals and Rationale" (Geographical Association, 2011) at: http://www.geography.org.uk/download/GA_GIGCCCurriculumProposals.pdf.

incorporates everything that is factual, in other words, where places are, key terminology, rivers, mountains, cities etc. The second is content knowledge, this encompasses place, space and interrelationship themes and includes all the organisational frameworks, models, principals and generalisations which help us (and our students) make sense of the world. Finally, the third knowledge is procedural knowledge which encourages thinking geographically, understanding connections and issues to do with investigative and enquiry skills along with the application of thinking, analytical and organisational strategies.

The three knowledges model has been well received by educators and politicians alike and so seems to have gone a long way in ensuring Geography is an influential contributor to the emerging new National Curriculum in England. Therefore, with a return to a knowledge-based curriculum prescribed by Government but where the interpretation and medium of delivery is left at the discretion of individual schools/teachers, GIS emerges a perhaps a unique and crucial tool to help Geographers rise to deliver the spatial literacy component of this new curriculum. GIS presents some things which are new and different, but the technology also sits within a much longer tradition of spatial thinking and graphic representation – the very essence, in my view, of geographical learning. It is for this reason that I devoted so much of my time during a Fellowship to University College London in 2011 to both understating the potential of, and developing curriculum resources using, GIS.

4. A snapshot of geography education in an English secondary school

The subject of geography at the school where I teach has long been in a state of flux and uncertainty, much like a microcosm of the national picture. I have found my job, since joining the school as a Newly Qualified Teaching in September 2003, to be one of trying to bring stability, consistency and to generally reinvigorate the subject's fortunes. As time went on a number of significant problems emerged. Our curriculums have, much like the national trend, moved away from being content rich to being issues or controversy based, and as such I have felt that crucial key geographical "basic skills" have been allowed to drift out of everyday classroom activities.

However, the "core knowledge" agenda in the emerging new National Curriculum will, as I see it, bring these "basic skills" – such as spatial literacy and mapping, potentially via using GIS – back to the fore, and as a school we cannot afford to ignore this. What's more, we lacked any formal teaching, or resources for teaching, Geographical Information Systems (in its simplest form digital mapping), something which has recently grown in importance for the department since there is now an explicit expectation to teach some form of GIS in the Office for Standards in Education (Ofsted) school inspection criteria.

Meanwhile, uptake of geography for General Certificate of Secondary Education (GCSE) has been falling for many years – alongside a similar national trend – and so the subject seemed to be in danger of being removed from the curriculum in the future. Thankfully, geography's inclusion in English Baccalaureate (EBacc), the UK Government's attempt to answer critics who say that the GCSE has become too *easy* by giving it a new name and making the examination system more rigorous and focused on "academic" subjects, has had a significant impact. While some schools see this as a threat to the subject's autonomy and perhaps its very existence, in the case of my school this couldn't be further from the response it has received. While my school does not yet officially run the EBacc we do have a "quazi-EBacc" system whereby our most able students are guided towards an EBacc style set of options at GCSE – which happily includes Geography – and since the introduction of this our numbers have soared, from 44 GCSE students in 2010 to 138 students in 2011.

Therefore, I felt the solutions for a large number of these issues would seem to lay in developing GIS resources for both Key Stage 3 (11-13 year olds) and Key Stage 4 (14-16 year olds). Thus, with the local issues in my school are also a microcosm for what is happening in the national arena and there being a significant shift in the next 12-18months with the implementation and curriculum resource

creation following the recent publication of the UK government's new National Curriculum, it is my belief that GIS can go a long way to addressing the issues and aspirations of this… and by developing it now it places me and my school a-head-of-the-game.

More generally, to sustain the subject as a discrete discipline, Geography has, in many cases, had to look within itself and find ways to appeal to, or reposition within, the student "marketplace". One such way has been the technological revolution of both teaching materials for staff and learning media for students. Of the many examples of this new approach/pedagogy, the use of Geographical Information Systems is become ever more common in the secondary Geography classroom. Indeed, it is something which students in their everyday lives more than likely come into contact with and use, for instance on a computer game, in a mobile phone etc., it is a widely held expectation within GCSE syllabuses, and as such is a fact we can no longer ignore as a department, as a school, and as an education community as a whole.

