



GI Learner
Creating a learning line on spatial thinking

Curriculum opportunities for spatial thinking

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1 Approach of this report

The first publication of GI Learner was a review of the literature on learning lines and spatial thinking

It was important in this project to identify exactly what we want to reach, and how we can reach it. So, we must know exactly how the learning lines concept works best, and how we can fit the concepts of spatial thinking into it, taking into account age group (and connected development of brain functions).

Based on this review, in no particular order, ten geospatial thinking competences are proposed by the GI-Learner project team:

- Critically read, interpret cartographic and other visualisations in different media
- Be aware of geographic information and its representation through GI and GIS.
- Visually communicate geographic information
- Describe and use examples of GI applications in daily life and in society
- Use (freely available) GI interfaces
- Carry out own (primary) data capture
- Be able to identify and evaluate (secondary) data
- Examine interrelationships
- Synthesise meaning from analysis
- Reflect and act with knowledge

For each outcome a level of complexity has been described. In the next chapter these are described into more detail.

These are the lower anchors in a learning progression line concept that will be created in the next phases of the GI Learner project, taking existing themes common in all curricula of the countries involved as upper anchor.

To reach this in the following chapters curriculum opportunities for all countries of the GI Learner consortium have been analysed.

2 GI Learner competencies

K7-8 K9 K10 K11 K12

1	Critically read, interpret cartographic and other visualisations in different media	interpretation	A	B	C		C
	A: Be able to read maps and other visualisations	Example: use legend, symbology ...					
	B: Be able to interpret maps and other visualisations	Example: use scale, orientation; understand meaning, spatial pattern and context of a map					
	C: Be critically aware of sources of information and their reliability	Example: critically evaluate maps identifying attributes, representations (e.g. inappropriate use of symbology, or stereotyping) and metadata of the maps					
2	Be aware of geographic information and its representation through GI and GIS.	learning about	A	B	C		C
	A: Recognize geographical (location-based) and non-geographical information	Example: describe GPS, GIS, Internet interfaces; be able to identify geo-referenced information					
	B: Demonstrate that geographical information can be represented in some ways	Example: employ some different representations of information (maps, charts, tables, satellite images...)					
	C: Be critically aware that geographic information can be represented in many different ways	Example: be able to evaluate and apply a variety of GI data representations					
3	Visually communicate geographic information	produce	A		B		C
	A: Transmit basic geographic information	Example: produce a mental map, be aware of your own position					
	B: Communicate with geographic information in suitable forms	Example: basic map production for a target audience - using old and new media, Share results with target group					
	C: Be able to use GI to exchange in dialogue with others	Example: discuss outcomes like survey results/maps online or in class, referring to a problem in own environment					
4	Describe and use examples of GI applications in daily life and in society	applying	A	B	C		C
	A: Be aware of GI applications	Example: know about GPS-related/locational (social networking) applications including Google Earth; produce a listing of known GI applications or find them on the internet/cloud					
	B: Use some examples of (daily life) GI applications	Example: problem-solving oriented with GI application like navigating; use an app to read the weather, environmental quality, travel planner					
	C: Evaluate how and why GI applications are useful for society	Example: assess the functionality and use for society of a GI application (emergency services, police, precision agriculture, environmental planning, civil engineering, transport, research) and present the results					

5 Use (freely available) GI interfaces	use	A	B	C	C
A: Perform simple geographical tasks with the help of a GI interface	Example: Find your house in a digital earth browser; finding a certain location; measuring the distance between two points by different means; use applications for mobile phones (ex. GPS) to locate a place				
B: Use more than one GI interface and its features	Example: collect data and compare to set the best route from school to home and back; get a topographical map for a walk				
C: Effectively solve problems using a wide variety of GI interfaces	Example: Find and use data from various data portals (SDI) to look for the best facilities of a specific region, or for the 'best' place to live using parameters like infrastructure, noise, open spaces, ...				
6 Carry out own (primary) data capture	produce / gathering	A		B	C
A: Collect simple data	Example: gather data during fieldwork (coordinates, pictures, comments...) e.g. sound data to analyse impacts of traffic; map attractive places for children in your city				
B: Compare different qualitative and quantitative data and select an appropriate data gathering approach, tool etc.	Example: when investigating environmental factors choose what data is needed				
C: Solve issues concerning data gathering and select the most suitable alternative approaches to data capture	Example: design a methodology which explains the data collection for land use change, like how to collect data from different sources and classify them appropriately				
7 Be able to identify and evaluate (secondary) data	use / evaluate	A		B	C
A: Locate and obtain data from source maps (different visualisations)	Example: Find and download data on migration and be able to use it				
B: Acknowledge that there is different quality in data, not everything is useful	Example: Identify multiple data sources for example of population or pollution and be able to assess their level (scale), detail, frequency, accuracy and other considerations; analyse different sources and decide which is the most useful				
C: Fully assess value / usefulness / quality of data	Example: Use data on climate change from ESA, IPCC compared to Facebook graphs				
8 Examine interrelationships	analyse		A	B	C
A: Recognise that items may, or may not, be related (connected) in different ways to one another	Example: recognize simple relationships between things, e.g. heat and sunshine, or city size and traffic jams // inverse relationships // some things are not related				
B: Demonstrate interrelationships between a variety of factors	Example: changes in environment, influence, connections and hierarchy of ecosystems				
C: Valuate different relationships and judge causes and effects	Example: Evolution of ecosystems over time is complex and is related to many variables; problem-oriented exploration of interrelationships like: where do my jeans or my mobile phone come from				

