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CARTOGRAPHIC RESEARCH FOR BLIND AND PARTIALLY-SIGHTED PEOPLE APPLIED IN PRACTICE

ROHONCZI A.
ELTE, BUDAPEST, HUNGARY

INTRODUCTION

One special and lesser-known topic of cartography is the branch dealing with blind and partially-sighted people, for which these days our country also possesses fairly comprehensive technical conditions. However, we do not take advantage of the given opportunities.

The topic of my thesis was to create an experimental tactile map, which was made for blind and partially sighted people. Its completion was based on both the studying of the national and international observations and the result of the questionnaires filled in by the target audience.

According to my analysis I ascertained that from the beginning of the Enlightenment the endeavour was demostrable on the part of a group of the ”developed world’s” geographers and cartographers to help the blind and partially sighted obtain special maps.

Although, in Hungary, the number of available maps is limited, and most of the maps still in use have obsolete contents and they are made with outdated techniques.

BRIEF INTERNATIONAL HISTORICAL OUTLINE

The first specialist school for the Blind was founded in Paris in 1784. A teacher, Niessen under the influence of one of his blind students, Weißenburg made the first tangible geographical map in 1752 for which he used four kinds of material. At the beginning of the 19th century Louis Braille developed dot writing in Paris, which has still been used since that time. In the second half of the century August Zeune (the founder of Berliner Blindenanstalt) invented the first embossed globe made of wood.

Eleven colours appeared on the map, he mixed materials of different graines into the paint. Thus, he made it possible to use it for the blind and partially sighted as well [Junker 82]. Later the globes were made of paper and their size was reduced so that they could be encircled by hands. Therefore, the partially sighted could feel the connection of the spatial continents better. In Germany until the 1870s in every special school large wooden wall-maps were used to teach. Their disadvantage was that they could not be used individually. The first transportable, tangible maps were compiled on paper by Matthias Kunz in 1884, but Braille writing still had not appeared on them. Between 1930 and 1944 Przyremble made the first topographic atlas, which had already contained Braille, and later was further improved by Hildebrand [Przyrembel 29].

From the second half of the 20th century a practical solution appeared to multiply tactile maps: the vacuum pressure process. The plastic foil was heated and embossed onto the base map with the help of vacuum, this is how the tangible picture was created.

In the GDR Paul Georgi, the employee of the Karl-Marx-Stadt Rehabilitation Centre produced a world atlas consisting of 34 maps with this technique. In 1955 Johannes Scheuer developed a world atlas with 84 maps in Düren which has still been widely used.

In the 1970s Gill was the pioneer of creating tactile maps on computer. He digitalized the drawn maps in his own graphical system and designed it on the screen interactively. Therefore objects could be placed, erased from and moved on it.

The scale of the map could also be easily changed, and the letters were turned into dot writing.

The first issue of the the Tactual Atlas of Australia was published by the Division of National Mapping in Australia. The atlas includes 63 maps and text supplements about Australia and the world. The curiosity of the map collection is that blind people were also involved in the compilation building upon their experience and opinion.

Still in the 1980s the application of Information Technology gathered ground in the field of tactile cartography in the USA. Frigge developed the prototype of the touch screen which was complemented with a special pen and a user software by Matschulat. In 1988 the Australian Parkes Nomad invented the first audio-tactile dialogue system, which allowed the blind to use computers.

In Saxony the Federation of the Blind and Partially Sighted created the Audio-Touch-System in 1992. This system runs on average PC. The knowledge of Braille writing is not necessary for the use of it, as it solves the control of the computer with touch screen and sound effects [Kahlisch05 96].

Nowadays tactile maps are also designed with Geographic information systems (Figure 1). In Vienna Eva Papst, Erich Schmid, Helga Gawher, Michael Rohlfing and Bernhard Engelbrecht developed the GI-Tools software with the contribution of the GEOSolution Firm, with the help of which the objects on the screen can be seen in dimension. The keyboard of the computer was supplemented with Braille signs.

On the complete digital spatial map the coordinates of the data are converted with a programme called PrimCam so that the moving of the robotic arm (with a milling head) embosses the three-dimensional town map from the wooden panel.

