

# READING THEMATIC MAPS IN ARGENTINE AND HUNGARIAN SCHOOLS

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**Abstract:** This project was organized on the basis of a bilateral agreement signed by the Argentine and Hungarian governments to support research in various fields. Participant cartographers prepared two similar questionnaires to collect information about the use of thematic maps by teachers and pupils in elementary schools in both countries. The main aims of this research are the analysis of the actual situation in the teaching of map concepts in both countries, the identification of difficulties to face during the teaching of map concepts, and the recognizing of positive experiences on teaching and use of thematic maps in the interest of their possible adoption in both countries. The final result includes the proposal written by specialists in the respective countries to adopt these positive aspects in the educational system. All the databases, results, comparisons and proposals written by the participants are placed on the Web.

## ORGANIZATION OF THE INTERNATIONAL COOPERATION

The specialist members of both research teams exchanged their first ideas about this project during the meetings organized yearly by the ICA “Cartography and Children” Commission. The interest in this theme (to study how the pupils of both countries understand the information represented in maps in the classroom) was accentuated by two special factors:

- Argentina and Hungary are two countries geographically distant each from other, situated in continents of very different political, economical and social characteristics,
- These countries have only little experience of joint research in the field of education and the cartography.

A bilateral agreement for the support of scientific research, signed by the Argentine and Hungarian government, was announced in 2003. In about three months, the research teams were organized with three Hungarian and five Argentine specialists from the fields of cartography and geography. Both teams presented the common project entitled “Map reading by children in school age: Cartographic education and practice in Hungary and Argentina” for the institutions responsible of this cooperation in the respective countries, and the project was approved for a period of two years between 2004 and 2005.

During our previous contacts the general aims of the project were determined:

- Analysis of the actual situation in the teaching of map concepts in both countries.
- Research about the use of maps by teachers and pupils in elementary schools.
- Identification of difficulties to face during the teaching of map concepts.
- Recognizing of the positive experiences of teaching map concepts in the interest of their possible mutual adoption.

We decided to divide our research in two parts, corresponding to the number of years of the project:

- During the first year (2004) we would study the use of thematic maps in elementary schools, how pupils and teachers use these maps in their daily work after the study of the elemental cartographic concepts.
- In the second year (2005) we would study how pupils understand the methods of representation of relief in the different maps (mainly atlases, wall maps, and – in very few cases – topographic maps) used in the classrooms.

## DESIGN AND STRUCTURE OF THE TESTS

After the study of the characteristics of both educational systems (specifically in which grades the pupils learn the elemental concepts related to maps and when they begin to apply these concepts in practice) we took the decision of applying the planned test to 7<sup>th</sup> grade pupils of Elementary Schools in the case of Hungary and to 1<sup>st</sup> year pupils of Secondary School in Argentina. To take this decision we considered the following factors:

- In Hungary the pupils learn elemental map concepts between grades 3 and 5. During 6<sup>th</sup> grade they use more often the maps in the subjects related to Geography and History, and by the beginning of the 7<sup>th</sup> grade the pupils should have practical experience that lets them answer the test about thematic maps.
- In Argentina, the reasons were very similar, focusing attention on when pupils learn concepts related to maps and have at least a minimal practice using maps in the classroom. In Argentina, the practical use of maps presents a serious difficulty: there is no systematical edition of School Atlases and teachers and pupils have to use atlases published for the general public.

In interest of planning a cheap (budget-priced) survey we decided that the test should be printed in a A5 format, with a maximum of four questions designed in black and white. This was important because the Argentine specialists did not have any kind of financial support to execute the survey in their country in 2004, while the Hungarian team had only financing for the first part of the project (the bilateral agreement finances only the exchange of specialists between both countries). We had to word the questions taking into account these limitations, because the absence of colours could not mean an obstacle to understand the information represented in the maps.

