Rewarding Learning

Teacher Guide

Unit 2

Mapping with a GIS

For first teaching from September 2013
For first assessment from Summer 2014

For first award in Summer 2014

space science technology

Level 2 Certificate

Teacher Guide Unit 2

space science technology

UNIT 2: Mapping with a GIS

Learning Outcome 1: The learner will understand the general concepts behind map and map making

The learner can:

1.1: Investigate how maps are flat representations of curved surfaces

- Use an orange example or a real orange to illustrate the difficulty of producing a flat map from a spherical object.
- Note that all flat maps are inaccurate. Mapping small areas of the earth's surface requires little distortion to get flat maps, but mapping large areas such as countries or continents does.
- A short written piece, or an animation or diagram would demonstrate understanding here, as would a short podcast, perhaps of candidates discussing the difficulties of representing a curved surface on a flat piece of paper or on a flat computer screen.
- General background on map projections

  http://nationalatlas.gov/articles/mapping/a_projections.html

  A site which allows users to investigate making map projections
  http://www.btinternet.com/~se16/js/mapproj.htm

1.2: Show that maps are drawn to scale and represent real landscapes

- A range of maps could be presented illustrating the scales to which maps are drawn. Candidates should be warned that scale is not easily demonstrated using a GIS, as the maps can be viewed and printed at many different sizes and so scale becomes meaningless unless a scale line is used on the same map. However, with a grid pattern of 1km in 1:50,000 maps, scale can still be shown on them. Care should be taken at other scales to identify particular distances and illustrate that by use of an appropriate scale line.
- A presentation of the scale of these maps could be put together to demonstrate how real landscapes are reflected in mapping, particularly by combining orthophotograph and maps to illustrate scale and symbols on maps.

1.3: Distinguish between maps of large, medium and small scales

- This can be done alongside 1.2 to examine maps of various scales. Large, medium and small scale are relative terms. However, most maps in an atlas

typically could be 1:5,000,000 – 1cm on the map represents 5,000,000cm or 500km on the ground: a large area shown with a small amount of detail. At one five millionth of the size of the original, it is easy to picture this map as small scale. Larger scale maps show a smaller area in much more detail, and these might be thought to include 1:10,000 maps (1cm on the map represents 100m in real life. The intermediate scale of our choice of mapping might be 1:50,000 (1cm to 500m).

- Cartographic generalisation (1.5) can be introduced here, if wished, as generalisation will have to increase as the scale gets smaller.
- Candidates could prepare a presentation with a range of maps at various scales, demonstrating that they can distinguish between large, medium and small scales.

1.4: Compare the difference between topographic, thematic and cadastral maps

- Compare the three types of maps and contrast their uses/purposes.
- *Topographic mapping* is used to show natural and human features, generally at a large scale, and usually showing relief e.g. a 1:50,000 Ordnance Survey map.
- *Thematic mapping* uses a base map to show a pattern of something which is found there e.g. a geology map, a population density or land use map, or a climate map.
- *Cadastral mapping* shows the boundaries of land ownership. Often the maps, or associated documentation, will additionally provide details about who owns the land, the area of the land parcel, the tenure and the value e.g. a Griffith's valuation map.
- Illustrate the differences. Candidates should be encouraged to research maps for themselves to come up with examples from each of these three types. These could be combined in a digital display.

1.5: Investigate the principle of cartographic generalisation

- Maps cannot remove some information in order to make that which is retained understandable, keeping a balance between the complexity of the surface being represented and the ability of the viewer of the map to understand it.
- The level of detail on the map will partly depend on the scale at which it is drawn – in a large scale map much information will have to be omitted, in a smaller scale map, less generalisation can take place.
- Generalisation can take place by selecting, simplifying, smoothing, combining elements or enhancing specific details.

- Illustrate these decisions made by cartographers is to use a digital map and zoom in on it. Use ArcGIS Explorer (http://explorer.arcgis.com/ - right-click to zoom in by increments, and shift-right-click to zoom out). In NIMaps, if you have access to that, Streetmaps category provide access to "All inc. Mastermap" which will allow you to go from a 1:5,000 up to a 1:300,000 map in increments. As the candidates follow this, they can see cartographic generalisations increase.
- Candidates could source a range of maps at various scales to show the cartographic generalisations that have to be made – less at small scales but needed there too – and display them in a digital format, or as a display.

