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GIS presence in Geography textbooks – a highway to spatial thinking development?

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Abstract

It is our intention to present some of the preliminary results of an international comparison of Geography textbooks, worldwide, that we are developing using the assets of Georg-Eckert Institute for International Textbook Research (GEI). It has been analyzed 43 textbooks from 24 countries dating between 2005 and 2011 in order to know the different didactical approaches of it, like orientations by objectives, competences, skills, geographic literacy or spatial thinking. One aspect that we analyzed in those textbooks, as a case study, it was the approach to GIS (Geographical Information Systems) because they are, as it is said by the reference literature, a privileged tool to develop the spatial thinking in pupils. In this way, we analyzed the textbooks and we identified 3 main groups of countries looking to the approach of GIS in Geography textbooks. It is our intention to present this characterization and some examples of GIS in Geography textbooks that can develop spatial thinking in pupils. The knowledge and the discussion of these aspects can contribute for a better approach and integration of GIS in Geography textbooks in several countries in order to improve the spatial thinking development.

Keywords: Geography Textbooks, GIS in Education, Spatial Thinking, Resources for Geography Teaching

1. Introduction

The research line about spatial thinking and GIS in Geography textbooks has be developed particularly by Jo and Bednarz (2011), Jo, Bednarz and Metoyer (2010) and Incekara (2010). The thematic of GIS in Geographical Education is a vanguard theme in Geographical Education research nowadays like is demonstrated by the project digital-earth.eu (www.digital-earth.eu in 03.01.13) and several reference authors (Milson, Kerski and Demirci, 2012; Bednarz and Bednarz, 2008; Bednarz and Lee, 2011; Bednarz and Kemp, 2011; Gersmehl, 2008; Goodchild and Janelle, 2010; Gryl and Jekel, 2012; Kerski, 2011; Lee and Bednarz, 2009, 2012; Souza, 2011).

Exactly in this research line, Jo and Bednarz developed the taxonomy of spatial thinking (Jo and Bednarz, 2009) that they used to analyze textbooks from USA, understanding spatial thinking as "the use of spatial concepts such as distance, direction, and region; tools of

representation like maps and graphs; along with the appropriate thinking processes, to conceptualize and solve problems" (Jo, Bednarz and Metoyer, 2010, p. 49), based on NRC (2006) and defending that Geography textbooks can give an important contribute for the development of spatial thinking in pupils (Jo and Bednarz, 2009).

Thus, the taxonomy developed by Jo and Bednarz is structured starting from "three components of spatial thinking: (1) concepts of space, (2) using tools of representation, and (3) processes of reasoning" (Jo, Bednarz and Metoyer, 2010, p. 51). The Figure 1 was made by the authors of the taxonomy and allows us to classify each question or activity in one of the 24 cells of the figure, being that the number 1 represents the minimum level of development of spatial thinking and 24 the maximum.