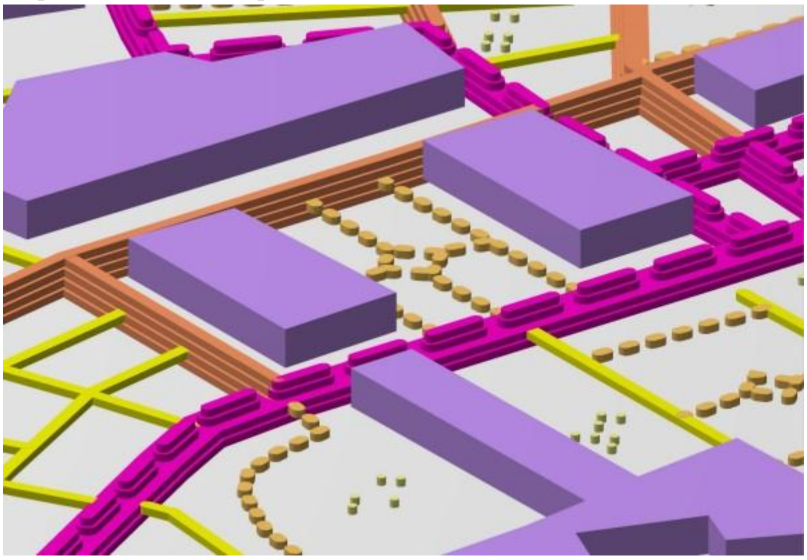

Figure 1: 3D tactile map

Brief historical outline of Hungarian tactile maps

I have found quite few sources on this topic. Between 1872 and 1896 tactile maps were produced at the Map Department of the State Printing Company edited by Imre Péchy (Budapest and its surroundings, Herkules Bath surroundings, Lake Balaton and its surroundings). In 1885 on the National Geographical Congress in Antwerpen, the Hungarian Geographical Society displayed the relief map of the Corinth and Panama Canals. The maps were made by István Türr.

In 1900 Manó Kogutowicz multiplied the embossed map of the ”Geographical Fundamental concepts” with gypsum moulding.

In 1927 István Turner founded his Globe and Embossed Cartography. 31 types of maps were produced for educational purposes. Apart from these, tactile maps of tourist areas and the surroundings of Lake Balaton were also made [Klinghammer 83] .

From the beginning of the 20th century relief maps and globes were made of paper in Hungary, and mainly teachers of special needs working in Schools for the Blind dealt with the creation of them. Vince Molnár made the maps of the continents. Ferenc Cseresznyés created more tangible maps: the geographical maps of Budapest, many countries and continents. In the 1950s Tibor Markovits made the wall map of Africa.

After World War II nobody was concerned with this topic for a longer time, so the Primary Shool for the Blind needed to purchase the equipment for teaching Geography from the GDR.

The Cartography Firm published Hungary’s relief map at a scale of 1:1.250.000 in 1960 and at 1:1.000.000 in 1978 in a couple of hundred copies.

In 1983 for the request of the National Federation of the Blind and Partially Sighted, the Ágoston Tóth Cartography Institute of the Hungarian Peoples Army started to make tactile maps again under the direction of József Bíró and László Buga.

In 1984 the tactile map series of the 13 most important pedestrian underspasses were made. The makers separated different levels in the underpasses and the establishment of five layers was found ideal.

The maps can be imagined as if the cover of the underpasses had been removed. The surface of the territories designated for pedestrians differs from the rest of the area. The objects which mean obstruction for the blind were indicated on the map.

A separate sign was applied for the road-system of the vehicles running on designated lines.

The relations between the different traffic lines are also indicated. 500 copies were made of the maps, which were handed to the National Institute of the Blind and Partially Sighted. The tactile maps of underpasses were displayed on two cartographic exhibitions, in Australia and Mongolia. [József Bíró, László Buga 85].

In Hungary these days only the HM Cartographic Public Company possesses the modern technology needed for producing tactile maps (Figure 2). The essence of the CNC technology is that the milling head is connected to a computer. The base mould is made of gypsum by the robotic arm, in which the different heads can be changed. The milling route is determined by giving the x and y coordinates of each point.

The head goes along the x and y coordinates. The foil is placed on the complete gypsum mould with vacuum pressure. The geographical content and the relief model have to fit each other accurately. Due to the high production costs, no maps are made for blind people, therefore teachers are forced to adapt.