After numerous consultations, the four questions of the test were penned after the following principles:

1<sup>st</sup> question (Figure 1):

We would evaluate the use of two methods of thematic representation (points and choroplets) to draw similar themes (population and density of population) in two different maps (in the Hungarian test these maps were of China and Venezuela, in the Argentine test China and South Africa). In the point map two squares of different size were delimited, and asked in which of them live more people and which of them has the highest density of population.

In the legend of this map the pupils could read the equivalence of a point and the population number. In the second map five shades of grey were applied to identify the density of population, without any textual or numerical information about the meaning of these shades in the legend. We asked the pupils to indicate which tone of grey represented the highest density of population in the legend and the map.

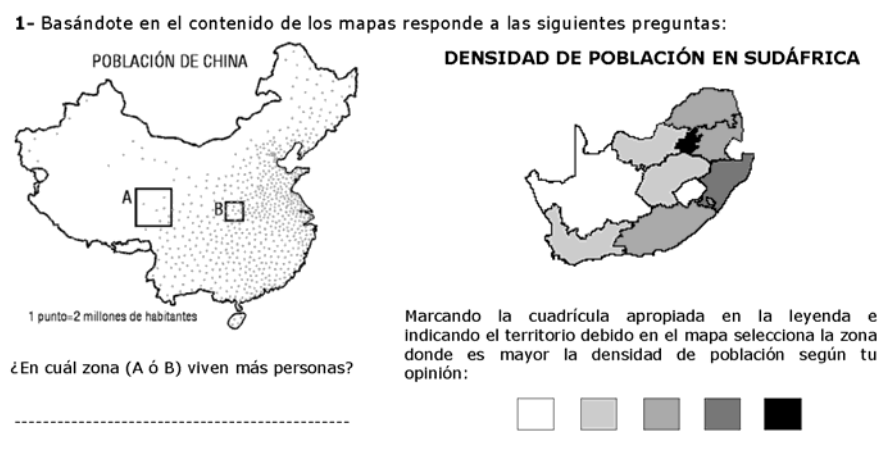


Figure 1: First question of the Argentine test

2. A térképen levő információ felhasználásával egészítsd ki a következő szöveget:

A történészek szerint Portugália afrikai terjeszkedésének a kezdete 1415, amikor a portugálok elfoglaltak \_\_\_\_\_ városát Észak-Afrikában.

1434-ben Gil Eanes felfedező túljut a \_\_\_\_\_ on, amelyet nem véletlenül "Félelem-foknak" is neveztek, mivel addig európai tengerész nem hajózott e ponton túl. Utána éveken keresztül folytatták a felfedező utakat a kontinens nyugati partján, és az \_\_\_\_\_ évben Diogo Cão utazó elérte a Kongó-folyó torkolatát.

Öt év múlva a felfedező \_\_\_\_\_ az afrikai kontinens déli csücskére jut, amelyet ő "Viharok fokának" nevezett. Ezzel a felfedezéssel megnyílt az út India felé. E jó hír hallatán II. Joao portugál király megváltoztatta a fok nevét és \_\_\_\_\_-nak nevezi.

\_\_\_\_\_ júliusában Vasco da Gama Lisszabonból indult el négy hajóval. Novemberben elérte Afrika keleti partját, amelyet felderített és néhány alkalommal partra is szállt. 1498 áprilisában lehorgonyzott Calicut kikötőjében: ő volt az első európai utazó, aki Afrika kerülésével \_\_\_\_\_-ba jutott.

