



Report on opportunities to use GIS in curricula

iGuess Project

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1 Summary

GIS can be used in a wider range of educational subjects than we imagine. As an example the curricula of the VVKSO (secondary education in Flanders) have been analysed.

The following list is an overview of the different learning objectives in which GIS offers opportunities. It is based solely on these learning objectives, without the ability to list of project work or transdisciplinary content.



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2 Geography

This is the most useful subject for GIS.

The curriculum specifies that in the course of geography, you can hardly make a distinction between knowledge, skills and attitudes. As a result there are 5 important learning lines:

- Fieldwork
- Working with visual material (image, graphs, video)
- Working with maps
- Working with statistics
- Construction of knowledge

Three of these learning lines deal directly with GIS, whilst fieldwork uses GIS for preparation and/or processing.

And of course all maps of the atlas can be visualized using GIS, offering more possibilities for cross-linking of different subjects.

2.1 First grade (age 12-14)

GIS in the first grade can be used for following subjects:

2.1.1 Reference maps

The curriculum specifies these maps for the own region, Belgium and Europe, and stipulates literary the terms 'points, lines and polygons'.

2.1.2 Theme 'Landscape and map'

- *ET 1, 2 & 4: Starting from fieldwork pupils have to*
 - *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.*

2.1.3 Theme relief

- *ET 13, 14: Starting from fieldwork the pupils have to*
 - *Use topographical maps to calculate the relief,*
 - *Make relief profiles.*

2.1.4 Surface rocks, soils and underground

- *ET 10: Using thematical maps of soils and surface rocks pupils learn the different regions of Belgium.*
- *ET 28: Determine the ecological and landscape impact of exploitations.*

2.1.5 Climate and vegetation

- *ET 17: Pupils use maps to read and interpret temperature and precipitation data.*
- *ET 19, 20: They are able to distract the major vegetation and climate zones from these data.*

2.1.6 Urbanisation and population

- *ET 1: Starting 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 built-up area.
Structure the complex distribution of the urbanization in the landscape habitation scattered by using orthophotos and topographic maps.*
- *Derive the link between density of urbanisation and population from the comparison of orthophotos with maps of population.*
- *Structure the European metropolis, based on aerial photographs and maps.*
- *ET 26: Structure large cities into a centre, agglomeration and banlieu zone using maps and photos.*
- *ET 15, 22: Identify the environmental impact of a concentration of economic activity using landscape images, maps, text and statistical sources.*

2.1.7 Landscape exploration of Europe

- *ET 1: Distinguish between natural and cultural landscapes from aerial photographs and satellite images .*

2.1.8 Touristic landscapes

- *ET 4: Situate the observed tourist regions and different forms of tourism on a thematic map.*
- *ET 19, 20, 34: Find the link between the tourist destination and the natural and/or attraction to human factors and the accompanying factors, using maps, brochures, images ... for a tourist region in Europe.*
- *ET 35, 36: Study the impact of tourism on the landscape, environment and the economy using landscape images, text resources and statistics.*

2.1.9 Agricultural landscapes

- *ET 21: Deduce the growing diversity in land use and farming types in Europe (including unproductive regions) using satellite images, landscape photos and diagram.*
- *ET 19, 21: Study the link between farm types and physical conditions in an area with physical limitations in Europe.*
- *Study the relationship between farm type, company size and population density in an area with few physical limitations (in Europe or Belgium or its living space).*

2.2 Second grade (age 14-16)

In the second grade the pupils' natural environments and different types of study space are analysed through the study of regions and regional related issues, through which students learn to see simple and more complex relationships. This regional and thematic approach is underpinned by a common world reference and a series of world maps. Through regional studies the world is refined step by step and for certain aspects of land one can work towards a global synthesis.

Because of this content this is again the most appropriate course for using GIS.