This led to the formulation of a series of crucial and fundamental questions facing geography teachers like myself: What GIS programmes are available for schools? How can teachers harness, and get the most out of, the many GIS programmes on the market? Should they simply teach *about* GIS or is there a wider and deeper approach of teaching *with* GIS? In other words, can GIS be seen as part of the wider toolkit which a teacher uses to communicate geographical concepts and stimulate students to think geographically?

5. Building a GIS-based curriculum

I decided that to be able to effectively create GIS teaching resources I had to go back to the beginning and consider my own knowledge and understanding of GIS. This, to be honest, was not very extensive prior to embarking on creating the lessons using GIS, amounting to only one module's worth of experience with a very primitive form of GIS when I was completing my undergraduate geography degree in 2002. So, I felt the starting point had to be to first of all gain familiarity with the current GIS market.

From this I then chose my preferred product and created a Key Stage 3 unit of 12 lessons which had the intention of exposing students to the attributes and functionality of GIS via structured lessons where skill and ability are built up sequential. Then I felt that having gained this experience lower down the school students would not require "the same again" at GCSE, instead, and assuming they retained the skills learnt earlier, they could really push their spatial and geographical learning boundaries. Thus, I wanted to create a series of "one off" lessons which would be integrated with and support the themes, issues and case studies covered in the GCSE specification.

Finally, and following from this, there was much discussion between the Geographical Association, Royal Geographical Society with Institute of British Geographers and myself about the role and purpose of GIS in geographical education. It was felt that, although my school's geography teaching area/department is fortunate enough to have a dedicated ICT room solely for the subject's use, many departments in other school up and down the country are not so lucky. Therefore, it was felt that the wider Geography teaching community needed a way to get involved with, and benefit from, GIS but with lessons which did not require students to have access to the software on individual computers.

As a result of this, the concept of a small number of lessons which are capable of being delivered by the teacher "from the front" was created. Throughout all of this it was important for me to remember what an ESRI representative had told me which was that to get the best out of GIS you should teach *with* GIS rather than teach *about* GIS.

6. Evaluating GIS programmes in the UK market

I now set about assessing the two leading GIS products available to UK schools – ESRI's DigitalWorlds/ArcView and the Advisory Unit Computers in Education's AEGIS3 platforms – to assess which I felt was most appropriate and best suited to my needs. This involved me, after having kindly been supplied with free copies of both products with which to work, initially setting up each and teaching myself how to use each programme. Then I evaluated the lesson materials supplied with each, and I concluded by having a go at creating some sample lesson to see how I might use each to generate my own lessons for my own curriculum back at school.

My view at the starting point of this was, going by my only previous experience of GIS which dated from when I was a university undergraduate in the early 2000s during which time I undertook an independent learning module using a program called MapInfo , that all GIS programmes were much the same as each other: a series of pre-loaded maps and/or maps that you geocoded yourself using a digitising tablet, chloropleth or isopleth coloured overlays, and a range of tasks linked to these designed to encourage the interrogation of the maps or to solve some sort of problem/scenario. How far this notion was from the truth quickly became apparent, since as soon as I installed and switched each on I quickly realised the two programs were surprisingly different from each other (a summary of this evaluation can be found in Tables 1-3).

The AEGIS3 program was essentially a series of self-contained worksheets about a range of given topics. The worksheets all follow a common format which incorporates a map extract, a table of data, and some activities for the students to do which requires them to interact with and interrogate the map and data provided and the answers to these are then written onto/into the worksheet. Tasks or activities can be written about almost any geographical topic or theme, however there is no "searchable" United Kingdom or worldwide map so once you have decided what the topic or area of study is to be the map you use is confined by those parameters, a school playing field, a city centre street, a collection of villages for example.

In other words, you cannot start looking at one place in a town country or the world and then pan (travel/scroll) to look at somewhere else, without having previously decided where that somewhere else is going to be at the point in time when the worksheet was created. While this offers a very neat, "all-on-one-page" approach to GIS it is perhaps a bit restrictive, inhibiting teachers' and students' potential natural curiosity to look at other places, landscapes etc. Plus, one may consider it and quite expensive given that each map you wish to use from which to create a worksheet has to be purchased and you are only able to buy four maps per annum. However, there are numerous pre-written maps supplied with AEGIS3 at the point of initially purchasing the programme, and it is very easy to set up sheets/activities where the students can directly input their own data which they have collected (from fieldwork or the like) and it will, with one or two clicks, appear on the map, so simple a process that I would imagine the vast majority of primary age students could do it with ease.

