

**EUROCARTO**  
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# The GEOTHNK Approach to Spatial Thinking

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# GEOTHNK: Semantic pathways for building a spatially-thinking society

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- ▶ Online repository and authoring environment for the collection, creation, and sharing of educational resources that **cultivate spatial thinking skills through different disciplines and educational contexts.**
- ▶ **Supports:**
  - ▶ access to various resources and educational scenarios
  - ▶ creation of new educational scenarios through an authoring environment
  - ▶ semantic association and exploration of knowledge and resources
  - ▶ geographic and semantic visualization of educational scenarios

# Consortium

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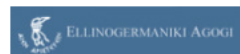
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# Target groups and educational contexts

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- ▶ **Target groups:**
  - ▶ Teachers
  - ▶ University students
  - ▶ Science center educators
  - ▶ Adult learners
- ▶ **Levels of education**
  - ▶ Schools (primary and secondary)
  - ▶ Higher Education
  - ▶ Adult education
- ▶ **Educational environments**
  - ▶ Formal (school and university)
  - ▶ Informal (science center / museum)
- ▶ **Languages**
  - ▶ English
  - ▶ Bulgarian
  - ▶ Dutch
  - ▶ German
  - ▶ Greek
  - ▶ Romanian

# Resources

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- ▶ Educational objects: individual, reusable digital units such as text, images, maps, websites, and interactive and multimedia materials.
- ▶ Educational scenarios: describe a whole lesson plan or any other formal or informal activity using the **inquiry-based educational model**
  - ▶ pre-structured template mainly for formal activities
  - ▶ open template mainly for informal activities

# What is spatial thinking?

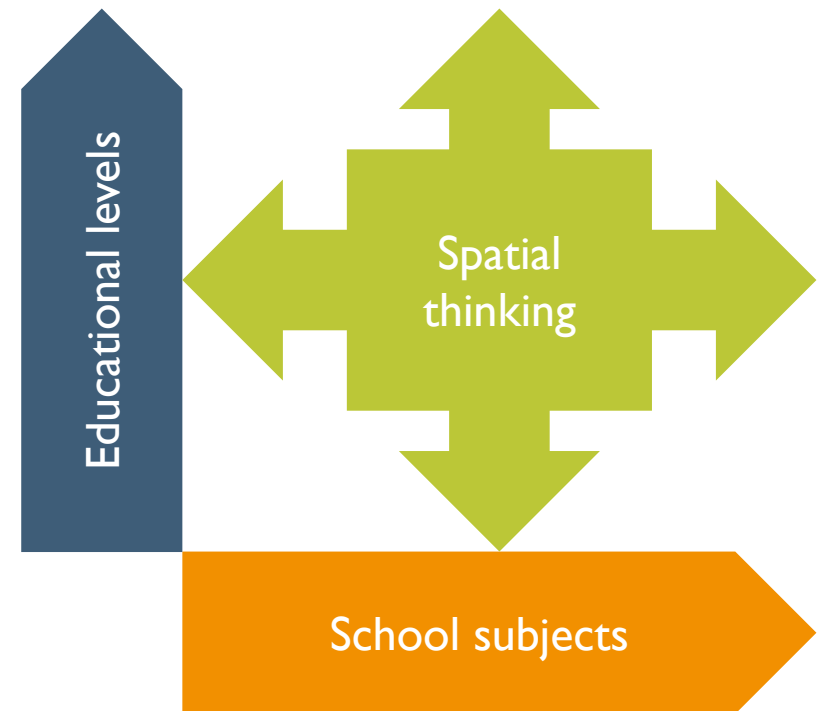
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- ▶ not a single ability
- ▶ a **blending of knowledge and skills**
- ▶ supports people in identifying, interpreting, and visualising location, distance, relationships, movement, change, patterns, and trends through space.
- ▶ **can be cultivated** with substantial results

# Importance of spatial thinking (Sinton et al., 2013)

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- ▶ a **horizontal thread across the curriculum** (learning to understand and practice spatial thinking in all school subjects) and
- ▶ a **vertical thread through the curriculum** (from kindergarten through college)



## 1<sup>st</sup> underlying idea regarding spatial thinking

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Spatial thinking is a synthesis of 3 components: concepts, representation tools, and reasoning processes (National Research Council, 2006).