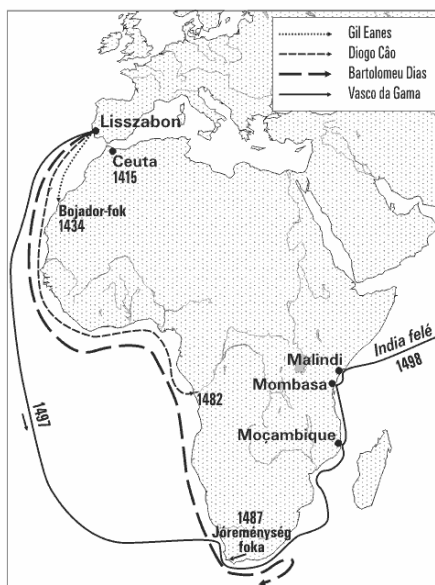


Figure 2: Second question in the Hungarian test

The purpose of this question was to determine if pupils were able to draw a parallel between the two methods of representation, to realize that the highest density of points and the darkest choropleth areas have a similar meaning in both maps.

2<sup>nd</sup> question:

Filling of a text based on information represented in a historical map about the exploration of African coasts by the Portuguese navigators in the 15<sup>th</sup> century (Figure 2).

History was selected because during the teaching of this subject teachers use a considerable number of maps to illustrate their explanations and the pupils work very often with maps included in textbooks, workbooks, atlases, etc. We cared to redact a text that made the pupils read the information offered in the map to fill it.

In this question we wanted to evaluate how the pupils can understand the thematic information represented in a map with content that did not relate directly to a geographical subject. We used the same text and map in both countries.

3<sup>rd</sup> question:

Reading and joint analysis of two methods of representation (diagrams and choropleths) in the same map.

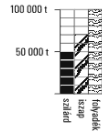
In the Hungarian test the pupils had to answer three questions related to environment protection, represented in a map of the country (Figure 3):

- In the first one pupils had to compare visually only one column of the diagrams (to identify the province with the highest volume of dangerous solid waste)
- In the second one they had to analyze all the columns of the diagrams (to identify the province with the highest volume of dangerous waste)
- In the third one they had to interpret the content of the diagrams and the values represented by choropleths (to identify the province with a relatively high volume of dangerous waste, but only a small part of this volume is stored in that county, namely, it is not translated for recycling).

In the Argentine test a map of Buenos Aires was used, applying the same methods to represent the thematic information (total of grassy areas represented by choropleths, as well as the number of parks, squares and gardens represented by diagrams) and putting two questions:

3. Magyarország térképén jelöld meg pirossal (vagy kereszttel) azt a megyét, amelyekben a legtöbb szilárd halmazállapotú veszélyes hulladék keletkezik!  
 Jelöld meg kékkel (vagy nyíllal) azt a megyét, amelyikben a legtöbb veszélyes hulladék keletkezik!  
 Jelöld meg csillaggal azt a megyét, amelyikben viszonylag sok veszélyes hulladék keletkezik, de ennek csak kis része marad a telephelyeken!  
 (A keletkezett hulladékok nagy részét elszállítják, újrahasznosítják, vagy ártalmatlanítják.)

A keletkező veszélyes hulladék mennyisége halmazállapot szerint:



A telephelyen felhalmozott veszélyes hulladék mennyisége:

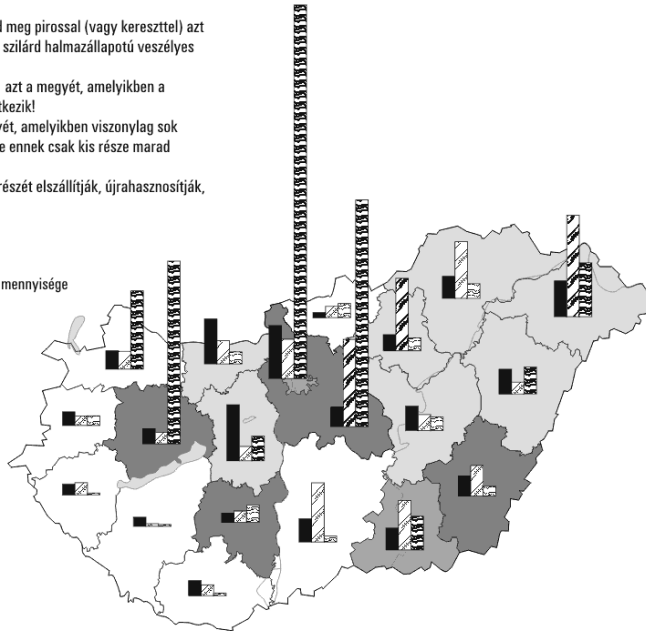


Figure 3: Third question in the Hungarian test

- Which is the district with the largest number of grasslands?
- Which is the district with the highest number of squares in the city?