DigitalWorlds UK, on the other hand, is almost the exact opposite to AEGIS3. In DigitalWorlds, or indeed its older, more sophisticated, brother, ArcGIS, each element of the lesson – the map, the overlay layer(s), the worksheet etc. – exist as separate files, more akin to the way you may store files in folders on your PC's hard drive. While this allows for larger maps and greater clarity from not having to fit everything onto one sheet of A4, it can perhaps lead to a somewhat cluttered screen with perhaps 3 or 4 files needing to be open at the same time for the user/student to complete their work. However, that said, the big advantage in my opinion is that the maps and layers capable of being displayed are pan- and zoom-able, this meaning that one's natural curiosity to see other places and compare our place in the world with that of others is catered for with seemingly infinite possibilities.

With DigitalWorlds UK from day one, "straight out of the box", and the moment you install it, you get Ordnance Survey (the United Kingdom's official national map provider),

historic maps (typically dating from the 19th century), and high-quality aerial imagery maps of the UK. As well as this you get world topographic, street view, shaded relief, and satellite imagery maps. Whether you are producing lessons or activities using the UK or global resources the same is true, any number of these layers can be opened or used in conjunction with each other. Further, the data which comes with the program is far more extensive and flexible in its potential use as it is made available as separate layers which can be added to the map and which can be as broad or narrow as the user requires. In other words if for example you want the crime rate for every sub-district of the South East of England you can have it, however, equally, if you just want the crime rate for the sub-districts that make up an individual town then you can filter the parent data table and map only the data which is require.

This is largely due to the fact that where there is a sizable range of pre-written activities/tasks; these are not in the form of pre-created worksheet with a map extract already embedded and "locked" into it. What's more, the maps are pan and zoom-able meaning that maps can be created exactly to the users requirements, and even when the map is created if the user is so inclined they can move around the map to carry out further or extensions to their study. This program also, and similar to AEGIS3 but to a far greater extent, comes with a wealth of map functions which allow the learner to use choropleth, proportional shapes, and many other mapping forms, as well as mark, measure, and analyse features on the map(s). While the number of preloaded lessons is fewer with DigitalWorlds UK, the possibility to easily and quickly create your own material far outweighs this.

After reaching this point I felt it was important to take both programs into my school and get a sample cross-section of students to test both before coming to a decision about which they preferred and found most "user friendly". From these tests it became apparent that my students and I both preferred the DigitalWorlds program and so I could then progress onto the main area of my work, to create a suite of GIS-based lessons.

AEGIS
• Can "ask questions"/search the data/map to show certain patterns/trends/parts of the data • Data balloons – hover over point to see the data of a location/pinned to that location • Multiple data tables and can show multiple sets of data/graphs • One-off payment • Mastermaps are already geo-referenced/ each item has a seed so data can be instantly mapped (no need to draw polygons for building before mapping land-use for example) • Easy to access – worksheet style format • Worksheet (and all associated documents e.g. table/spreadsheet) can be created (and locked) ready for students to input their data/mapping their data
DIGITALWORLDS/ARCVIEW
• Historic map layer already embedded • Gives whole of UK Ordnance Survey mapping coverage (at all scales and down to Mastermap scale) • Gives whole of UK satellite imaging layer • Hyperlink any number of/type of information points to a location on the map • Buffering – can use this to predict location of coastline in X years' time • World topographic layer + OS layer gives 3D effect to relief of the land • Cheap, no extras to subscribe/pay for • Large amount of 2001 Census data already in programme (already available on LLSOAs) – no need to download it from Office of National Statistics • Can show Census data for a region or any combination of regions and compare them – don't need to show data for all of England & Wales • Able to provide/work on maps through internet interface – ArcGIS or ArcExplorer Online – so don't always need access to the program

Table 1. Strengths comparison AEGIS3 vs. Digital Worlds/ArcView.

AEGIS
• No historic map layer/data available • Have to buy/subscribe to OS for Mastermap maps/GOAD maps have to be purchased separately • Can only work with UK maps etc. unless map is scanned in and displayed as a picture/or photo is used as the raster • No automatic UK wide coverage/layer • Have to subscribe/pay to get Mastermaps etc. • Have to download any data you want from Office of National Statistics website before mapping it via LLSOA layer for England & Wales which comes with package • When download excel data spreadsheets from Office of National Statistics (or other sites) the data has to be reorganised so that there is only one row containing the field headings • As well as basic programme if want to use Mastermaps or Goad Town Plans have to buy these programs separately and at additional cost
DIGITALWORLDS/ARCVIEW
• Annual subscription required to use the program • Have to draw polygons before able to map land-use for example • Have go through editor process to add data – no table/spreadsheet onto which to entre data directly

Table 2. Weaknesses comparison AEGIS3 vs. Digital Worlds/ArcView.