9 Extract new insight from analysis	produce	A	B	C
A: Read what the analysis says	Example: understand there are different types of climate			
B: Combine elements from the analysis to make sense of the outcomes	Example: realise that climate is changing			
C: Assess the analysis in depth, create new meaning and make links to the bigger picture	Example: responding and suggest solutions on climate change			
10 Reflect and act with knowledge	action: decision making / applying in real world	A	B	C
A: Recognise the decisions that had to be made	Example: Use geodata to assess which new road system should the local authority build			
B: Judge implications for individuals and society	Example: conclude there will be winners and losers for each road proposal			
C: Design future actions to stakeholders - including themselves	Example: develop a campaign to persuade decision makers concerning traffic planning; make a blog or a website with collected and visualized data; write a documented article in a magazine using GI information			

Level of learning over the secondary school curriculum (K7-12)

Competency	K7-8	K9	K10	K11	K12
1	A	B	C	C	C
2	A	B	C	C	C
3	A		B	C	C
4	A	B	C	C	C
5	A	B	C	C	C
6	A		B	C	C
7	A		B	C	C
8		A	B	C	C
9			A	B	C
10	A		B	C	C



3 Austria

Subject	school type	year (grade)	(content) theme written in the curriculum	(methodical) skills/competencies written in the national curriculum	GI Learner Competencies	possible example	example resources needed
Geography & Economics	general education, upper secondary school	k9-12 learning principle	Didactic Principle: Use of Geographic Information Systems should be used where useful to gain better learning results.				See below
Geography & Economics	general education, upper secondary school	k9	cartography learning about and working with maps	describe, create, interpret, criticize maps	4, 6,	pupils create and edit maps using a WebGIS and free data. They learn how to apply different statistical methods, styles & scales.	GPS devices/smartphones, webGIS, data, ArcGIS institutional account
		k10	Europe (landscape, topography, climate, population, demographics incl. migration, economics, culture), European integration: How does the EU work)	learn about the topics (see E) using different media	1, 10	using Eurostat data analysing one of the topics to peers in other countries.	Web Browser, Communication platform
		k11	Austria (landscape zones, climate, population, migration, economy: national economy, taxes; disparities, tourism)	learn about the topics (see E) using different media	1, 4	pupils present their country/culture/etc & discuss results in a video-skype-session	Presentation tool (google slides/prezi), Skype, any Geomedia e.g. Storytelling tool ArcGIS online
		k12	landscape planning; globalisation; poverty; world trade system, alternative trading	learn about the topics (see E) using different media	1, 3, 4, 7, 10	pupils research „famous“ products/brands of their country >where are they developed/produced/so ld/recycled/disposed? Why? > a map could be one of the products to be discussed...	Web Browser/Geomedia & Search tool

Geography & Economics	general education, lower secondary school	k5-8	K7: learn about national/regional using satellite imagery, orthophotos, maps etc... > make a map of your school environment using google earth/maps; Centres and peripheries; K8: Europe – European landscapes & cultures K8: Centres and peripheries worldwide	Use of electronic media for active learning, especially for projects and holistic discussion of complex questions.	1, 3, 5, 7, 8, 9, 10	school environments of partner schools PLUS cultural elements of partner countries (food, agriculture, industry, tourism, internet use ...) producing maps using a questionnaire developed by pupils on different topics: What do you eat for breakfast? Parents' profession? People working in different economic sectors in your country/region? Topography, people go for holiday to...)	ArcGIS online, satellite imagery (ESA, national providers, Google Earth...) Analytic tools (AGO, QGIS) Google forms for questionnaires Navigation tools (incl. smartphones), Gaming tools such as Mr. X, Geocaching; Beginners: Google maps
Geography, history and political education	technical professional secondary schools	K9-13	practical use of GIS (K9 and k12); e.g. demographics/migration (k9)	practical use of GIS (in k9 and k12)	2,3,5,8, 9, 10		QGIS, AGO, Online-Geomedia (e.g. Eurostat)
Economic Geography	economical professional secondary schools	K9-13, Geography K9&10.	K9: Working with maps, digital tools for orientation, GIS.	K9: Working with maps, digital tools for orientation, GIS.	1,2, 4, 5,8, 10		Navigation tools (incl. smartphones), Gaming tools such as Mr. X, Geocaching; Beginners: Google maps

4 Belgium (Flanders)

The curriculum program in Flanders very detailed. As a result, much of the information in the column 'possible examples' is found in the column '(methodical) skills/competencies'.