2.2.1 Landscapes and world map

- *By analyzing information sources, situate the continents and oceans, the main relief units and rivers, the major states, the major blocks on the map (ET 1, 16, 17).*
- *Using images, a simplified year isotherms map, a simplified year isohyets map and some climatograms, derive the main features of the major vegetation zones and climate zones of the earth and situate on climate and vegetation maps (ET 1, 3, 16).*
- *Describe and read the differences on the world maps of population distribution and degree of development (ET 1, 16).*

2.2.2 Development opportunities through tourism

- *Describe a popular holiday destination in a developing country by analyzing images, maps and other information from the tourist landscape (ET 3, 6, 12, 15, 18).*

2.2.3 Differences between agricultural regions

- *By analyzing images, maps and other information, study the relationship between (ET 2, 3, 4, 6, 12, 15, 16, 17):*
 - *An agricultural landscape and traditional farming area in Africa 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.*

2.2.4 Tensions and environmental problems in regions

- *Study by analyzing images, maps and other information:*
 - *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).*

2.2.5 Compare the facet maps.

- *At the end of each theme a 'facet map' is constructed. This can be done with GIS.*
 - *As synthesis on a world map the studied facet cards are related to:*
 - *The differences in population distribution*
 - *The differences in level of development (ET 1, 2, 16, 17).*

2.2.6 Choice themes

- *Carry out independently an adjusted and limited geography research supported by ICT (ET 13, 15, 16, 18).*
- *Discuss a development project in relation with the physical and human geographical features by analyzing images, maps and other information(ET 3, 4, 5, 11, 12, 14, 15, 18).*

2.3 Third Grade (age 16-18)

Except for the part of cosmography all other subjects of the curriculum will have added value using GIS.

2.3.1 Cross Theme objectives

2.3.1.1 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.*

This is perfectly possible in the theme 'Urbanisation as spatial planning', since a lot of materials are available via local governments.

2.3.1.2 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 into a structure and draw the characteristics of the landscape.*

2.3.2 Urbanisation and spatial planning

This theme is divided into different items. As mentioned before a lot of GIS material and data (via on line applications and as downloadable data sets) is available.

2.3.2.1 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)*

2.3.2.2 Urbanization processes and problems in Flanders - Brussels

- *Examine how the Flemish government tries to solve urbanization and other spatial problems via land use planning. (A13, 15, 29)*

2.3.2.3 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)*

2.3.2.4 Environmental problems in the own region

- *Starting from an environmental problem in the own region finding a sustainable solution. (A13, 27, 29)*

2.3.3 Atmosphere

Using image overlays together with weather plots and data of society can be a very useful instrument using GIS.

- *A5, 20: Starting from the examination of a Western European satellite weather, prove the usefulness for society.*
- *S17: Using current and historical sources, distract the characteristics of ENSO (El Niño and Southern Oscillation).*
- *S 3, 14, 17, 19, 22: Understand that ENSO is a combination of many factors that may cause La Niña and El Niño in turn.*

2.3.4 Sustainability and global shifts

This theme gives a lot of opportunities for using GIS, as the items described by the learning objectives describe a wide variety of subjects.

- *A7, 27: Investigate a global environmental problem using a concrete*

example from the media and associate the causes with socio-economic activities.

- *A10, 27: Causes and solutions of food inequality traced and linked with demographic trends and wealth disparities.*
- *Associate the stress production - consumption for energy and mining with differences in demographic trends and wealth disparities.*
- *A7, 10, 27: Use the concept of ecological footprint to suggest the uneven regional pressure on the sustainability of the earth and demonstrate sustainable solutions.*
- *A11, 27: Use examples to investigate the effects of globalization from socio-economic or political position.*
- *A11, 27: Use examples to study of push and pull factors of population migration.*

2.3.5 Construction and demolition of physical landscapes

2.3.5.1 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)*

2.3.5.2 Comparative study of 2 regions

- *Describe 2 regions in Belgium by connecting them with geological structure, lithology and geomorphologic processes. (A 9, 24, 25, S 3, 6, 29)*

2.3.5.3 Geographical excursion

- *From field observations and maps (geology, soil and topography) explain the relief region by associating with geomorphologic processes, geological structures and lithology. (A 9, 24, 25, S 29)*

2.3.6 Soils

2.3.6.1 Soils in Belgium

- *From field observations and/or mapping, describe and examine the relationships between soil, climate and vegetation. (S2, 14)*

3 History

3.1 First grade

Part of the curriculum uses space as the area where history takes place.