AEGIS
• £921 initial outlay if you buy all packages (needed to equal basic functionality of Digital Worlds) and Ordnance Survey Mastermap subscription and ECW aerial photos (minimum cost of which is £36 for one 1km sq. tile) plus £85 every three years thereafter to retain access to Ordnance Survey Mastermaps
DIGITALWORLDS/ARCVIEW
• £250 for DigitalWorlds/£350 for ArcView (£500 if brought together)) annual subscription covers everything

Table 3. Price comparison AEGIS3 vs. Digital Worlds/ArcView (2011 prices).

7. Building the lesson resources

Once the purpose and value of GIS as part of everyday classroom activity is established, and that I feel is largely agreed, there follows perhaps the most formidable barrier preventing it from actually being embedded in the classroom – the need to create resources which ensure it is used effectively, and not simply a toy or gimmick, as a tool to enthuse, engage an inspire our young geographers, resources which also do not necessitate "reinvesting the wheel" or rewriting everything which has gone before, but add to and enrich lessons in pre-existing units of work, including GCSE schemes of work. This is what I shall now turn my attention to as described below are the three sets of resources which I have recently written for us in my, and other, geography departments in UK secondary schools.

The first resources I created was a 12 lesson unit aimed at Key Stage 3 (11-14 year olds) designed to introduce students to the world of mapping and digital mapping, and ultimately give them a hands-on experience of working with GIS (Table 4 and Figures 1-3). The lessons themselves are independent of each other in terms of geographical content but, and most crucially, develop and build sequentially the users GIS skills base. For instance the first lessons introduce the concepts of panning (moving) around the map and zooming in and out, then they gradually build up to creating new layers and buffering features on their maps. Ultimately the intention is the user/student has developed sufficient proficiency that they are able to create maps independently.

The assessment for the unit takes two forms – at the mid-point (lesson 6) there is a practice assessment whereby students do exactly as they will do in the end of unit assessment, using the same criteria/mark scheme etc. but when it is marked, the teacher provides comments which the student use to feed-forward into their final assessment – the idea being that this helps the student to perform better in the final assessment.

These lessons will go a long way to addressing the lack of spatial literacy currently in the United Kingdom's geography curriculum as well as assisting in meeting the UK

Government's desire for a greater emphasis on children acquiring core knowledge. What's more, this will benefit all students, and in time as these Key Stage 3 students move up into Key Stage 4 they, hopefully, will carry their acquired GIS knowledge form these elementary lessons into more sophisticated GIS lessons and activities as part of their GCSE educational experience.

Key Stage 3 lessons:
• Crime mapping using Census data • Plate tectonics • Classifying land-use • Coastal erosion • Brazil – case study • Microclimates (feed forward/mock assessment) • Traffic survey • Hurricanes • Wind energy – where to site wind turbines • Latitude and Longitude • Assessment lesson

Table 4. Key Stage 3 lessons prepared using DigitalWorlds.

The next phase of my development of GIS-based teaching resources took the form of a series of twenty lessons linked to the GCSE syllabus which I teach in my secondary school (Table 5 and Figure 4). These lessons expose the students to key geographical concepts, knowledge and understanding through their direct interaction and manipulation of GIS-based maps and associated investigation tasks. These lessons also crucially build on the knowledge and skills the students gained whilst completing the Key Stage 3 GIS unit lower down the school. The lessons here do not aim to develop any particular, or new, skills or competencies with the use of GIS, they serve, instead, to reinforce the skills learnt earlier on and provide opportunities for the students to enhance and extend their learning about the topics and themes covered in the chapters of the course textbook.