Learning Outcome 2: Understand how maps are drawn

2.1: Recognise three common map projections and understand the advantages and disadvantages of each

- Candidates need not know how a map projection is constructed, but they can learn to recognise three common and quite different projections *(Mercator, Gall-Peters and Interrupted Mollweide)*, understand the compromises that the map makers have made to represent the curved surface on a flat piece of paper, and understand more generally that any map projection has had to distort the curved earth to produce a flat map.
- Each has advantages and disadvantages
- **Mercator's Projection** is a very early one (1569), but it is still in common use today. Directions are preserved, but areas are distorted as you move towards the poles.
- The **Gall-Peters Projection** was first developed in 1855, and taken up by Arno Peters in 1973. This map projection has preserved equal areas for places, so that countries retain their relative sizes. However, this has been at the expense of the shapes of many countries.
- The **Interrupted Mollweide** is one example of an interrupted map which makes a number of 'cuts', usually in the oceans. It was first published in 1805.
- Some people suggest that an 'interrupted' equal-area map is the best solution to the 'round world on flat paper' problem.
- Candidates could use a number of ways to demonstrate recognition of these projections and their relative merit. They could put the maps into a blog with accompanying text. Other candidates could comment on the blogs.

2.2: Investigate how a map can be drawn by survey or derived from remotely sensed data

- The earliest maps were drawn in ancient Egypt, using ropes and geometry.

- In 1791, the Ordnance Survey was established and used a theodolite to measure angles and metal chains to measure distances.
- The people in modern times who survey the land to get the information needed to create maps, surveyors, still use theodolites to help them to draw maps. Often these are used alongside GPS units to help to pinpoint their location.
- Remote sensing is the aspect of Geography and science which relates to obtaining information about the Earth from a distance. This can come from images taken by satellites (satellite imagery) or from aircraft (aerial photography). Remotely sensed data is increasingly being used by cartographers.
- An aerial photograph taken from an aircraft may not be accurate enough to be used to draw a map. It has to be adjusted (orthorectified) to ensure that it is accurate enough to be used for mapping purposes. The result is an orthophotograph.
- Even with remote sensing techniques, there may be a need to survey part of an area by people.
- Candidates could research mapping techniques of the past and more recent ones to see how maps were drawn and how increasingly they are being produced by remote sensing. A local mapping agency could be contacted to get a surveyor to come and talk to them or videoconference with the candidates.

2.3: Compare the advantages and disadvantages of maps from a national mapping agency with those from a collaborative digital mapping initiative.

- The national mapping agency in Northern Ireland is Land and Property Service (LPS), the name given to the agency of the Department of Finance and Personnel which combined the Rating Agency and Ordnance Survey Northern Ireland. This new agency has a combined responsibility for mapping, land registration, rating and valuation.
- Candidates could research these at http://www.dfpni.gov.uk/lps/. The production and use of cadastral mapping would be key to land registration, rating and valuations for example.
- One of LPS's innovations is Positional Improvement, an effort using Global Positioning Systems to ensure that detailed maps of Northern Ireland are as accurate as possible.
- The main disadvantage of mapping from national agencies is that they are often copyrighted and expensive to use.

- Collaborative mapping uses the internet to allow many people to cooperate in producing a map electronically. Examples are OpenStreetMap (www.openstreetmap.org) and WikiMapia (http://wikimapia.org).
- The main disadvantage of a free mapping tool might be thought to be that the map can easily be vandalised, but, like a Wiki, it is designed to be equally easy to fix if that happens.
- The main advantage is, at least in theory, that the map is drawn by local 'experts' who can quickly and easily amend the map to reflect changes which happen to the landscape.

2.4: Add information to a collaborative digital map to improve its quality, and then save it for other users

- Candidates should create an account and login to OpenStreetMaps, WikiMapia or another collaborative mapping site. They can then go into the Edit function and amend the map. Users should be warned that editing the map is a considerable responsibility, and they should edit the map with care. They should provide some information about areas with which they are familiar. Many parts of the world have been mapped in detail, particularly the roads. There may be names of roads yet to be added, and smaller features such as bus stops, benches may be added if appropriate. In some mapping it may be necessary to amend what is there already if inaccurate or incorrect, which would be a valid exercise here.
- Candidates should provide screendumps of the map before and after amendment, with a brief description of what has been done and why.

Learning Outcome 3: Understand the key concepts behind geographical information systems (GIS)

3.1: Describe the term GIS and the concept that underpins it

- A GIS is a computer-based information system which is used to capture, store, manipulate, analyse, manage, and present all types of information which is about ‘place’. GIS allows databases of information to be shown on maps to make it easy to see where things are happening. Examples you may wish to use include the Rivers Agency Flood map (http://www.dardni.gov.uk/riversagency/index/) or Geography, Class and Fate, concerning the Titanic at http://storymaps.esri.com/stories/titanic/index.html
- GIS allows ‘layers’ of maps to be built on each other and to be able to be switched off and on.