3.1.1 Concepts of space (R1)

Pupils:

- – R1.1 has notion of space (level knowledge)
- – R1.3 can use concepts of space in the context of the studied civilizations; (level application/skills)
- – R2.3 can, using the reference and/or the studied society, give an example of
 - Open and closed space,
 - Urban and rural society
 - Continental and maritime perspective,
 - Centre and periphery,
 - Near and far away. (15)

3.2 Second grade

3.2.1 Historical knowledge

- *The students can systematically make connections between the dimensions time, space and sociality, among the various domains within the sociality between the history of our regions and general European history, Western culture and non-Western cultures, the contemporary problems of life and the past (E2, 5, 8, 9, 13) (E2, 5, 9, 10, 11).*

3.3 Historical Skills

- *Accountability and criteria*
The ability to situate in time (on a timeline), the precise geographic location (on a map) and the applicable social areas.

3.3 Third grade

In this grade the emphasis lies on understanding the contemporary world from a master of historical frames of reference, an exemplary application of historical research methods to evolving societal problems, reflecting on the underlying human and world views, acting with conscious of values.

Using GIS can help interpreting and understanding.

4 Informatics:

4.1 First grade

In the first grade pupils receive a basic knowledge of informatics, mainly using the OS and an office package.

The following learning objectives are interesting for GIS:

- *Pupils have positive attitudes towards ICT and are prepared to use ICT to support them in learning.*
- *The pupils can use ICT for searching, processing and retention of digital information.*
- *The pupils can use ICT in the presentation of information to others.*

4.2 Second grade

The general objectives require:

- *3.3 Acquiring basic practical skills in using the computer, the system and some key application programs;*
- *3.4 Development of problem solving through design and description, for alleged problems;*
- *3.5 Analyse problems and formulate a structured solution. This includes:*
 - *Regardless of the simplicity or complexity of a problem, analyse the problem and before proceeding to the realization of a solution, at least for them the principle of formulating a solution. "Think first, act later";*
 - *Self-reliance and self-reflection (metacognition) in order to independently develop solutions;*
 - *Persistence in seeking to develop and implement a solution;*
 - *Develop a more critical attention the results of certain operations, check and correct if necessary.*

5 Social education (MAVO)

This is a course in some technical and in vocational schools; it is more or less a combination of geography and history.

5.1 First grade

Out of the list with learning objectives these are the ones where GIS can be useful as a learning or demonstration tool:

5.1.1 City and location

- *4 Use street maps of a city or town*
 - *Finding your location and/or way using the street maps.*
 - *Situate on a map the community in a wider area.*
- *10 Scope some important places on a map of the area.*
- *12 Determine with a map the location of adjacent towns of their own city by the wind directions.*

5.1.2 City and community in the past and present

- *1 Understand the composition of the population of a municipality or a city.*
- *2 Distinguish different groups in a multicultural society.*
- *12 Read the main functions of a city.*

5.1.3 Class and school

- *9 Find its way to school. Orientation Exercise in reality and on a (digital) map.*

5.1.4 Mobility

- *2 Indicate traffic hazard in the vicinity of the school.*
- *11 Mention a few mobility problems and formulate a proposal for solution.*

5.2 Second grade

5.2.1 ICT

PAV indicates the daily aspects of information and communication technology as increasingly entwined with daily life.

This may include:

- *Working with text or data (numerical or otherwise) through a computer;*
- *New features to communicate with each other to act (whether or not the*

- computer);
- *Through electronic systems (maps) data retrieval, making themselves known, business registration, access to...*

More precisely the program states the following learning objectives that can be done using GIS:

- *1 Find, select and use under supervision relevant and accessible information about*
 - *Search Strategies*
 - *Selection Strategies*
 - *Information and Communication Technology (ICT)*
- *3 Locate, orient and move through the use of appropriate information. (1, 12, 14, 32)*

5.2.2 Spatial consciousness in practical situations

One learning objective is ideal for using GIS:

- *33 Get relevant information out of tables, graphs and diagrams. (14)*

5.3 Third grade

5.3.1 Supporting skills

- *Independently and in practical situations relevant and accessible information use. (1 - 3 to 5 - 6 - 11 to 12)*

6 Biology

6.1 Second grade

A major part of the curriculum deals with ecology. This opens the door to fieldwork in which GIS can be used for preparation and/or processing.