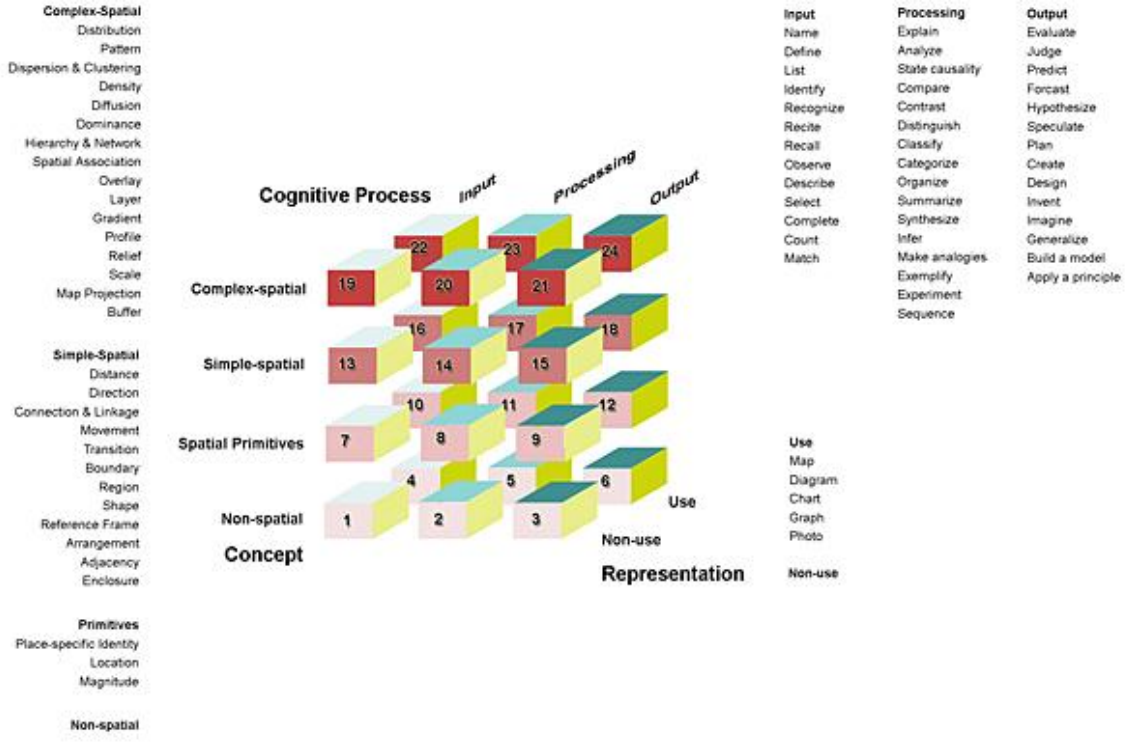

Figure 1. Taxonomy of Spatial Thinking by Jo and Bednarz (2009).
Source: Jo, Bednarz and Metoyer, 2010, p. 52.

2. GIS in Geography textbooks – methodological notes of the research

Internationally, in the context of textbooks research, we must underline the Georg-Eckert Institute for International Textbook Research (http://www.gei.de/ in 03.01.13) that develops structured research about Geography textbooks (Pingel, 2010; Banerjee and Stöber, 2010; Meyer, Henry and Stöber, 2011).

We must underline that our research started with our stay, in the beginning of 2012, in Georg-Eckert Institute for International Textbook Research (GEI) that is yet documented (Martinha, 2012a, 2012b, 2013). In this stay we not only enriched our theoretical board but also made the initial collection and scanning of our research sources – Geography textbooks from several world countries.

The recent publication of the taxonomy of spatial thinking (Jo and Bednarz, 2009) launched the challenge, unquestioningly relevant for the scientific community on Geographical Education, of it use for analysis of activities inserted in Geography textbooks from several countries.

Thus, we made the identification and scanning in GEI of Geography textbooks (published after 2005) of a significant number of counties. For each country that we found textbooks of Geography dated of after 2005 in the library of GEI, we selected two textbooks: one of basic education and one of secondary education. We selected and scanned textbooks and then, we intend to analyze the practical activities of those textbooks using the taxonomy of spatial thinking.

We estimate that, in average, each textbook has about 600 practical activities, what will make us analyze nearly 29.400 activities in several languages (that will be translated). Each one will be classified in the three axes of the taxonomy of spatial thinking, in order to know its level (in the scale from 1 to 24 of taxonomy of spatial thinking of Jo and Bednarz). So, we aim to determine the level of each textbook through the averaging of the activities. Thus, we will make content and statistic analysis.

We made the research (and the scanning) of the textbooks in the library of GEI. In a demonstrative way, we present next (Figure 2) the textbooks searching platform of GEI.