- ▶ **Implementation:** users are prompted to enrich their educational scenarios with concepts, representation tools, and reasoning tools
- ▶ **Objective:** cultivate all 3 components of spatial thinking



# I. GEOTHNK concepts

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- ▶ **342 concepts** defined by the consortium based on the analysis of:
  - ▶ TeachSpatial
  - ▶ Schools Online Thesaurus (ScOT)
  - ▶ Canadian National Standards for Geography
  - ▶ Geography and Mathematics Dictionary and Glossary for students (ITS Asia)
  - ▶ Open Discovery Space (ODS) Vocabulary

# I. GEOTHINK concepts

- ▶ Each concept is described by:
  - ▶ a term
  - ▶ a definition (from WordNet)
  - ▶ links to useful online resources (770 in total collected by the consortium)

The screenshot displays the GEOTHINK interface for a concept page. On the left is a vertical navigation menu with the following items: Geo-Concepts, Geo-Instances, Reasoning Tools, Representation Tools, User's educational objects, Community's educational objects, ISE educational objects, Upload files, and Add external links. The main content area is titled 'Selected Concepts' and features a red 'show graph' button at the top. Below the title, the selected concept is 'accuracy', indicated by a red 'x' icon. The 'Concept Description' section includes a 'Concept term' (accuracy) and a 'Concept definition' (the quality of being near to the true value). Under the 'Resources' section, there are four hyperlinks: 'Wikipedia: Accuracy and Precision', 'Math Is Fun: Accuracy and Precision', 'Wolfram MathWorld: Accuracy', and 'NOAA Celebrating 200years – Surveying: Accuracy vs. Precision'. At the bottom right of the interface, there is a '+ Attach' button.

## 2. Representation tools

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- ▶ Links to [55 online representation tools](#) (added by the consortium)
- ▶ Types:
  - ▶ maps, map viewers, and map making,
  - ▶ country maps,
  - ▶ atlases,
  - ▶ historical maps,
  - ▶ virtual globes,
  - ▶ satellite and areal imagery,
  - ▶ data visualizations,
  - ▶ models
- ▶ Example: [Geogebra: Interactive 2D and 3D geometry models](#)

### 3. Reasoning tools

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- ▶ Any kind of tool (educational game, learning activity, interactive application, etc.) that may facilitate the understanding of a concept or scenario and prompt reasoning processes.
- ▶ Due to being scenario-specific, are **added by users**.
- ▶ Examples:
  - ▶ [Mercator puzzle](#)
  - ▶ [Layers of the atmosphere virtual lab](#)
  - ▶ [ArcGIS \(Trial Edition\)](#)
  - ▶ [Geocaching: GPS-based hunt game](#)

## 4. Instances – geographic representation of educational scenarios

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- ▶ **Thousands of instances** linked to concepts are dynamically drawn from the GeoNames Geographical Database.
- ▶ Support:
  - ▶ the visualization of educational scenarios in geographic space
  - ▶ an additional search mechanism, i.e., the map-based search: the user interacts with the map to select geo-instances of interest