4<sup>th</sup> question:

Drawing of thematic information on an outline map, based on data and legend attached to it.

We offered the choice to create their own symbolization (in black and white or colour), and represent the symbols in the legend. In Hungary a map of the western provinces was used, and in Argentina a map of some districts of Buenos Aires (Figure 4).

### APPLYING OF THE TESTS

In Hungary, a total of 1534 pupils answered the questions of the test, while in Argentina a total of 567 pupils participated in the survey. The major part of the Hungarian pupils (a 72.7%) were 12 years old, in Argentina 48% of the participants were 13 years old and 42.7% were 14 years old.

4- Completa el mapa de "Barrios" de la Ciudad Autónoma de Buenos Aires (Capital Federal) utilizando los datos y la leyenda. Ten presente que en el mapa solo encontrarás algunos de los Barrios que conforman a la Ciudad Autónoma de Buenos Aires.  
 Si trabajas solamente con un lápiz negro utiliza la leyenda situada a la derecha de las categorías. Si trabajas con lápices de colores, entonces rellena con el color que selecciones las cuadrículas ubicadas a la izquierda de las categorías.

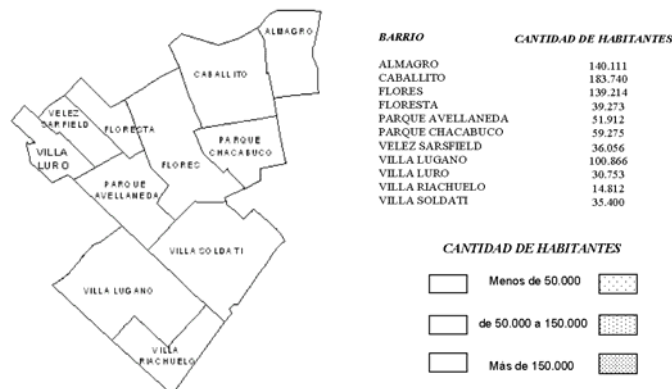


Figure 4: The last question in the Argentine test

In Hungary, the selection of the participant schools was made in a representative way, selecting at least one school from each county, and trying to have a similar proportion of schools in cities and smaller towns (44 schools from 34 cities and 24 schools from 24 towns were asked to participate). From the sixty-eight contacted schools a total of thirty-eight sent back their answers.

The time given by the teachers to answer the test varied between the participant schools. In Hungary, 138 teachers answered to a test designed for them, asking about the use of thematic maps in the classroom and other topics (see the last chapter of this paper). One of the questions was about how much time the pupils spent on responding the questionnaire; only 73 teachers answered this question. Based on their answers, 33.3% of pupils had between 21 and 30 minutes to complete the test, and 29.2% had between 10 and 15 minutes.

The Argentine organizers faced more difficulty to collect their data at a national level: the large extent of the country (the province of Buenos Aires is equivalent to the whole territory of Hungary), and the difficult communication with the remote regions represented a serious obstacle, and all this was aggravated by the unstable economic situation. They made and distributed the tests without any financial support. Finally, they succeeded in collecting answers from 10 schools. Pupils filled the tests without any special explanation and the time spent to answer the questions varied between the different schools.

## GENERAL RESULTS OF THE TESTS

The obtained results are summarized in Table 1. This table contains the results according to the answers received till March 30, 2005 in Hungary and December 10, 2004 in Argentina. Both dates do not coincide because the school year begins at different times in these countries.