Further, these lessons were designed to provide a subtle blend of representing material already in the textbook, but in a much more accessible and visually pleasing way, and providing different examples or case studies which skilfully complement those in the textbook. Not only that but I felt it was necessary to try, where possible, to give these lessons a local flavour. This is because all too often my students tell me that they find the subject of geography difficult due to the fact that they have no first-hand experience of the places being studied or of the issues being discussed. Therefore, in order to try and address this I took the conscious decision to develop, where possible, examples and investigations which were based on the town in which the school is located and most of the students live, or the surrounding area. This I hope will give students the familiarity, ownership and confidence to engage with their learning in a better and deeper way as it will be principally about the areas which they know and interact with on a daily basis.

Like this I hope these resources will help my students, irrespective of their academic abilities, and will particularly be of use to visual learners – those who statistically make up almost half of the school population – which, as research suggests, is becoming the predominate learning style of students throughout the developed world, perhaps, one might speculate, due to their ever more frequent, dependence even, on electronic "gadgets" which operate in the visual medium. Further, I had recently become aware of the widespread use of GIS within the world of work, at the town's Sixth Form College, and within the tertiary education sector so it was my intention that if they have had exposure to GIS at school they would become more employable and/or better equipped to undertake further study beyond my school.

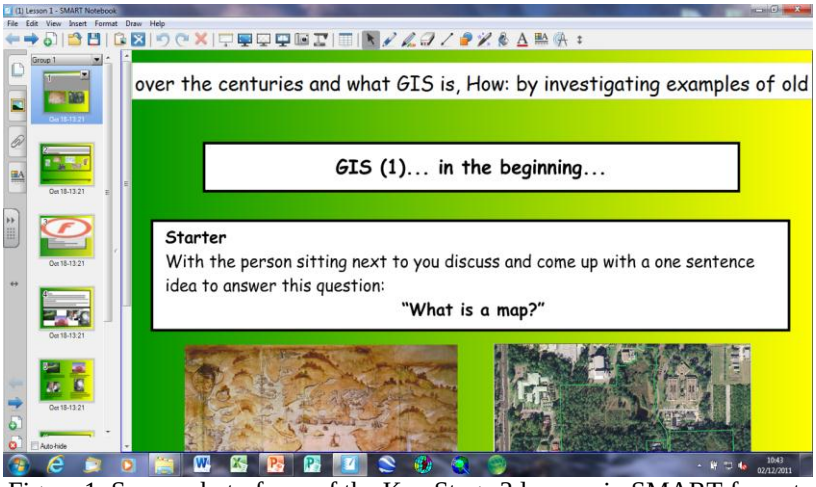

Figure 1. Screen shot of one of the Key Stage 3 lessons in SMART format.

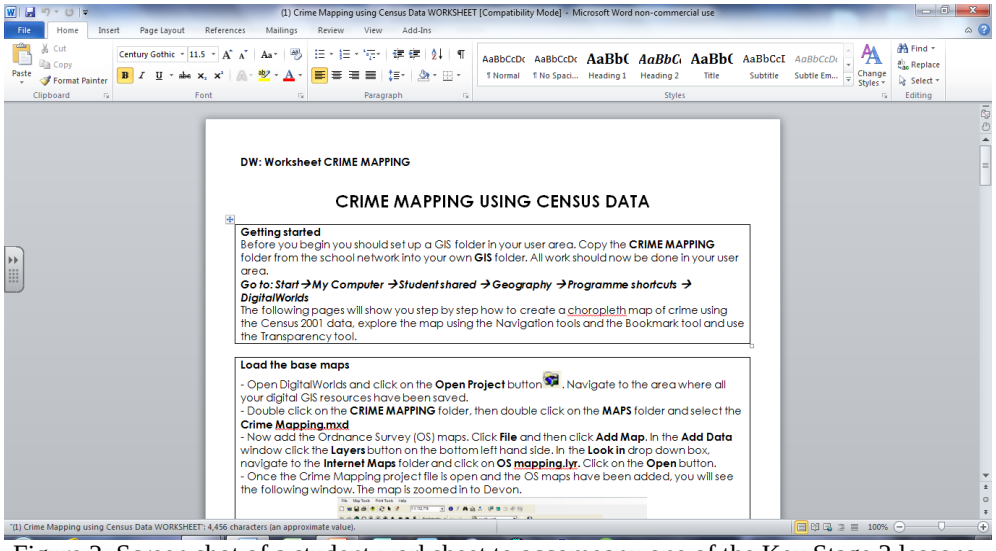

Figure 2. Screen shot of a student worksheet to accompany one of the Key Stage 3 lessons.