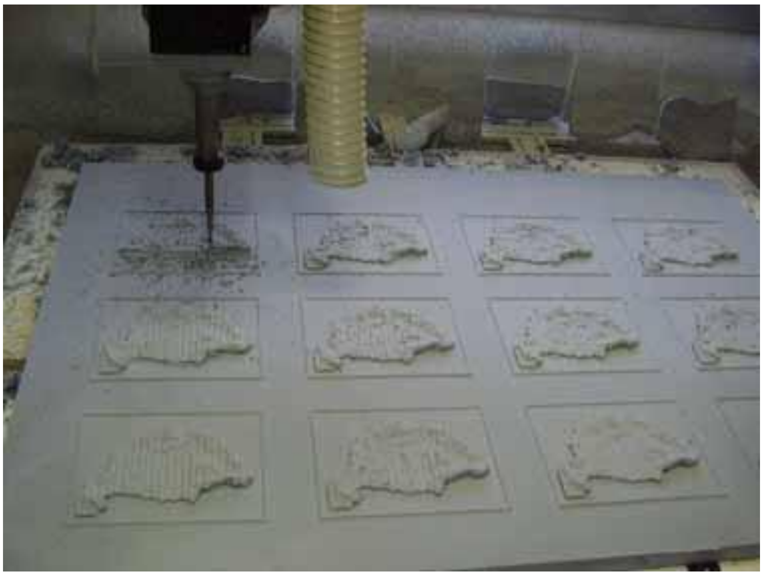

Figure 2: CNC technology

THE REPRESENTATION OF THE QUESTIONNAIRE PREPARED FOR THE BLIND

The description of the sample

Nine blind students responded to the questionnaire who are graduates of the Nursery School, Elementary School, Special Vocational School, Methodological Institute, Dormitory and Children’s home for the Blind. I did not design the dot written version of the survey, therefore I read the questions aloud and marked the given answers on a sheet. 5 girls and 4 boys participated in my research. Besides two fifteen-year-olds and one sixteen-year-old, the rest of the partipants were 14 years old. Four of the students are totally blind, which can be seen in the results too. Three of them perceives shadow and light.

The question can emerge whether the research involving nine people can be representative or not. Generally the reliability of researches on the basis of such few samples is low, but considering that during my work I interviewed a whole graduate school grade, my results can be regarded valid.

The analysis of the date

In the first questions I asked the respondents to evaluate the given line types according to their distinguishability. Most of them were able to perceive and differentiate between the types. It can be appointed (Figure 3) that the single straight line was tangible for all of them. Therefore I indicate the main orientation lines on the map (borders, rivers) with a single continuous line. I also got good results for the dotted and wavy lines. The broken and dotted-broken lines are the most difficult to perceive, that is why these are the less frequently used.

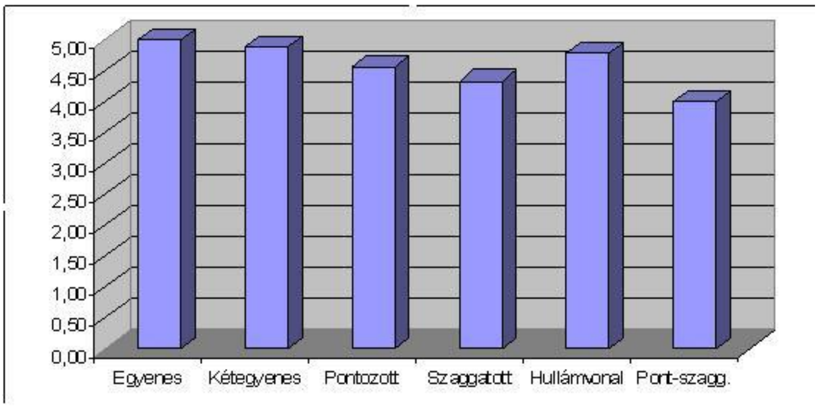

Figure 3: The differentiation of line types

With the answers to the second question set I evaluated to what extent they can recognise geometric shapes (Figure 4). It is surprising that they are able to distinguish at least quite well between all the shapes and between some of them extremely well. In terms of maps the circle and the triangle are the most important shapes because all the interviewed blind students distinguish them without any mistakes. Among the interviewed students, one of them well and the rest of them can excellently distinguish the square. Stars and crosses are the most useless while creating a map and according to the results these were the most difficult to recognise too. Considering all the shapes, I concluded that the more standard and simple a shape was the better it could be used.