## ANALYSIS OF THE RESULTS

Hungary:

In the 1<sup>st</sup> question there were no significant difficulties to read the information represented by points (Figure 5). The result of the second part of this question is interesting, because the majority of pupils did not have any difficulty to identify the highest density of population in the legend (they did not receive any written help about the meaning of the shades), but only a 52.6% of them identified correctly the data in the map. We should consider that within the 47.4% of wrong answers a part of the pupils marked the correct square in the legend, but did not pick out it in the map. We can say that only one of two pupils associated properly the similar meaning of both methods of representation in the maps, having the needed ability and practice to recognize that the darker shade of a color is used to represent higher data values. It can be considered also an ambiguous result, reflecting that about a half of the pupils had difficulties to complete this kind of exercise.

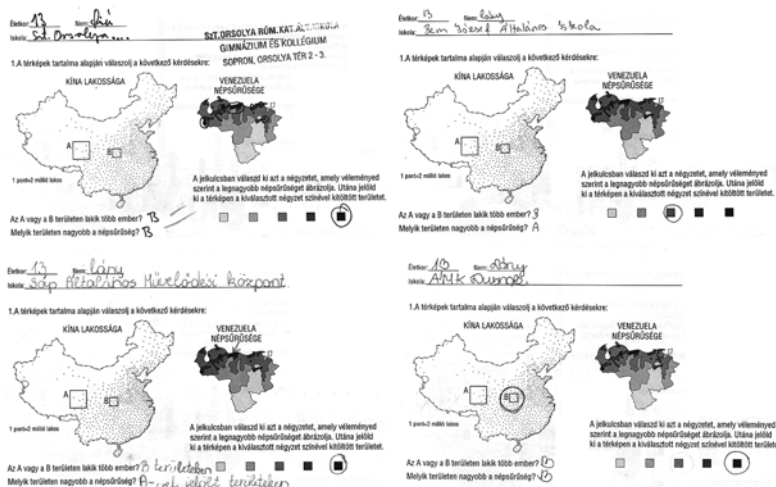


Figure 5: Some of the answers to the 1<sup>st</sup> question of the survey (Hungary)

RESULTS OF THE SURVEY FOR PUPILS (SHORT VERSION)						
	ARGENTINA			HUNGARY		
<b>1<sup>st</sup> QUESTION: Similar information represented by points and choropleths in different maps</b>						
	Right answers	Wrong answers	No answer	Right answers	Wrong answers	No answer
Map of China: -Territory with highest number of inhabitants	489	75	3	1418	116	-
-Territory with highest density of population	22	8	537	1260	273	1
Map of Venezuela/South Africa: -Highest density of pop. in the legend	394	126	47	1160	374	-
-Highest density of pop. in the map	137	43	387	807	727	-
<b>2<sup>nd</sup> QUESTION: Filling of text based on information represented in historical map</b>						
	Right answers	Answers with one or more errors	No answer	Right answers	Answers with one or more errors	No answer
Topic: Exploration of the African coasts in the 15 <sup>th</sup> century.	180	373	14	501	1033	-
<b>3<sup>rd</sup> QUESTION: Analysis of two methods of representation (diagrams and choropleths) in the same map</b>						
	Right answers	Wrong answers	No answer	Right answers	Wrong answers	
-Reading of information represented in a column of a diagram	378	13	176	1386	47	
Hungary: -Reading of information represented in the diagram Argentina: -Reading of information represented by choropleth	415	121	31	1251	182	
-Joint analysis of information represented by diagram and choropleth	-	-	-	818	615	
				No answer: 101		
<b>4<sup>th</sup> QUESTION: Drawing of a thematic (choropleth) map</b>						
Task: Making of a choropleth map	Correct categoriz.	Wrong categorization	Quality of work	Correct categoriz.	Wrong categoriz.	Quality of work
Hungary – Map of the West Hungarian counties Argentine – Map of some districts of Buenos Aires	434	112	High:137 Ave.: 182 Low: 217 No ev: 31	1147	248	High: 1075 Ave.: 214 Low: 104 No eval: 3
	No answer: 21			No answer: 138		