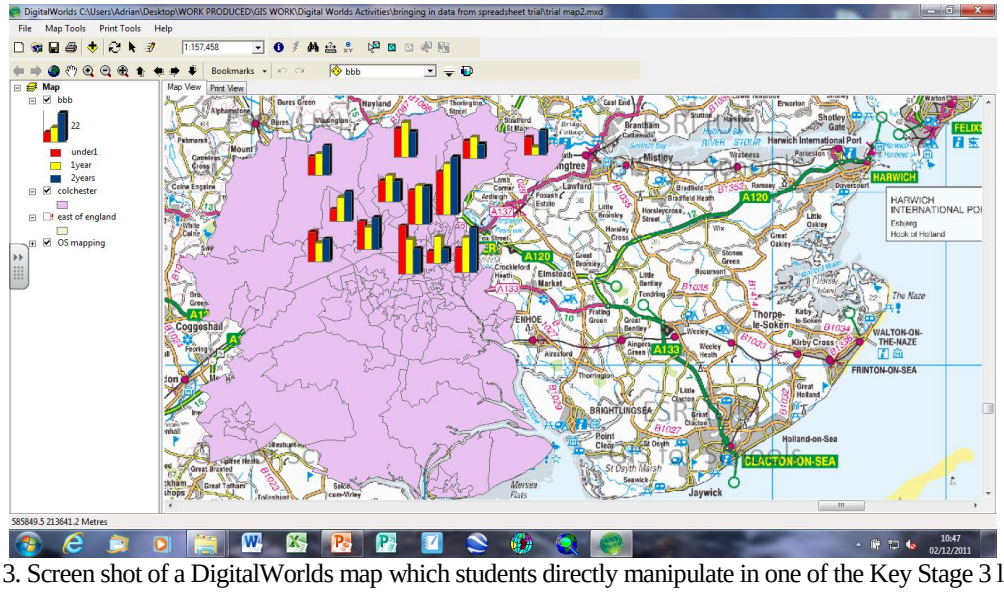

Figure 3. Screen shot of a DigitalWorlds map which students directly manipulate in one of the Key Stage 3 lessons.

Key Stage 4 lessons:
• Socio-economic indicators – Colchester • Social patterns in Colchester • Access to services in Colchester • UK population dynamics • Urban planning issues • Global population dynamics • Conflicting demands on the countryside • Managing rural environments under pressure from visitors • Investigating hurricanes • Water supply in the UK • Flood hazards • Flood management • Technology and the world of work • World development • Global imports and exports • The need for aid • What location factors attract business • How does a global company operate • Biodiversity • Microclimates

Table 5. Key Stage 4 lessons prepared using DigitalWorlds.

Following from developing these resources, there was much discussion between the Geographical Association, Royal Geographical Society and myself about the role and purpose of GIS, not least, although my department is blessed with having a dedicated ICT room solely for the use with Geography glasses/by Geography colleagues, many school Geography departments are not so fortunate. Therefore, it was collectively felt my fellow teachers, as well as the wider Geography teaching community, needed a way to get involved with GIS but with lessons which did not require students to have direct access to the software on a computer in front of them.

Hence the concept of lessons which are capable of being delivered by the teacher *from the front* and where students, rather than needing direct access to a GIS programme, complete their learning using paper-based activities following the lead demonstrated by the teacher (Table 6 and Figure 5). Therefore, I set about creating a small number of lessons which could be delivered in this mode. In total I have created eight lessons – four concerning physical geography topics (such as glacial landscape features) and 4 on human geography topics (such as where a by-pass road should be built).

These lessons are aimed to be multipurpose, aiming to both developing skills and competencies with using GIS software, as well as enabling the acquisition of geographical knowledge and understanding by picking up on eight common topics taught widely across the United Kingdom curriculum. These resources, whilst undoubtedly being of use and capable of integration with my earlier Key Stage 3 and GSCE lessons, primarily aim to meet the needs of a wider audience – that of the large body of teachers who have little or no experience of or with GIS and who either lack the confidence or ICT resources to allow their students to directly use GIS. These indeed intend to be a way into GIS or an entry level product.

From the front lessons:
• Investigating whether Halstead needs a bypass • River flooding • Glacial landscapes • Land-use • River landscapes from source to mouth • Sheffield socio-economic contrasts lesson • Locating a wind farm • Disparities in world development

Table 6. From the front lessons prepared using DigitalWorlds.