## 2<sup>nd</sup> underlying idea regarding spatial thinking

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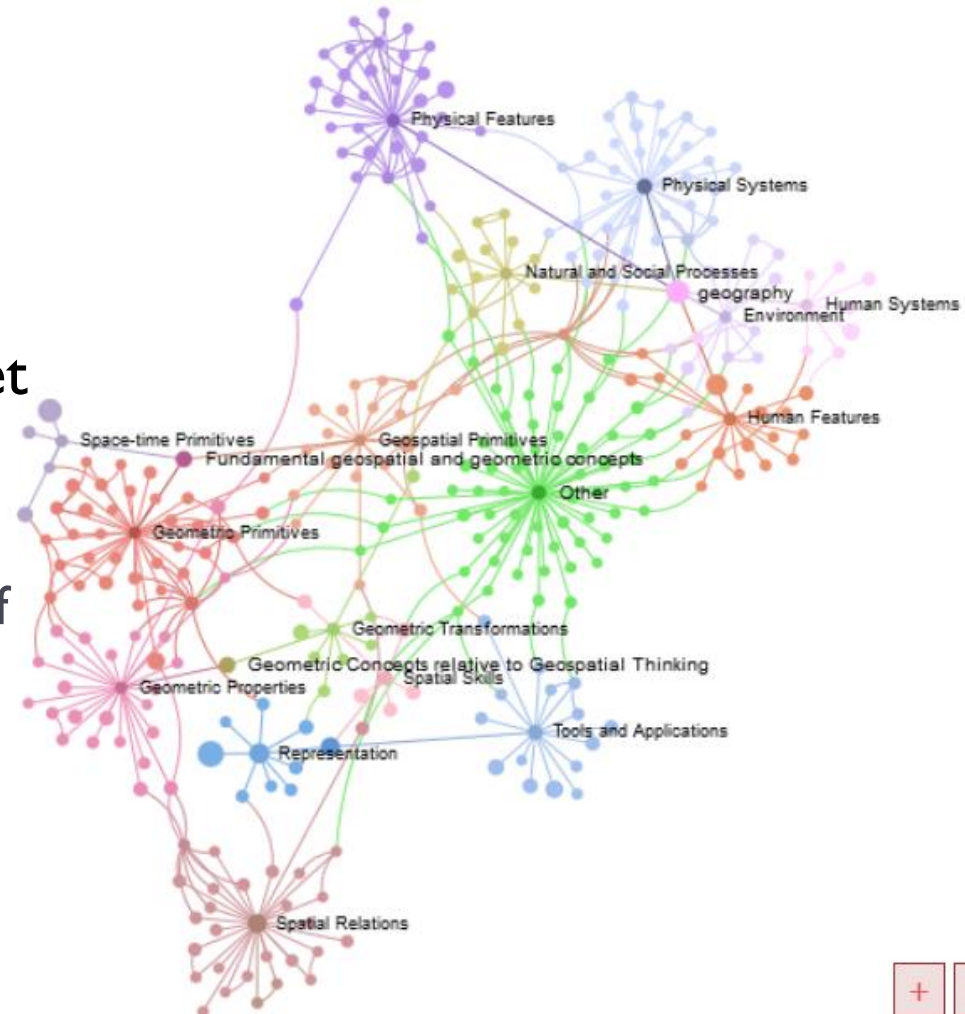
Spatial thinking is a multi-dimensional, transversal ability that cross-cuts several subjects and grade levels.

- ▶ **Implementation:** multidisciplinary organization and semantic association of knowledge
- ▶ **Objective:** cultivate spatial thinking through different subjects, at different stages of education.

