

Pedagogy and Thinking

Definition of GIS

A Geographical Information System is a way of displaying and analysing spatially referenced information. The three main components of GIS are: a map, spatially referenced data and software that displays the data.

GIS is a way of displaying data and analysing spatially referenced information. The three main components of a GIS are a map, spatially referenced data and software to display the data. Other components are the people who will be using the data, the procedures for the data handling and the networks which will be handling the data. It is widely used in industry, government and local authorities to aid decision making and planning.

Spatial thinking and analysis is fundamental to the study of geography. GIS can be used to visualise complex facts and improve their understanding. It is for this reason that the recent revisions of the national curriculum and examination criteria for geography have made specific mention of the use of GIS.

National Curriculum Guidance on the use of GIS

At Key Stage 3 (KS3) GIS is specifically mentioned in the importance statement at the start of the programme of study when it is stated that 'pupils should learn to think spatially using GIS'. Some of the explanatory notes about the key processes mention GIS in the collection of data for enquiry and as a fieldwork tool. The key process of 'graphicacy and visual literacy' can also be enhanced by the use of information generated by GIS. In the delivery of the KS3 programme of study students should have the opportunity to learn with and about GIS as an integral part of the curriculum with an explanation of its real life applications.

The subject criteria for GCSE, with which all specifications have to conform, states that all learners must be required demonstrate a knowledge and understanding and to use new technologies including GIS to assist geographical investigations. Similar statements are made for A level where 'students should use modern technologies, including GIS, appropriate to the content and should be able to synthesis geographical information in various forms and from various sources.

These criteria are then used by the awarding bodies to draw up their specification and the degree to which GIS is mentioned varies, although there are mentions of GIS in all the specifications for first teaching from September 2009. For example AQA GCSE specification A states 'candidates should be able to extract information from a variety of source s including GIS'. Edexcel GCSE B states 'candidates should be able to use new technologies, including GIS, to assist geographical investigation'.. OCR GCSE A states 'candidates should use CD Roms, GIS, fax, email..... and a wide range of other technologies to access information from different sources'. WJEC states 'candidates should use ICT for example GIS (and other ICTs) to enhance geographical analysis and enquiry'.

The A level specification for OCR states that 'candidates should become proficient in a range of research and investigative skills including the use of modern technologies such as GIS in each of the option and core modules. AQA specifies that the ICT skills should include GIS and Edexcel states that the 'students are required to ' use modern information technologies including GIS as

appropriate to the content'. WJEC states that the skills should include modern information technologies including GIS'.

Thus at each stage of the secondary phase GIS should be embedded in the curriculum. This booklet gives an idea of what the various proprietary software packages offer allowing a comparison between them.

Information about the main software packages available

Software packages are evolving all the time. Some are specifically designed for school audiences; others are adaptations of industry standard systems. They all have different functionality, installation, ease of use and curriculum relevance. Evaluations of the different software can be found at www.rgs.org/gis and on the Ordnance Survey site at <http://www.ordnancesurvey.co.uk/education/mappingnews>

Examples of the use of GIS in teaching

There are plenty of sources of inspiration to be found on the internet. The Geographical Association's Spatially Speaking project has the aim of finding how GIS can invigorate learning and teaching geography. The Royal Geographical Society with the Institute of British Geographers website www.rgs.org/schools has worked examples and case studies.

Benefits and challenges of using GIS

GIS can be used at different levels of progression, from producing a simple map to complicated spatial analysis and geographical information science. The use of GIS in the classroom is only as complicated as the teacher wants to make it. Its uses progress from the presentation of spatial data, through the processing and analysis of data and as confidence increases data can be added and edited for analysis. Although access to computers is essential for students to actually use the software they can experience what GIS can be used for through the display of pre prepared data.

However it is used it can contribute to the development of geographical skills and thinking through spatial development and analysis, pattern recognition and data analysis and manipulation.