8. Alternative sources of GIS and where do we go from here?

In this article, and as is the case with the majority of my research and work developing teaching resources, I have focused entirely and solely on commercial, pay-to-use, GIS software programmes like DigitalWorlds UK. However, there is an increasing wealth of free-to-use programmes and application on the market or readily downloadable from the Internet, Indeed a future area of research would take the form of looking at the potential of GIS in the future Geography curriculum via programmes and services such as Google Earth, Gapminder, Google Maps, or even ESRI's spin of service ArcGIS Explorer Online which has similar functionality as the commercial DigitalWorlds programme but is a free web based platform.

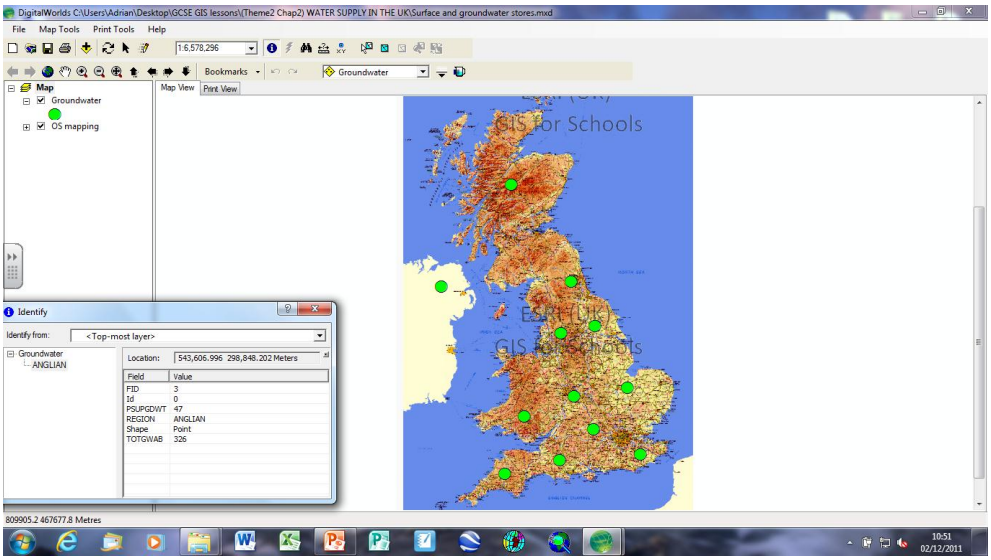

Figure 4. Screen shot of a DigitalWorlds map which students directly manipulate in one of the Key Stage 4 lessons.

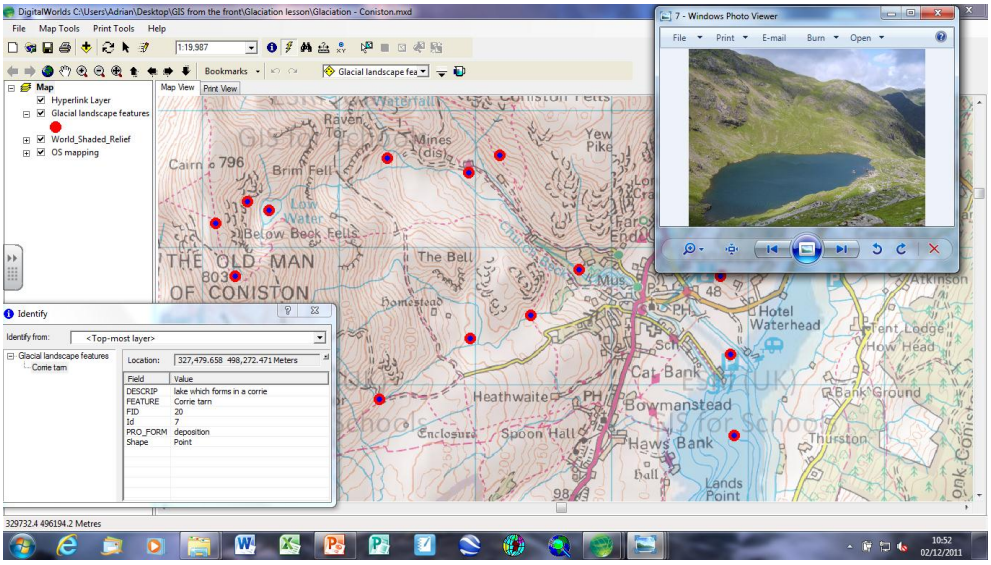

Figure 5. Screen shoot of a Digital Worlds map which students directly manipulate in one of the frontal lessons.