Table 1

At first sight the results of the 2<sup>nd</sup> question are not satisfactory: the 67.3% of pupils made at least one error while they filled the text reading the information represented in the map. But exactly 51.6% of this group of pupils made only one mistake and 23.5% two mistakes (a total of 747 children), as shown in Figure 6. More frequent mistake made by the pupils was the change of digits of a year (for example, writing 1842 instead of 1482) or the change of the discoverers' name (writing Vasco da Gama instead of Bartolomeu Dias). This second kind of mistake is probably explained by the fact that the pupils could not read correctly the data in the map: at this point of the map four data were represented in a very small space (please note that the page format for the test was A5), but on other hand the location of the lines showing the two discoverers' routes were very close to each other.

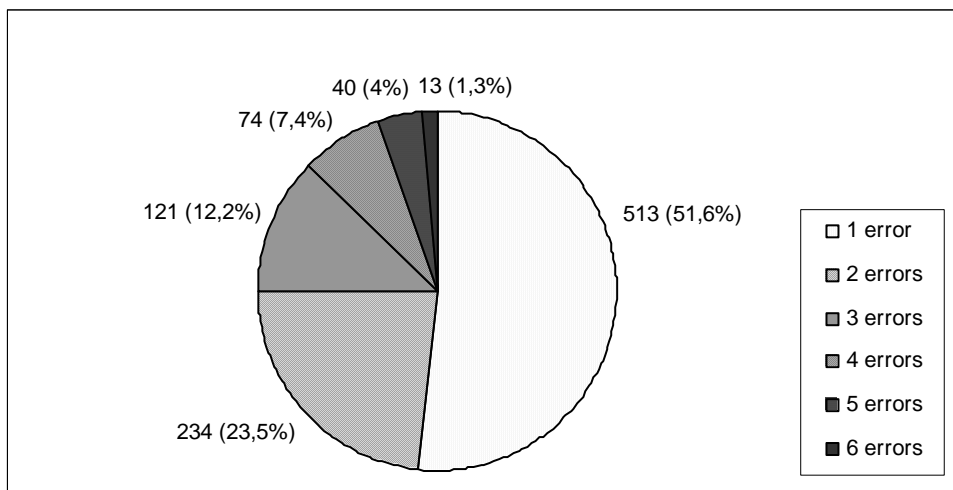


Figure 6: Number of errors in the wrong answers given to the second question of the test (Hungary)

The results of the 3<sup>rd</sup> question raised the highest interest among us, because this question evaluated the children's capacity not only to read, but also to analyze the represented information. The first part was only an introduction, asking pupils to read information drawn in a column of the diagram, and the second one required the reading of the whole diagram. A major percentage of pupils did not have difficulties to give the correct answers to these questions. The main obstacle was the final part of the question, when the children were requested to analyze diagrams and choroplets together: 40% of the answers were erroneous. A total of 101 pupils did not answer this question; they were not included in the calculated 40%. A possible reason of the questions without any response can be the lack (shortage) of time. But at same time we could observe that those pupils, who gave right answers to the first two points, did not response correctly this one. In other words, they are able to read literally the values in a diagram, but they do not have the sufficient practice to analyze values represented together by different methods in the same map.

The main aim of the 4<sup>th</sup> question was to measure the pupils' abilities to create themselves an easy (choropleth) thematic map. We can consider satisfactory the obtained result, because the majority of the pupils put correctly the given data to the appropriate categories. To detail the information contained in Table 1, a total of 1042 answers were made in black and white, and 351 pupils used colours to fill their map. We assessed these works from a graphical point of view too and more than a 70% of them obtained an evaluation of good quality in the tracing of lines, filling areas, etc. This fact demonstrates that a noteworthy percentage of the pupils denoted interest in tasks that let them express – with some liberty – their graphical abilities.