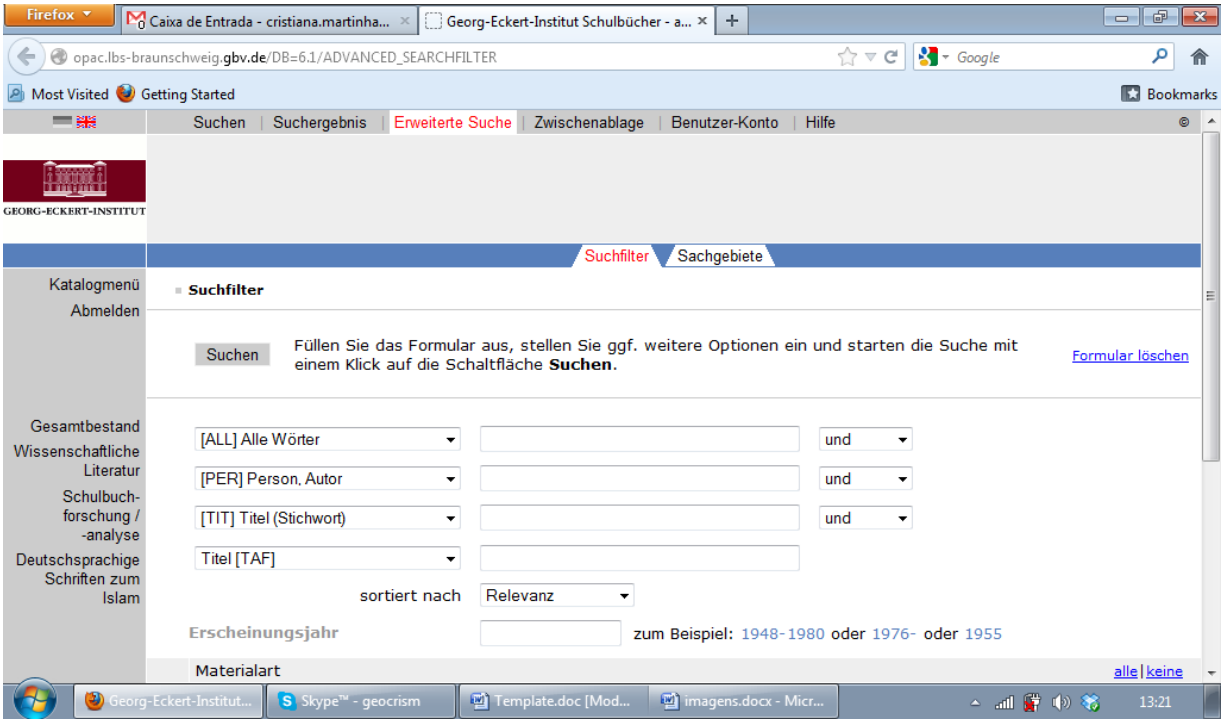

Figure 2. Textbooks searching platform of GEI.
Source: http://opac.lbs-braunschweig.gbv.de/DB=6.1/ADVANCED_SEARCHFILTER.

The Geography textbooks that we are analyzing are identified in the Table 1.

One of the aspects that we analyzed in these textbooks, in a case study logic, was the approach to GIS (Geographical Information Systems) because they are, like it is defended by the reference literature, a privileged way to develop spatial thinking in pupils.

Thus, we analyzed the textbooks and we were able to identify three groups of countries related to the approach to GIS in Geography textbooks. These groups are:

1. *no reference to GIS*. It encompasses a set of countries where there is no reference to GIS in the analyzed textbooks;
2. *reference to GIS only in a theoretical way*. It encompasses a set of countries whose analyzed textbooks approach GIS but only theoretically, explaining what is GIS theoretically but proposing no

practical activities for pupils about this topic;

3. *reference to GIS with an associated practical dimension*. It encompasses a very limited set of countries whose textbooks not only explain what is GIS but also present practical activities to pupils make, presenting webGIS platforms of the country or presenting specific webGIS developed by the publishing house of the textbook (adapted to mother tongue and curriculum of the country) (Figure 3).