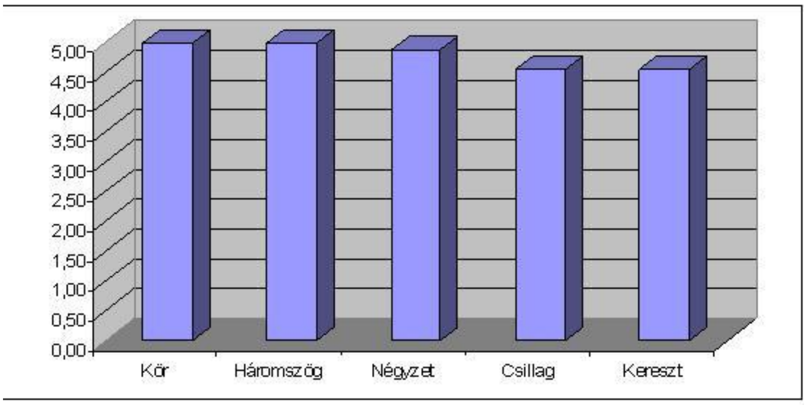

Figure 4: The differentiation of shapes

In the next part I examined the ideal map size (Figure 5). The poster (A3) is the most favourable among the interviewed which can be explained by its bigger size and less crowdedness. The standard paper (A4) was also quite favourable, possibly because they usually use this size while doing exercises at school. The A5 size would not be a good solution as very little information can be put on it so that it would not be overcrowded for the blind. The more information you can find on a map, the more valuable it is. I wished to compile the maps made for my target groups on the basis of the same theory. But it is still have to be considered that although the tangibility of the blind is very refined, it is not equal to the sensitivity of the human eye. Therefore – as it appears in the questionnaire as well – my task was to create the possibly largest map including as much information as I can without the expense of readability.

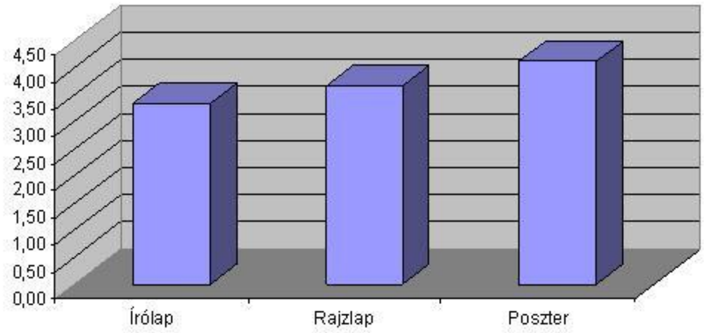

Figure 5: The choice of map size

I was asking about the ideal material in terms of tangibility in the fourth question set (Figure 6). Paper and plastic proved to be the most suitable materials, with which the earlier experience was justified. Most of the tangible maps are made of these two materials. Currently paper seems to be the best solution. With the available technological conditions I was planning to make a paper map.

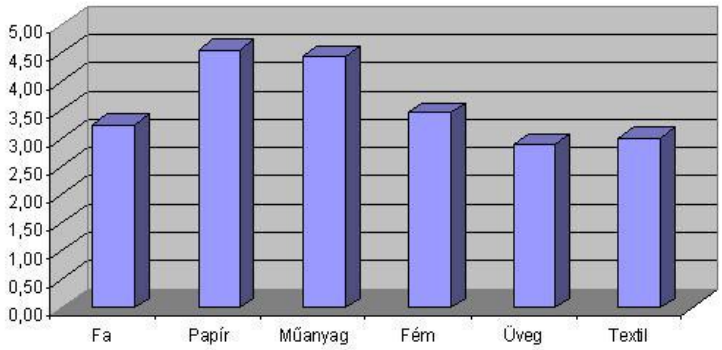

Figure 6: The choice of material

In the fifth section it becomes clear that blind people also often use maps. Most of them during their studies but some of them also for orientation. Therefore it is important to make a map suitable for both purposes.

In the sixth section I enquired about the map types they have encountered so far. All the students gave a positive answer to wall maps and globes. However, none of them has ever experienced a digital map.

At the end of the questionnaire all of them identified their most favourable map type. According to this they all chose tangible maps. Technology is able to design digital maps for even blind people. In Hungary Information Technology is not the part of the education for the blind. Their tactile maps have already become outdated. They would definitely make use of an up-to-date, tangible map which suits the needs given by them and evaluated by me.