Subject	school type	year (grade)	(content) theme written in the curriculum	(methodical) skills/competencies written in the national curriculum	GI Learner Competencies	possible example	Example resources needed
geography	general education, lower secondary school	K7-8	1.1.1 Theme 'Landscape and map'	ET 1, 2 & 4: Starting from fieldwork pupils have to <ul style="list-style-type: none"> • Use orthophotos, topographical maps, • Measure distances on maps, • Make the relationship between scale and map content, • Make a reference map of the own region, Belgium and Europe 	3	See column skills	Geopunt website: www.geopunt.be Using ArcGIS online make own maps
geography	general education, lower secondary school	K7-8	1.1.1 Theme relief	ET 13, 14: Starting from fieldwork the pupils have to <ul style="list-style-type: none"> • Use topographical maps to calculate the relief • Make relief profiles 	3	Pupils are challenged to measure a small hill, both the method and the effect	Simple theodolite, computer using spreadsheet program
geography	general education, lower secondary school	K7-8	1.1.1 Climate and vegetation	ET 17: Pupils use maps to read and interpret temperature and precipitation data	1	See column skills	Online atlases, printed atlases
geography	general education, lower secondary school	K7-8	1.1.1 Landscape exploration of Europe	From aerial photographs and satellite images distinguish between natural and cultural landscapes.			Geopunt website: www.geopunt.be Using ArcGIS online make own maps

	general education, lower secondary school	K7-8	1.1.1 Urbanisation and population	ET 1: Outgoing from satellite images and/or air and ground observations of Belgium or own region note that the landscape is a variety of open space and build up area. Structuring the complex distribution of the urbanization in the landscape habitation scattered by using orthophotos and topographic maps. Derive from the comparison of orthophotos with maps of population density the link between density of urbanisation and population. ET 26 Using maps and photos structuring large cities into a centre, agglomeration and banlieue zone.		See column skills	Geopunt website: www.geopunt.be Using ArcGIS online make own maps
Geography	general education, lower secondary school	K7-8	1.1.1 Agricultural landscapes:	ET 21: Using satellite images, landscape photos and diagram deduce the growing diversity in land use and farming types in Europe (including unproductive regions).		See column skills	Geopunt website: www.geopunt.be Has detailed information about agricultural use of parcels.
Geography	general education, lower /upper secondary school	K9-10	1.1.1 Landscapes and world map	Designate and name on a blanc map- by analysing information sources - the continents and oceans, the main relief units and rivers, the main states, the large world blocks as a knowledgeable knowledge to use.	8, 9	See column skills	Using webGIS you can make your own mental map
Geography	general education, lower/upper secondary school	K9-10	1.1.1 3 Differences between agricultural regions	Study by analysing images, maps and other information the relationship between: (ET 2, 3, 4, 6, 12, 15, 16, 17): <ul style="list-style-type: none"> • An agricultural landscape and traditional farming of Black Africa with and the natural environment and human conditions • The intensive rice cultivation and the physical conditions and population density in the Asian monsoon region • The agriculture in a region of North America and the natural conditions and human impact. 	5, 6, 8, 9	See column skills	Using webGIS or story maps like https://tinyurl.com/zuasy3y or https://tinyurl.com/k4epl83

Geography	general education, lower/upper secondary school	K9-10	1.1.1 4 Tensions and environmental problems in regions	Study by analysing images, maps and other information: <ul style="list-style-type: none"> The tensions by scarcity of water in a region of the Arab world The physical characteristics of tropical rainforest in Amazonia and the environmental impact of mining (ET 2, 3, 4, 7, 10, 11, 16). 	6, 8, 9	The study of deforestation can be done using image software available via the ESA.	Using webGIS or story map like https://tinyurl.com/lubwqbs For the rainforest a worked-out example can be found on deforestation in Rondonia, Brazil: go to https://tinyurl.com/loqay3a
Geography	general education, upper secondary school	K11-12	1.1.1.1 Cartography	A2: Suggest with a few examples that a picture or a map are a coded representation of reality A3: Illustrate with an application of GIS its importance to society.	1, 2, 4, 5	A good start is having an inflatable globe and a large (A2) sheet of paper: try to project the globe on that sheet	There are many good programs to help here, like http://www.flexprojector.com or NASA G-projector https://tinyurl.com/l7446ot
Geography	general education, upper secondary school	K11-12	Research and ICT skills	A16: Search for geographic information, organize it in a simple way using available information sources and contemporary techniques. A25: Analyse a landscape, organize the elements to a structure and draw the characteristics of the landscape.	6, 7, 8, 9, 10	Using the needed software and field work pupils can investigate	Software like ArcGIS Online, combined with the Survey 123 app to create own data.
Geography	general education, upper secondary school	K11-12	1.1.1.1 Spatial structure of Flanders - Brussels	· Study the structure of the built and open space of the own region and Flanders - Brussels using images, functional maps and statistics. (A12) · Description of current morphological and functional structure of Flanders and Brussels as a framework for further research. (A25)	5, 7, 8, 9		Using www.geopunt.be and www.cartesius.be Or http://www.geo.irisnet.be/nl/ For the morphological and functional structure using webGIS.
Geography	general education, upper secondary school	K11-12	1.1.1.1 Environmental problems in the own region	· Starting from an environmental problem in the own region finding a sustainable solution. (A13, 27, 29)	5	This is best done as a combination of field survey and data/maps	Using www.geopunt.be and own fieldwork data
Geography	general education, upper secondary school	K11-12	1.1.1.1 Spatial planning in the own region	· Starting from a problem area of tension between different users in their own environment finding a sustainable solution. (A13, 14, 26, 27, 28, 29, 30)	8, 9, 10	The spatial planning maps can be found online. Combine this with a field survey	You can import the layers of Geopunt in e.g. www.arcgis.com and thus do investigations.