	Basic Education		Secondary Education	
Countries	**Number in GEI Library**	**Year**	**Number in GEI Library**	**Year**
Austria	A G-214 (1,2011)1	2011	A G-158 (6, 2010)5	2010
United Kingdom	GB G-594 (1,2011)	2011	GB G-601 (1,2011)	2011
France	F G/H-218 (1,2011)4	2011	F G-320 (1,2011)	2011
Italy	I G-349 (3,2010)3	2011	I G-352 (1,2010)	2010
The Netherlands	NL G-184 (2,2008)2V	2008	NL G-184 (1,2008)6v	2008
Spain	E G/H-105 (1,2009)3	2009	E G-72 (1,2009)2	2009
Norway	N G-77 (1,2009)9	2009	N G-79 (1,2009)	2009
Germany	GD-V 345 (1,2011)2	2011	GE-V-109 (1,2011)2	2011
Finland	SF G-69 (1,2010)2	2010	SF G-70 (2,2009)	2009
Poland	PL G-161 (1, 2011)3A	2011	PL G-127 (5,2011)3	2011
Romania	R G-86 (1,2008)5-7	2008	R G-55 (1,2006)9	2006
Bulgaria	BG G-13 (1,2007)5	2007	BG G-23 (1,2004)9	2005
Hungary	H G-100 (9,2011)8	2011	H G-95 (1,2006)2	2006
Ireland	IRL G-48 (1,2010)	2010	IRL G-49 (1,2010)3	2010
Lithuania	LT G-32 (1,2010)8,1	2010	LT G-29 (1,2007)9	2007
Brazil	BR G-29 (1,2003)	2005	BR S-17 (1,2010)	2010
USA	USA G-88 (1,2005)10	2005	USA G-119 (1,2005)	2005
Canada	CDN G-40 (1,2006)	2006		
South Africa			ZA G-29 (4,2009)10	2009
Morocco			MA G-7 (1,2005)	2005
Nigeria	WAN S-2 (1,2008)6	2008		
Russia	RUS G-65 (3,2011)9	2011	RUS G-17 (18,2011)9	2011
Turkey	TR G-33 (4,2009)10	2010	TR G-30 (1,2001)	2001
China	No number given	2006		

Table 1.Textbooks in analyzing process.
Source: Own made.

The distribution of the analyzed textbooks in these groups is represented in Figure 4.

We can conclude that the majority of analyzed textbooks make no reference to GIS. Only few explain it only in a theoretical way and only few also explain theoretically GIS and ask pupils to solve practical exercises about it.