As a result of the survey, I knew what the most appropriate map for the blind was like. The map used by blind people should meet at least the following standards:

- the preference of simple geometric shapes,
- the appliance of continuous lines,
- paper or plastic material,
- adequate size which can still be held in hand (A3, A4).

THE REPRESENTATION OF THE QUESTIONNAIRE PREPARED FOR THE PARTIALLY-SIGHTED

The description of the sample

The questionnaire for the partially sighted was also filled out by elementary school graduates from the Elementary School for Partially-sighted, the Special Needs Methological Institute and Dormitory. There were five girls and three boys among the interviewed students. There was a fourteen-year-old, two fifteen-year-old and a sixteen-year-old girl and the boys were 14, 15 and 18 years old. The extent of the students' sight damage was variable which was very useful in terms of the representativity of the survey, as it embraced the whole scale of the partially sighted.

The analysis of the data

The favourable size for the partially-sighted is not particularly different from the needs of the blind, they also prefer at least the poster size (A3) but the standard (A4) size is also acceptable for them to almost the same extent (Figure 7).

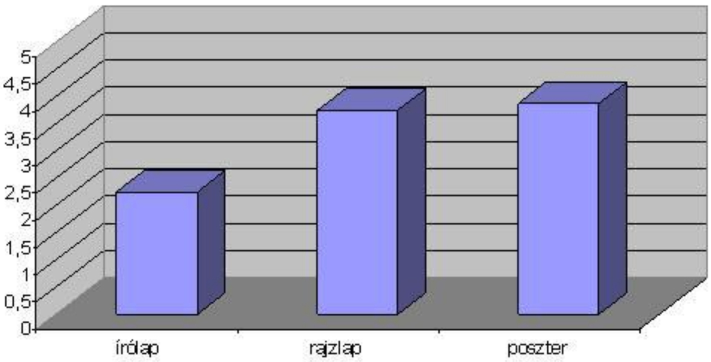

Figure 7: The choice of size

Regarding the applicable line types the results of the partially-sighted are also nearly equivalent to those of the blind, the only significant difference is in connection with the wavy line, which is considered to be the most easily distinguishable among all line types by the partially-sighted (Figure 8).

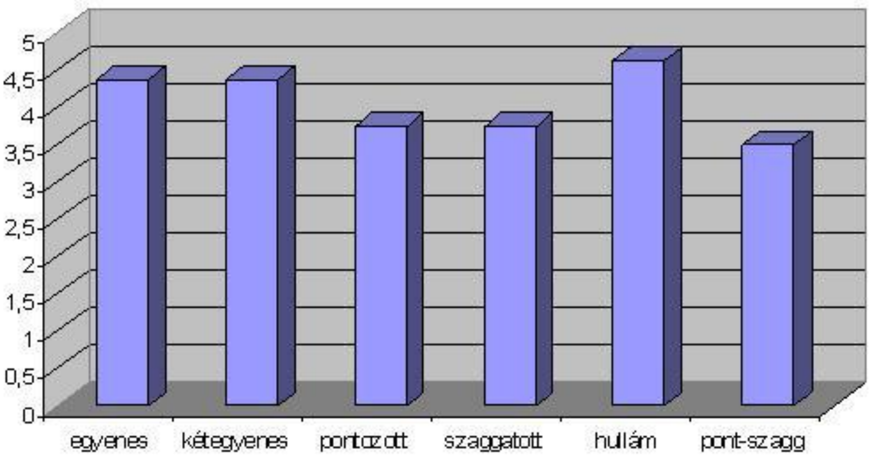

Figure 8: The differentiation of line types

Regarding he recognition of various shapes I also concluded the same as in case of the blind (Figure 9). At first sight it seemed surprising that perceiving the star and the cross the partially-sighted showed even worse results than the blind. But analyzing it more deeply the difference became clear that through their tangibility the blind are also able to perceive the more complicated shapes whilst in case of the strongly inhomogenous group of partially-sighted people, the variance in perceiving more complex shapes is bigger.