Geography	general education, upper secondary school	K11-12	1.1.1 Sustainability and global shifts migration.	A7, 27: Investigate a global environmental problem using a concrete example from the media and associate the causes with socio-economic activities. A11, 27: Use examples to study of push and pull factors of population migration.	8, 9	Simple example: let the pupils investigate in their own home the origin of lots of stuff, and make with it their own 'globalisation' map	Use the webGIS ArcGIS online to create your own globalisation map, add layers. Or use existing story maps like on McDonalds https://tinyurl.com/lmpd9ne Or the globalization investigation https://tinyurl.com/lc3yq4s
Geography	general education, upper secondary school	K11-12	1.1.1.1 Plate tectonics	Explain the distribution of volcanism, earthquakes, and rock folding on the basis of plate tectonics. (A 8, 24, 25, S 2, 6, 19). Describe the relief of the ocean floor on the basis of maps and cross sections and connect with plate tectonics. (A 8, 9)	8, 9	This can be done using the printed atlas, but much easier is in a GIS environment where layers can be checked/unchecked, or made transparent, or using buffers	Using webGIS like ArcGIS online or Google earth with extra layers on it, including life data feed.
Social education (MAVO)	technical & vocational education, lower secondary	K7-8	1.1.1 City and location	4 Use street maps of a city or town <ul style="list-style-type: none"> Finding your location and/or way using the street maps. Situate on a map the community in wider area. 10 Scope some important places on a map of the area. 12 Determine with a map the location of adjacent towns over their own city by the wind directions.	3, 5		Using Geopunt or route planners
Social education (MAVO)	technical & vocational education, lower secondary	K7-8	1.1.1 Class and school	9 Find its way into the school. Orientation Exercise in reality and on a (digital) map	5, 2	Using route planners	http://maps.google.be
Social education (MAVO)	technical & vocational education, lower secondary	K7-8	1.1.1 Mobility	2 Indicate traffic hazard in the vicinity of the school. 11 Mentioning a few mobility problems and formulate a proposal for resolution.	5, 6, 8, 9, 10	Pupils can collect own data during a field survey (using apps or printed maps), this	Using survey apps like Survey123 – connects with ArcGIS online to visualize the collected data.

						info is then put on a (online) map	
Economy	general education, upper secondary school	K9-10	1.1.1 Theme 5: Production for the world market.	<p>The pupils can</p> <ul style="list-style-type: none"> • Identify reasons for companies to establish themselves in other countries. • Indicate advantages and disadvantages of the presence of foreign companies for the host country. 	8, 5	<p>See column skills</p> <p>Pupils can do a survey asking companies their reasons of location</p>	<p>A nice story map about the biggest ports:</p> <p>https://tinyurl.com/ly8n89p</p>



5 Romania

Subject	School type	year (grade)	(content) theme written in the curriculum	(methodical) skills/competencies written in the national curriculum	GI Learner Competencies	Possible example	Resource example need needed
Geography	General education, lower secondary school	10 - 11 years old K7	Representations of the Earth's surface	1.2 Recognize and use correctly geographical terminology 3.1. Transfer content & knowledge from Maths & Science 4.2. Use conventional signs 4.3. Use geographical graphical elements correctly in specific cartographical representations 4.4. Use of simple graphical representations	1, 2,3,5	Mapping Apply concepts Using different types of maps	Computer generated maps ArcGIS Map Creator Google Earth Satellites Images
Geography	General education, lower secondary school	K7	Tectonics: Earthquakes & Volcanos	1.1. Recognition of geographical terms in different texts 1.2. Expressing, in their own words, the meaning of basic geographical terms 1.3. Using basic geographical terms in similar or different (new) contents 3.1. Transfer content & knowledge from Maths & Science 3.2. Identify connections between noticeable elements, phenomena & processes 3.4. Describe the planet Earth components structure 3.5. Explain the relationships between perceivable reality and natural sciences phenomena 4.2. Use conventional signs 4.3. Use geographical graphical elements correctly in specific cartographical representations 4.4. Use of simple graphical representations 5.1. Make researches using internet and databases	1, 2, 3, 5, 7, 8, 9	Use maps and digital/computer mapping	http://www.gplates.org/ GPlates 2.0 iPhones ArcGis

Geography	general education, lower secondary school	K7	Climate: Local weather Temperatures & Precipitations	<p>1.1. Recognition of geographical terms in different texts</p> <p>1.2. Expressing, in their own words, the meaning of basic geographical terms</p> <p>3.1. Transferring elements of Math and science in Geography, for understanding and describing the characteristics of the planet as a whole</p> <p>3.2. Identifying links between elements, observable phenomena and processes</p> <p>3.3. Explaining phenomena and processes specific to the local environment and the planet</p> <p>3.5. Explaining the links between reality and phenomena observed in natural sciences</p> <p>4.2. Use conventional signs</p> <p>4.3. Use geographical graphical elements correctly in specific cartographical representations</p> <p>4.4. Use of simple graphical representations</p> <p>5.1. Identify geographical information from different data bases on Internet</p> <p>7.4. Information processing: filling a table with data derived from other sources</p>	2, 4, 5, 7, 10	<p>Mapping and spatial modelling</p> <p>GIS climate Change Scenarios</p>	<p>WorldClim Apps</p> <p>NOAA</p>
Geography - Ecology	general education, lower secondary school	K7/ K8	Biosphere & Biodiversity conservation	<p>1.3. Using basic geographical terms to already known or new contexts</p> <p>3.2. Identifying links between elements, observable phenomena and processes</p> <p>3.3. Explaining phenomena and processes specific to the local environment and the planet</p> <p>3.4. Configuration of the natural components of the planet as a whole and the local environment</p>	1, 3, 4, 5, 8, 10	<p>Collect information</p> <p>Use Free GIS data portal</p>	<p>ArcGIS</p> <p>YouTube</p> <p>Mind Maps</p> <p>Google Map</p>