Summary of course

The most important thing to remember is by using GIS that confidence will be built and more complicated lessons can be undertaken. Pupils can begin by using pre prepared data sets and then gradually progress to using data collected through fieldwork or from data site such as the National Statistics site. Using GIS in the classroom need not be expensive. Google earth can be used to mark places and undertake simple manipulation of data

Useful websites offering free advice

<http://www.rgs.org/schools>

<http://www.magic.gov.uk>

<http://mapzone.ordnancesurvey.co.uk>

<http://www.esri.com/mapmuseum>

<http://www.geography.org.uk/projects/spatiallyspeaking>

Plenary / conclusion

Objectives

- Understand the pros and cons of each GIS type in the teaching context
- Understand what is the best way to use GIS in the classroom for your specific case
- Understand how to use the GIS exercises from previous sessions as teaching resources
- Become familiar with other GIS teaching resources

What have you learnt so far?

You are familiar with 3 kinds of GIS software:

- Web-based GIS (ONS and London Profiler)
- Geobrowser (Google Earth)
- Desktop GIS (ArcGIS)

You have done step-by-step exercises using:

- Census data
- Deprivation data
- Postcode data

You have also learned how to create a GIS project by:

- Georeferencing a digital (or scanned) map
- Adding post code data
- Adding pictures and landmarks in Google Earth

Types of GIS

You have learned to use three different types of GIS software:

- Web-based GIS: ONS and London Profiler
- Geobrowser: Google Earth
- Desktop GIS: ArcGIS

Let's look into the pros and cons of each type of GIS for classroom teaching.

Web GIS: ONS and London Profiler

Pros:

No data or software is needed. The only resource required is a computer with internet connection and internet browser.

Cons:

You cannot download the map and re-use it later. Once the map has been produced, it is not possible to save it as a GIS project or copy into a different machine. The only way to keep the map is to print it out.

Geobrowser: Google Earth

Pros:

Software is free of charge.

Software is user-friendly and intuitive.
Personal data can be added and saved to be retrieved later.
No external data is required.
Cons:

Software must be installed on individual computers.
It only performs limited analysis. It cannot incorporate GIS data from external sources such as Census data. It does not produce maps such as choropleth (graduated colours) maps.

Desktop GIS: ArcGIS

Desktop GIS category includes commercial GIS packages such as ArcGIS, Manifold, Idrisi. There is a wide range of products in the market.

In sessions 5 and 6 you got familiar with ArcGIS. ArcMap is a software package that is capable to perform a wide range of spatial analysis. Thus it can be used for both teaching and commercial uses.

There are a number of GIS packages designed specifically for teaching. They are simplified versions of commercial software, and usually present a limited range of spatial analysis methods. Examples of GIS packages designed for teaching are AEGIS, Digital Worlds, and Infomapper.

Pros:

Potentially a very good investment, since a single package can provide a wide range of uses.

Cons:

Specific training for use of software might be required.
Software license is required for each computer/site and can be costly.
Computers must have minimum specification to run the software.
External data is required. Although there are free sources of GIS data, some resources might incur an additional cost.

But how can you use GIS for teaching?

Let's start by recapping the requirements for GIS teaching in the UK:

Key Stage 3 Students will 'use varied resources, including maps, visual media and geographical information systems'(QCA, 2007a)

Key Stage 4 Students are to 'become more independent learners through the use of geographical skills, new technologies and enquiry to serve them in their future' (QCA, 2007b)

Teaching will embrace 'use of new technologies including GIS, to assist geographical investigation'

A Level Students will 'use modern information technologies, including geographical information systems as appropriate to the content' (QCA, 2006)

Table source: Comber, A. et. al (2008). Developing Spatial Literacy secondary education: GIS practicals for key stage 3. GISRUUK, Manchester, April 2008. Available at http://www.le.ac.uk/gg/splint/pdf/conference%20papers/GISRUK08_SecondaryEducation.pdf

In what follows we are going to help you to understand how you can fulfil this requirement with what you have learnt in this online course.