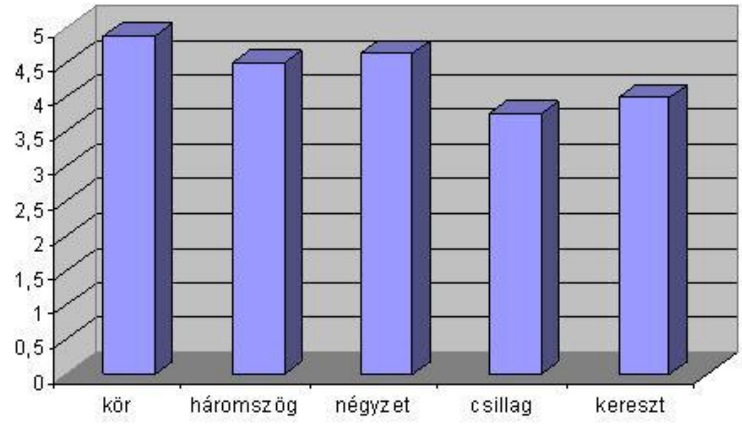

Figure 9: The differentiation of shapes

Similarly to the blind, the partially sighted are also in favour of paper and plastic maps, the only difference is in the extent of support (Figure 10). The needs of the two target groups vary as the partially sighted less support metal maps than glass and textile ones.

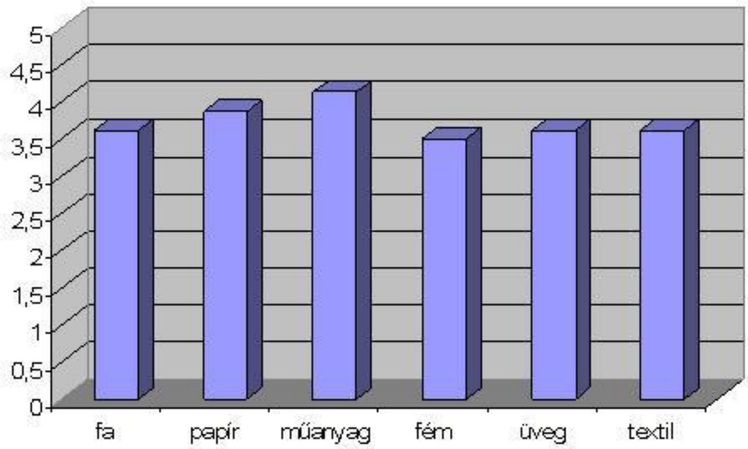

Figure 10: The choice of material

The group of questions in connection with colour tones can also be pertained to the partially-sighted (Figure 11). In the course of my research I gave my own maps to the partially-sighted students (Appendices: 3, 4, 5 and 6) regarding which I got some positive reactions. Among other things they liked the appearance of the map, especially the bright and pale-bright colours which are visible for them too. Moreover, they also found useful the easy readability of white letters put on a black background because of the stronger impulses. They had only encountered amateur methods, maps made by their teachers on the purpose of visualization, therefore they looked at my modern maps with great interest.

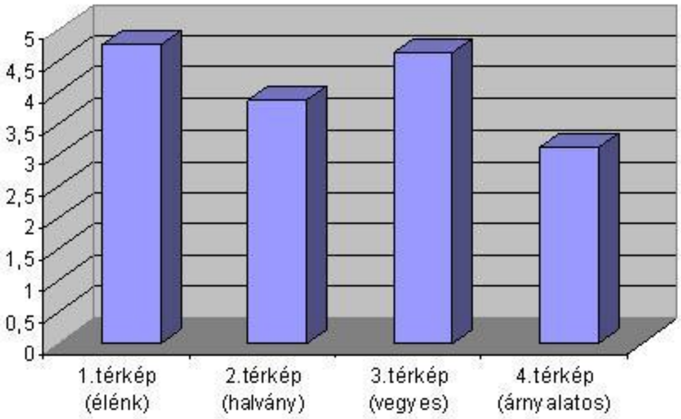

Figure 11: The choice of colour tone

I can summarize my questionnaire-based research done among partially-sighted students with two essential thoughts. On one hand, with reference to the questions interpreted for both target groups, I got the same results, thus the results of the partially-sighted further enhanced those of the blind. On the other hand, the colour tone question only related to the partially sighted brought the expected result, according to which bright colours and significant contrasts should be applied when making the map.

On the basis of the above mentioned results, as a summary it can be concluded that the map used by both the blind and the partially-sighted should have the following features:

• the preference of simple geometric shapes,
• the appliance of continuous lines,
• paper or plastic material,
• adequate size which can still be held in hand (A3, A4),
• bright colours, strong contrasts.

RESEARCH

It was particularly useful for me that during my research I came across a modern but simple and fairly cheap technology, heat embossing, with which I could finally make the map for my thesis.