6.1.1 Life forms and their environment

6.1.1.1 Study of an area

The purpose of this subject is:

- *Determination by observations in the field the diversity of organisms ((W1)(B18-partim, B22-partim)*
- *Identification of species*
- *Description of habitat of species*
- *Observation of interactions between organisms and between organisms and the environment (biotic and abiotic factors) (W1, W3, W5, W6, W7, W*26, W*28)(B4- partim, B18-partim)*

The results of the observations can be visualised using GIS, with extra ecology layers, human influence ...

5.2.4 Relationships between organisms and their environment

- *Influence of organisms on the environment*
- *Producers, consumers and decomposers*
- *Functions of micro-organisms in nature*
- *Matter cycles and energy flow*
- *Understanding ecosystem*
- *Impact of humans on the environment*
- *Importance of sustainable development*

*(W1, W2, W3, W6, W*24, W*26, W*27, W*28)
(B2, B3, B4, B5, B7,B*8, B20-partim)*

Using GIS the relationships can be analysed and visualised using maps, graphs and reports.

7 Economy

7.1 Second grade

Students who study economics in the second grade, are expected to:

- muster interest for economic and social problems;
- have capacity and interest in the structuring and processing of information;
- have clear, logical and critical thinking patterns.

Part of the curriculum deals with international trade.

7.1.1 Theme 5: Production for the world market

The pupils can

- *Identify reasons for companies to establish themselves in other countries.*
- *Indicate advantages and disadvantages of the presence of foreign companies for the host country.*

Using GIS different variables can be queried at the same time, and the visual presentation makes it easier for pupils to understand the theory.

7.1.2 Theme 6: Growth and prosperity

The pupils can:

- *Explain how economic growth is measured and evaluate the Gross Domestic Product (GDP) as an indicator of growth critically (SET 13);*
- *Motivate why the UN Human Development Indicator (HDI) is a better indicator to compare the quality of life in different countries (SET 13);*
- *Illustrate that economic growth is also connected with negative aspects (SET 13);*
- *Declare that the market can result in unequal income distribution (SET 4);*
- *Illustrate wealth inequality in the world based on wealth indicators and identify factors that form the basis of these.*

The variables GDP, HDI ... are best studied in a map display. Using GIS, correlation can be made between the different variables enabling the pupils with a better understanding.

7.1.3 Research Competencies

The pupils can:

- *Formulate research questions for a given or chosen topic (SET 17);*
- *Gather information in a systematic manner, including through electronic means, based on selected sources for a given or chosen research question (SET 16);*
- *Draw using ICT, select, organize and edit information in different ways: verbal, graphical, tabular and mathematical/arithmetic (SET 16);*
- *Formulate and interpret research results (SET 17);*
- *According to a given pattern, report on the results of its research activity with oral or written measures (SET 18).*

A lot of these research competences can be achieved using GIS.

7.2 Third grade

7.2.1 Research competences

The students can

- *Orient themselves to a research problem addressed by collecting information, organize and edit (SET 16);*
- *Prepare, implement and evaluate a study about an economic issue (SET 17);*
- *Research and report findings and confront them with other positions (SET 18).*

7.2.2 Income, income inequality, poverty and redistribution

The students can

- *Determine income distribution and income inequality within a country setting on the basis of the Lorentz curve;*
- *Define the term GDP as welfare indicator and critically evaluate it (SET 13);*
- *Compare economic growth on an international level (SET 13).*

7.2.3 International economic relations

The students can

- *Explain the emergency of international trade;*
- *Analyse forms of trade barriers (SET 15);*
- *Evaluate arguments for and against trade barriers;*
- *Demonstrate how the barriers can be reduced through multilateral negotiations under the WTO and through the creation of regional trade zones (SET 15).*



8 Human sciences: Cultural sciences

8.1 Second grade

8.1.1 Overarching objectives

- *O6 select a research unit and use a specified data collection tool. (37)*
- *O7 assimilate the data, i.e. analyzing, selecting and organizing in order to answer the questions. (38)*
- *O9 produce a research report using a specified format. (39)*

GIS is an excellent tool for these overarching objectives, taking into account some subjects of the curriculum.

