Spatial Thinking Instruments for Students With Visual Impairment

Charcharos C., Kavouras M., Darra A., Kokla M., Tomai E., Beserianou M.
National Technical University of Athens

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What is Geospatial Thinking?

- What is common in tasks such as reading a map, finding your way in a shopping mall, interpreting a diagram, and understanding the spatial distribution of a phenomenon or the association of places and events?
- They are all tasks that rely on a mental skill called spatial or geospatial thinking.
- (Geo)spatial thinking is a cognitive ability to visualize and interpret location, position, distance, direction, relationships, movement, and change over space, in different situations and at different scales (Sinton et al. 2013).
National Research Council’s report “Learning to Think Spatially”

Committee on Support for Thinking Spatially (2006, 55) argues that spatial thinking is essential in science:

“Spatial thinking is deeply implicated in the conduct of science...[M]any classic discoveries and everyday procedures of science draw extensively on the processes of spatial thinking.”

It argues also that:

“Without explicit attention to [spatial literacy], we cannot meet our responsibility for equipping the next generation of students for life and work in the 21st century”.
(Geo)spatial Thinking Components

- Defined as the synthesis of 3 components (cognitive skills):
Spatial Skills

Spatial skills include abilities related to:

- recognize spatial distributions and patterns,
- connect locations,
- associate and correlate spatially distributed phenomena,
- comprehend and use spatial hierarchies,
- regionalize,
- orientate to real-world frames of reference,
- imagine maps from verbal descriptions,
- sketch map,
- compare, overlay and dissolve maps

Facts about spatial skills:

- Spatial skills can be improved
- Training matters
- Improvements to cognitive spatial ability are durable
- Bridging gender differences
- There is a relationship of performance on tests of spatial skills and the choice of careers
GEOTHNK Project
(Semantic Pathways for Building a Spatially-Thinking Society)

The GEOTHNK approach aims at enhancing geospatial thinking skills and engaging users in meaningful, inquiry-based learning experiences.

Main goals:

1. Enhancing spatial thinking through an innovative ICT-based approach and an open, collaborative educational environment.
2. Offering a methodological approach which allows the interdisciplinary organization and semantic linkage of knowledge.

NOT just another repository of geospatial knowledge; aims at developing an innovative socially empowered learning platform, where scientific (geospatial) concepts and ideas are taught in a way that emphasizes their correlation and relevance.
EMPOWERING SPATIAL THINKING OF STUDENTS WITH VISUAL IMPAIRMENT

http://visteproject.eu

Project Number: 2016-1-EL01-KA201-023731

26 - 30 June 2017 · Trinity College · Dublin · Ireland · www.imc16.com · #imc16
Spatial Thinking for VI Students

• For students experiencing disabilities, such as visual impairment (VI), spatial thinking proves to be an imperative skill for perceiving the world far beyond their immediate experience.

• By using tactile maps and innovative ICT technologies, children may deploy their spatial notion more effectively compared to proximate orientation experiences in accordance with verbal directions.

⇒ Providing a concrete set of such tools would empower specific spatial thinking skills, not only of students with VI but of all students.
Maps for VI Inclusion
Anke Brock (Potioc), Christophe Jouffrais (CNRS, IRIT)

• Visually impaired people face **important challenges** related to orientation and mobility.

• Indeed, 56% of visually impaired people in France declared having **problems concerning autonomous mobility**. These problems often mean that visually impaired people travel less, which influences their personal and professional life and can lead to exclusion from society.

• A social challenge as well as an important research area. Accessible geographic maps are helpful for acquiring knowledge about a city's or neighborhood's configuration, as well as selecting a route to reach a destination.
Project VISTE
Empowering Spatial Thinking of Students with Visual Impairment

• Cooperation for Innovation and Exchange of Good Practices, co-funded by the Erasmus+ programme. Duration: Three years (01/09/2016 - 31/08/2019).

• **Goal**: Effective spatial thinking of upper elementary and secondary school students with visual impairment, → facilitating inclusion.

• **Six partners**: National Technical University of Athens (NTUA), Institut National de Recherche en Informatique et en Automatique (INRIA), Intrasoft International SA, Casa Corpului Didactic Cluj (CCD Cluj), Special Elementary School for the Blind in Athens (SESBA), Liceul Special pentru Deficienti de Vedere Cluj-Napoca (LSDV).
VISTE Intellectual Outputs

1. VISTE inclusive educational framework for spatial thinking of students with VI
2. Spatial thinking educational components
3. Innovative toolkit
   • Community for educators of VI students on GEOTHNK platform
   • Augmented reality tool
4. Guide of good practice for policy recommendation

Additional outputs: a) Multiplier events  
   b) Short-term joint staff training events

Activities completed so far:
VISTE Users’ Needs Analysis

- **Aim:** Research users’ needs for VISTE intellectual outputs ➔ provide input for design activities

- **Four workshops held in January 2017:**
  1. Two workshops in Athens, Greece (NTUA with SESBA)
  2. Two workshops in Cluj-Napoca, Romania (CCDC with LSDV)

- **Participants:** 50 (total) educators of school students with visual impairment
  1. Highly experienced
  2. Large number of specializations
  3. Elementary and secondary school level
Workshop Structure

- Presentations by the project team
- Work in small groups: Elaboration on spatial thinking skills for students with VI
- Users’ needs analysis questionnaire
Findings

• New Spatial Thinking Concepts for VI

• 118 new concepts proposed

• **80 new concepts approved** for inclusion

• Analysis:
  1) 60 concepts have been subsumed in existing GEOTHNK Concepts categories.
  2) Significant number subsumed under category “Representation”: model, (mental) schema, cognitive map, foreground, background
  3) New “Spatial Skills” added: laterality, echolocation, localization, proprioception
  4) Similarly, new “Tools”: senses/sensations: touch/tactile sensation, sound/auditory sensation, smell/olfactory sensation
Points 2, 3 and 4 reveal the need for encompassing mental domains to compensate for visual impairments. Thus,

• Representation is extended more to **mental** representation than graphic (GEOTHNK).

• Skills, includes **faculties** such as echolocation, proprioception etc.

• Tools, is extended to **cognitive abilities**: senses/sensations (auditory, tactile, olfactory).
Findings

The remaining **20 new concepts** formed two new categories:

- Physical Properties and
- Physical Phenomena

**Physical Properties** as opposed to spatial ones, again to facilitate VI students grasp certain entities in space: hardness, softness, visibility, weight, thickness, thinness, texture, difference, similarity, intensity, sound, luminosity, form.

**Physical Phenomena**, again, to help the understanding of spatial concepts: opacity, pressure, transparency, gravity, shade, light, darkness.
Future Steps

• New cartographies will be explored such as a variety of cartographic styles and techniques with the aim of producing accessible maps to communicate geospatial and thematic information in creative ways to students with VI.

• VISTE inclusive educational framework for spatial thinking will be developed.

• VISTE Toolkit for teachers of students with VI will be designed and implemented.

• VISTE Guide of Good Practice, which is expected to discuss benefits and recommendations for further application, improvement, and integration of the project results in training policies and practices.
Thank you!