				<p>3.5. Explaining the links between reality and phenomena observed in natural sciences</p> <p>7.2. Using simple methods of investigation (observation, analysis, interpretation)</p> <p>8.1. Finding solutions for environmental protection locally or geographically distant areas</p>			
Geography - Ecology	general education, lower secondary school	K10	Human Geography: Human Population	<p>1.1. Recognition of geographical terms in different texts</p> <p>1.2. Expressing, in their own words, the meaning of basic geographical terms</p> <p>2.1. Recognition of names and geographical terms in foreign languages</p> <p>3.1. Transferring elements of Math and science in Geography, for understanding and describing the characteristics of the planet as a whole</p> <p>3.2. Identifying links between elements, observable phenomena and processes</p> <p>3.6. Using elementary mathematical operations and concepts</p> <p>4.1. Identifying the main natural and socio-economic elements and interests represented on a map</p> <p>4.2. The use of symbols</p> <p>5.1. Identifying information geographically in databases accessible via the Internet</p> <p>6.2. Explaining human and natural diversity of the world making correlations with information acquired from other subjects</p>			<p>ArcGIS</p> <p>Worldometers http://www.prb.org/</p> <p>http://www.worldpopdata.org/index.php/map</p>
Geography - Economy	general education, lower secondary school	K8	Europe tourism: general features	<p>1.1. Recognition of geographical terms in different texts</p> <p>1.3. Using basic geographical terms to already known or new contexts</p>			

				<p>3.2. Identifying links between elements, observable phenomena and processes</p> <p>3.5. Explaining the links between reality and phenomena observed in natural sciences</p> <p>4.2. The use of symbols</p> <p>4.3. Proper mapping of specific geographical elements</p> <p>7.1. Applying knowledge of the acquired skills</p> <p>7.4. Information processing: filling a table with data derived from other sources</p> <p>7.5. Ordering of items, phenomena and processes using different classification criteria: quantitative, qualitative and territorial</p>			
Geography	general education, lower secondary school	K7	Natural resources	<p>1.2. Expressing, in their own words, the meaning of basic geographical terms</p> <p>3.2. Identifying links between elements, observable phenomena and processes</p> <p>3.4. Configuration of the natural components of the planet as a whole and the local environment</p> <p>3.5. Explaining the links between reality and phenomena observed in natural sciences</p> <p>4.1. Identifying the main natural and socio-economic elements and interests represented on a map</p> <p>4.4. Using simple graphic representations</p> <p>5.1. Identifying information geographically in databases accessible via the Internet</p> <p>7.2. Using simple methods of investigation (observation, analysis, interpretation)</p> <p>7.5. Ordering of items, phenomena and processes using different classification</p>			

				criteria: quantitative, qualitative and territorial			
Ecology - Geography	general education, lower secondary school	K9	Vegetation & Climate of Europe	<p>1.1. Recognition of geographical terms in different texts</p> <p>3.2. Explaining specific natural and human phenomena and processes of the Geography of Europe</p> <p>3.3. Configuration of geographical components of Europe, its regions and countries</p> <p>3.4. Comparative analysis of the European geographic reality after the required characteristics, establishing similarities and differences</p> <p>5.1. Identifying information geographically on Europe in databases accessible via the Internet</p> <p>5.2. Presenting geographical characteristics of countries based on data accessed via the Internet</p> <p>7.7. Explaining the relationships between groups of elements, phenomena and processes of geographic environment</p>			
Geography		K9	Energy resources & Natural and socio – economic differences				
Geography & Economy & History		K9	Administrative division of Romania	<p>1.2. Expressing, in their own words, the meaning of basic geographical terms</p> <p>3.3. Configuration of geographical components of Europe, its regions and countries</p> <p>4.2. Map reading and proper use of symbols</p> <p>4.3. Correct positioning of geographic elements on cartographic representations of Europe</p>			

				4.4. Using simple graphic representations illustrating elements of geography of Europe 5.1. Identifying information geographically on Europe in databases accessible via the Internet			
Geography & Biology		K10	Elements of sustainable development				
Geography	general education, upper secondary school	k 9-12	k10 - Global Population k12 Europe Population	exposure, questioning, modelling, interactive methods	3. Produce / Visually communicate geographic information 1. Critically read, interpret cartographic displays in different media	pupils can create layers in gis-software on the natural dynamic and geodemographic structure, or simply analyse the thematic maps that are already created.	
Geography - Biology - Ecology	general education, upper secondary school	k 9-10-11	Types of environment	exposure, questioning, modelling, interactive methods, harmonizing the content elements of the thematic maps	4. Describe and use examples of GI applications in daily life and in society 9 Synthesise meaning from analysis	pupils can map or create different layers of vectors or rasters of the species distribution on a specific area / the wet and flooding area for a map of risk / the climate parameters interfering on a specific area	
Conservation Biology	general education, upper secondary school	9 - 10	Preservation of biodiversity	modelling, interactive methods, field work	8. Examine complex and changing interrelations hips, 3.	Pupils can gather data on the distribution of endangered species and of suitable habitats for them, and carry out gap	