The results of the research done among blind and partially sighted people can be summarized on the basis of two important thoughts:

• in case of the questions interpretable for both target audiences I came to the same conclusion, so the results of the partially sighted enhanced the ones pointed out about the blind,
• the colour tone question which was only interpreted for the partially sighted, a predictable result was found: according to which bright colours and significant contrasts should be used at the production of the map.

According to my observations and questionnaires so far it can be concluded that the maps used by partially sighted people have to possess the following features:

• the preference of simple geometric forms
• suitable size, which can be held in hands (A3, A4)
• bright colours, strong contrasts
• depicting too much information is not practical

The maps for blind people need to have the following featues:

• the preference of simple geometric forms
• the use of continual lines
• the maps should be paper or plastic based
• suitable size, which can be held in hands (A3, A4)
• depicting too much information is not practical
• the number of applicable signs are limited to 10-15, which cannot be drawn onto or close to each other.
• the embossed elements on the map have to be bigger than 0.3 mm
• the texts have to be minimized to an optimal amount for blind people

• abbreviations are common due to the big space demand of Braille writing
• names with dot writing should be highlighted
• the scale should be given in lines
• the northern direction has to be marked with a unique symbol
• the contents of the map can be demonstrated with tangible lined and dotted signs and areas of different surface.

In the course of making the sample map I considered it particularly important to complete a work which meets the expectations of the concerned target groups: the blind, the partially sighted and the teachers of special needs who deal with the previous two. The questionnaire survey and the several personal consultations in the preparation phase all served this purpose. Therefore it is also natural that I visited these people with the completed map and I asked their opinion about it.

It was a great relief and pleasure that both the people with sight disorders and their teachers without any exceptions approved of the sample map. From the improvement point of view, the notices with a corrective intention for further refinement were even more relevant. The most essential ones among these were the following:

• Braille letters should be bigger
• The paper carrier layer and the plastic microcapsule coating provides only limited life-span. In case of heavy duty-use another kind of technology is advisable.

Figure 12: Sample Map

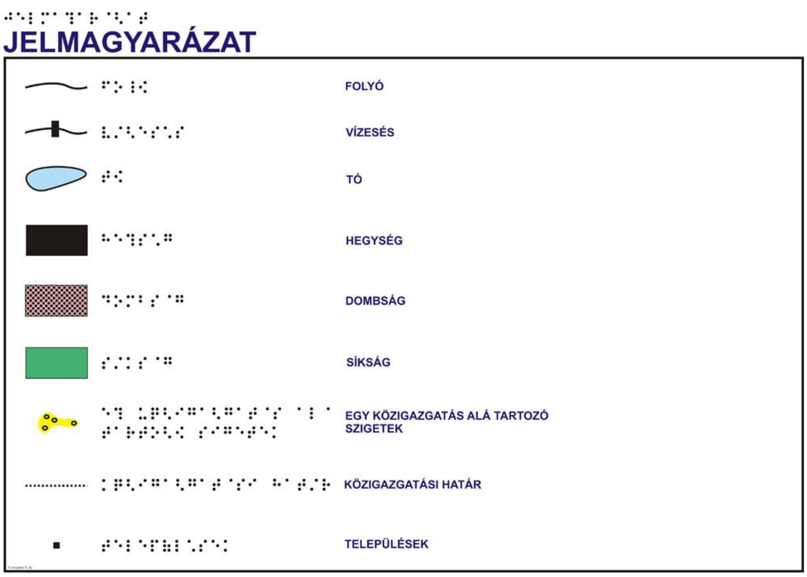

Figure 13: Key to the Sample Map

With the improvement of this special map the Special School Atlas was made for partially-sighted students. Prior to the practical execution I had done research and consulted with internationally acknowledged experts. In March, 2008 I participated in a study trip in Germany by favour of Cartographia School-Book Publisher Ltd. I visited institutes where modern tactile maps are made and used.

The stages of my study trip were: the German Central Library for the Blind in Leipzig, the German Federation for the Blind and Partially Sighted in Berlin and finally the Blind Education Centre in Hannover. I got acquainted with the vacuum pressure, dot-writing and the swell paper methods. I took self-made sample pages about which the German special needs teachers and cartographers told me that they were professional and usable for the handicapped.

When I got to the practical execution part, a problem came up: due to physical obstacles the key of the same map could not be suited both the blind and the partially sighted at the same time.