# Semantic network: semantic representation and association of educational scenarios

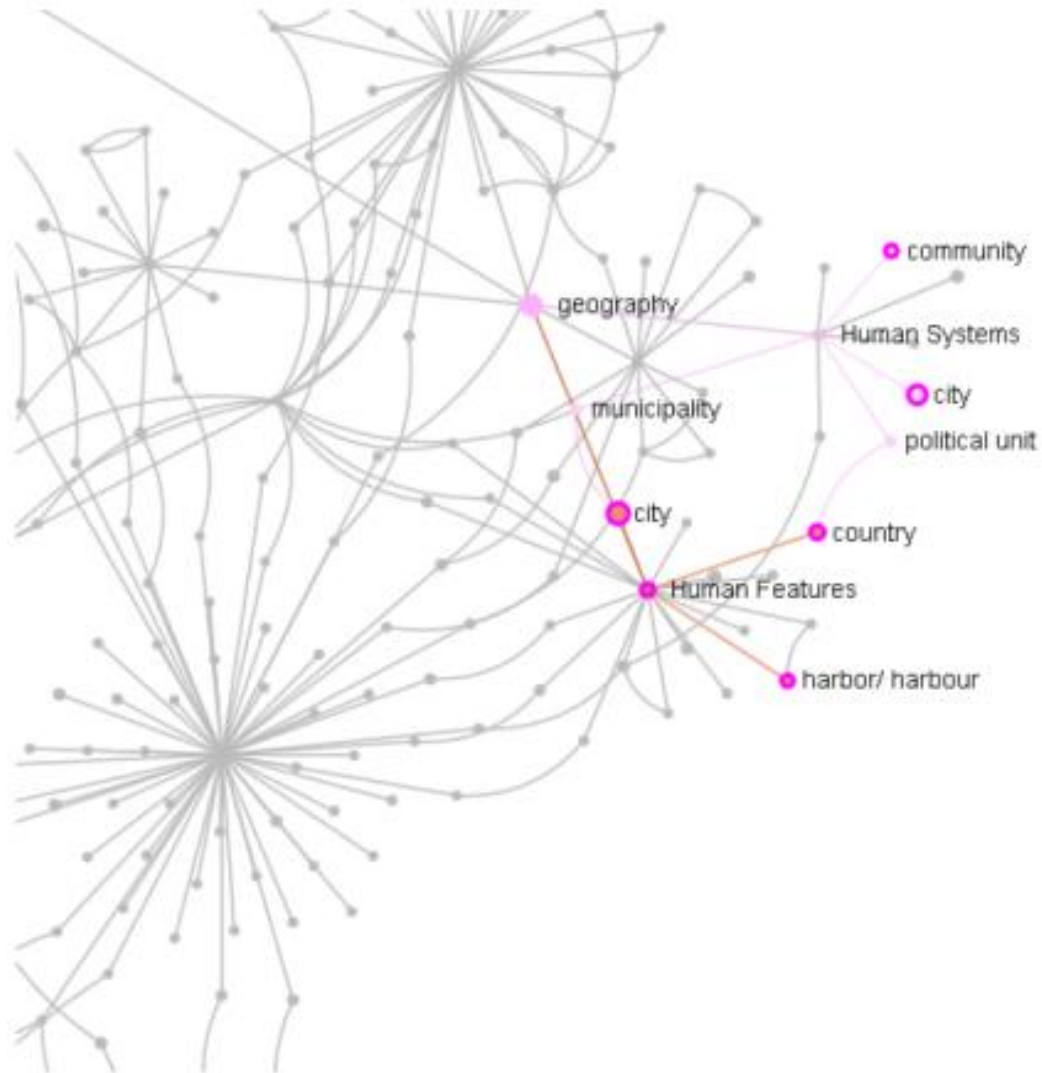
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- ▶ 342 concepts and 802 taxonomic relations
- ▶ Translated into 5 languages with a semi-automatic approach employing BabelNet and manual translations
- ▶ Supports:
  - ▶ efficient search and retrieval of educational material
  - ▶ creation of educational scenarios
  - ▶ semantic – visual representation of educational scenarios



# First World War: the conflict of ideologies

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# Crowdsourcing results

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- ▶ Users contribute to the repository by:
  - ▶ creating new educational objects or scenarios,
  - ▶ reusing educational scenarios developed by other users,
  - ▶ tagging educational resources, and
  - ▶ creating new reasoning tools.
- ▶ **656** registered members
- ▶ **413** featured resources (143 educational objects and 270 educational scenarios)
- ▶ **68** reasoning tools
- ▶ **>4000** tags added on resources

# GEO THINK resources and education levels

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Education level	Resources
Primary Education	116
Secondary Education	291
Higher Education	69

# Primary Education

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- ▶ [Make your own Globe](#)
- ▶ [Make your own Compass](#)
- ▶ [Deep Inside The Earth](#)
- ▶ [Teaching directions -3rd and 4th grade](#)
- ▶ [Giving directions: How can I get to.... Map orientation for 5th grade](#)
- ▶ [Mathematical orientation for 5 grade](#)
- ▶ [Open Streetmaps: Missing Maps](#)
- ▶ [World Market Routes game](#)
- ▶ [Me and my family](#)
- ▶ [Pyramids](#)

# Secondary Education

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- ▶ Touch the Sun
- ▶ The planet's atmosphere
- ▶ Milky Way - the backbone of night
- ▶ Navigation then and now
- ▶ Distances and scales
- ▶ From counting pebbles to the GPS
- ▶ Towns and villages in Bulgaria - 10 grade
- ▶ Map Projections
- ▶ Eratosthenes' measurement of the Earth's Circumference
- ▶ Volcanoes and Plate tectonics
- ▶ Google Earth the Metropolitan cities
- ▶ Regular Pyramid