					Produce/Visually communicate geographic information	analyses in order to protect significant plant and animal species	
Biogeography - Biology - Ecology	general education, lower secondary school	5,8	Terrestrial Ecosystems	Investigate local forests, Create dot density maps of beech, oak, pine, maple	6. Carry out own (primary) data capture, 7. Be able to identify and evaluate (secondary) data, 3. Produce/Visually communicate geographic information 2. Be aware of geographic information and its representation through GI and GIS. 9 Synthesise meaning from analysis	Pupils can carry out fieldwork studies in local forests, gather required information and create dot distribution maps of the most relevant/ rare tree species	

6 Spain

Subject	school type	year (grade)	(content) theme written in the curriculum	(methodical) skills/competencies written in the national curriculum	GI Learner Competencies	possible example	example resources needed
Geography & History	general education, lower secondary school	K7	Earth representation. Latitude. Longitude	Classify and distinguish map types.	1, 2,3, 4	Analyse a time zone map. Locate a place on a map with coordinates.	webGIS, data, ArcGIS online, IDEE (Spanish Spatial Data Infrastructure)
Geography & History	general education, lower secondary school	K7	Relief: components and landforms		1, 2,3, 4	Locate on a physical map ranges of relief in Spain, Europe and the world. Describe relieve zone.	webGIS, data, ArcGIS online, IDEE (Spanish Spatial Data Infrastructure)
Geography & History	general education, lower secondary school	K7	Physical Geography: Spain, Europe and World: relief, hydrography, climate, diversity landscapes, bioclimate zones, environmental, environmental problems.	Elaborate and comment climate diagrams. Students geo-inquiry on evolution in European ecosystems	1, 2,3, 4	Analyse and compare bioclimatic zones. Classify climatic zones in Europe.	webGIS, data, ArcGIS online, IDEE (Spanish Spatial Data Infrastructure)
Geology	general education, lower secondary school	K7	Ecosystems	Identify ecosystems factors	1,2,5	Identify ecosystems characteristics and unbalances	webGIS and Maps on several viewers
Geography & History	general education, lower secondary school	K8	Population: Analyse migrations movement on the last three decades. European population and development areas in the world.	Explain Spanish population and Autonomous Communities pyramid.	1, 2,3, 4, 5	Make and explain the picramide of your municipality. Evaluate flows and volumes of international trade from data, charts, maps. It can be done the same with migrations.	AGOL
Geography & History	general education, lower secondary school	K8	Settlements: distinguish rural and urban elements	Compare low densities places and high-density places	1, 2,3, 4, 5	Comment an image of a rural and of an urban landscape	Google Earth, ArcGIS Earth, AGOL, Iberpix (Spanish National Geographical Institute viewer)

Geography & History	general education, lower secondary school	K8	Landscapes	Compare human landscapes according to their economic activity. Locate natural Spanish landscapes	1, 2,3, 4, 5	Interpret landscapes from remote sensing images	Google Earth, ArcGIS Earth, AGOL, Iberpix (Spanish National Geographical Institute viewer)
Geography & History	general education, lower secondary school	K8	Urbanization	analyse, identify, understand, apply to Spanish, European and World cities,	1, 2,3, 4, 5	Locale autonomous communities' capitals and the twenty more populated cities in the world.	Google statistical data, AGOL, SIGNA (Spanish GIS of the National Geographical Institute)
Geography & History	general education, lower secondary school	K9	Human activities: productive areas	Locate on a map: crops, mines, energy and industrial production.	1to 8	Create an itinerary following a product from its production to its consume	statistical data, AGOL, SIGNA (Spanish GIS of the National Geographical Institute)
Geography & History	general education, lower secondary school	K9	Systems and economic sectors	Compare active population in economic sectors and analyse country development. Elaborate different types of graphics with economic information.	1to 8	Compare consume characteristics of two countries.	Google Data Explorer. Gap Minder
Geography & History	general education, lower secondary school	K9	Sustainable development	Define sustainability development	1to 8	Search different sustainable development policies	Eye on earth; OSE (sustainable development observatory); Sustainable Development Goals
Geography & History	general education, lower secondary school	K9	Energy and natural resources	Identify alternative energy sources	1to 8	Compare two different alternative energy plants. Which countries have more wind power in the world?	Global Wind Energy Council http://www.gwec.net/global-figures/interactive-ma
Geography & History	general education, lower secondary school	K10	European integration, international conflicts, globalization, spatial impact of technological development	understand, apply, explain, analyse, evaluate	1to 8	Gathering data and elaborate geoinformation for debate on issues of the present world	statistical data, AGOL,
Biology & Geology	general education, upper	K10	Plate tectonics	understand what plate tectonics is	1,2,3	Make a topographic profile	Virtual globes and viewers with plate tectonics information