"Geographic Information Systems (GIS) are fundamental tools for learning geography. They provide a means of enquiring into geography through mapping. By extending and deepening the

way that maps are used to explore geographical issues, GIS can re-emphasise the spatial dimension of geography, which is one of the defining characteristics of our subject clarifying its unique role and importance in the school curriculum. Using GIS therefore encourages pupils to think spatially, or geographically."

Source:

<http://www.geography.org.uk/projects/spatiallyspeaking/>

Things to remember

As you can see, the curriculum recommendations are very general. By and large, they state that:

- GIS must be used as a tool for geography teaching, not a skill that students (or teachers) are required to master.
- For Key Stages 1 & 2, there are no specific requirements concerning GIS.
- For Key Stages 3 & 4, you are required to teach Geography using GIS and NOT teach students how to use GIS.
- It is only at A levels that students are required use a geographic information system. Any of the types of GIS software and exercises introduced in this course would meet this requirement.
- The basis of GIS is Geography, and geography teachers have the appropriate knowledge to learn and teach GIS.

Constraints for GIS teaching in schools

Whilst it is important that teachers build confidence with GIS, we are aware that this is not the only difficulty to GIS teaching in Schools. Here are some of those constraints:

- Availability of computers for teachers
- Number and power of computers available for students
- Availability of GIS software
- Availability of GIS data

We also understand that even when computers are available they might not be powerful enough to run a full GIS package.

In the following, we will provide you with guidelines on how to use GIS in the classroom despite potential resource constraints.

GIS in the classroom

There are at least three ways of using GIS in the classroom:

1. Demonstration - teacher uses GIS
 2. Step-by-step exercise - all students use GIS (individually or in groups)
 3. Inputting and analysing data collected in field work into GIS
 - data is collected by students and input into GIS by teacher
 - data is collected and input into GIS by students
- Demonstration

One of the ways of fulfilling the GIS teaching requirements, is to demonstrate the use of GIS in front of the class.

Demonstrations are particularly useful when the topic to be taught is not GIS per se. Let's say that the topic of the session is deprivation. By demonstrating the exercise you have done in Session 3, you can show the students how different areas in the city have different socio-economic aspects, providing evidence of social inequalities with real data.

GIS demonstrations usually aim to teach students about reality by using maps produced with GIS to reveal patterns or other spatial properties related to location such as proximity, contiguity, etc between different spatial elements or areas.

Advantages in using demonstration:

- The teacher can prepare for the exercise in advance as you do with any lecture or presentation, so there is no problem if the teacher's GIS knowledge is limited;
- Demonstrations can be performed with any of the GIS types you have learnt;
- Resources required for demonstrations are minimum and depend on the type of GIS that will be used. In all cases, a single computer is needed. For better visualisation, a projector connected to the computer is desirable, but this is not needed if class is divided in small groups that can get close to the computer.

Depending on the GIS type to be used for the demonstration, additional resources are needed:

1. Web-based GIS: although no software or data are required, internet access is mandatory. They are particularly useful for demonstration.
2. Geobrowser: the Google Earth software must be downloaded and installed in tutor's the computer in advance. If data will be presented on top of the Google standard map, (i.e. Georeferenced map, photos, etc) they must be previously downloaded to the same computer.
3. ArcGIS: the software and data must be previously installed and stored in the tutor's computer.

Examples

You can use any of the exercises from the previous sessions as demonstrations.

Step-by-step GIS exercises

Advantages

Step-by-step exercises are probably the most appropriate way to teach GIS, as it provides a control environment for both students and teachers.

This is particularly useful if the teacher does not have extensive experience (or confidence) with GIS.

Step-by-step exercises allow students to learn how to use GIS without feeling lost or frustrated for not knowing all about it. It is a safe way to motivate students to explore the capabilities of GIS. It is important to note that the step-by-step exercises not only can be used to teach geography using GIS, but can also be used to teach GIS.