# Higher Education

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- ▶ Representation of data using cartograms
- ▶ Perceptual image of an urban environment
- ▶ Visualization and Representation of multidimensional data in two-dimensional space
- ▶ Winery Sitting
- ▶ Hydrological Data Analysis of Thrace's Water Department
- ▶ Mapping roads and buildings from satellite data, through the procedures of unsupervised and supervised classification
- ▶ Online Analysis of Earth Observation data for Agricultural Applications
- ▶ Optical Instruments

# GEOTHNK resources and curriculum subjects

Curriculum subjects	Resources
Science	221
Geography and Earth Science	197
Environmental Education	41
Physics	13
Astronomy	9
Mathematics	52
ICT	32
English teaching	27
History	25

A closer look on Geography and Earth Science:

GIS: 19

Cartography: 9

Maps & plans: 21

Spatial Transformations: 6

...and on Mathematics:

Graphical display of data: 10

Geometry: 34

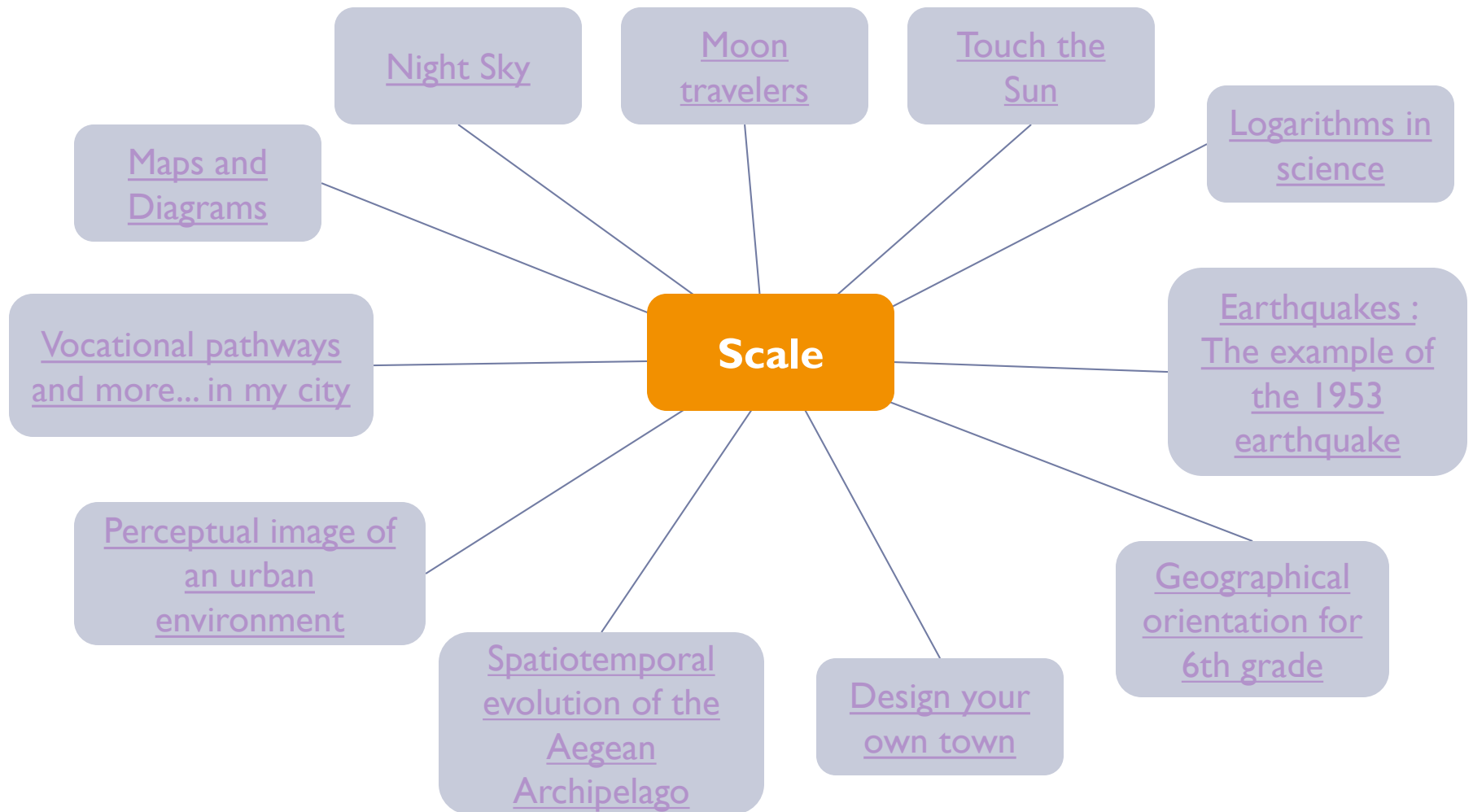
Transformation: 7

# 20 Most used concepts

Concept	Occurrences
map	109
location	90
geography	85
city	75
Representation	70
Spatial Relations	59
area	54
distance	52
Methods and Abilities	51
island	48
Fundamental geospatial and geometric concepts	44
geographic information systems	42
Geometric Concepts relative to Geospatial Thinking	42
city	39
scale	38
Spatial Relation	38
time	37
Physical Systems	36
mapping	35
Tools and Applications	35

# Multidisciplinarity

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# Conclusions

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- ▶ Implementation activities are necessary to train users to the GEOTHNK approach
- ▶ Target groups have a wide, multidisciplinary conception of spatial thinking; cross-cuts different subjects and levels of education
- ▶ Spatial concepts also relate to the international trend and discussion about crosscutting concepts in education
- ▶ Future steps
  - ▶ trace spatial thinking across the curriculum
  - ▶ address the learners – may and how the GEOTHNK approach enhance the spatial thinking skills of learners?
  - ▶ showcase how crosscutting concepts such as scale, pattern, and system may be explicated using real-case examples from the spatial or geospatial domain