Therefore two different maps had to be created. At first I started to compile the map collection for the partially sighted. Then I continued the tactile atlas on the basis of the first one.

It is important that the contents are based on the school curriculum. Comparing the curriculum of the special schools with the National Curriculum, they are identical. The primary aim is that children should get to know the maps, their use and how to navigate on them.

In Germany, tangible workbooks with bright colours are published with exercises to help children in nurseries and the lower classes of primary school recognize shapes and navigate.

I applied contrasted colours on the maps made for partially sighted people, I simplified and thickened the lines. I turned the layer colouring into a special, symbolic relief on which the bigger topographic forms are emphasized. This type of demonstration worked well internationally too.

At the formation of name placement the use of the names of the most important geographical forms remained in case of general geographical maps.

On administrative maps I indicated the country and county names, the main seas and oceans. When I chose the font style, I had to be aware of selecting a font without serifs. In favour of the easier readability, the text should not be designed curved.

The extent of the font size and the line thickness has not been finalized yet, I am continuously consulting with partially sighted people about it so that I can create the ideal parameters. Considering the size of the map sheet, I selected the ideal sheet size (the A3) on the basis of the questionnaire survey in my thesis and my experience.

I didn't add a search locator to the map sheet, but outside the frame I indicated the locations with spikes. With the help of these spikes and a ruler, the users can easily find the name they are looking for. In case of the font size and the type of the index we also need to be aware of the optimal parametres for the partially sighted.

Last year I successfully completed the content and key (legend) of the atlas and also determined its structure. I made further tests with the target group to detect the possible mistakes. The final version of the Geographical Atlas for partially sighted and special needs students was published in 2009 with the support of Cartographia School-Book Publisher Ltd. This atlas is unique in Hungary. This year I have presented the atlas at several places, in summer at the Federation of the Blind. In November on an international conference in Buenos Aires I gave a presentation about the cartography for the blind and partially-sighted.

Figure 14: The cover of the Special Geographical Atlas

I made the preparations for the relief atlas being made for blind people: within the confines of Cartographia Publishing Ltd. I ordered the embossing device (ZY-FUSE HEATER) and the special paper suiting the device (swell-paper). The digital base of the tactile map sheets, the files made for the partially sighted require a little modification:

• the elements which rise from the plane are coloured black

• the inscriptions are indicated in Braille writing.

• the northern direction is marked with a special symbol.

The tests are currently in progress in connection with the relief of the maps (15th illustration).

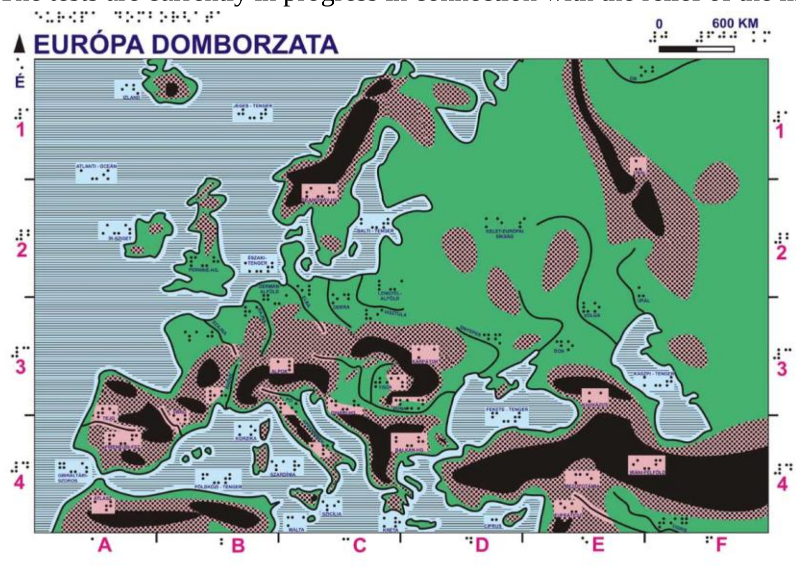

Figure 15: Special geographical atlas for the blind

The completed tactile atlas will be a basis for a digital audio-tactile map, with the help of which we will be able to visualize the maps digitally as well. Compared to the paper based maps a lot more data will be able to appear on these maps. With the use of the interactive board the digital map can also become „tangible": the programme reads the data aloud on which the users put their hands. I have only dealt with this topic in theory so far, thus there is still a long way ahead of me.

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