	secondary school						
Biology & Geology	general education, upper secondary school	K10	Ecology	understand, apply, explain, analyse, evaluate ecology concept	1 to 8	Identify ecology systems	statistical data, AGOL, IDEE, Iberpix, SIGNA
Biology & Geology	general education, upper secondary school	K11	Biodiversity	understand, apply, explain, analyse, evaluate biodiversity concept	1 to 10	Identify consequences on the loss of diversity	Images, map viewers (e.g. Web Maps), statistics
Biology & Geology	general education, upper secondary school	K11	Plate Tectonics	Understand plate tectonics theory	1 to 8	Identify plate tectonics borders and its consequences	Virtual globes and viewers with plate tectonics information
Economy	general education, upper secondary school (non-compulsory)	K11	Macroeconomy. Economic imbalances.	understand, apply, explain, analyse, evaluate macroeconomy indicators	1 to 10	Identify economic imbalances	Statistical data, European and world data map viewers (e. g. Eurostat)
Spanish Geography	general education, upper secondary school	K12	Analyse and identify the forms of representation of Our Planet: The Map in Spain. Locate places in Spain using Geographic Coordinate Data	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Locate a place in Spain on a map with coordinates accurately.	statistical data, AGOL, IDEE, Iberpix, SIGNA
Spanish Geography	general education, upper secondary school	K12	Relief in Spain	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Make a relief profile. Obtain Spanish bioclimatic regions on the SDI from MAGRAMA	statistical data, AGOL, IDEE, Iberpix, SIGNA
Spanish Geography	general education, upper secondary school	K12	Diversity of climates in Spain and vegetation	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Students geo-inquiry: impact of climate change in Spain	statistical data, AGOL, IDEE, Iberpix, SIGNA

Spanish Geography	general education, upper secondary school	K12	Hydrography	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Search for a hydrograph and make comments. Identify differences from north Spain rivers and other rivers	statistical data, AGOL, IDEE, Iberpix, SIGNA
Spanish Geography	general education, upper secondary school	K12	Natural landscapes	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Collect photos form PNOA about different natural landscape. Make an organize comment on it	statistical data, AGOL, IDEE, Iberpix, SIGNA
Spanish Geography	general education, upper secondary school	K12	Population	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Compare a satellite image the night and day world during and see where people use to live.	statistical data, AGOL, IDEE, Iberpix, SIGNA, Earth at Night 2012: http://earthobservatory.nasa.gov/Features/NightLights/page3.php
Spanish Geography	general education, upper secondary school	K12	Rural geography and primary sector	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Collect photos form PNOA about different rural settlements. Make an organize comment on it	statistical data, AGOL, IDEE, Iberpix, SIGNA
Spanish Geography	general education, upper secondary school	K12	Industry and power sources	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Describe spatial clusters of industrial production in Spain	statistical data, AGOL, IDEE, Iberpix, SIGNA
Spanish Geography	general education, upper secondary school	K12	Sector services	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Make and comments charts and maps that show the importance of tourism in Spanish economy	statistical data, AGOL, IDEE, Iberpix, SIGNA
Spanish Geography	general education, upper secondary school	K12	Spanish cities and urban space	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Analyse urban structure of Spanish cities and explain the cycles of urban extension	statistical data, AGOL, IDEE, Iberpix, SIGNA

Spanish Geography	general education, upper secondary school	K12	Administrative and territorial organisation in Spain. Spatial imbalances	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Compare more and less dynamic regions in Spain and explain the spatial processes	statistical data, AGOL, IDEE, Iberpix, SIGNA
Spanish Geography	general education, upper secondary school	K12	Spain in the European and global world	understand, apply, explain, analyse, evaluate geographical information	1 to 10	Explain why Spain takes advantages of integration in European Union and international organisations	statistical data, AGOL, IDEE, Iberpix, SIGNA
Earth Sciences	general education, upper secondary school (non-compulsory)	K12	Sustainable development	aware on resources limits	1 to 10	Explain sustainable development with a relevant example	statistical data, presentation programme (PowerPoint, Prezi, Sway...)

7 United Kingdom

This process involved a search for where GI is explicitly mentioned in curriculum documentation, or where its use is inferred by the tasks that have been suggested for students to complete.

In the UK, there are curricula for England, Wales* and Scotland, and also further curriculum documents for Northern Ireland. There are some similarities between the documents, but also differences in emphasis.

This document starts with England, and then adds in elements from Scotland, Wales and Northern Ireland where there are new emphases which can be explored.

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Subject	School type	Year (grade)	(content) theme written in the curriculum	(methodical) skills/competencies written in the national curriculum	GI learner competencies	Possible examples	Needed tools
Geography	general education, primary	k3--4	Interpret a range of sources of geographical information, including maps, diagrams, globes, aerial photographs and Geographical Information Systems (GIS)	Part of the Aims of the curriculum, and as a follow up from fieldwork	1,2,3,4,5	Exploring the local area and discussing activities in the local area. Global exploration. Comparisons between countries.	Mapping Digimap for Schools is a subscription service used in thousands of schools.
Geography	general education, primary	k4--5	Communicate geographical information in a variety of ways, including through maps, numerical and quantitative skills and writing at length.	Geographical skills	1,2,3,4,5	Mapwork and map skills units. Designing maps to follow a route e.g. route to school.	Mapping, including Ordnance Survey Mapping. Digimap for Schools is a subscription service used in thousands of schools Google Earth Scribblemaps and similar online mapping tools which allows students to create layers. ArcGIS Online may be a little advanced at this age, but a Story Map would enable sharing of information which could be collaborative.