8.1.2 Theme C41: Prosperity and welfare

- *C4106 Name positive and negative aspects of economic growth and illustrate them with examples of their own country, also using existing statistics.*
- *C4107 demonstrate tensions between some aspects of health and environmental concerns and economic growth.*
- *C4108 enumerate and describe different aspects of environmental issues. (A)*
- *C4115 describe some aspects of poverty in the country and state the causes.*

8.2 Third grade

8.2.1 Working in the 'Vrije Ruimte'

The lesson tables for the third grade classes in the ASO schools (general education) have, depending on the study, one to four hours lessons not dedicated to one course.

This provides an additional incentive to continue to work as school educational reform and the ongoing experiments and projects where in the regular class time there's no time.

One of the subjects here is:

Theme 3: Equality and inequality, social differentiation and segregation in cities.

Staging and division in groups: 4 stages

- *Concepts and mechanisms of social and differentiation - segregation function*

of space and time.

- *Analysis of residential and social differentiation in their own city.*
- *Monitoring and confrontation grounds. Resources Research.*
- *Evaluation: from confrontation to solutions. A synthesis based on strong arguments.*

Certainly the two middle stages will have benefit from using GIS.

9 Program Tourism

9.1 Second grade: Applied economics

9.1.1 Introduction

- *3 Detection of the importance of the tourism sector within the economy.*
- *4 Search and interpret numerical data related to economy and tourism.*

4.2.2 Travel Behaviour

- *Read statistics and charts on the expenditure pattern of holidays and examine the evolution of holiday spending.*

9.2 Second grade: Tourism

The course Tourism is issued for six weekly timetables. This creates sufficient space for the students to work independently.

Many subjects in this curriculum can be done using GIS, at the same time fulfilling the aim to work independently.

9.2.1 Coastal Tourism

- *2 identify the different zones of a coastal area and locate on photo and map.*
- *3 locate the main European coastal tourist areas on the map.*
- *5 some critical comments of the coast:*
 - *Mass tourism*
 - *Traffic*
 - *Impact on local people*
 - *Environmental*
- *6 view and interpret for coastal tourism resources with statistics. Self statistics graphically imagined.*
- *7 At least two major coastal tourist areas are discussed in terms of their natural and manmade offer.*

9.2.2 Winter sport

- *3 identify the main ski destinations in Europe and locate on the map.*
- *4 analyse and discuss a resort while consulting sources.*

9.2.3 Nature Tourism

- *3 indicate the relationship between tourism and climate, landscape, fauna and flora.*
- *5 locate the main areas for nature tourism in Belgium on the map.*
- *7 discuss a natural region in Belgium: tourism-recreational.*

9.3 Third grade: tourism

9.3.1 Tourist geography

- *1 Inventory and location on the map of the current host regions and countries in the Mediterranean .*
- *2 Inventory and location on the map of the current European destination regions in terms of holidays by car.*
- *3 Identification and location on the map of the region's current destination for cruises in Europe.*
- *4 Exemplary analysis of the current regions: the Canary Islands and/or the Balearics.*

This can be studied with emphasis on: accessibility, touristic analysis, impact tourism on the economic and cultural development.

10 International transport and freight shipping

10.1 Second grade

10.1.1 Introduction to the socio-economic area through traineeship

Pupils have traineeships in different companies. As a preparation they have some tasks.

- *Situate the internship companies within the relevant economic region and describe their activities.*
 - *Economic activities in various sectors of the region*
 - *Functions and activities of placement companies*
 - *The relationship between the location of the region and economic activity*
 - *Transport and economic activity in the studied region*
- *Make a circuit diagram of a documentary credit format.*

10.2 Third grade

10.2.1 Business oriented data management: applied to data from the internship company

- *The creation and updating of a database*
- *The arrangement of data from the above files*
- *Selecting data from those files*
- *The linking of various files and data*

10.2.2 Spreadsheet: applied to data from the internship company

- *Establish tables of statistical data of the training company and the sector*
- *Perform calculations using statistical and mathematical data*
- *Take care of the layout and readability of the table*
- *Graphics processing and display of data*
- *Integration of the sign package for word processing package and the layout of a business presentation of the thesis*
- *Integration of word processing and spreadsheet package for the processing of the thesis, such comments and decisions recorded in tables and graphs*
- *Integration of word processing and data management package: merge of standard documents and data from business-oriented exercise*

- *Integration of the various packages to a computer presentation (presentation of the company, a product to a potential customer...)*

Instead of using the normal Office applications working with GIS could for certain economic sectors be a better option.