Argentina:

In the 1<sup>st</sup> question, the majority of the pupils (a 94.7% of them) did not answer the question related to the density of population in China. This was an unexpected result, because we considered the first two questions easier than the last two. The Argentine colleagues' opinion is that this high percentage of no answers could have a main cause: namely, pupils do not work with this method of thematic representation in the classroom. We can notice a similar trend in those Hungarian and Argentine cases, when the pupils had to identify the areas with the highest density of population represented by choropleth without any explanation in the legend: 387 children (68.2%) did not answer this question (if we add the 43 wrong answers, it means 75.8%). This percentage is relatively higher than the 47.4% of wrong answers in Hungary, and we can affirm that a considerable number of pupils was not able to associate the two methods of representation.

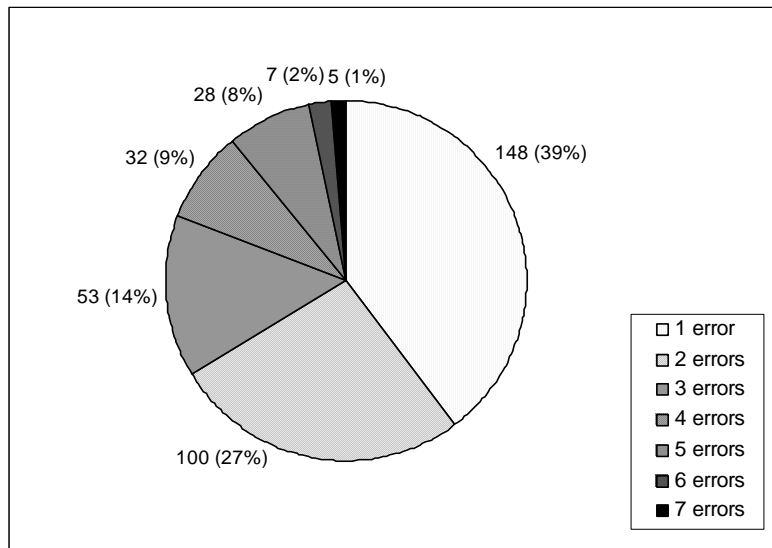


Figure 7: Number of errors in the wrong answers given to the second question of the test (Argentina)

The results of the 2<sup>nd</sup> question are also similar to the Hungarian one: in Argentina the number of erroneous answers was very high too (65.7%), but the major part of them had only one or two errors (Figure 7).

The answers given to the 3<sup>rd</sup> and 4<sup>th</sup> questions had better results than the answers to the first two questions. Although there were a relatively high number of blank answers reading the information represented in a column of the diagram, the number of wrong answers was low and more than 66% of participants gave correct answers to this part of the question. In the second part the pupils were asked to read information from choropleths, and the result was satisfactory (73.2% correct answers).

The results obtained in the 4<sup>th</sup> question can be considered satisfactory. From the total of answers, 449 (79%) were made in colour and only 102 (18%) in black and white. This result emphasizes our opinion about the interest manifested by the pupils in this kind of graphical and creative activities.

## SURVEY FOR TEACHERS

Simultaneously with the survey for pupils, we sent a questionnaire designed for the teachers and asked them about the use of maps in the classroom and their suggestions to enhance the use of maps in school. In the Table 2 some of the answers given by the teachers to this questionnaire in both countries are included.

## PRELIMINARY CONCLUSIONS (AFTERWORDS)

People interested in this topic can find free access to all the databases, documents, etc related to this project visiting the following site: <http://lazarus.elte.hu/hun/dolgozo/jesus/mag-arg/proyect1.htm>. All the documents are in two languages of the participant countries (Spanish and Hungarian), but we plan to traduce the databases and final documents to the English language too.