So where do I go from here… having created the resources profiled in this article I taking them into my school and used them with my students in the classroom, This has given them a thorough "test-driving" allowing me to make modifications to them which only became apparent when one gets a class of thirty students all trying to use the programme at the same time. This has in turn enabled me to enhance the teaching materials, increase their functionality and, most crucial of all, ensure they are accessible to all, from the most technologically literate student (or indeed teacher) to those who are picking it up for the first time.

Having created, as I was told by the ESRI colleagues with whom I worked so closely while designing and creating my GIS lessons, the largest single repository of such teaching

materials using DigitalWorlds UK – a total of some 40 lessons – in the country I, along with ESRI and the Geographical Association, am keen to share them with other teachers. Hence the idea from ESRI that we could work my lessons up into a book or series of books combined with targeted releases on the Internet and their companion Arc GIS Explorer Online site. In conjunction with this, there are on-going discussions with regard to me demonstrating some of the lessons I have created to the wider technology in education audience via educational conferences and/or teacher training events both nationally/regionally or by going into schools to work with specific groups of geography teachers.

Most recently, I have been accepted to study for a PhD at University College London. In this I intend to investigate the impact/potential of GIS within the geography classroom. I envisage this as enabling me to both continuing the process I have started of devising GIS lessons but also combining this with looking much deeper into the teaching pedagogy of working with GIS, the way in which it appears, in a very timely way, to help Geography promote itself within the core knowledge agenda being championed by the UK Government in its curriculum review, and the barriers to its wider use in the classroom – whether these barriers be technological, conceptual, financial or other. Indeed the current lack of uptake of GIS-lead teaching and learning in the classroom is an issue which is troubling the Geographical Association at this very point in time.

9. Conclusions – A personal review

At the start of this process, or journey, I had very little knowledge or experience of GIS – other than what I did with it as part of an independent learning module as part of my degree in 2002. As I expected to find, things have moved on substantially since then! I now feel I have at the very least a good grasp of what current-day commercial GIS programmes can do, and most crucially how they can be integrated with geography teaching. I feel I have demonstrated throughout this learning journey that my knowledge and skills have grown and my ability to develop teaching materials which exploit GIS to the full has improved as a consequence. Furthermore, and on a deeper level it has been a personal journey for me, a chance to reconnect with, or connect with in a different way, the world of geography in academia. Working with GIS has given me an opportunity to re-ignite my passion for the subject as a discipline, and to study for my own interests and fulfilment. Ultimately working with GIS has improved my own learning as well as that of my students.

Above and beyond the impact this experience of working with GIS has had on me and the context of my school I have also, I feel, been able to start at least to have an impact on the wider Geography community and pedagogy of Geography teaching beyond my classroom. For example, along with my colleagues at the Geographical Association, Royal Geographical Society and ESRI I have made a contribution to the national debate on “core knowledge” and the UK’s new National Curriculum though my investigation of the potential for GIS to play a significant part in delivering this new approach.

Furthermore, and perhaps most significant of all, I am taking an active lead in the debate as to the purpose of and potential for GIS in the Geography curriculum. I started my “journey” by “test driving” and evaluating the two main commercial GIS products on the market aimed at secondary schools in the United Kingdom. This evaluation, whist serving as a starting point for my work, has also revisited similar evaluations which the Royal Geographical Society commissioned 3-4 years ago. To that end I have updated and reassessed these and my findings are being fed into the wider body of knowledge on this subject.

It has become clear to me that teaching with GIS is still in its infancy in many schools, and completely absent in many more, and consequently the number and breadth of lessons available to those schools who do wish to engage with it, but don’t want to sit there for hours designing their own materials (time is so stretched in the busy school environment), is extremely limited. Thus, the lessons I have designed and used at my school also act as an off the shelf option for other teachers, and as

such they are regarded by ESRI as the largest single repository of DigitalWorlds lessons currently in existence in the UK. Following from this I am currently exploring avenues for dissemination of the resources I have created in the form of textbooks perhaps for teachers from elsewhere to access, use, and benefit there from.

Therefore, rather than having completed or come to the end of my GIS-journey, instead, I feel, that I have only just begun to scratch the surface, and have merely reached the end of the beginning…

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