- Any information that has 'place' information can be used in a GIS if it is in the correct format e.g. the temperatures of places can be mapped, the location of supermarkets in a city, the pollution levels in different points along a river or the distribution of oak trees across a forest.
- Candidates could research GIS and produce a short presentation aimed at a younger audience to introduce them to GIS.

3.2: Explain some of the applications of a GIS

- A range of fairly mundane uses will quickly be apparent to learners, using the GIS to display mapping e.g. locating buried electrical cables. More sophisticated uses including the combination of maps and database information for viewing, and also for analysis should also be examined. This could be done by exploring a range of GIS applications such as those showing flood risk, crime, noise levels, route planning, archaeology, history, health, population change and more. A range of GIS programs are available, many of which will show these for the local area or for further afield.
- Look at some of the videos relating to GIS use (e.g. http://www.youtube.com/watch?v=kEaMzPo1Q7Q&feature=related) for some ideas
- Mashups, which are the combination of two or more different types of software and data, and can reasonably easily be created using GIS with databases. A range of these can be found at www.geocommons.com which can be saved as kml, shapefile, or other formats, and displayed in GIS applications. Mashups are a major growth area of GIS.
- Learners can easily envisage their own mashups, even if they have not got access to the tools or data to create them. A map showing property for sale, a map which provides access to bus locations and waiting times to be displayed at bus-stops, a map showing hotspots of common illnesses or an interactive map showing traffic congestion are just a few examples of these.
- Candidates could research and present plausible mashup ideas which would solve problems for identified individuals or groups.

3.3: Show how different maps and orthophotography can be displayed and navigated within a GIS

- In most GISs it is straightforward to change map types and to navigate in various ways
- Candidates could take a GIS and produce a short manual to describe how to change maps and display orthophotography where available and also cover a

range of ways of navigating around the mapping and orthophotography e.g. searching, panning, zooming

3.4: Demonstrate how thematic maps can be viewed within a GIS

- A thematic map can be uploaded or, if already uploaded, displayed on the GIS.
- Candidates could be encouraged to demonstrate to others a range of thematic data overlaid on maps of various scales. This could be combined with 3.2 to illustrate the usefulness of the thematic data for various individuals or groups.
- Some thematic mapping may be available as kml files for use in GoogleEarth, for example, and these can be found on the web created by individuals or organisations. Alternatively they can be created using the Thematic Mapping engine (http://thematicmapping.org/engine/).

Learning Outcome 4: Be able to use a GIS to display information

4.1: Upload two different types of spatial information to a GIS

- Whichever GIS is being used, the candidate should show that they are able to upload information onto it. This might be a photograph or a weblink, for example.
- For example, if GoogleEarth or GoogleMaps is being used, a placemark, path or polygon should be created with some a link or image and some text. Other GISs will allow different functionality, but also allow uploading of information.
- Candidates should capture screenshots of their published information.

4.2: Use a GIS to create and display a thematic map for a purpose with an audience in mind

- This may be combined with 3.4 but the emphasis here is on the **use** of the thematic map, rather than the ability to display it.
- Candidates may use a thematic map(s) to persuade or inform an audience e.g. that an area should be protected, that a supermarket should be constructed or that action needs to be taken by governments to tackle a global problem.
- The thematic map should be saved alongside text stating the audience and the purpose of the map in persuading that audience. This could be in the form of a letter, with the map attached, or in a short report format. Whatever approach is taken, the map should be explained and used to advance the argument being made.

4.3: Make conclusions based on an analysis of thematic mapping data

- Perhaps combined with 3.4 and 4.2, candidates will show that they have an understanding of what a thematic map shows, as well as understanding the implications of the spatial distribution illustrated e.g. they will be able to describe in writing, or orally, a thematic layer showing protected areas, such as ASSIs, and the impact that has on a decision to develop or not to develop a feature on the map.
- Candidates should capture the thematic mapping being used, which may be the same as 3.4 and 4.2, and their analysis, either written or digitally recorded.

4.4: Describe the advantages of displaying spatial information such as that on a thematic map, using a GIS

- This is likely to be a reflective description following the various elements of this Unit, with a range of advantages made explicit throughout.
- Candidates can do this in a written format, or as part of a presentation, for example part of the presentation that may be produced for 3.1. If a younger audience are in mind, the advantages nevertheless have to be effective, if accessible to that audience.