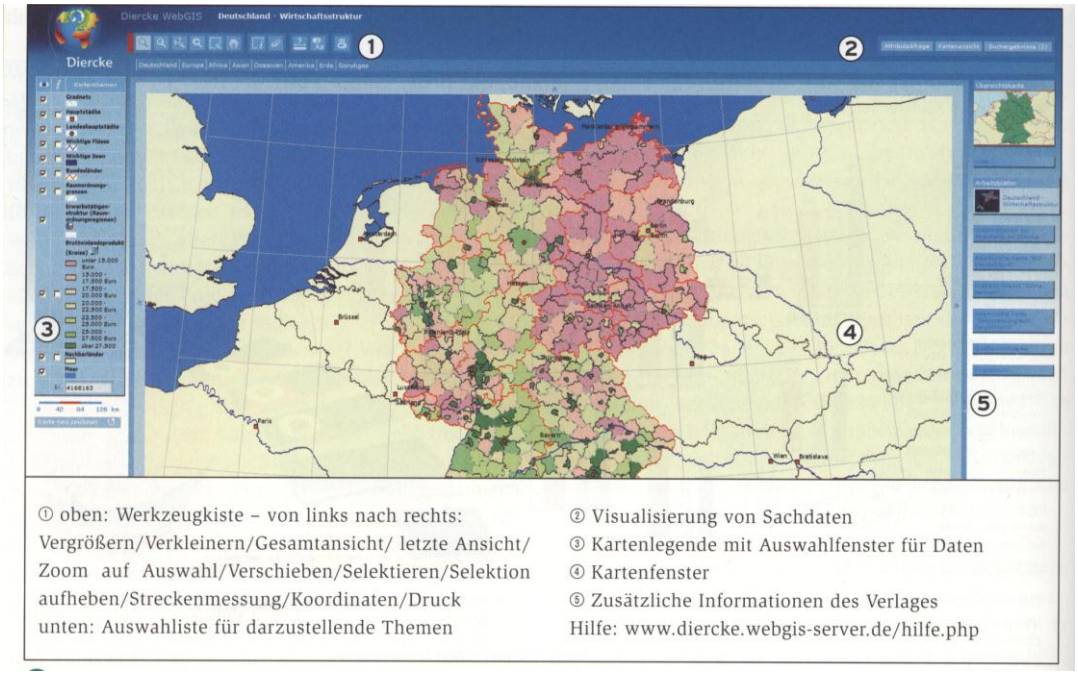

Figure 3. GIS platform in a German Geography textbook.
Source: Bauer et al., 2011, p. 94.

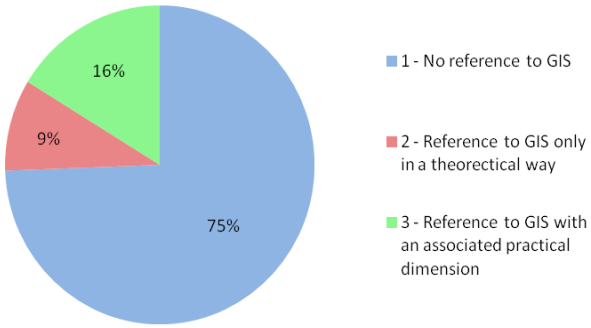

Figure 4. Reference to GIS in the analyzed textbooks.
Source: Own elaboration.

3. Some examples of GIS approach in Geography textbooks and the level of spatial thinking development

Below we present some examples of approach and exploration of GIS in Geography textbooks of different countries. We will privilege "good examples", or in other words, examples that we considered well done and that can be examples to be followed by textbooks authors in other countries.

Some examples are the following Textbook A (TA; Figure 5), Textbook B (TB; Figure 6) and Textbook C (TC; Figure 7).

Using these examples, we were able to determine and compare the level of spatial thinking development of each example, using the taxonomy of spatial thinking of Jo and Bednarz (2009). The results are shown in the Table 2 and in the Figure 8.

About "concept", the TA was evaluated as "spatial primitives" because the exercise asks pupils to identify the location that is on the map; in "representation" we put "use" because the exercise makes pupils use a map and in the "cognitive process" we put "input" because the exercise only asks to pupils identity elements of the platform but not make them develop cognitive process of "processing" like "explain" or of "output" like "judge".

Textbook A (TA):