Geography	general education, primary	k3--4	Use world maps, atlases and globes to identify the United Kingdom and its countries, as well as the countries, continents and oceans studied at this key stage	Geographical skills	1,2,3,4,5	Unit on the UK, possibly connected with its relationship to the EU	Maps, including Ordnance Survey mapping. Google Earth Globe Various atlases
Geography	general education, primary	k3--4	Use simple compass directions (North, South, East and West) and locational and directional language [for example, near and far; left and right], to describe the location of features and routes on a map	Geographical skills	1,2,3,4,5	Compass work, including the local area and work on the school grounds	Digimap for Schools is a subscription service used in thousands of schools
Geography	general education, primary	k3--4	Use aerial photographs and plan perspectives to recognise landmarks and basic human and physical features; devise a simple map; and use and construct basic symbols in a key	Geographical skills	1,2,3,4,5	Aerial photography analysis	Digimap for Schools is a subscription service used in thousands of schools, which includes the ability to compare maps and aerial imagery. Also use free tools such as Where's the Path
Geography	general education, primary	k5--6	Use maps, atlases, globes and digital/computer mapping to locate countries and describe features studied	Geographical skills	1,2,3,4,5	Compass work, including the local area and work on the school grounds	GIS packages, which can include the Scottish Map Library which has released old maps at different scales http://maps.nls.uk/
Geography	general education, primary	k5--6	Use the eight points of a compass, four and six-figure grid references, symbols and key (including the use of Ordnance Survey maps) to build their knowledge of the United Kingdom and the wider world	Geographical skills	1,2,3,4,5	Compass work, including the local area and work on the school grounds	OS Maps - Digimap for Schools

Geography	general education, primary	k5--6	Use fieldwork to observe, measure, record and present the human and physical features in the local area using a range of methods, including sketch maps, plans and graphs, and digital technologies.	Geographical skills	1-7 at this age, but with the potential to develop more by the time students are at k10-12	Fieldwork is an important component of Geographical study.	Fieldwork opportunities. Geographical enquiry. http://maps.nls.uk/ The Geographical Association and Field Studies Council provide guidance in this area.
Geography	general education, secondary	k7-9	Students need to be competent in the skills needed to interpret a range of sources of geographical information, including maps, diagrams, globes, aerial photographs and Geographical Information Systems (GIS)	Geographical skills	1-7	This would come into the majority of units potentially.	Digimap for Schools is a subscription service used in thousands of schools
Mathematics	general education, secondary	k7-9	Pupils should be taught to interpret and present data using bar charts, pictograms and tables, and interpret data presented in many contexts.	Representation of information, possibly GI	1-5	This would include the visualisation of data from mathematical examples, or as a result of some investigation e.g. sampling a population, carrying out surveys etc.	A range of GI tools, including online tools e.g. Chartico to generate maps which could be positioned within Google Earth or other free GI tools.

Science	general education, secondary	k7-9	The principal focus of science teaching in key stage 1 is to enable pupils to experience and observe phenomena, looking more closely at the natural and humanly-constructed world around them. They should be encouraged to be curious and ask questions about what they notice. They should be helped to develop their understanding of scientific ideas by using different types of scientific enquiry to answer their own questions, including observing changes over a period of time, noticing patterns, carrying out simple comparative tests, and finding things out using secondary sources of information. They should begin to use simple scientific language to talk about what they have found out and communicate their ideas to a range of audiences in a variety of ways.	Representation of information, possibly GI if Earth Science	1-5	Exploration of some Earth Science topics. Visualisation of locations where scientific processes occur.	Free GI tools., including Google earth Representations of weather data e.g. WindyTV, Null School, Ventusky
Computing	general education, secondary	k7-9	Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users	Representation of information, possibly GI			Mapping tools with an API

Computing	general education, secondary	k7-9	Create, re-use, revise and re-purpose digital artefacts for a given audience, with attention to trustworthiness, design and usability	Representation of information, possibly GI			Mapping tools with an API
Geography	general education, secondary	k7-9	In England and Wales, there are externally validated assessments which take place at the end of K10 and K12 These are operated by Awarding Bodies (ABs) The specifications include guidance on the use of particular GI tools which vary.				Google Earth Digimap for Schools Many schools are looking at ArcGIS Online, and apps such as Collector which allow for the data to be collected in the field by students.

Specification Documents

E.g.

AQA Specification A for GCSE Geography: can be downloaded from <http://filestore.aqa.org.uk/subjects/AQA-9030-W-SP-14.PDF>

States:

GIS and Alternative Futures In studying this specification there are many opportunities for the use of Geographical Information Systems and for candidates to be made aware of Alternative Futures. GIS involves the use of a range and variety of resources to locate, capture and manage data and information for the study of geographical concepts and issues; these include satellite images, remote sensing and maps on various scales, websites, software and other modern technologies.

This provides guidance on where GI can be used to teach particular topics

Opportunities for the use of GIS in this section include:

Forecasting earthquakes & volcanoes
Hazard mapping.

E.g. for Plate Tectonics

Similar guidance appears for the other specification documents, which are produced by Edexcel, OCR, WJEC and CCAC

Also, MYP and IB Geography specifications will have guidance on the use of GI