Next September the organizers will send to all the participating schools the results achieved during this survey. At the end of the present year we are going to prepare a document to present and analyze the results of the survey. This report will sum up the positive experiences detected during the teaching and practical use of map concepts, drawing up those ideas and suggestions that could be applied mutually in both countries. We intend to send this final document to Argentine and Hungarian institutions related to educational activities in the fields of geography and cartography (Ministries, research institutes, teachers organizations, etc).



<b>RESULTS OF THE QUESTIONNAIRE FOR TEACHERS (SHORT VERSION)</b>		
<b>Questions</b>	<b>Answers</b>	
	<b>Argentina</b>	<b>Hungary</b>
What kind of atlases do you use in the classroom?	Physical – 75% Political – 67,86% Outline atlas – 57,14% Historical – 46,4% Other – 14,28%	Physical – 84,05% Outline atlas – 51,45% Historical – 23,2% Literary – 6,5% Other – 6,5%
What kind of map is more difficult to understand by the children?	Geological – 35,7% Historical – 32,14% Climatic – 21,43% Other – 17,86% Physical – 10,7% Population – 10,7% No answer – 10,7% Agricultural – 7,14% Contamination of environment – 3,57%	Geological – 28,25% Climatic – 19,6% Contamination of environment – 13% Other – 5% Population – 2,9% Historical – 1,45% Physical – 0%
Which grade do you consider more appropriate to teach the map concepts?	2 <sup>nd</sup> grade – 3,57% 3 <sup>rd</sup> grade – 25% 4 <sup>th</sup> grade – 25% 5 <sup>th</sup> grade – 35,71% 6 <sup>th</sup> grade – 57,14% 7 <sup>th</sup> grade – 75%	3 <sup>rd</sup> grade – 22,4% 4 <sup>th</sup> grade – 52,2% 5 <sup>th</sup> grade – 45,65% 6 <sup>th</sup> grade – 23,2% 7 <sup>th</sup> grade – 8,7% 8 <sup>th</sup> grade – 4,3%
Do you consider sufficient the pupils' knowledge about maps to use them in the classroom?	Yes – 17,86% No – 82,14% No answer – 0	Yes – 45% No – 42% No answer – 13%
Which map concepts should be accentuated during the teaching activities at present?	Map symbols – 64,28% Scale and graphic scale – 64,28% Orientation – 60,71% Representation of relief – 60,71% Geographic coordinate system – 46,43% Writing of geographic names – 39,28% Map history – 14,28%	Writing of geographic names – 44,6% Orientation without compass – 39,1% Scale and graphic scale – 39,1% Orientation with compass – 38,4% Geographic coordinate system – 29,7% Hypsometry – 21,7% Contour lines – 16,6% Map history – 5,8%
Which other cartographic concepts do you consider important to add to the actual curriculum?	Practical use of maps – 78,57% Reading of thematic maps – 75% Reading of aerial photos – 67,86% Reading of satellite images – 64,28% Reading of the relief on the maps – 60,71% Use of multimedia CD atlas – 35,71% GIS basics – 32,14% Computer Cartography – 32,14% Orientation with GPS – 10,71% Map projections – 0 Other – 0	Practical use of maps – 88,4% Reading of the relief on the maps – 53,6% Reading of thematic maps – 45% Use of multimedia CD atlas – 28% Reading of satellite images – 14,5% Orientation with GPS – 10,1% Computer Cartography – 6,5% GIS basics – 4,3% Map projections – 1,4% Other – 2,9%
<b>Total of answers/country:</b>	<b>28</b>	<b>138</b>

Table 2

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*This paper was written in the framework of activities of the MTA-ELTE Research Group on Cartography and GIS, financed by the projects ARG-6/03 of the Hungarian Ministry of Education and A/0029/2004 of the Hungarian OKTK Foundation, and the project HU / PA03 – UVII / 002 of the Argentine SECYT-ME.*