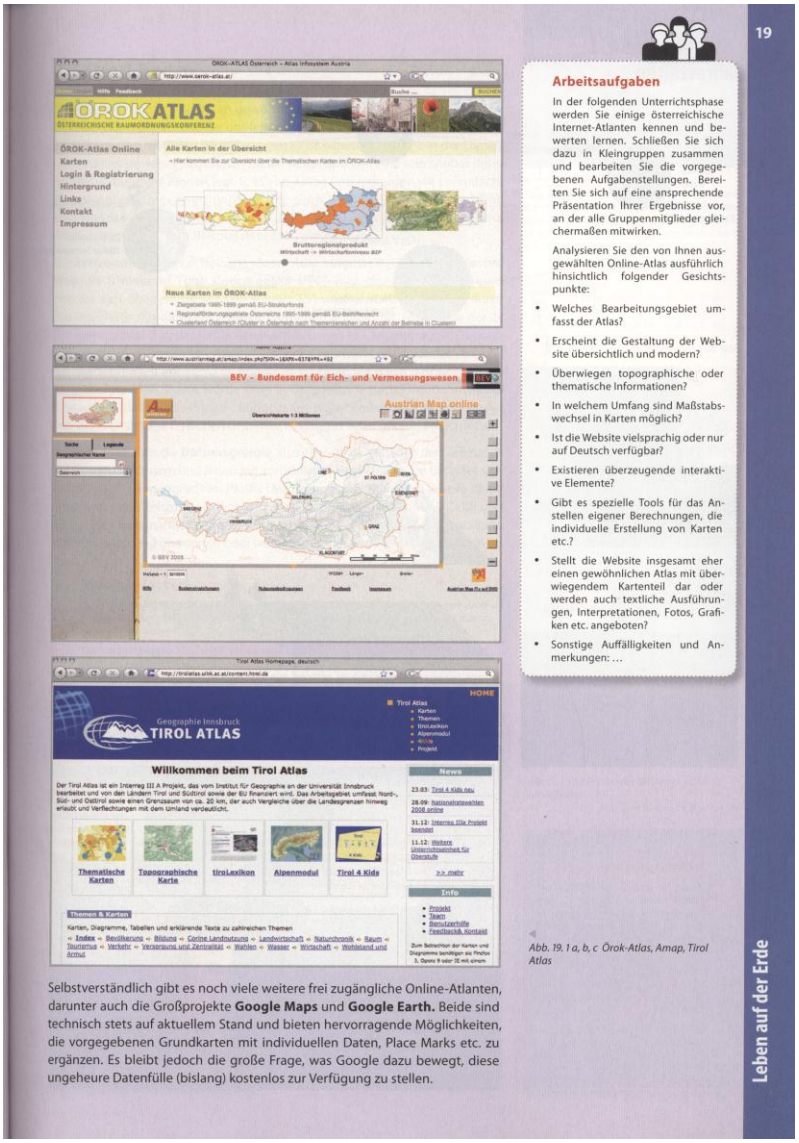

Figure 5. GIS in an Austrian Geography textbook.
Source: Keller and Schober, 2011, p. 19.

Textbook B (TB):

Figure 6. GIS in a French Geography textbook.
Source: Hazard-Tourillon and Fellahi, 2011, p. 215.

Textbook C (TC):