## THE CONSORTIUM

European Network of Partners: National Technical University of Athens, Ellinogermaniki Agogi, INTRASOFT International S.A., Association of Geographic Information Laboratories of Europe, Casa Corpului Didactic Cluj, Konstantin Preslavsky University of Shumen, Bundesministerium fuer Bildung und Frauen, Stichting GeoFort

[READ MORE +](#)



## TARGET GROUPS

[Science Educators](#)
[Students](#)
[Adult Learners](#)
[Teachers](#)



For **science center educators**, GEOTHNK provides open interfacing solutions to easily prepare learning pathways for their communities, construct their virtual didactic counterparts, and share them with teachers and researchers in the field.

FaLang translation system by Faboba

## GEOTHNK LATEST NEWS

### CCD Cluj - workshops Phase B in Septembe...

21-09-2015

Casa Corpului Didactic Cluj (Teachers Training Center of Cluj County) initiates the Phase B of the project " Semantic Pathways for Building a Spatially-Thinking Soc...

[Read more](#)

## TWITTER HERE! @GEOTHNK



About 3 hours ago From TweetDeck  
RT @TeachitGeog: Great animation for KS3  
#population #geography  
#geographyteacher  
<https://t.co/9B7ACcCHko>



About 3 hours ago From TweetDeck  
RT @Digimap4Schools: Free Getting Started webinar tomorrow afternoon for anyone looking for tips on using Digimap for Schools.

Sign up at h...

**Geothink** @SpatialThink 7 Nov  
#GEO THINK consortium would like to Thank all the participants in #GEO THINKConf  
Expand

**Geothink** shared their event. 4 days 7 hours ago.

**Spatial Citizens**  
**GEOTHNK Project Closing Conference**  
NOVEMBER 7, 2015  
**GEOTHNK Closing Conference Program**  
SATURDAY, November 7, 2015 – ELLINOGERMANIKI AGOGI, Pallini-Attica,...

[read more +](#)

- Leave
- Invite
- Customize Community
- New sub-community

**LEARN ABOUT GEO THINK**

The aim of this Community is to support educators to develop innovative pathways that will demonstrate learners innovative ways to associate geospatial concepts with concepts from other domains (e.g. Environment, Earth Sciences, Social Sciences, etc.) and infer and associate knowledge.

[find out more+](#)

Find out more **About** >>>

**TOOLS**

TOP TOOLS  
⇓

**123**  
USEFUL TOOLS

**RESOURCES**

FEATURED RESOURCES  
⇓

**413**  
TOTAL RESOURCES AVAILABLE

**PEOPLE**

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