Tips

A good step-by-step exercise mixes theoretical information about GIS with exercises in which the student uses those concepts in a practical way.

Allow further exploration. By the end of the guided exercise, add a question that needs further exploration in order to be answered. This will instigate the student's curiosity and make them explore the possible modifications of the exercise.

When well designed, there are limited problems that can occur when using a step-by-step exercise. The best way to assure that the step-by-step guidance is clear is to ask someone to test it, that is, to go through your instructions and check if there are any misunderstandings that might occur. Of course, this does not guarantee that student s won't have questions. We suggest that, every time your exercise is used, you make note of the questions and add that information to the exercise.

Examples of a step-by step exercise to be used in class:

a) Session 3: ONS WebGIS

This exercise can easily be used as a step-by-step exercise. No data or GIS software is required.

To complement this exercise, or to assess the work done by students, you can add questions about the spatial characteristics of the area at the end of the exercise.

b) Session 6 : Analysing Data in ArcGIS

This exercise can also be used in class. You can complement it by adding questions. For example, if the exercise provided guidance on how to find secondary schools in the borough of Camden, add a further exercise asking what are the names of the primary schools in Camden that have more than 100 pupils. In order to answer to the question extra analysis must be performed. This is also a way of testing the student's understanding on the exercise.

FieldWork

GIS can be used in a number of ways for field work. The simplest way is for the teacher to make a demonstration of the field work area with Google Earth.

The best way to use GIS for field work, however, is to add information collected in the field to be added to the GIS. Examples of information that can be added are: photographs, locations of things or places, information about these things or places.

It is also important to note that, depending on the availability of computers, the level of the pupils, and the confidence of the teacher with GIS, it is possible that:

- data is collected by students and input into GIS by teacher (or assistant)
- data is collected and input into GIS by students (as part of a step-by-step exercise)

Examples of exercises that can use fieldwork:

a) Session 4 - Exploring Google Earth

Google Earth can be used for different stages in field work. It is a very good way to show students the area they are going to visit (as a demonstration or exercise), and show them (or ask them) to explore specific features or characteristics of the area.

Once data is collected in the field, they can be added to Google Earth either by students themselves or by the teachers (or even by an assistant if the teacher is not comfortable doing it himself or herself!). The addition of photos, locations (points or addresses) and attributes to Google Earth can help students to understand how things are linked spatially.

b) Sessions 6 and 7 - ArcGIS

The exercises of sessions 6 and 7 can be used in a very similar way to session 4, just using ArcGIS instead of Google Earth. Point data can be added to ArcGIS after field trip, and ArcGIS can be used for the final analysis of the field work exercise.

Building confidence with GIS

GIS is a fast-developing technology which seems to be constantly presenting a novelty. While pupils seem to have a great deal of facility in learning computer skills, teachers may not always feel that they can keep up with the latest change in technology.

This makes many teachers to have a low confidence when comes to teaching GIS to pupils.

We suggest you remember you will be teaching Geography using GIS (instead of teaching GIS) which means that you will be using GIS as a tool to demonstrate Geography concepts that you feel comfortable teaching

It is important to remember that the basis for GIS is Geography! You would be surprised to find out that the GIS principles are originated from cartography. Remember that one way to define GIS is as "digital cartography".

Teaching Resources

Royal Geographical Society - <http://www.rgs.org/schools>

Ordnance Survey - <http://www.ordnancesurvey.co.uk/oswebsite/education>

Digital Worlds - <http://www.digitalworlds.co.uk/teacher.html>

Geography tools, particularly Google Earth related - <http://freegeographytools.com/>

Lesson Ideas

Digital Geography - <http://www.digitalgeography.co.uk/>

Digital Worlds - <http://www.digitalworlds.co.uk/teacher.html>

Geography Geek - <http://www.geographygeek.co.uk/>

Juicy Geography - <http://www.juicygeography.co.uk/index.htm>

KEGS - http://www.ke5ways.bham.sch.uk/keqs/cpd/gis_lesson_ideas.html