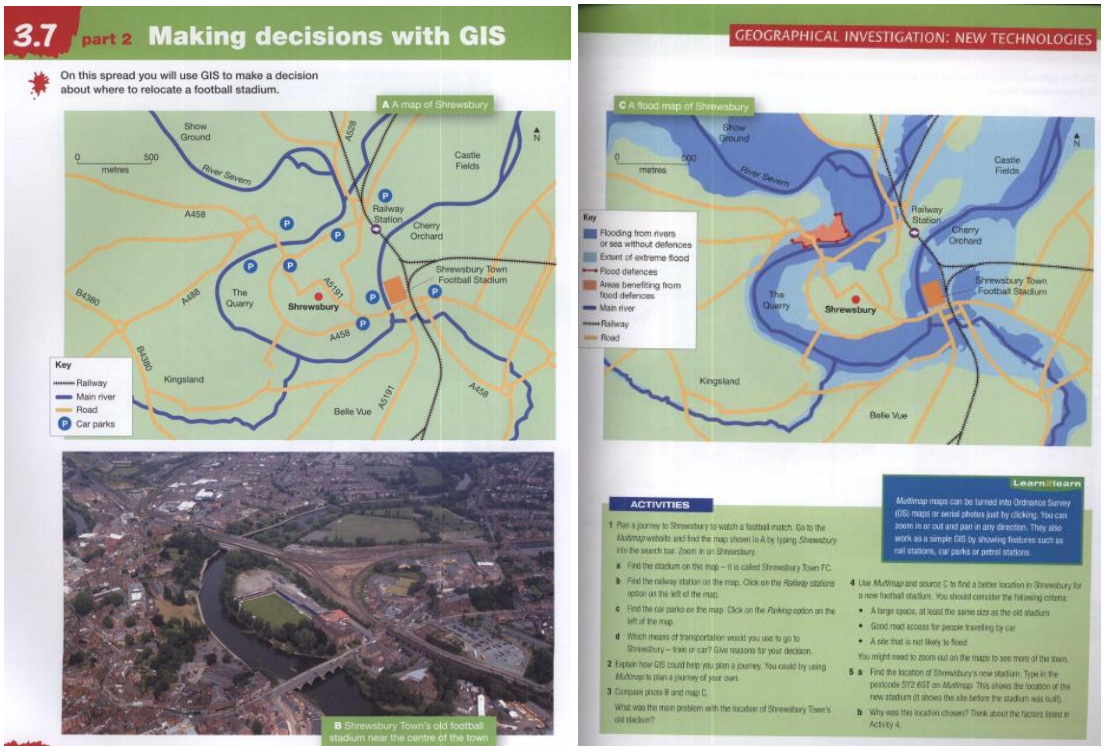

Figure 7. GIS in an English Geography textbook.
Source: Widdowson et al., 2011, pp. 62-63.

Textbooks	*Axes of Spatial Thinking* (in the taxonomy of Jo and Bednarz, 2009)			*Level of Spatial Thinking*
	Concept	Representation	Cognitive Process	
TA	Spatial Primitives	Use	Input	**10**
TB	Complex -spatial	Use	Processing	**23**
TC	Complex -spatial	Use	Output	**24**

Table 2. The level of spatial thinking in the analyzed examples of activities about GIS in Geography textbooks.
Source: Own elaboration.

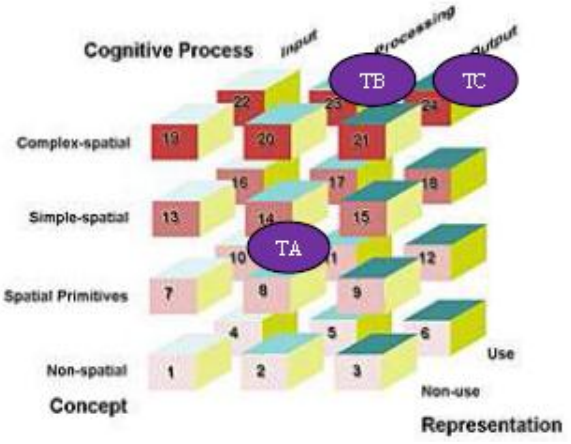

Figure 8. Location of the analyzed examples of activities about GIS in the Geography textbooks in the diagram of the spatial thinking taxonomy of Jo and Bednarz.
Source: Own made (base diagram from Jo and Bednarz, 2009).

The TB is evaluated in the "concept" as "complex-spatial" because it asks pupils to make "overlay"; in "representation" it is evaluated as "use" because it makes pupils use a map and in "cognitive process" it is evaluated as "processing" because it asks to pupils to explain something but not judge or other higher cognitive processes.

The TC is evaluated in the "concept" as "complex-spatial" because it asks pupils to make overlay and use other complex-spatial concepts; in "representation" it is evaluated as "use" because it makes pupils use maps and in "cognitive process" it is evaluated as "output" because it asks to pupils to make a judge about a location.

4. Conclusions

Starting from the general conclusion of our research that Geography textbooks around the world approach the GIS thematic in a very different way, identifying here clearly three groups, it is important now to reflect about the next reflection lines:

a) Having great importance the work with GIS for the development of spatial thinking in pupils and being the textbooks still very important in the teaching-learning process, what is the relevance that should GIS have in Geography textbooks of the future?

b) Should the Geography textbooks of the future include digital tools for GIS exploration?

c) Looking for good international examples, what improvements can be introduced in Geography textbooks around the world related to GIS approach?

As a last point, we would like to underline that it is not only important Geography textbooks explain theoretically what is GIS but also present to pupils practical exercises with GIS technology. And here, GIS use is very relevant for pupils to develop cognitive processes and spatial concepts of high level when they are using and analyzing the maps. Only in this way we can develop spatial thinking in our pupils in a deep way.

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